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Carolyn R. Hill, MS - B103
National Institute of Justice (Grant Support)
Gregory L. Hill, JD - W18
Discloses no financial relationship with commercial entities.
Mark A. Hilts, BS - W19
Discloses no financial relationship with commercial entities.
Ann-Margaret Hinkle- W8
Nomadics, Inc. (Other Financial/Material Support and Discussion of Commercial Products or Services)
Phyllis Ho, DDS - F4
Discloses no financial relationship with commercial entities.
Wen-Hsiung Ho, MS - D42
Ministry Justice Investigation Bureau (Speakers Bureau)
Delphi, Borland Enterprise, IBM, Hewlett Packard, Linux, Microsoft Corporation, Solaris (Discussion of Commercial Products or Services)
Andria L. Hobbs, MS - B129
EDAX (Discussion of Commercial Products or Services)
Jens Hoffmann, PhD - W25
Discloses no financial relationship with commercial entities.
Stephen P. Hogan- ES2
Discloses no financial relationship with commercial entities.
Thomas D. Holland, PhD - BS6, H49
Discloses no financial relationship with commercial entities.
Jennifer L. Holmes, PhD - C15
Discloses no financial relationship with commercial entities.
Cynthia A. Holt, MLIS - W27
Elsevier, Forensic Drug Advisor (Other Material/Financial Support)
Katie M. Horsman, MS - B87
Discloses no financial relationship with commercial entities.
Max M. Houck- SS2
Discloses no financial relationship with commercial entities.
Max M. Houck, BS, MA
National Institute of Justice (Grant Support) - B60, B146
McCrone Associates, Inc. (Other Financial/Material Support) - W24
Kimberly Hoy-Hill, MSW - W18
Discloses no financial relationship with commercial entities.
Tsun-Ying Huang, MS - B43, G73
Discloses no financial relationship with commercial entities.
Davia T. Hudson, BS - B12
Netherlands National Police Agency (Grant Support)
Marilyn A. Huestis, PhD - K47
National Institute on Drug Abuse (Grant Support)
National Institutes of Helath (Grant Support)
Kevin B. Hufnagl, MA - H1
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Discloses no financial relationship with commercial entities.
David R. Hunt- W13
Discloses no financial relationship with commercial entities.
Timothy E. Huntington, MS - G59
Discloses no financial relationship with commercial entities.

I

Nicole Inacio, BS - B30
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Francesco Introna, MD, PhD - F1, G26
Discloses no financial relationship with commercial entities.

J

Carrie B. Jackson, BS - B159
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Michael B. Jackson, MD - I14
Discloses no financial relationship with commercial entities.
Jon O. Jacobson- W22
Stark *rxp* (Other Financial/Material Support)
Betty L. James, RN, BSN, MA - D6
Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
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National Institute of Justice (Grant Support)
Applied Biosystems, Incorporated, ATCC, Dremel, Edge Biosystems, Qiagen, Roche Scientific, SPEX, USB (Discussion of Commercial Products or Services)
David E. Jarrell, JD - E18
Discloses no financial relationship with commercial entities.
Alexander Jason, BA - D31
Discloses no financial relationship with commercial entities.
Ronnie D. Jewell, MS - B150
Discloses no financial relationship with commercial entities.
Cassie L. Johnson, MS - B39
Discloses no financial relationship with commercial entities.
Chris Johnson, JD - E28
Discloses no financial relationship with commercial entities.

L. Thomas Johnson, AB, DDS - F44
American Board of Forensic Odontology (Grant Support)
American Society of Forensic Odontology (Grant Support)
California Forensic Dental Association (Grant Support)
Adobe Systems, Inc., Statistical Analysis Software (Discussion of Commercial Products or Services)
Robert D. Johnson, PhD - K21
Discloses no financial relationship with commercial entities.
Alan W. Jones, PhD - K35
Discloses no financial relationship with commercial entities.
Gareth P. Jones, MSc - D1
The Centre of Forensic Sciences, Ontario Provincial Government (Employee)
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Discloses no financial relationship with commercial entities.
Chelsey A. Juarez, MA - H70
UCSC, Chicana Latina Scholarship (Grant Support)
Kip Judice- W5
DNAPrint Genomics, Inc., Reliagene Technologies (Discussion of Commercial Products or Services)
Rebecca A. Jufer, PhD - K43
Discloses no financial relationship with commercial entities.
Jane S. Juusola, PhD - B120
Federal Bureau of Investigations (Other Financial/Material Support)

K

Sawait Kanluen, MD - BS3, G23
Discloses no financial relationship with commercial entities.
Sreetharan Kanthaswamy, PhD - SS2
Discloses no financial relationship with commercial entities.
Daniel E. Katz, MFS - G61
Applied Biosystems, Incorporated, Promega Corporation, Qiagen (Discussion of Commercial Products or Services)
Mark F. Kavlick, BS - B8
Marligen Biosciences, Promega Corporation, Qiagen (Discussion of Commercial Products or Services)
Joseph A. Keierleber, MFA - D20
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Denise C. Kellaher, DO - I11
(Discussion of Unlabeled/Investigational Use of Product/Device)
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Paid Consultant
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OCME/University of New Mexico (Employee)
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Robert D. Keppel, PhD
DuPont, Microtrace (Discussion of Commercial Products or Services) - D32
Academic Press, CRC Press LLC, Inc. (Discussion of Commercial Products or Services) - W9
Sarah Kerrigan, PhD - K34
Discloses no financial relationship with commercial entities.
Sarah A. Kiley, BA - H56
Discloses no financial relationship with commercial entities.
Elizabeth L. Kinnison, MD - G86
Discloses no financial relationship with commercial entities.
Heike Klotzbach, MD, PhD - G22, G74
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Curtis D. Knox, BS - B28
The Forensic Science Service (Discussion of Commercial Products or Services)
Edgar F. Koch, MS - B3
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Sandra L. Koch, MFS - B97
Discloses no financial relationship with commercial entities.
Adam Kolatorowicz, MS - H6
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Debra A. Komar, PhD - H78
Discloses no financial relationship with commercial entities.
Dave Kontny- W8
Nomadics, Inc. (Other Financial/Material Support and Discussion of Commercial Products or Services)
Robert D. Koons, PhD - J14
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Discloses no financial relationship with commercial entities.
Roger Koppl, PhD - D2
Discloses no financial relationship with commercial entities.
James C. Kraner, PhD
Discloses no financial relationship with commercial entities - K11
Astra Zeneca (Discussion of Commercial Products or Services) - K12
Adrian S. Krawczeniuk, MS - B138
Discloses no financial relationship with commercial entities.
John Krolikowski, MD - W3
Discloses no financial relationship with commercial entities.
Mark W. Kroll, PhD - C18
Taser International (Other Financial/Material Support)
Taser International (Discussion of Commercial Products or Services)
Anne Kroman, MA - H64
Discloses no financial relationship with commercial entities.
Robert Kronstrand, PhD - W26
National Board of Forensic Medicine, Linkoping Sweden (Employee)
Doris M. Kupfer, PhD - B91
Agilent Technologies (Discussion of Commercial Products or Services)
Mark Kurowski, BS - W5
DNAPrint Genomics, Inc., Reliagene Technologies (Discussion of Commercial Products or Services)
Maiko Kusano, BA - B102
National Institute of Justice (Grant Support)

L

Romano La Harpe, MD - G9
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Russell C. Lain, BDS - F26
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Discloses no financial relationship with commercial entities.
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Lynette Landon-Chellemi - G77
Ronald E. McNair Scholars Program/U.S. Department of Education (Grant Support)
Asahi-Pentax, Inc., Canon Camera Co., Eastman Kodak, Hoya Filters, Sony Camera Co, Tiffen Filter Co. (Discussion of Commercial Products or Services)
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Stark *rxp* (Other Financial/Material Support)
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Discloses no financial relationship with commercial entities - G104
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Discloses no financial relationship with commercial entities.
Henry C. Lee, PhD - ES1
Discloses no financial relationship with commercial entities.
Steven B. Lee, PhD - B10
Hemcon, Medica-Z (Other Financial/Material Support and Discussion of Commercial Products or Services) - B10
HemCon (Discussion of Unlabeled/Investigational Use of Product/Device) - B10
Applied Biosystems, Inc., MiraiBio, Promega (Discussion of Commercial Products or Services) - B153
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Joint POW/MIA Accounting Command (Employee)
Microanalytica (Discussion of Commercial Products or Services)
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Kristen E. Lewis, MS - B54
Dean of College of Humanities & Sciences - VCU (Grant Support)
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Santi Aventis (Discussion of Commercial Products or Services)
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Discloses no financial relationship with commercial entities - C13
Stark *rxp* (Other Financial/Material Support)
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MJIB (Speakers Bureau)
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Taiwanese National Science Council (Grant Support)
U.S. FAA Civil Aerospace Medical Institute (Grant Support)
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Elsevier, Forensic Drug Advisor (Other Financial/Material Support) - W27
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Ana E. Lopez, MD - G90
(Discussion of Commercial Products or Services)
Manuel Lopez-Leon, MD - I4
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Intramural Research Program, National Institute on Drug Abuse (Other Financial/Material Support)
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James R. Lyle, PhD - C31
Discloses no financial relationship with commercial entities.

M

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Ray Allen Manufacturing Company, Sigma-Aldrich (Discussion of Commercial Products or Services)
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Elsevier, Forensic Drug Advisor (Other Financial/Material Support)
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Discloses no financial relationship with commercial entities - ES2
Stark *rxp* (Other Financial/Material Support) - W22
McCrone Associates, Inc. (Other Financial/Material Support) - W24
Lindsey Manning, PE - W22
Stark *rxp* (Other Financial/Material Support)
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Discloses no financial relationship with commercial entities.
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PSC-CUNY/U.S. Department of Education (Grant Support)
Agilent Technologies (Other Financial/Material Support)
Murray K. Marks, PhD - H58
Discloses no financial relationship with commercial entities.
Judy Y. Marshall, DMD - F40
Adobe Systems, Inc., Canon (Discussion of Commercial Products or Services)
Daniel A. Martell, PhD - I3
Harcourt Assessment Company (Discussion of Commercial Products or Services)
Thomas L. Martin, Jr.- E7
Discloses no financial relationship with commercial entities.
Laurent Martrille, MD - H52
Discloses no financial relationship with commercial entities.
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Washington State Patrol Crime Laboratory (Employee)
Alpharma USPD Inc., Ansell Healthcare Products Inc., Avon Products Inc., Chesebrough Ponds USA Co., Clinique Laboratories Inc., Dayton Hudson Corp., Inter-American Products Inc., L'Oréal USA Inc., Neutrogena Corp., Schering-Plough HealthCare Products Inc., Solar Cosmetic Labs, Inc., St. Ives Laboratories, Inc., The Kendall Company (Discussion of Commercial Products or Services)
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Stark *rxp* (Other Financial/Material Support)
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Discloses no financial relationship with commercial entities.
Brendan P. Max, JD - E11
Discloses no financial relationship with commercial entities.

Kerry L. Maynard, MFS - B112
Applied Biosystems, Inc. (Employee and Discussion of Commercial Products or Services)
Kathleen A. Mayntz-Press, BS - B161
National Institute of Justice/NCFS (Grant Support)
Applied Biosystems, Inc., Promega Corporation, ReliaGene Technologies (Discussion of Commercial Products or Services)
Bruce R. McCord, PhD - W6
Applied Biosystems (Other Financial/Material Support and Discussion of Commercial Products or Services)
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Edward T. McDonough, MD - W15
Discloses no financial relationship with commercial entities.
John D. McDowell, DDS, MS - F38, F39
Discloses no financial relationship with commercial entities.
Michael D. McDowell, MS, PE - C34
Discloses no financial relationship with commercial entities.
Patricia J. McFeeley, MD - W4
OCME/University of New Mexico (Employee)
Eamonn McGee - B170
Discloses no financial relationship with commercial entities.
Richard W. McLay, PhD, PE
Stark *rxp* (Other Financial/Material Support) - C4, W22
Discloses no financial relationship with commercial entities - C10
Gerald R. McMenamin, PhD - J8
Discloses no financial relationship with commercial entities.
James J. McNamara, MS - W19
Discloses no financial relationship with commercial entities.
Lee Meadows Jantz, PhD - H49
Discloses no financial relationship with commercial entities.
Sheri H. Mecklenburg, JD - E4
Discloses no financial relationship with commercial entities.
Audrey L. Meehan, BGS - H5
Oak Ridge Institute for Science and Education/ORISE (Other Financial/Material Support)
Kenneth E. Melson, JD - ES2
Discloses no financial relationship with commercial entities.
Terry Melton, PhD - B83
Mitotyping Technologies (Employee)
Mitotyping Technologies, Roche Molecular Systems (Discussion of Commercial Products or Services)
Maria Angelica Mendoza, MS - G37
Discloses no financial relationship with commercial entities.
Ling Ming Meng, MS - B89
Discloses no financial relationship with commercial entities.
Gary L. Menges, MLS - J16
Discloses no financial relationship with commercial entities.
Jennifer W. Mercer, BS
National Institute of Justice (Grant Support) - K19
Discloses no financial relationship with commercial entities - SS2.
Richard W. Merritt, PhD - G51
Discloses no financial relationship with commercial entities.
Michele L. Merves, BS - K10
Bio Integrated Solutions (Other Financial/Material Support)
Bio Integrated Solutions, United Chemical Technologies, Inc. (Discussion of Commercial Products or Services)
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Discloses no financial relationship with commercial entities.
Heather R. Metcalf, BSN - D13
Discloses no financial relationship with commercial entities.
Melissa S. Meyers, MS - B56
Discloses no financial relationship with commercial entities.
Amy L. Michaud, BS - B67
Discloses no financial relationship with commercial entities.
Corinne L. Michaud, BS - G64
Discloses no financial relationship with commercial entities.
Katarzyna Michaud - G17
Discloses no financial relationship with commercial entities.
Anastasia D. Micheals, MS - LW6
Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
Linda Milgrom, MSLS - W27
Elsevier, Forensic Drug Advisor (Other Financial/Material Support)
Gretchen Miller, BS - K24
PSC-CUNY (Grant Support)
Heather Miller Coyle, PhD - B36
Paid Consultant
Applied Biosystems, Inc. (Discussion of Commercial Products or Services and Discussion of Unlabeled/Investigational Use of Product/Device)
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Discloses no financial relationship with commercial entities.
Christopher M. Milroy, MD - K41
Discloses no financial relationship with commercial entities.
Andre A. Moenssens, JD, LLM - W24
McCrone Associates, Inc. (Other Financial/Material Support)
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Discloses no financial relationship with commercial entities.
Donna M. Mohr, BS, MS, PhD - B143
Discloses no financial relationship with commercial entities.
Angela S. Mohrhaus, BS - B17
Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
Karen P. Mooder, BSc, PhD - H83
Discloses no financial relationship with commercial entities.
Kim E. Mooney, PhD - B172
Discloses no financial relationship with commercial entities.
Christine M. Moore, PhD - K45, K46
Immunalysis Corporation (Employee and Discussion of Unlabeled/Investigational Use of Product/Device)
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Discloses no financial relationship with commercial entities.
Lilliana I. Moreno, MA, MS - B55
Discloses no financial relationship with commercial entities.
David A. Moretz, DDS - F14
WinID (Discussion of Commercial Products or Services)
Michael S. Morgan, ScD - W14
National Medical Services, Inc. (Employee)
Stephen L. Morgan, PhD - B77
Federal Bureau of Investigation (Grant Support)
Beckman-Coulter, Craic, Waters/Micromass (Discussion of Commercial Products or Services)
Stephen L. Morgan, PhD - B76
Federal Bureau of Investigation (Grant Support)
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Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
Susan E. Morton, BA - E19
Discloses no financial relationship with commercial entities.
Peter V. Mosher- E22, E23
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McCrone Associates, Inc. (Other Financial/Material Support)
Julio Mulero, PhD - B51
Applied Biosystems (Employee and Discussion of Commercial Products or Services)
Dawn M. Mulhern, PhD - W20
Leica Microsystems (Other Financial/Material Support)
Amy Z. Mundorff, MA - H49, H50
Discloses no financial relationship with commercial entities.
Turhon A. Murad, PhD - H39
Discloses no financial relationship with commercial entities.

N

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Matthew J. Nagle- W22
Stark *rxp* (Other Financial/Material Support)
Mohan Nair, MD - I1, I6
Discloses no financial relationship with commercial entities.
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National Forensic Science Technology Center (Employee)
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Discloses no financial relationship with commercial entities.
Mark S. Nelson, MS - W7
National Forensic Science Technology Center (Employee)
Margherita Neri, MD - G47
Discloses no financial relationship with commercial entities.
Klaus Neudecker, MD - W25
Discloses no financial relationship with commercial entities.
Peter J. Neufeld, JD - E4
Discloses no financial relationship with commercial entities.
Rita Newman, BS - W23
Discloses no financial relationship with commercial entities.
Michele Nielsen, DDS - F29
Adobe Systems, Inc., Dell, Loctite, McGill Course, Nikon, Phifer (Discussion of Commercial Products or Services)
David M. Northrop, PhD - B137
National Institute of Justice (Grant Support)
Agilent Technologies, MicroSolv Technology Corporation (Discussion of Commercial Products or Services)
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H. Dale Nute, PhD - B152
Florida State University (Employee)

O

R. Christopher O'Brien, BA, MFS - H41
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Jennifer O'Callaghan, MFS - H80
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Gregory B. Ohlson, BS - K49
Immunalysis Corporation (Discussion of Commercial Products or Services)
(Discussion of Unlabeled/Investigational Use of Product/Device)
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National Institute of Justice (Grant Support)
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Kerry L. Opel, MA
National Institute of Justice (Grant Support) - B2
Discloses no financial relationship with commercial entities - B115
Donald Orokos, PhD - D34
Discloses no financial relationship with commercial entities.
Michael Osterheider, MD - W25
Discloses no financial relationship with commercial entities.
Mary Ellen O'Toole, PhD
DNAPrint Genomics, Inc., ReliaGene Technologies (Discussion of Commercial Products or Services) - W5
Discloses no financial relationship with commercial entities - W17
Bernd Ottermann, MD - W25
Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities - B131
Drug Enforcement Administration (Employee) - W16
Stephen D. Ousley, PhD - H13
Discloses no financial relationship with commercial entities.
Douglas W. Owsley, PhD - LW5
Discloses no financial relationship with commercial entities.

P

Jesus Padilla, PhD - I9
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Anthony T. Paganini, PhD - G76
R.G. Medical Diagnostics (Other Financial/Material Support)
Hewlett Packard, Microsoft Corporation, RG Medical Diagnostics (Discussion of Commercial Products or Services)
Robert R. Paine, PhD - W20
Leica Microsystems (Other Financial/Material Support)
Christopher S. Palenik, PhD - B66
Discloses no financial relationship with commercial entities.
Dae-Kyoon Park, MD, PhD - H3, H33
Discloses no financial relationship with commercial entities.
Nicolette M. Parr, MS - H14
Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
Melissa A. Pasquale-Styles, MD - G100
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Robert F. Pastor, PhD - H59
Discloses no financial relationship with commercial entities.
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Biodynamics Engineering, Inc. (Employee)
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Discloses no financial relationship with commercial entities.
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Guillaume Perret, MD - G12
Discloses no financial relationship with commercial entities.
Michel Perrier, DDS - F24
Discloses no financial relationship with commercial entities.
Marie-Josee Perron, DDS - F29
Adobe Systems, Inc., Dell, Loctite, McGill Course, Nikon, Phifer (Discussion of Commercial Products or Services)
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Discloses no financial relationship with commercial entities.

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Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
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ReliaGene Technologies (Employee)
DNAPrint Genomics, Inc., ReliaGene Technologies (Discussion of Commercial Products or Services)
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Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
Cristoforo Pomara, MD - G78
Discloses no financial relationship with commercial entities.
Elayne J. Pope, MA - H38
Discloses no financial relationship with commercial entities.
Douglas K. Posey, MD - W12
Discloses no financial relationship with commercial entities.
Wendy E. Potter, BA, MS - H60
Eli Lilly and Company, GlaxoSmith Kline, Santi Aventis, Smith-Kline Beacham (Discussion of Commercial Products or Services)
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Discloses no financial relationship with commercial entities.
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Discloses no financial relationship with commercial entities.
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American Board of Criminalistics (Other Financial/Material Support and Discussion of Commercial Products or Services)
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Discloses no financial relationship with commercial entities.
Alan Price, MA, SCSA - D8
Discloses no financial relationship with commercial entities.
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Myriad Genetics Laboratories (Employee)
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Discloses no financial relationship with commercial entities.
Tammy Pruet, JD - W5
DNAPrint Genomics, Inc., Reliagene Technologies (Discussion of Commercial Products or Services)
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Discloses no financial relationship with commercial entities.

Q

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Bruce D. Quimby, PhD - B140
Agilent Technologies (Employee and Discussion of Commercial Products or Services)

R

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SS1 Behind the Scenes of Unthinkable Situations: How Do the Scientists Do That?

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On April 19, 1993, 74 people died in Waco, Texas; on April 20, 1999, 13 were killed and 24 were injured at Columbine High School; on Thursday, February 20, 2003, 100 people died in a club fire; on December 26th, 2004, an earthquake produced one of the biggest tsunamis killing close to 150,000; on August 29, 2005, Katrina hit the Gulf Coast and the body count is still on going.

Three topics of natural and man-made disasters will be reviewed in detail in this session. The first will be an in-depth look at the Columbine disaster. The Columbine presentation will provide investigative and analytical details deep from within the case folder. Facts brought to you will paint a picture of the extensive planning prior to the event, the narrow scope of the disaster due to the cache of failed bombs, and the alternative tactics taken by Eric Harris and Dylan Klebold to compensate for each miss-calculation.

The second topic will address another man-made disaster that occurred at the same time of the 2003 AAFS Annual Meeting. This is the Station Nightclub in Warwick, Rhode Island, where 100 people were killed and more than 200 were injured. The National Institute of Standards and Technology (NIST) has finished lengthy research into event details, providing insight into contributions of the building structure, smoke and toxic fumes. The actual modeling experiments will be presented in a video format accompanied by the videotape taken by cinematographer Brian Butler who was on location when the disaster occurred.

The final topic is the 2004 natural tsunami disaster. Speakers from the public and private realms will discuss their involvement responding to this unprecedented natural disaster. Topics will include initial response and recovery of remains, identification of the victims, and challenges faced during the entire process. The series of presentations will highlight the interaction of agencies and specialties within the field of forensic science.

This day long presentation will provide an education in: large case management, locating evidence, case analysis, implications of building structures to arson/pathology/toxicology analysis, and the consideration of other agency support in future forensic examinations.

Columbine, Station Nightclub, Tsunami

SS2 Young Forensic Scientists Forum: Frontiers in Forensic Science

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As its role in society evolves, the field of Forensic Science continues to grow and incorporate the skills and knowledge of many different experts and disciplines. This year's special program will bring to the forefront some emerging forensic science fields, and consists of presentations by established members of the forensic science community. Emphasis has been placed on areas such as: the importance of standardization within the field of science, advances in DNA analysis, forensic anthropology, animal forensics, paint analysis, how to make informed decisions about educational and career goals within the field of forensic science, bloodstain pattern analysis, and the importance of forensic science publications. The session will also demonstrate the role that young forensic scientists play in mass disaster efforts. The YFSF will also serve to make young forensic scientists aware of the opportunities available to them in reference to membership advancement in the AAFS.

This program should appeal to individuals with a strong desire to enter the field of forensic science as well as those with a few years of experience within the field and looking to get ahead. The session aims to cover a wide range of emerging fields through presentations, discussions, and interactions with new and established members of the forensic community. This program will provide a well-rounded understanding of different areas within forensic science.

The objectives of this year's special session are as follows: to introduce emerging fields in forensic science; to provide an understanding of the Emerging Forensic Scientist Award; to introduce not only emerging forensic scientists but also prospective forensic scientists to established forensic scientists through interaction, discussions, and presentations; to provide an opportunity for discussion about the opportunities for forensic scientists to further both their education and career; and to increase involvement within the Young Forensic Scientists Forum.

Education, Young Forensic Science Forum, Careers

ES1 The Role of the Forensic Scientist in the Investigation of Police-Related Deaths – A Current Dilemma

Cyril H. Wecht, MD, JD, Allegheny County Coroner's Office, 542 Fourth Avenue, Pittsburgh, PA 15219; Henry C. Lee, PhD*, Chief Emeritus, Connecticut Forensic Laboratory, Connecticut State Police, 278 Colony Street, Meriden, CT 06456; and Michael M. Baden, MD*, 15 West 53rd Street, #18B-C, New York, NY 10019*

The goal of this session is to define and clarify the functions and responsibilities of forensic scientists in the investigation, analysis, and handling of deaths known, alleged, or possibly related to official actions by law enforcement officers. Better understanding and appreciation of this critical role will enhance both the civil and criminal justice systems.

Forensic scientists have an ethical responsibility to conduct their professional endeavors in police-related deaths in an unbiased, honest, and objective manner. This presentation will impact the forensic community and/or humanity by demonstrating the importance and beneficial impact on society of such a philosophical attitude, and the damage and adverse consequences arising out of an incompetent, biased, or dishonest investigation in such cases. Lives are enriched and humanity is enhanced when all people, especially minority groups, are dealt with by law enforcement officials in a sensible, appropriate, and just fashion.

Perhaps the most complex and controversial cases that fall within the purview of coroners and medical examiners are deaths that occur during the pursuit, apprehension, arrest, and incarceration of individuals who were in apparent good health immediately prior to their interaction with the law enforcement officials present and involved at the fatal scene. The fact that a substantial majority of such deaths in the United States involve police officers who are Caucasian and victims who are members of a minority group (e.g., African-American, Hispanic, Asian, Native-American) makes these cases much more sensitive and potentially explosive within that particular community. These kinds of fatalities have triggered significant riots, created ongoing sociopolitical problems, and resulted in huge expenditures of time, effort, and money. Arguably, the most damaging ramification of such contentious deaths has been the adverse psychological effect on the minority population within that particular community, especially on young adults.

Most of these highly controversial cases do not involve individuals who have committed a serious felony or some other significant act that has already injured someone, or who might in the immediate future endanger the lives of innocent third parties. Thus, when a death ensues during or following a seemingly minor incident, it is understandable that many questions will be raised regarding the need for police to have used tactics that resulted in such a fatal outcome.

Alleged "electrical" deaths caused by Tasers, positional asphyxiation, excited delirium, and other dynamic processes that are frequently encountered in these kinds of cases will be highlighted in this program. Examples of seemingly egregious police conduct are usually explained and subsequently defended on the premise that the victim posed a serious and imminent threat to innocent bystanders and/or to the police, and hence, aggressive force was required to subdue and incapacitate the actor. Shooting, beating, piling on, hog-tying—when are these kinds of responses and actions justified? How does the forensic pathologist differentiate between positional asphyxiation and cocaine-induced excited delirium as the cause and mechanism of death? How does the criminalist reconstruct the most probable fatal scenario by examining all of the physical evidence?

Inasmuch as forensic scientists to a great extent are employed by official governmental agencies, their professional endeavors routinely involve close working relationships with police officers, detectives, and other law enforcement officials. Such an occupational milieu often results in the development of a subconscious bias that compromises intellectual objectivity and independent analysis. Obviously, there is no category of cases that demands impartiality to a greater extent than police related deaths. Investigations in such cases must be absolutely thorough and scrupulously honest. Final conclusions and opinions must be rendered without hesitation or fear, no matter how unpleasant and uncomfortable that may be for the governmentally employed forensic scientist.

The authors of this paper will present cases in which they have been directly involved as forensic pathologists (Baden and Wecht), and as a criminalist (Lee). Highly controversial and forensically complex police-related deaths will be reviewed from all perspectives, i.e., coroner-medical examiner, law enforcement, and independent private consultant. In addition, correlation with legal concepts and presentation of testimony in both civil and criminal trials will be critically discussed in order to effectively demonstrate the societal impact of such cases.

References to the relevance and need for other forensic scientists in such cases will be included, namely, engineers, psychiatrists, engineers, and toxicologists. Specific suggestions and procedural guidelines will be offered that could significantly decrease the number of police-related deaths.

Police-Related Deaths, Taser, Positional Asphyxiation

ES2 Forensic Science and the Rule of Law: The Role of Discovery in Today's Crime Laboratory

Betty L. DesPortes, JD, Benjamin & DesPortes, PC, PO Box 2464, Richmond, VA 23218; Stephen P. Hogan, JD*, New York State Police, Building 22, State Campus, 1220 Washington Avenue, Albany, NY 12226; Joseph J. Maltese, JD*, New York Supreme Court, 355 Front Street, Staten Island, NY 10304; Kenneth E. Melson, JD*, United States Attorney's Office, 2100 Jamieson Avenue, Alexandria, VA 22314; and Amy Sirignano, MFS, JD*, 12629 Carmel Court, NE, Albuquerque, NM 87122*

Although there are many definitions of forensic science, one description reveals the additional influences affecting scientists working in crime laboratories: "Forensic Science is the application of the "natural" sciences to the purposes of law." This unique relationship between science and the law creates a set of controlling parameters foreign to most other scientific fields.

Practicing forensic scientists working in crime laboratories understand the technical requirements of their professions, but often are unfamiliar with the legal requirements that impose special responsibilities of disclosure, which may vary from case to case and from jurisdiction to jurisdiction. These responsibilities go to the very heart of Due Process, the crux of criminal justice system's fairness and integrity, and include complying with discovery orders, revealing exculpatory evidence, exposing impeachment information, and fully disclosing expert witness qualifications. Constitutional Due Process is akin to the laboratory's quality assurance system; its requirements help ensure that defendants and the public receive fair and just trials with valid results.

The responses of crime laboratories to these court-imposed disclosure obligations vary and are often hindered by a lack of understanding or clarity of purpose. In this panel session, representatives from United States Attorney's Office, a federal law enforcement agency, the defense bar, and the state judiciary will discuss the role of discovery and other disclosure requirements and answer questions regarding what forensic scientists must know regarding information that must be relinquished and that which may be retained.

Crime Laboratory, Disclosure, Discovery

BS1 Bioterrorism Mass Disasters

Ingrid A. Gill, JD, Law Office of the Cook County Public Defender, 69 West Washington, Suite 1500, Chicago, IL 60602*

Attendees will learn how the Court's handling of the major legal issues arising out of the war on terrorism impacts the forensic community. As state crime labs work in cooperation with federal agencies to detect criminal acts of bioterrorism, the current battle over the extent of discovery needed by the defense is being weighed by the Courts against the Government's need to conduct ongoing criminal investigations while protecting national security. The author will examine major court decisions since 9/11, prior acts of bioterrorism in the U.S., and the current status of field testing as it impacts on discovery disclosures of Department of Justice and the Department of Defense funded research to satisfy admissibility requirements under *Daubert*.

Since 9/11, major cities across the nation have revamped Offices of Emergency Management to work more closely with state and federal agencies to prepare for future attacks by enemy combatants in the War on Terrorism. As part of these efforts, forensic crime labs and law enforcement agencies are now being faced with the added task of accessing crime scenes as potential bioterrorist incidents.

In the fall of 1984 in Dalles, Oregon, followers of the Bhagwan Shree Rajneesh were suspected to have used salmonella to contaminate salad bars in ten restaurants within the city. This bioterrorism attack sickened 751 people, 45 of who were hospitalized. It was more than a year before authorities learned that the illnesses were the result of bioterrorism. More recently, anthrax tainted letters were sent through the U.S. mail beginning in September of 2001. In that bioterrorism attack, there were 22 anthrax cases reported to the Centers for Disease Control. Bioterrorism is not restricted to the U.S. Japan has also witnessed bioterrorist attacks against its citizens in a major city by the followers of a cult.

Bioagent monitoring and detection has become a reality in major cities around the globe. With the increased awareness of the threat, governments recognized that there is a gap in detection technology and equipment. Forensic labs are faced with the necessity of bringing online new technologies with the speed of military deployment while being required to comply with the constitutional demands that form the foundation of many the admissibility standards set by the Courts. There are the competing forces of the rights of the defendant against the government as has been seen in major decisions such has *Hamdi v. Rumsfeld, Rumsfeld v. Padilla, United States v. Moussaoui*, and In re Guantanamo Detainee Cases.

For the forensic scientist, there are the practical considerations of what are the necessary features in bioagent detection for admissibility in the courtroom: sensitivity, reliability, and reproducibility have been the focus in the past. But the detection and monitoring systems must not only identify the bioagent in question, but must be expanded to include the identification of the offenders involved in such bioterrorist criminal acts. The application of imagining surveillance technology, computer forensics, forensic DNA field-testing microchip technology, and biometrics to the application of new and improved bioagent detection capability is inevitable. The rapid application of these technologies to forensics and the criminal justice system posed new challenges to the prosecution and the defense that impact on the constitutional rights of citizens concerning freedom of expression, protections against unreasonable searches and seizures, due process of law, rights to fair trials, capital punishment, and other unremunerated or fundamental rights that must be balanced against national security.

Legal Issues, Criminalistics, Digital Evidence

BS2 International Perspectives on Depravity

Michael Welner, MD, The Forensic Panel, 224 West 30th Street, Suite 806, New York, NY 10001*

After attending this presentation, attendees will understand the application of forensic science to the development of evidence-based, objective guidelines for criminal sentencing.

Where numerous non-scientific bodies have failed, the Depravity Scale research will impact the forensic community and/or humanity by offering considerable promise for an evidence-based approach to distinguishing the worst of crimes.

The Depravity Scale is an objective, evidence-based instrument currently completing validation research in American and international samples to standardize the legal distinctions of "heinous" or "depraved" crimes. These legal terms are used today as aggravating circumstances in capital and other criminal sentencing codes in the U.S. and abroad without any present standardized definitions. This research incorporates public input into defining the specific intents, actions, and attitudes of a crime that warrant the most severe sanctions.

Since 2001, data have been gathered from citizens from around the world – of a wide range of educational, occupational, ethnic, and other demographic backgrounds. Previously released findings among American participants reflect a striking consensus of support for the majority of items under study for inclusion in this instrument.

This presentation updates the progress of this landmark research and for the first time, compares perspectives on depravity among large samples of American, British, Brazilian, Danish, and Australian participants. In this age of worldwide terrorism consciousness, and the increasingly defined role of the international criminal court, there are important gains to establishing criteria for universally repudiated behavior. Where numerous non-scientific bodies have failed, the Depravity Scale research offers considerable promise for an evidence-based approach to distinguishing the worst of crimes.

Evidence, Research, Sentencing

BS3 The Tsunami Disaster: Thailand

Sawait Kanluen, MD, Chulalongkorn University, Department of Forensic Sciences, 254 Phayathai Road, Bangkok, Thailand 10330*

After attending this presentation, attendees will understand the techniques used in victim identification in the tsunami disaster and how to utilize the Interpol Disaster Victim Identification Protocol in mass disasters.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of an organized, systemic approach to mass casualty scenes and victim identification.

The Asian tsunami disaster on December 26, 2004, involved one of the largest, international forensic identification efforts. This presentation will focus on the forensic identification efforts in Phuket, Thailand.

The Interpol Disaster Victim Identification Protocol has frequently been utilized in mass disasters such as earthquakes, fires, and hurricanes; however, never before in a tsunami. The victim identification process in Thailand was challenging due to multiple factors including rapid decomposition of bodies, significant number of foreigners, unprecedented number of victims, and lack of prior fingerprint and dental records. The death toll in Thailand included over 5,395 persons of which 1,953 were foreigners.

Two teams of forensic experts identified tsunami victims: the International Disaster Victim Identification Team and the Thai Disaster Victim Identification Team. All victims were examined utilizing the Interpol Disaster Victim Identification Protocol at three sites in southern

Thailand. Antimortem records such as DNA, fingerprints, dental records, and victim characteristics were obtained from victims' families and cross-matched with postmortem information utilizing the PLASDATA software program at the Thai Tsunami Victim Identification and Information Management Centre. Potential victim identifications were verified by a committee and released to families or embassy officials.

Families quickly identified most Thai nationals based upon physical characteristics, clothing, and personal items. Dental records identified the remaining Thai victims. Due to logistics in obtaining physical characteristics, dental, and fingerprint records, international victims required greater time for identification. DNA identification of victims has proven to be difficult. In many cases, decomposition of victims limited physical and fingerprint identification.

Mass disaster victim identification requires an organized protocol to effectively manage the large number of victims. In the Thai tsunami disaster, forensic experts from nearly two dozen countries utilized the Interpol protocol to examine nearly 5,000 victims.

Tsunami, Mass Disaster, Victim Identification

BS4 The Atypical Serial Killer

Barbara C. Wolf, MD, Office of the District 21 Medical Examiner, 70 Danley Drive, Fort Myers, FL 33907; and Wendy A. Lavezzi, MD*, Office of the Medical Examiner, County of Cook, 2121 West Harrison Street, Chicago, IL 60612*

After attending this presentation, attendees will understand that serial murderers frequently do fit the established paradigm in terms of their physical and psychological profiles, background, and motives to kill.

This presentation will impact the forensic community by pointing out that although establishing a profile for the "typical" serial murderer has proven useful in some cases, making generalized assumptions about the characteristics and motives of serial killers may lead investigators astray and delay the apprehension of these criminals.

The phenomenology of serial murderers has become a fascination in this county partly due to sensationalism brought on by media coverage. Since the 1950s, attempts have been made to predict the demographics and behaviors of serial killers, so called "profiling." The typical profile of a serial murderer is that of a white male between the ages of 20 and 35 who suffered emotional or physical abuse as a child. Some authors have referred to a "triad" of bedwetting, fire setting, and animal torture as being frequent in the background of serial killers.

According to the typical profile, serial killers tend to be intelligent; however, many have low-level jobs with minimal responsibility and are dependent on family or on other women for financial support. Serial murders are often thought of as being nonaffiliated loners. They are believed to crave power and control, and many are thought to be sexual sadists whose crimes are based on fantasies. Attempts have been made to characterize serial killers by their modus operandi, by the means in which their victims were killed, or by signature elements of the killings and the keeping of souvenirs. The means of killing are usually "hands on" methods such as asphyxiation or stabbing, with only rare instances of firearms being employed. In contrast, the victims of serial murders are often vulnerable and easy to control, and include a majority of women and children. Additionally, some researchers believe that because serial murders are most commonly intraracial, with perpetrators and victims of the same race, the majority of victims are also white.

More recently, questions have been raised over the validity of attempts to profile serial murderers. It has been hypothesized that there may be greater variations in their backgrounds, motives, and in their crimes. The authors have had the opportunity to participate in two unusual cases in which five and eight murders were committed in upstate New York. The perpetrators of these serial murders were highly atypical and did not fit the usual stereotype of the serial killer.

Serial, Killer, Profile

BS5 Racial Profiling on the Genetic Level: Can Population Genetics Escape Being Misused in the Courtroom?

Ingrid A. Gill, JD, Law Office of the Cook County Public Defender, 69 West Washington, Suite 1500, Chicago, IL 60602*

The emerging field of population genetics to trace the migration of man has grasped the public's fascination. As more books are published illuminating that humans share a common ancestor by tracing the Y chromosome Single Nuclear Polymorphisms (SNPs) in modern man across many continents, scientists have forced mankind to reexamine racial perceptions. The forensic community has been quick to develop applications utilizing single nuclear polymorphisms (SNPs) to narrow the pool of suspects based on physical characteristics arising from the biological samples left at the crime scene. Forensic scientists have used SNP technology that can identify, with an alleged degree of scientific certainty, the racial make up of unidentified remains from mass disasters.

However, this new technology presents potential bioethical, and legal questions of first impression that the Courts, the Legislature, and the Executive branches will have to address in the coming years. Since some diseases are more prevalent among certain ethnic groups, will the sequencing of genes that are statistically more frequent among certain racial groups raise privacy concerns and trigger HIPPA compliance? Can the racial genetic profiles generated from SNPs' technologies violate the individual's right to declare ethnicity under current law? How do the current statutes of legislation mandating DNA testing of convicted sexual offenders, convicted felons, and arrestee's impact the utilization of race based SNPs technology? Are there justifications for the dissemination of the racial classification data generated by such testing performed under mandatory DNA? Can the expansion of this technology to the prison population serve as a government sponsored validation study of the reliability and suggestibility of its photo composite program and false identification by eyewitnesses? Finally, can the use of such DNA testing which generates a racial profile justify DNA dragnets in the area of a crime? These thought provoking situations and the constitutional implications of this novel technology will be discussed.

Population Genetics, Jurisprudence

BS6 Authors, Science, and the Law: True Crime and Reality, Fiction, or Faction

Ann Rule, PO Box 98846, Seattle, WA 98198; Kathleen J. Reichs, PhD*, UNC - Charlotte, Sociology and Anthropology, Charlotte, NC 28223; Linda B. Kenney, JD*, and Michael M. Baden, MD*, 15 West 53 Street, New York, NY 10019; and Thomas Holland, PhD, USACIL-Hawaii, 310 Worchester Avenue, Hickam AFB, HI 96853; and Thomas D. Holland, PhD, USACIL – Hawaii, 310 Worchester Avenue, Hickam AFB, HI 96853*

The goal of this presentation is to review actual cases and determine how they translate onto paper, why they translate into a novel, and is there any leeway taken with forensic truth? The participants will also learn the steps required to get published.

Many members of the AAFS and many other persons dealing with criminal investigation or the legal aspect of crime or alleged crime are sought out by the entertainment media - whether it's the book business or television - to share their expertise with the public. This presentation will demonstrate why such true crime books or novels have garnered the public interest, the importance and beneficial impact on the public, the impact on would be jurors, and why publishers are looking to real life experts to enter the publication field.

A recent review of all best seller lists in a non-fiction reveals that at least 50% are taken up with true crime or fiction novels related to murder,

mystery, and mayhem. Even the best selling child/series, *Harry Potter*, concentrated a major plot theme dealing with an innocent person accused of a crime, Sirius Black. The true crime book is devoted to telling a true story. The mystery and thriller novel is devoted to telling a fictional story but many times the plot is based on real life cases. This panel discussion will explore what cases best translate onto paper, why certain books appeal to the public, and the depth in which the truth is fictionalized in order to achieve best selling status. In order to get published, a forensic scientist must understand the principles of the book business.

Book Publication, True Crime, Forensic

BS7 Is Your Daughter Trolling for Pedophiles on the Internet?

Don L. Lewis, Lakewood Police Department, 445 South Allison Parkway, Lakewood, CO 80226*

The goals of this of this presentation are to introduce the audience to the level of sophistication of children who are using the Internet, to help investigators and analysts identify and collect evidence found in email and internet chat, and to identify a camera using digital image metadata. The presentation will also assist examiners in identifying artifacts and interpreting metadata using commercially available software. It will discuss the extent of data loss that occurs when an email account is closed, and alternate methods to recover some of the lost data.

In two recent Sexual Exploitation of Children cases investigated by the Lakewood Police Department, the level of sophistication and risks taken by minor victims was of great concern to the investigators involved. The parents were unaware of the activities of their daughters in both of these cases.

The author will provide a case study presentation of the evidence and the analysis of the evidence surrounding the incidents. Some surprising information was recovered which included Yahoo email, Yahoo chat, and Internet artifacts. Also recovered were photographs of the victims including child pornography created and shared by the victims. In one case the images were distributed as Yahoo Message Icons. The metadata recovered from the pictures led to the identification of the camera used in their creation. Submission of images of a known victim to the National Center for Missing and Exploited Children (NCMEC), Known Victim Database, will be discussed.

The presentation will review preservation requests, search warrant service, and issues encountered in compliance. One of the issues to be addressed will review what occurs when the account user closes an email account. A Yahoo email .txt file will be explored in the format it is provided by the Yahoo Legal Compliance Department. Additionally, a method of converting the text file into a traditional email format will be demonstrated. The conversion of the email will enable investigators, prosecutors, defense and the court to view the email in its natural state. The conversion process will allow the "base 64 encoded" files to be viewed properly.

Yahoo Icons, Metadata, Child Pornography

BS8 Thomas Krauss Memorial Bite Mark Breakfast: Rescue and Recovery Operations at the World Trade Center and the New York City Fire Department's Role in the Collection of Forensic Evidence

Michael D. O'Keeffe, The City of New York Fire Department, 251 Lafayette Street, New York, NY 10012*

This presentation will describe the response of the New York City Fire Department (FDNY) to the terrorist attack on the World Trade Center (WTC) on September 11, 2001. As the magnitude and complexity of the incident grew, the Incident Command System was implemented. Following the disastrous collapse of both towers, the FDNY had to regroup. Command and Control needed to be restored, despite the loss of many top commanders, fire officers, and firefighters.

The primary mission at this time was to organize and control a massive search and rescue effort throughout the 16-acre WTC site and the surrounding area where many other buildings also sustained significant damage.

In addition to search and rescue, the recovery of the remains of the deceased was a daunting task. A means to organize and document these recoveries had to be developed. This required communication and cooperation among city, state, and federal agencies and numerous private contractors. A map grid was devised, dividing the site into 75' by 75' squares. The date, time, map grid location, and item recovered were documented manually.

While the search, rescue, and recovery efforts were going on around the clock, the FDNY Planning Unit was working with private vendors and computer experts to develop a GPS system to document findings. This system, believed to be the first of its kind to be used at a large-scale disaster, went into operation on September 30, 2001. The precision and accuracy of recovery documentation increased dramatically at this point.

The Bureau of Fire Investigation became the liaison to the New York City Medical Examiner. During this time period and for months thereafter, the two agencies worked closely together, both at the temporary morgue onsite and at the Medical Examiner's office on East 30th Street. The FDNY Counseling Service Unit and the newly formed Family Assistance Unit interacted with the Medical Examiner as the remains of deceased members were recovered and identified.

Finally, a brief narrative will describe the efforts of the FDNY to recover from this event, to provide for the medical and mental health needs of members and their families, and to rebuild the Department.

World Trade Center, Forensic Evidence, New York City Fire Department

L1 From the Green River: Forensic Evidence and the Prosecution of Gary Ridgway

Jeffrey Baird, JD, Senior Deputy Prosecuting Attorney for King County, Washington State, W554 King County Courthouse, 516 Third Avenue, Seattle, WA 98104*

The goal of this presentation is to describe the apprehension of Gary Ridgway as the perpetrator of multiple homicides and discuss the role of forensic evidence in the prosecution of this serial killer. This presentation will impact the forensic community and/or humanity by providing attendees with insight into the organization of a multi-agency manhunt; and understand the enormous contribution and the limited role of forensic evidence in this case.

In July and August of 1982, five women were murdered and left in or near the Green River in King County, Washington. All five had a history of prostitution; all five had been strangled. These murders were the community's first notice that a serial killer was preying on young women.

Over the next several years, the bodies of more and more victims, most of them teenage girls, were found in wooded or remote parts of King County. Most were found with no clothing or possessions. In many cases, months or even years had passed since the victim's disappearance, and all that was found were skeletal remains. Identification of the victims sometimes took years. Eventually, 49 victims were listed as victims of the Green River Killer.

Despite extraordinary efforts by county, state, and federal investigators, and public and private forensic scientists, these murders remained unsolved for nearly two decades. Hundreds of suspects were identified, but no convincing evidence of their guilt was developed. Finally, in 2001, Beverly Himick and Jean Johnston at the Washington State Patrol Crime Laboratory discovered DNA evidence linking Gary Ridgway to several of the Green River homicides. Ridgway, a King County resident who had worked for decades in the paint shop at a local truck factory, was charged with four murders.

For the next 18 months, a team of detectives and prosecutors painstakingly reviewed approximately five dozen unsolved homicides (most of them attributed at the time to the "Green River Killer") for any evidence linking them to Ridgway or any other suspect. Hundreds of items of evidence were submitted to scientists in various forensic disciplines throughout the country. In 2003, shortly before the court-imposed charging deadline in the case, Skip Palenik, a private forensic scientist at Microtrace, reported that he had discovered tiny spheres of sprayed paint from a number of the crime scenes and on evidence seized from Ridgway in the 1980s. Based on this evidence, Ridgway was charged with three additional murders.

Faced with this additional forensic evidence of his guilt, Ridgway offered to provide prosecutors with a full account of his criminal activities in King County and to plead guilty to all the murders he had committed in that jurisdiction if the prosecution would agree not to seek the death penalty. After considerable discussion and contemplation, Norm Maleng, the King County Prosecutor, accepted this offer. Detectives, prosecutors, and mental health experts interviewed Ridgway for nearly six months. In November of 2003, Gary Ridgway pled guilty to 48 counts of aggravated, first-degree murder.

The Ridgway case illustrates both the extraordinary power of contemporary forensic science, and its equally striking limitations. Without DNA evidence, the Green River Killings would never have been solved. Yet despite extraordinary efforts by premier public and private forensic laboratories employing state-of-the art methods, no physical evidence whatsoever linked Ridgway (or any other suspect, identified or unidentified) to the majority of the Green River murders. Even after Ridgway was identified — and after he provided irrefutable corroborative evidence of his guilt to investigators (e.g., leading them to additional bodies) – forensic science was unable to link him to most of his victims. The unsophisticated but ruthlessly successful way Ridgway committed his crimes – the victims he chose, the manner in which he killed them, and the way he disposed of their bodies – yielded surprisingly little forensic evidence of his guilt.

Serial Killer, DNA, Forensic Evidence

L2 Dying to Kill: Understanding the Motives of Suicide Bombers

Mia Bloom, PhD, University of Cincinnati, ML 0375, PO Box 210375, Cincinnati, OH 45221-0375

Upon completion of this presentation, attendees will understand the motivations of suicide bombers. This presentation will demonstrate the need for an understanding of the complex dynamics of suicide bombing.

What motivates suicide bombers in Iraq and around the world? Can winning the hearts and minds of local populations stop them? Will the phenomenon spread to the United States? These vital questions are at the heart of this discussion of suicide terror's allure and impact on world politics. This presentation will examine the use, strategies, successes, and failures of suicide bombing in Asia, the Middle East, and Europe, and assess the effectiveness of government responses. In many instances the efforts of Israel, Russia, and the United States in Iraq have failed to deter terrorism and suicide bombings.

Discussion of this subject considers how terrorist groups learn from one another, how they respond to counter terror tactics, the financing of terrorism, and the role of suicide attacks against the backdrop of larger ethnic and political conflicts. The presentation will start with a review of the long history of terrorism, from ancient times to modernity, from the Japanese Kamikazes during World War II, to the Palestinian, Tamil, Iraqi, and Chechen terrorists of today. Consideration of how suicide terror is used to achieve the goals of terrorist groups; to instill public fear, to attract international news coverage, to gain support for their cause, and to create solidarity or competition between disparate terrorist organizations; will be included. It is often social and political motivations rather than inherently religious ones that inspire suicide bombers.

Suicide Bombers, Terrorism, Motives

W1 The Tri-State Crematorium Incident: A Mass Disaster Over Seven Years

Kris L. Sperry, MD, and Frederick J. Snow, PhD*, Georgia Bureau of Investigation/DOFS, 3121 Panthersville Road, PO Box 370808, Decatur, GA 30037-0808*

After attending this presentation, attendees should be able to understand how to approach a mass disaster created when large numbers of bodies are not cremated in accordance with standard funeral practice. Participants will also gain an understanding of how multiple agencies interact in dealing with a complex mass disaster. Approaches to public and media involvement will also be discussed.

This presentation will impact the forensic community and/or humanity by demonstrating how this crematory incident created social havoc throughout Georgia, Tennessee, and Alabama. The impact was felt among countless thousands of individuals who had sent the bodies of their loved ones to be cremated. This incident also captured national and international attention.

In February, 2002, 339 bodies were discovered at a run-down crematory in rural Northwest Georgia. The bodies were strewn in the woods, buried in pits, and deposited within several buildings on the property. The crematory owner maintained essentially no records regarding cremation practices. This initiated the largest criminal investigation in the history of the state of Georgia, during which over 500 individuals from more than fifty-five local, state and federal agencies were involved in the recovery and identification of these bodies. This incident attracted rapid media attention from around the world, and necessitated daily interaction with grieving family members and the national and international press. The governor of the state of Georgia and both United States Senators from Georgia visited the scene during the recovery process. The recovery of the bodies was accomplished within a three week time period, and forensic evidence to assist in identification was gathered with the assistance of DMORT. The identification process included collection of thousands of DNA samples from family members and lasted almost two years. The ultimate cost of this man-made disaster to the State of Georgia was approximately ten million dollars. The crematory owner was eventually charged with 787 felony counts, was convicted, and sent to prison. Numerous civil lawsuits were eventually settled for a total exceeding eighty-four million dollars. This presentation will show the way in which each of the different agencies interacted to recover and identify the bodies and how the directors of the investigation dealt with a problem that grew with each passing day.

Crematory, Forensic Anthropology, Identification

W2 Research, Writing, and Reviewing: A Guide to Designing, Conducting, Writing, Publishing, and Analyzing Scientific Research

Amy C. Gruszecki, MSFS, DO, Southwestern Institute of Forensic Sciences at Dallas, 5320 Medical Center Drive, Dallas, TX 75235; Gregory G. Davis, MD, MSPH*, Jefferson County Coroner/Medical Examiner Office, 1515 6th Avenue South, Room 611, Birmingham, AL 35233-1601; and J. Keith Pinckard, MD, PhD*, Southwestern Institute of Forensic Sciences at Dallas, 5230 Medical Center Drive, Dallas, TX 75235*

After attending this presentation, attendees will be able to design a scientific study, including hypothesis formation and control group selection; become familiar with the roles of HIPAA and an IRB; be aware of funding resources for forensic research; define standards for authorship on a research project; understand the basics of how to write a scientific paper; understand the publication process, including peer review and editing; and analyze and interpret scientific literature already published.

Evidence collected at a crime scene or during a forensic autopsy has important implications for both victims and suspects. Medicine, in general, and forensic science, in particular, is coming under increasingly intense scrutiny and pressure to produce scientific research supporting its conclusions (i.e., *Daubert v. Merrell Dow Pharmaceuticals Inc.* (1993)). This workshop is designed to discuss the elements needed to design and perform a valid scientific study and the steps needed to write and publish that study through a peer review process. It also is designed to teach a forensic scientist how to analyze a research study that has already been published, as not all published studies have scientifically valid conclusions. (Thus scientifically invalid literature may have gone unchallenged in the scientific community and perhaps even in the courtroom.) The presentation will impact the forensic science community and/or humanity by increasing the participant's understanding of research thereby to improving the quality of forensic science literature published in the *Journal of Forensic Sciences*, *The American Journal of Forensic Medicine and Pathology*, and other journals which represent the forensic field.

Increasingly, medicine and forensic science must rely on the 'evidence based' scientific approach. No longer can assertions be made without valid scientific research to support those conclusions. Judicial systems rely on forensic science to provide sound science based on properly conducted research as a basis for the adjudication of suspected criminals. A scientist must also possess the skill to critically review published literature and come to his own conclusions. The importance of sound research and critical reading is vital, as people's lives can be forever altered by poorly performed or improperly interpreted research.

This workshop is designed to teach the novice forensic scientist (or serve as a review for the experienced forensic scientist) about scientific research and literature. The workshop will consist of didactic presentations in four major areas. In the first section the development of a research study will be presented. During this section the development of a hypothesis and the importance of appropriate control groups and sample sizes will be discussed. The role of institutional review boards and the effect of the Health Insurance Portability and Accountability Act (HIPAA) will also be presented. The second section will address the importance of and suggestions for clear and concise scientific writing. In the third section, the path of a paper through the publication process will be reviewed. This section will include information on authorship responsibility, a journal's editorial and peer review process, and steps toward final publication, focusing on the *Journal of Forensic Sciences* and *The American Journal of Forensic Medicine and Pathology*. The fourth section will address the principles for critically reviewing a published manuscript to decide for oneself whether it should be considered appropriate and fundamentally valid in its design and conclusions.

By attending this workshop, participants will begin to appreciate the circular path of scientific research, writing, and reviewing. Understanding the principles of research design allows not only the performance of sound and valid research, but also the critical evaluation of published studies. Critical evaluation in turn reinforces the principles essential for scientifically testing an approach to solving problems encountered in the work of forensic science. The principles are applicable whether the problem being solved is related to a specific case on a specific day or to an unsolved issue in the field of forensic science.

Research, Scientific Publication, Forensic Science

W3 Investigating, Evaluating, and Litigating Cases of Mass Disaster

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The goals of this presentation are: (1) to provide information on current and future methods and trends in managing and processing crime scenes in mass disasters, (2) to present factors to be considered by medical examiners in collecting and evaluating evidence, (3) to provide insight into the types of chemical weapons of mass destruction, their detection, analysis, evaluation and use of the results of analysis in litigation, and (4) to present the attorneys perspective on litigating civil and criminal cases involving mass disasters. Attendees will gain insight into the rationale for the use of integrated teams when disasters strike, the role of the medical examiner, the effective use of the results of forensic analyses and how the results of analyses can be used to bring about a fair and just result in both criminal and civil litigation.

This program will impact the forensic community and/or humanity by providing crime scene investigators, laboratory managers, forensic scientists, medico-legal practitioners and attorneys with insight into the proper approach and procedure for processing crime scenes and collecting evidence from scenes of mass disasters; managing the investigation, establishing appropriate interagency relationships and how to integrate necessary governmental agencies into the investigation; understanding of forensic toxicology evidence and its significance, limitations, and uses in litigation; types of civil litigation appropriate to mass disasters and the effective use of forensic analyses in litigation to bring about a fair, just and equitable result.

The workshop will begin with a detailed overview of mass disasters and proper procedures for processing crime scenes as this first step can greatly impact the end result of litigation, whether civil or criminal. Proper processing is most important in dealing with mass disasters that originate from varied sources ranging from physical forces such as seismic waves or explosive materials to chemical agents. Moreover, there must be coordination between various government agencies, each of which plays a vital role during the beginning phases of an investigation. Attendees will learn the various governmental agencies necessary to form the appropriate team for a specific scene and how to integrate these essential agencies into the process.

The need to integrate the medical examiner into the team effort to deal with terrorism is key. The role of the medico-legal examiner may vary from discovering an agent to diagnosing and/or confirming the presence of a "weapon of mass destruction" (WMD). The crime scene of a WMD may exist at locations not normally associated with mass disasters. The young and aged, the most vulnerable in society due to their fragility, may be the first casualties from an attack and because of their fragility may not have the opportunity to go to a health care facility which may lead to their discovery at home. In these type situations, the medical examiner would be charged with the responsibility of examining these individuals and determining a cause and manner of death. The medical examiners role is critical in determining what evidence must be collected and specific sampling for specific agents. The workshop will include a survey of the most important biological agents and how to deal with them from the perspective of the medical examiner. Examination, laboratory evaluation and integration into the emergency operations will be reviewed.

The Forensic Toxicologist is also an integral part of the team. Their analysis and interpretation of test results is key in the litigation process. The toxicologist must determine what information based on the type of disaster can and cannot aid in determining liability.

Finally, the potential for civil liability as a result of mass disasters will be explored and compared to criminal liability through exploration of international, national, federal, state and other jurisdictional laws. Examples of causes of action leading to liability, i.e. wrongful death, and available remedies and defenses will be discussed. The attorney's role in successful achievement of a fair and just result on behalf of families of victims and the community at large begins at the crime scene and continues to the forensic laboratory and on to the courtroom. The attorney must understand the result of forensic analyses and most importantly the significance of the results in proving liability.

The workshop will conclude with a discussion and question and answer period.

Biological Warfare Agents, Toxicology, Civil and Criminal Litigation

W4 Expectations and Responsibilities of Expert Pathology Witnesses and the Attorneys Who Consult or Scrutinize Them

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After attending this presentation, attendees will know how to think about preparing for and presenting forensic pathology testimony and also how attorneys think about pathologists as expert witnesses either as the primary pathologist who performed the autopsy and determined the cause and manner of death or as a consulting pathologist hired to review the case.

Pathologists, as any other expert witnesses, are increasingly likely to be challenged in pretrial Daubert hearings as to their methods and conclusions and then again at trial when they are confronted both by a skilled and schooled cross-examiner and a competent expert for the opposing side who will make a case for opposite expert conclusions and opinions before the jury. Attention will be directed toward adequate preparation long before the presentation of expert testimony at deposition, hearing or trial in order to avoid either the expert or the attorney appearing to the judge or jury to be the dummy in a ventriloquism routine.

This presentation will impact the forensic community and/or humanity by demonstrating realistic forensic abilities. Given the new joker of the so-called CSI effect that is reportedly being dealt from time to time, both experts and trial attorneys need to be prepared to adequately deal with unrealistic expectations about what can and cannot be proved by the application of the arts and science of morbid anatomy.

This workshop is designed primarily for experienced forensic pathologists and trial attorneys who need to learn how to get the most out of these experts when attempting to prove or disprove a particular manner or cause of death. It should also serve as a thoughtful forum for less experienced litigators, jurists, pathologists and forensic experts in general, who have not yet experienced the exceptional amounts and various types of scrutiny in high profile cases, which accompany the presentation of expert forensic pathology evidence in published reports, *Daubert* challenge hearings, trial testimony and the entire appellate process. The discussion will additionally address the moral and ethical responsibilities of a consulting expert witness and proffering attorneys.

By examining several high profile cases that have triggered one or more of these exceptionally intense extra-forensic types of scrutiny, the pathologist and attorney, with over fifty years of combined experience in handling homicide investigations and trials of all types, and a jurist with extensive experience both on the bench and in the courtroom as an

advocate, will guide the attendees through a series of presentations, demonstrations and discussions concerning major success stories as well as resounding failures, in order to accentuate the strategies that have worked for others; but more importantly, to learn from their most egregious mistakes.

Forensic Testimony, Forensic Evidence, Expert Witness

W5 Solving the South Louisiana Serial Killer Case – New Approaches Blended With Older Trusted Techniques

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After attending this presentation, attendees will learn the application of forensic techniques to a very complex, multifaceted investigation of multiple murders and multiple crime scenes. Aspects to be covered include coordination and communication with investigating officers and the media, physical matching and comparison coupled with database and data mining, STR DNA, Y STR DNA and trace/LCN DNA techniques applied to crime scene samples, large scale screening of suspect samples, unique and traditional DNA database applications, application of SNPs as an investigative tool including racial determination, and outcomes including policy, legislation, and funding impacts. Attendees will gain understanding of the strengths and limitations of each approach, as well as future potential technological applications towards solving serial crimes, including investigative and prosecutorial perspectives.

This presentation will impact the forensic community and/or humanity by teaching the forensic community the keys to success, and avoiding the pitfalls in large multidiscipline multiple murder investigations. Techniques learned will be immediately employable by forensic scientists, investigators, and administrators in their own jurisdictions and casework. The forensic community and society as a whole will benefit through protection of individual's rights by exoneration of innocent suspects, the increased public safety resulting from early apprehension of serial predators, and the reduced cost benefit of an effective investigation using the latest technology.

In 2002 and 2003, the murders of six female victims were linked to a single assailant in Southern Louisiana. Multiple agencies were involved in the investigation and eventual prosecution of the cases, culminating in the death penalty sentence for the accused in 2004.

STR DNA typing was performed on a variety of biological materials found at crime scenes and used to link murders that differed sufficiently in modus operandi that they may not have been otherwise associated. As the hunt for the serial killer generated considerable media coverage, the media was used to involve the public in the investigation itself. Over 2500 suspects were generated and cleared with STR DNA typing.

Rare alleles were examined in the suspect STR DNA profile in an attempt to determine information regarding race, to examine the potential to search for possible relatives, and to provide rapid screening. Y-STR DNA was used as an additional investigative tool in screening suspects. SNPs were employed to provide racial information about the killer. An FBI profiler authored a behavioral profile of the serial killer and provided assistance in the investigation.

The investigative use of databases generated unique leads when applied to the field of physical comparison involving running shoes. Trace/LCN DNA produced a mixed profile from sweat of an assailant in an attempted sexual assault and attempted murder that was interrupted by the victim's son. The deduced profile of the minor contributor to the mixed DNA profile was linked to the serial killer. A very detailed sketch drawn from the vivid memory of this living witness was released shortly before his capture. Telephone/computer cord from two crime scenes was physically matched to provide a link between the living witness and one of the serial killer's victims.

The accused had a number of arrests and convictions that could have placed him in a DNA database prior to the murders. Had his DNA profile been in the database, the lives of his victims could have been spared. The search for the living victim to help solve the case resulted in the working of cold cases, including Project Cold Case Resolution carried out by Acadiana Crime Lab. The serial killer cases produced wide sweeping effects to policy, legislation and funding in Louisiana, including arrestee DNA sampling. This multifaceted operation resulted in a number of learning experiences, which involve improved use of existing investigative tools, as well as application of novel approaches to crime solving and prevention.

Serial Killer, DNA, Database

W6 Advanced Topics in STR DNA Analysis

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After attending this presentation, attendees will 1) better understand the application of capillary electrophoresis methods to DNA typing involving STR markers; 2) know the essential elements in validating a new STR kit; 3) be able to understand anomalies in STR data and troubleshoot problems with the ABI 310 and ABI 3100 instruments; and, 4) understand the role and function of Y-chromosome and mitochondrial DNA analysis as compared to conventional STR typing.

This presentation will impact the forensic community and/or humanity by assisting forensic DNA analysts will in understanding the analytical instrumentation and aspects of the DNA typing performed in the laboratory. The knowledge gained from this workshop should help scientists better troubleshoot and do their job on a daily basis. In addition, more rapid validation should be able to be performed in their laboratories leading to more casework samples being run sooner.

With the advent of sophisticated techniques such as multichannel capillary electrophoresis, laser induced fluorescence and realtime PCR, it becomes increasingly important for the user to grasp the underlying principles behind the technology used in their laboratory. Effectively troubleshooting these systems requires the operator to play an active role in the operation of the laboratory. Advanced knowledge of the principles behind STR technology permits trouble free and efficient laboratory procedures. This workshop will present the user with the theoretical underpinnings necessary for them to better understand the application and validation of advanced technology in the analysis of forensic microsatellites. This one day workshop will present the user with a series of advanced topics in the application of short tandem repeats in their laboratory from two active researchers in the field.

Topics discussed will include an introduction and overview of the rationale behind the use of short tandem repeats, including issues with primer sequences, miniSTRs, and other biological aspects of the use of STRs, a section on the theory and application of capillary electrophoresis

to STR typing, and a section on developing ways to more effectively use validation studies. Troubleshooting laboratory instrumentation will also be covered. The presentations will conclude with a series of lectures on new technology currently affecting laboratory procedures such as realtime quantitative PCR, mitochondrial DNA, and Y STRs.

Attendees at this workshop can expect to gain a better appreciation of the fundamental issues surrounding the analysis and detection of forensic DNA in their laboratory. The lectures will conclude with an open discussion in which the attendees and lecturers can discuss relevant issues in their own laboratories with the speakers.

DNA Typing, Short Tandem Repeats (STRs), Capillary Electrophoresis (CE)

W7 Grants, Grant Progress Assessments, & DNA Audits: Before, During, & After - Lessons Learned & Tools to Help

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The goal of this workshop is to provide an understanding of The National Institute of Justice's (NIJ)'s grant process, from the issuance of a solicitation to grant closeout. A range of grant programs will be covered. Additionally, the workshop will provide a thorough explanation of the National Institute of Justice's Grant Progress Assessment and DNA Audit programs provided through a Cooperative Agreement with the National Forensic Science Technology Center (NFSTC), including common opportunities for improvement identified in the past and techniques to maximize conformance.

This presentation will impact the forensic community and/or humanity by preparing attendees to apply for and compete for grants, as well as to comply with the requirements of grant programs. They will also be prepared for Grant Progress Assessments DNA Audits through an understanding of common non-compliances.

The NIJ has provided hundreds of millions of dollars in grant funds to state and local crime laboratories for the analysis of convicted offender and forensic casework samples. As part of the NIJ grant administration responsibilities there is also an obligation to review the status and impact of these grants by conducting site visits to grant recipients.

To assist the NIJ in this oversight role, a Grant Progress Assessment (GPA) program has been developed. The NIJ has directed NFSTC, through its Cooperative Agreement, to provide the resources necessary to deliver this GPA program. The NFSTC already has a viable and community requested no-cost DNA Audit Program that annually reaches over seventy publicly funded DNA laboratories in the United States. The NFSTC uses contract qualified DNA analysts/auditors that deliver the Free DNA Audit Program to deliver the Grant Progress Assessment to the NIJ.

Grant Award, DNA Audit, Assessment

W8 The Nose Knows: Canine and Instrumental Detection of Suspects, Explosives, and Cadavers

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After attending this presentation, attendees will be aware of the applications of emerging technologies of instrumental detection; be familiar with the application of canine detection techniques; and understand the limitations and capabilities of current canine and instrumental methodologies. The open question session planned at the end of the day will allow workshop participants to address both the invited speakers and each other in a relaxed and productive environment.

This presentation will impact the forensic community and/or humanity by promoting the application of canine and instrumental methodologies, furthering the detection capabilities of human scent, explosives, and cadavers.

Canine detection is generally accepted as the best real-time method of detection of explosives and cadavers, although developments in instrumental design and application have produced new complementary strategies. This workshop brings together speakers from federal agencies, private companies, and research universities, to present modern applications of canine detection and instrumental methods, as applied in the field of explosives detection, human scent identification, and cadaver detection. After an introductory opening presentation detailing optimal combinations of dog and machine, speakers will discuss the application of explosive detection canines to homeland security and military applications, supported by innovative chemical sensors that operate at very low detection levels. Discussion of the science of explosive odor will support these talks. Attention will then shift towards the use of canine and instrumental methods to discriminate between the scents of human suspects, as applied in "line-up" identifications in Europe, and by specialized bloodhound teams in the USA. A presentation detailing instrumental differentiation of human scent will also discuss potential biometric applications in human identification. The final section of the workshop will focus on the use of canine and novel detection methods for cadaver location, including recent research featuring sonar and volatile chemical sampling.

The objectives of this workshop include:

- to develop familiarity with the application of canine detection techniques of human scent, explosives and cadavers
- to provide awareness of applications of the emerging technologies of instrumental detection
- to increase the understanding of the limitations and capabilities of current canine and instrumental methodologies.

Explosives, Human Scent, Cadavers

W9 Practical Homicide Investigation and Sex-Related Murders

Vernon J. Geberth, MS, MPS, PO Box 197, Garnerville, NY 10923; and Robert D. Keppel, PhD*, Criminal Justice Program at Seattle University, 11831 SE 66th Street, Bellvue, WA 98006*

After attending this presentation, attendees will 1. Understand the role of fantasy in sex-related murders; 2. Collect and preserve physical evidence in sex-related death investigations; 3. Determine the M.O. and signature characteristics at crimes scenes left by sex-murderers; and 4. Understand the follow-up investigative procedures involved in rape, sodomy, lust murder, and serial murder investigations.

This presentation will impact the forensic community and/or humanity by providing information on the proper procedures for investigating sex-related murder cases.

The Practical Homicide Investigation® and Sex-Related Murder Workshop will expand upon last year's workshop entitled "Practical Homicide Investigation." In the 2006 workshop, Commander Vernon Geberth and Dr. Robert Keppel will integrate and illustrate the tactics, procedures, and forensic techniques of practical homicide investigation to the investigation of sex-related murders. For homicide detectives, the book Practical Homicide Investigation® has been recognized as the benchmark and "Best Practice" model for professional death investigation. Contained within are protocols for detectives to follow in dealing with various types of death investigation. Now, the presenters will focus more narrowly on the often-troubling sex-related investigations. After experiencing the first workshop section, attendees will understand the investigative significance of fantasy in sex-related murders and procedures involved in the collection and preservation of physical evidence in sex-related death investigations. Following that presentation, a historical review of *Modus Operandi* and signature cases and analysis procedures for determining the M.O. and signature characteristics of sex-murderers will take place. Specifically, follow-up investigative techniques will be given regarding rape, sodomy, lust murders, and serial murder investigations. And finally, a discussion will take place where attendees may ask questions of the presenters. The overall goal of the workshop is to provide comprehensive and practical information that will serve as an investigative guide to the investigation of sex-related murders as well as serial homicide.

Homicide, Sexual Related Murder, Signature

W10 Forensic Image and Video Processing

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After attending this presentation, attendees will learn how quality assurance principles are applied to AV, what can be done with digital images and video stream, and which techniques can be used in forensic science.

This presentation will impact the forensic community and/or humanity by demonstrating how visualization in court, measurements in images and error estimations, and image processing techniques can be used.

During this workshop information will be provided on new developments of forensic investigation of (digital) images and video streams and the use of 3-dimensional computer modeling in forensic investigations.
Traditional sources of images as evidence concern crime scene photography, and more specifically, photographs of fingerprints, toolmarks, shoe prints, and other impressions. A short overview of image processing techniques will be. Special attention is given to the introduction of artifacts by image processing (e.g., FFT on fingerprints), imaging in pathology and quality assurance aspects.

During the last 25 years the use of CCTV-camera systems has become widespread. Typical questions concern the quality and the selection of images from a specific camera in a multi-camera-recording. Digital processing of video streams for presentation and storage purposes, and the compression techniques that are applied in digital CCTV-systems, lead to questions about the integrity and authenticity of recordings. Also questions about image interpretation like facial recognition, body length, or car speed, often in low resolution, time lapse, or compressed images have increased.
New sources of video streams and images are video recordings from handy cams, digital photo cameras, internet and cellular phones. Typical questions about these recordings concern the integrity and authenticity of the recordings, the data compression techniques used the synchronicity of sound and images, compensation for camera movement, and the conversion of a video stream to a higher resolution image.

This workshop will focus on methods for digital capture and analysis of analogue and digital multiplex surveillance recordings, state-of-the-art image enhancement techniques as contrast stretching and de-blurring, as well as new methods as super resolution, stabilizing and automatic tracking.

Since more images are being processed for forensic investigation, new methods have been developed to answer questions about the interpretation of images. Examples given: Is it possible to read a license plate number? Is the suspect, or his car, the one depicted in the image? What is the body length of the robber or the speed of a car? Is it possible to do a reconstruction of an accident or a shooting incident from the information in these images? Methods for image comparison, facial comparison with non standardized images, image reconstruction, and photogrammetry are presented and discussed. Special attention is given the accuracy of the results and the impact on the conclusions from these investigations. Furthermore, there will be a hands-on training during this workshop. Finally, some extra attention is given to the use of 3-dimensional computer modeling in forensic investigations.

Computer models and animations have been recently used for analyzing video by superimposition of computer generated views of the model on the video images, for the visualization of complex scenarios in animations, and for testing scenarios against video footage and evidence in crime scene photographs. Examples: the reconstruction of car accidents from photographs, analysis of blood spatter patterns from photographs using a computer model of the crime scene, the visualization of wound channels in computer models of human bodies, the reconstruction of bullet trajectories, the reconstruction of a burglary using the limited information in dark images from a multi-camera video recording, and the analysis of firework explosions from video recordings, photographs and geographical data. Special attention is given to modeling techniques, the accuracy of the models, methods for visualizing uncertainties and possibly erroneous suggestions coming from these visualizations.

The use of image processing in the analysis of patterned injury of the skin, with emphasis on child abuse and as an aid in image analysis in forensic pathology will be discussed. The interpretation and recognition of image processing artifacts and image quality issues in forensic pathologic evaluation will be demonstrated.

Image Processing, Video, 3D Reconstruction

W11 The Medicolegal Investigation of Recreational Diving Fatalities

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After attending this presentation, attendees will: 1. have a basic understanding of the special physiology and specialized equipment associated with SCUBA diving; 2. appreciate the epidemiology of deaths associated with recreational diving, including geographic distribution, common causes of death, and contributing factors to these fatalities; 3. be able to adequately investigate and interpret the historical events and circumstantial evidence associated with diving fatalities; 4. understand the recommended approach to the autopsy of persons who died while diving and be able to interpret the anatomical findings in the context of the historical events; and 5. have handout material and points of contact for future reference to competently investigate a diving related death.

This presentation will impact the forensic community and/or humanity by providing a knowledge base and resources for investigation of a type of death that is seen more frequently in a select few jurisdictions but one that can occur anywhere.

The popularity of recreational diving using scuba (self-contained underwater breathing apparatus) has increased dramatically over the past three decades. Present estimates place the number of active recreational divers in the United States at between 500,000 to one million. The number of fatalities involving U.S. citizens performing recreational dives averages 90-100 each year. These fatalities challenge the investigators and pathologists who must investigate and certify these deaths. Recreational diving fatalities are often litigated in civil court. This workshop is designed for the pathologist, criminalist, attorney, and general section member who may become involved in the investigation of a scuba diving accident or fatality. The instruction level is intermediate.

The initial portion of the workshop will include a brief overview of diving physiology, including the effects on the body of breathing compressed air. The pathophysiology of barotrauma, nitrogen narcosis, oxygen toxicity, gas embolism, and decompression illness (caisson disease) will be reviewed. The pathophysiology of drowning will be reviewed since it is a frequent final outcome in a fatal diving mishap.

Following the discussion on physiology, the epidemiology and risk factors associated with recreational diving fatalities will be presented. A detailed presentation on the recommended investigation of a fatal diving mishap will be given using illustrative cases from south Florida and the Divers Alert Network (DAN). The importance of interviewing witnesses and gathering information on the diver's past medical history, diving experience, pre-dive status, and the circumstances surrounding the dive will be emphasized. The relevance of knowing the exact depth and bottom time of the dive, as well as when and where the diver began to run into difficulty, will be discussed. Additionally, the workshop will include a hands-on section where typical diving equipment will be available for examination and familiarization by attendees. This will be accompanied by a brief discussion on the evaluation of dive gear. In the past few years highly technical diving equipment such as rebreather apparatus and complex gas mixes have been used more frequently by divers. Diving in caves and shipwrecks has also increased in popularity. Deaths involving these aspects of diving will also be discussed.

In the final portion of the workshop, presenters will review the autopsy protocol for scuba diving victims and emphasize those tests and observations that are helpful in determining the cause of death. The significance of finding intravascular bubbles will be discussed, as will the proper interpretation of the findings of the autopsy. Natural diseases likely to cause sudden incapacitation and death while scuba diving will be reviewed. Finally, related topics such as hazardous marine animals, zoophagia, and trauma leading to recreational diving fatalities will be presented.

Thorough handouts will be provided by the speakers, including checklists of important information to obtain regarding a diving mishap, a diving fatality reporting form, a suggested autopsy protocol for use when diving related fatality, and recommended resources for consultation and referral.

Cause of Death, Diving Fatalities, Medicolegal Investigation

W12 Interpretation of Toxicological Analysis in the Elderly

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After attending this presentation, attendees will be able to distinguish between the results interpreted for the young versus the elderly; will be able to discuss common toxicities in elderly decedents; will be able to describe the concept of toxicology in the elderly population; will be able to discuss the importance of toxicology analytical testing; and will be able to identify appropriate interpretations of toxicology of prescription, illegal, and over-the-counter drugs.

This presentation will impact the forensic community and/or humanity by demonstrating that in postmortem toxicology, one size does NOT fit all, particularly when the individual is elderly.

The goal of this workshop is to discuss the unique situations encountered or overlooked in elderly individuals undergoing postmortem examination in the medical examiner's office and to make laboratory professionals aware of the possibility that current/routine postmortem drug screens may not be adequate for geriatric patients.

Older adults use more prescription, herbal and traditional over the counter (OTC) medications than any other age group. This group also uses significantly fewer illegal street drugs of abuse. Due to the number of medications and the different doses and times of administration required, older individuals are at high risk for medication mismanagement. In addition, drug interactions may occur between individual medications or between medications and herbal supplements. Complicating this problem are the changes in physiological functioning of organ systems that occur with age and the possibility of elderly abuse.

Many laboratories do not perform toxicology analysis or perform only routine drugs of abuse screen on postmortem specimens. Although such a screen may detect some common opioids, it will not find calcium channel blockers, erectile dysfunction medications, antidepressants or any of a number of other drugs found disproportionately in the elderly.

This workshop will introduce the attendee to the physiological changes that occur with age, the signs of elderly abuse both postmortem and in the emergency department, and some of the unique aspects of geriatric toxicology including the possibility of altered metabolism, adverse drug reactions and drug interactions. The attendee will learn that in postmortem toxicology, one size does NOT fit all, particularly when the individual is elderly.

Toxicology in the Elderly, Geriatric Toxicology, Pathology of Aging

W13 Operation Street Smart: An Overview of Current Street Drugs and Drug Culture

John F. Wyman, PhD, John R. Sudimack, BS, Michael N. Powell, and David R. Hunt*, Franklin County Sheriff's Office, 410 South High Street, Columbus, OH 43215*

After attending this presentation, attendees will gain up-to-date and in depth knowledge of what street drugs are, the current drug culture and the trends for the future. They will be able to recognize what was probably previously unnoticed, drug related behavior, terminology, paraphernalia, dress, and physiological signs of drug use.

Bench scientists, pathologists, and others may have little exposure to what is happening at street level with illicit drug abuse (what drugs are currently popular in different regions of the country, how drugs are packaged, characteristic signs of use and abuse, routes of administration). Knowing how designer drugs are manufactured and packaged and the associated paraphernalia used in drug abuse will be of value to drug chemists, investigators, and toxicologists. Real-world examples of designer drugs and drug paraphernalia will be available for inspection (no free samples). The United States demands and abuses more drugs than any other country. This demand has turned drug trafficking into a competitive business that generates billions of dollars for major Drug Cartels throughout the world. Humanity is engaged in a Drug War, the outcome of which is in doubt, without the positive involvement of families and communities. Most of us are parents or will be parents. This presentation will impact the forensic community and/or humanity by empowering us to build a foundation for drug abuse education for ourselves, families, and communities. This presentation will raise the consciousness of the audience about the global size of the "Drug Problem" (it is bigger than you think), and educate them about the signs and symptoms of drug abuse in young people.

Operation Street Smart was created in July 2002, as a collaborative effort to provide current information on trends, terminology, paraphernalia, and physiological effects of illicit drugs. This endeavor is the first of its kind in the United States and last year received the FBI Director's Community Leadership Award. The workshop is conducted by two current undercover detectives, who possess over thirty years combined narcotics experience. Their program includes actual examples of current designer street drugs such as XTC, AMT, 5-Meo-DMT, LSD, GHB, Ketamine, and Khat. D.A.R.E. officers escort the examples throughout the audience for hands on effect. Current drug paraphernalia examples are available to depict the ease in camouflaging drug use from adults. A strong emphasis is placed on the physiological effects of the drugs and indicators to look for. So-called "traditional" drugs such as marijuana, cocaine, crack, heroin, and methamphetamine are also covered extensively as teenagers still heavily abuse these drugs. A portion of the program also deals with prescription medications, including DXM, because of their easy accessibility in most households.

Illicit, Drug, Abuse

W14 Forensic Toxicology – The World Outside of Drugs

Lee M. Blum, PhD, and Edward J. Barbieri, PhD*, National Medical Services, Inc., 3701 Welsh Road, Willow Grove, PA 19090; Christopher D. Simpson, PhD*, University of Washington, Department of Environmental & Occupational Health Sciences, Seattle, WA 98195; Ela Bakowska, PhD*, National Medical Services, Inc., 3701 Welsh Road, Willow Grove, PA 19090; Michael S. Morgan, ScD*, University of Washington, Department of Environmental & Occupational Health Sciences, Seattle, WA 98195; and Richard C. Harruff, MD, PhD*, King County Medical Examiner's Office, 325 Ninth Avenue, HMC Box 359792, Seattle, WA 98104*

After attending this presentation, attendees will be able to understand the importance of considering chemical exposures from the environment, home, and workplace in forensic investigations.

With the prevalence of chemicals found in communities and workplaces, this presentation will impact the forensic community and/or humanity by raising awareness of these chemical exposures to include them as an integral part of forensic investigations.

With the prevalence of chemicals in society, exposures to them in workplaces, homes, and communities can be anticipated. These chemical exposures can influence behavior and performance, cause injuries, or result in death. Chemical exposures from dusts, gases, vapors, or solvents may be responsible for non-fatal and fatal injuries that occur in industries such as agriculture, construction, manufacturing, and mining. Industrial releases of chemicals into the air, streams, and groundwater expose employees and neighboring community populations to potentially toxic substances. Although many of these exposures have legal implications, often times they are not considered in such investigations as workplace accidents, mysterious illnesses, or unknown deaths. This workshop will explore the world outside of the drugs that forensic toxicologists primarily encounter, and consider the relevancy of occupational and environmental chemical exposures in forensic investigations. The analysis of environmental organic and inorganic compounds will be discussed. In addition, the forensic implications of biological monitoring will be explored as well as the significance of such exposures in death investigations.

Forensic Toxicology, Biological Monitoring, Environmental and Occupational Chemical Exposures

W15 Recovery, Examination and Evidence of Decomposed and Skeletonized Bodies: An Anthropological and Entomological Approach

M. Lee Goff, PhD, Division of Natural Sciences & Mathematics, Chaminade University of Honolulu, 1340 Waialae Avenue, Honolulu, HI 96816-1578; William C. Rodriguez III, PhD*, Office of the Armed Forces Medical Examiner, 1413 Research Boulevard, Building 102, Rockville, MD 20850; Edward T. McDonough, MD*, OCME, 11 Shuttle Road, Farmington, CT 06032; and Wayne D. Lord, PhD*, Critical Incident Response Group, FBI Academy, Quantico, VA 22135*

Upon completion of this workshop, the participant should be able to recognize bioenvironmental evidence, to properly collect and preserve such evidence, and to record supplementary data required for later analyses.

Successful interpretations of various types of forensic evidence are crucial to the solution of most death investigations. Sound analyses of bioenvironmental evidence from outdoor scenes are dependent on proper collection and preservation. This presentation will impact the forensic community and/or humanity by providing the necessary background for these activities.

One of the most challenging cases faced by any forensic scientist or investigator is that of the badly decomposed or skeletonized body. It is a common misconception that such remains, particularly those discovered outdoors in a field or wooded area, provide little useful information concerning the circumstances of death. However, through applications of techniques from the fields of anthropology and entomology, significant data may be obtained. The outdoor death scene is quite unique, since the remains and associated evidence can be viewed as temporary alterations to the ecology of the immediate area. Methods and techniques for recognition and interpretation of this "bioenvironmental" evidence will be presented during the workshop. The workshop is designed to be at the intermediate level, with an overview of anthropological and entomological techniques, followed by considerations of recent advances in these areas of research. Decompositional processes will be covered along with the varied applications of entomological evidence, including entomotoxicology, preservation and processing of entomological evidence, and applications of entomological evidence in cases involving the living as well as the dead.

Anthropology, Entomology, Decomposition

W16 Accreditation of Forensic Science Laboratories Under ISO/IEC 17025: Addressing Specific Requirements in the Accreditation Process

Joseph P. Bono, MA, Drug Enforcement Administration, Office of Forensic Sciences, 2401 Jefferson Davis Highway, Alexandria, VA 22301; Scott R. Oulton, BS*, Drug Enforcement Administration, Southwest Laboratory, 2815 Scott Street, Vista, CA 92081; Robert B. Stacey, MA*, Federal Bureau of Investigation, 2501 Investigation Parkway, Quantico, VA 22135; Donald A. Wyckoff, BA, BS*, Idaho State Police Forensic Services, 209 East Lewis, Pocatello, ID 83201, 208-232-9474; Jami J. St. Clair, MA*, Columbus Police Crime Laboratory, 520 King Avenue, Columbus, OH 43201; and Jerry A. Walker, BS*, U.S. Drug Enforcement Administration, Office of Forensic Sciences, 2401 Jefferson David Highway, Alexandria, Virginia 22103*

The goal of this workshop is to present practical information in a format that laboratory management can use, to address specific requirements of an "ISO accreditation" assessment. The presentations will include suggestions for preparing documentation a forensic science laboratory must have for accreditation under ISO/IEC 17025 General Requirements for the competence of testing and calibration laboratories and the American Society of Crime Laboratory Directors/Laboratory Accreditation Board International (ASCLD/LAB-International) Program. (A general information workshop was presented at the 2005 American Academy of Forensic Sciences Meeting.)

This presentation will impact the forensic community and/or humanity by demonstrating how accreditation is becoming and, depending on the jurisdiction, is already a de facto requirement for a forensic science laboratory to achieve credibility within the judicial system. This workshop will address specific requirements for a forensic science to achieve accreditation under ISO/IEC 17025.

The Drug Enforcement Administration (DEA) laboratory system was accredited by the ASCLD/LAB-International in February 2005. The complexity of laboratory management requirements evolved significantly from the early days of preparing for the "ISO accreditation." The education of management and staff evolved from early 2002 through the recognition of accreditation. From evaluating and addressing the requirements for the accreditation assessment in the preparatory stages through implementing the corrective action requests (CARS) that resulted from the on-site assessments, all members of the laboratory system were engaged and informed. The quality management process continues with follow-up action to prepare for the annual audit scheduled for early 2006. Complying with the ISO/IEC 17025 general requirements for the competence of testing and calibration laboratories and with the ASCLD/LAB-International Supplemental Requirements for the Accreditation of Forensic Science Testing and Calibration Laboratories was facilitated because the latter (directed at forensic science laboratories) complemented the generic ISO requirements.

This workshop is an extension of the 2005 American Academy of Forensic Sciences "ISO Preparation" workshop presented by DEA representatives. The 2005 workshop was general and addressed many different facets in preparing for the accreditation process. This 2006 workshop will focus on five specific ISO/IEC 17025 and ASCLD/LAB-International Requirements:

1. Generating a conformance file and a Quality Assurance Manual
2. Developing a system to address Document Control requirement
3. Evaluating the requirements for technical records
4. Documenting corrective and preventative actions
5. Addressing the "Uncertainty" requirements

Also included in this workshop will be a short section on progressing from the 1999 version of ISO/IEC 17025 to the 2005 version.
An important element of this workshop will be a panel discussion session directed at addressing policies and procedures required to meet the "ISO/IEC 17025 - 2005" accreditation requirements. The question which will be addressed is: How best should policies and procedures be formulated to meet the requirements of the accrediting body? Participants on the panel will be members of management from other laboratories which have been accredited or are preparing for accreditation by ASCLD/LAB-International. The discussions in this workshop will be candid and focus on how sound laboratory systems are further improved by addressing the ISO/IEC 17025 and ASCLD/LAB-International requirements. The goal of the organizers is to present practical suggestions for laboratory managers in developing viable, practical approaches to achieving accreditation and maintaining an ISO accreditation program in a forensic science laboratory.

Laboratory Accreditation, ISO/IEC 17025, Drug Enforcement Administration

W17 Understanding the Psychopath: The Theoretical and Conceptual Issues Related to Psychopathy and the Practical Applications to the Assessment and Understanding of Violent Offenders and Their Behavior

Mary Ellen O'Toole, PhD, FBI, Behavioral Analysis Unit, FBI Academy, Quantico, VA 22135; and Robert Hare, PhD*, University of British Columbia, University of British Columbia, Vancouver, BC V6T 1Y7, Canada*

After attending this presentation, attendees should be able to better understand the theoretical, conceptual, and operational issues regarding psychopathy and violence, and the impact of this personality disorder on the law enforcement, mental health and judicial professions.

Participants will learn the importance of the accurate assessment and understanding of psycopathy, and its predictive implications for violence, recidivism, and crime scene behavior.

This presentation will impact the forensic community and/or humanity by demonstrating how psychopathy has emerged as one of the most important clinical constructs in the mental health and criminal justice systems. The psychopathic construct distinguishes the psychopath and his crimes from other violent offenders, particularly violent sexual offenders, and it is critical for those working particularly in the mental health, law enforcement and judicial professions to understand this distinction. Psychopathy is predictive for recidivism, violence, and response to therapy.

Dr. Robert Hare has researched psychopaths for more than a quarter century and is recognized as the world's foremost expert in this personality disorder.

Psychopathy has emerged as one of the most important, clinical constructs in the mental health and criminal justice systems. The psychopath is defined by a unique constellation of affective, interpersonal, lifestyle and antisocial characteristics. These include egocentricity, manipulativeness, callousness, impulsivity, shallow emotions, grandiosity and lack of remorse for one's actions. Not every psychopath will have contact with the criminal justice system. However, the traits associated with this personality disorder place psychopaths at risk for committing crime, and acting out violently.

Psychopathy is not limited to a remote murder scene in the middle of a desert. Psychopaths can also be found in board rooms, and government and political offices throughout the world where they wreak havoc on co-workers, investors, clients, and others with whom they come into contact.

Co-morbidity of psychopathy and sexual offending elevates the psychopath's threat to society and further distinguishes his crime scenes from those of other offenders. For some psychopath's who become serial offenders, their lack of conscience, remorse and empathy allows them to become human predators, and engage in unprovoked aggression without concern for the victims or others around him.

This workshop will be two faceted: Information will be presented regarding both the theoretical and conceptual issues related to psychopathy, including current research on psychopathy as a risk factor for recidivism, violence and sexual offending. The assessment instruments for Psychopathy will be discussed including the Hare Psychopathy Checklist (PCL-R), the Screening Version (PCL-SV) and Youth Version (PCL-YV).

In Part II, information will be presented which "operationalizes" the psychopathy construct in terms of a crime scene behavior classification system. This perspective on psychopathy will identify some key behaviors observed at a violent crime scene which can be indicative of a psychopathic offender. Utilization of this type of behavior classification system can assist law enforcement in developing strategies for investigations, interviews, and prosecution of cases involving psychopathic offenders

Psychopathy, Risk Assessment Sex Offenders, Crime Scene Behavior

W18 Psychological & Legal Considerations for the Death Penalty in America: Justifiable Deterrent or Exercise in Futility?

Alan R. Felthous, MD, Chester Mental Health Center, 1315 Lehmen Drive, Chester, IL 62233; Gregory L. Hill, JD*, National Clearinghouse For Science, Technology & The Law at Stetson University College of Law, 1401 61st Street South, Gulfport, FL 33707; Michael M. Baden, MD*, 15 West 53rd Street, #18B-C, New York, NY 10019; Charles H. Dold, JD*, Box 775, Everett, WA 98206-0775; Nola T. Foulston, JD*, 18th Judicial District of Kansas, 535 North Main Street, Wichita, KS 67203; Abraham L. Halpern, MD*, 720 The Parkway, Mamaroneck, NY 10543-4299; Kimberly Hoy-Hill, MSW*, Psychotherapeutic Services of Florida, 4251 Henderson Boulevard, Tampa, FL 33629; and Emanuel Tanay, MD*, 2977 Philadelphia Street, Ann Arbor, MI 48103*

After attending this presentation, attendees will be provided an update on the ethical, professional, and legal obligations for the mental health professional and attorney working on death penalty cases. Upon completion, the participant will have a better understanding and respect for the roles that others play in these complex and high profile cases. Attendees will be able to participate in a discussion with the panel on whether the death penalty, as it exists today, is a justifiable deterrent or an exercise in futility that possesses limited benefit.

This presentation will impact the forensic community and/or humanity by demonstrating how mental health and legal professionals will benefit from an updated status of the ethical, professional and legal obligations that they possess in dealing with death penalty cases. The forensic community will also benefit from an improved dialogue and understanding between mental health and legal professionals. The scientific and legal communities will benefit from the identification and discussion of issues or concerns from the other community. The discussion should also raise issues for further research.

The intersection of mental health and legal professions in death penalty cases is constantly evolving. From practical and ethical considerations to court decisions, these professionals interact in one of the most intense environments-the death penalty trial. Understandably, given this environment, it is difficult for the respective professions to grasp their legal and ethical obligations that each possess in carrying out their duties. This workshop will shed some light on the world of the various participants, the legal and ethical obligations, and start a dialogue with the hope of increased understanding and respect. A complete spectrum of issues and considerations will be presented by a distinguished panel of experienced professionals. Participants will hear an eyewitness account of an actual execution and be invited to partake in a lively discussion of this controversial subject at the end of the presentation.

Death Penalty Case, Mental Health, Legal Aspects

W19 Sexual Homicide — Fantasy Becomes Reality

James J. McNamara, MS, FBI, Behavioral Analysis Unit NCAVC, FBI Academy, Quantico, VA 22135; Mary Collins-Morton, BS*, FBI, Washington Field Office, 601 4th Street Northwest, Washington, DC 20535; and Robert J. Morton, MS*, and Mark A. Hilts, BS*, FBI, Behavioral Analysis Unit NCAVC, FBI Academy, Quantico, V 22135*

After attending this presentation, attendees will be familiarized with sexual murder and its unique issues, as well as the successful investigative, forensic, and multidisciplinary approaches used to recognize, identify, apprehend and successfully prosecute sexual killers.

This presentation will impact the forensic community and/or humanity by exposing the participants to the practical issues involved in investigating and analyzing the actions of a sexual murder and the benefits of input from different disciplines and the need for cooperation between professionals.

The purpose of this workshop is to provide investigators and medico-legal professionals with an understanding of sexual murder, the offenders who commit sexual murder, their motives, methods of operation, victim selection, and body disposal as highlighted through case examples and the latest empirical research. The focus of this workshop is on the practical issues involved in investigating and analyzing the interaction between a sexual killer and his victim, the benefits of input from a multi-disciplinary approach, and the need for cooperation between professionals.

This workshop is targeted at providing investigators and medico-legal practitioners with a broad base of knowledge regarding sexual murder, to include single and serial offenders. This workshop will include a discussion of sexual murder and its parameters, motivation of the offender, forensic and investigative issues. Workshop discussions will be augmented by both research and case presentations.

The FBI's NCAVC is routinely consulted by federal, state, local, and international authorities in a variety of cases involving violent crimes, especially sexual homicides. The NCAVC has extensive experience in assisting federal, state, local and international law enforcement agencies in the analysis and investigation of sexual homicides, to include single and serial sexual homicides, and has reviewed hundreds of sexual homicides for research purposes. Currently the NCAVC is engaged in a research project specifically targeting sexual murder. The material presented in this workshop is based upon actual case experience, ongoing research, and current interviews with sexually motivated offenders.

Upon completion of this workshop, participants can expect to have a greater understanding of the "truth" about sexual homicide, to include the scope of sexual homicide, serial sexual homicide, offender motivation, methods of operation, victim selection, body disposal, forensic issues and cooperative investigative strategies useful to successful case resolution.

Sexual Homicide, Sexual Assault, Serial Sexual Murder

W20 Forensic Bone Histology

Helen Cho, PhD, Davidson College, PO Box 6934, Department of Anthropology, Davidson, NC 28035-6934; Robert R. Paine, PhD*, Texas Tech University, Department of Sociology, Anthropology, and Social Work, Lubbock, TX 79409; Douglas H. Ubelaker, PhD*, Department of Anthropology, Smithsonian Institution, PO Box 37012, National Museum of Natural History, MRC 112, Washington, DC 20013-7012; Dawn M. Mulhern, PhD*, Department of Anthropology, Smithsonian Institution, PO Box 37012, National Museum of Natural History, MRC 138, Washington, DC 20013-7012; Samuel D. Stout, PhD*, The Ohio State University, Department of Anthropology, 124 West 17th Avenue, 244 Lord Hall, Columbus, OH 43210-1364; and Margaret A. Streeter, PhD*, Boise State University, 1910 University Drive, Department of Anthropology, Boise, ID 83725-1950*

After attending this presentation, the participant should have a better understanding of various applications of quantitative and qualitative histology of human skeletal tissue to aid in the identification of unknown individuals.

Much can be gleaned from skeletonized human remains, even if they are extremely fragmentary. Standard osteological methodologies coupled with specialized techniques, such as bone histology, will impact the forensic community and/or humanity by improving the likelihood that unknown skeletal remains will be identified.

Mass disasters (natural or man-made), mass transportation accidents, acts of terrorism, and other incidents result in a large number of casualties, and human remains are often discovered in skeletonized and fragmentary conditions. Extremely fragmentary conditions of the remains limit the abilities of forensic specialists to identify the individuals and for forensic anthropologists to reconstruct the individuals' biological characteristics such as sex, age-at-death, stature, ancestry, etc. Standard osteological methodologies coupled with specialized techniques, such as bone histology, improves the likelihood that unknown skeletal remains will be identified. Applying microscopy in examining skeletal tissue aids in distinguishing human from non-human bone, estimating age-at-death from various fragmentary skeletal elements, and determining other individual characteristics such as dietary deficiency that are helpful in making a positive identification. In this workshop, various applications of bone histology (e.g., age estimation) and issues such as instrumentation, methodology, and bone diagenesis are presented. Participants will have hands-on experience with microscopes and numerous bone thin-section slides.

Histology, Bone, Microstructure

W21 Victims of Technology - A Case of Identity Theft Involving a Walk Through From the Crime Scene to the Courtroom

Dara Sewell, BS, FBI, CART, Engineering Research Facility, Quantico, VA 22135; Don L. Lewis*, Forensic Computer Analyst, 445 South Allison Parkway, Lakewood, CO 80226; Timothy E. Allen*, U.S. Secret Service, FLETC/USSS, Building 262, Room# T-5, Glynco, GA 31524; and John Dilday*, Forensic Analyst, North Carolina Bureau of Investigations, PO Box 29500, Raleigh, North Carolina 27626*

After attending this presentation, attendees will be able to recognize hardware devices that may contain digital evidence; and will be able to recognize the artifacts and trails left behind from using software; and will be able to protect themselves and others from identity theft.

This presentation will impact the forensic community and/or humanity by showing attendees how identity theft suspects steal information and how they leave digital "fingerprints" when they commit their crimes. Participants will be able to recognize hardware, software, and technology used by criminals in commission of crimes.

Identity theft causes untolled damage to people and the economy. Advancements in technology make it easy for anyone with minimal computer skills to commit these crimes. All that is needed is access to a computer, printer, access to the internet, and a willingness to commit these crimes.

Advancements in technology allow the digital evidence practitioner to recover the trails left behind. This fragile digital evidence can be stored in many different ways and to a variety of devices. By carefully seizing and searching digital evidence, it is possible to recover artifacts created by the hardware and/or the user.

This workshop focuses on processing digital evidence involving identity theft from the crime scene to the courtroom.

Metadata, Skimmers, Identify Theft

W22 Panel on Use and Misuse of Engineering Standards

Richard W. McLay, PhD, PE, 1231 Hamilton Court, Iowa City, IA 52245; Donald J. Anderson, BSME*, Anderson Engineers, 13176 Pierce Street, Blaine, MN 55434; Ian l. Mattoch, JD*, 737 Bishop Street, Suite 1835, Honolulu, HI 96813; Laura J. Liptai, PhD*, Biomedical Forensics, 1660 School Street, Suite 103, Moraga, CA 94556; Joe S. Cecil, PhD, JD*, Federal Judicial Center, Div. Research, One Columbus Circle, Washington, DC 20002-8002; Jeffrey Lange, MSFE*, Lange Technical Services, Ltd., 751 Long Island Avenue, Deer Park, NY 11729; Joseph J. Maltese, JD*, New York Supreme Court, Home Port House, 355 Front Street, Staten Island, NY 10304; Robert N. Anderson, PhD, PE*, RNA Consulting, Inc., 27820 Saddle Court, Los Altos Hills, CA 94022; Jon O. Jacobson*, 5220 Roosevelt Way, NE, Seattle, WA 98105; Lindsey Manning, PE*, PO Box 13392, Reno, NV 89507; David V. Scott, JD*, Scott, Forrest, and Bourne, 821 Mount Tabor Road, Suite 302, PO Box 785, New Albany, IN 47151-0785; John M. Steele, JD*, 418 Groveland Avenue, Minneapolis, MN 55403; Timothy W. Waldeck, JD*, Waldeck & Lind Law Firm, 1400 TCF Tower, 121 South 8th Street, Minneapolis, MN 55402; and Matthew J. Nagle*, Lynch Dallas, PC, 526 Second Avenue, SE, PO Box 2457, Cedar Rapids, IA 52406-2457*

After attending this presentation, attendees will understand the three forms of engineering evidence and be able to evaluate the types of engineering standards that are used in a court of law.

This presentation will impact the forensic community and/or humanity by proposing methods of fairness in engineering standards evidence.

This program, both a tutorial and panel on engineering standards evidence, presents case studies on the uses and meanings for engineering standards in a court of law. The tutorials are on technical content and precedents in the law:

- Fundamentals of evidence: What is real evidence, what is hearsay, what is prima facie.
- An environmental engineering case study.
- Engineering design standards in testimony.
- National Fire Protection Association standards.
- Medical standards: Their link to engineering.
- Admissibility of engineering standards.
- An American Society of Testing Materials standard.

The panel discussion will continue along with the presentations on engineering standards. The panel will review the precedents in the law and the methods to ensure that the evidence is good science and engineering. The speakers will include an expert on the law; the author of the amicus curiae brief for engineers, submitted to the U.S. Supreme Court in *Kumho Tire vs. Carmichael;* a Justice of the New York Supreme Court; and the Director of the Evidence Project at the Federal Judicial Center. These will be joined by several forensic engineering experts with experience in technical evidence.

Engineering Standards, Evidence, Standards Precedents

W23 Interferences in Fire Debris Analysis and Interpretation of Data From Complex Samples

Eric Stauffer, MS, 1222 Jefferson Drive, Atlanta, GA 30350; Julia A. Dolan, MS*, Bureau of Alcohol, Tobacco, Firearms & Explosives, Forensic Science Laboratory - Washington, 6000 Ammendale Road, Ammendale, MD 20705; and Rita Newman, BS*, Pinellas County Forensic Laboratory, 10900 Ulmerton Road, Largo, FL 33778*

Upon completion of the workshop, participants will have a clear understanding of what interfering products are found in fire debris analysis and how they render the identification of ignitable liquid difficult. Also, the participants will gain knowledge of the different ignitable liquid classes and their chemical characteristics. They will understand the effects of the extraction techniques onto the ignitable liquid residues recovered. Finally, they will have a good understanding of the thought process used to identify interfering products and ignitable liquids from fire debris samples. After this workshop, the participants will be able to return to their forensic laboratory and handle the interpretation of the most difficult fire debris samples.

This presentation will impact the forensic community and/or humanity by forensic scientists a better understanding on the interpretation of data related to the analysis of fire debris samples, which will lead to a reduction in the number of false negative conclusions and will eliminate false positive conclusions. Direct impact of this workshop on the forensic community will be a more accurate and reliable science being practiced in crime laboratories.

The attendees will learn how to properly interpret complex chromatograms obtained from the analysis of extracts from fire debris samples. They will first learn what fire debris samples are and what are the processes or stages that the samples go through before they reach the laboratory. This will provide the necessary foundations for understanding the origin of interfering products such as pyrolysis products. The physical and chemical processes leading to the presence of interfering products will be presented in great detail. Also, the different types of ignitable liquids and their chemical characteristics will be reviewed. Then, the influence of the extraction procedures will be presented in great depth. The thought process used to carry out the identification of ignitable liquid residues will be presented in detail. Finally, practical examples will be presented along with the proper interpretative methodology. The workshop will conclude with small-group practical exercises conducted under the close supervision of the presenters.

Fire Debris Analysis, Fire Debris Analysis, Fire Debris Analysis

W24 How *Frye* & *Daubert* Have Changed the Presentation of Criminalistics & Questioned Documents in Court

Joseph J. Maltese, JD, New York Supreme Court, 355 Front Street, Staten Island, NY 10304; John L. Sang, MS*, 1 Harbour Lane, Glen Head, NY 11545; Howard A. Harris, PhD, JD*, University of New Haven, Forensic Science Program, 300 Boston Post Road, West Haven, CT 06516; Andre A. Moenssens, JD, LLM*, at Shriner Lake, 1760 East Poplar Road, Columbia City, IN 46725; Robert J. Muehlberger, BA*, U.S. Postal Inspection Service, Forensic & Technical Services Division, 22433 Randolph Drive, Dulles, VA 20104-1000; John J. Lentini, BA*, ATS, Inc., 1190 Atlanta Industrial Drive, Marietta, GA 30066; and Max M. Houck, MA*, West Virginia University, Forensic Science Initiative, 886 Chestnut Ridge Road, Suite 309, Morgantown, WV 26506*

After attending this presentation, attendees will have a clear understanding of the legal requirements outlined in *Daubert* and subsequent decisions for expert testimony. Some examples of how expert witnesses have handled the challenge of an admissibility hearing will be presented and discussed. The emphasis will be on several of the more contentious expert areas such as handwriting examination and comparison, presentation of arson reconstructions and trace evidence testimony, particularly microscopic hair comparison. The information provided should be highly instructive for anyone faced with an admissibility hearing.

This presentation will impact the forensic community and/or humanity by demonstrating how although most recognize that physical evidence, if properly examined and the results properly presented, is the most reliable type of evidence available in many cases, it is perhaps easier to attack because of its often subjective nature. Subjectivity of some physical evidence interpretation should not be confused with lack of reliability and the criminal justice system is made more effective by its inclusion.

Each forensic discipline faces similar and yet unique problems in preparing for a *Daubert* challenge to proposed testimony.

This workshop has been designed to give a clear understanding of the legal requirements outlined in *Daubert* and subsequent decisions for expert testimony, as well as some examples of how expert witnesses have handled the challenge of an admissibility hearing.

The program will be introduced by Judge Joseph J. Maltese who will present an overview and basics of the historical *Frye* Standard and the current standards developed from the *Daubert* trilogy of cases. The next speaker will be Professor Andre A. Moenssens discussing how *Frye* and *Daubert* have changed the presentation of criminalistics, fingerprint, and questioned documents in Court." If time allows both authors will discuss some other significant cases.

Robert J. Muehlberger will discuss preparing for and testifying in a *Daubert* challenge to forensic document examination, particularly in the area of handwriting comparison. Max M. Houck will discuss the expert's role in gaining admissibility for trace evidence with emphasis on forensic hair examination and comparison. John J. Lentini will cover the admissibility challenges faced by experts in a variety of types of testimony in suspicious fire cases.

Because each of the presenters has been deeply involved in *Daubert* and other admissibility issues, it is intended that the attendees will hear presenters experienced on the specific subjects and be able to take away practical suggestions that will assist them in dealing with such issues. There will be time for questions after each presentation and an open forum at the end of the session to sum up some of the approaches presented and to address any further questions.

***Daubert*, Criminalistics, Document Examination**

W25 Case Analysis of Sexual Crimes and Psychiatric Evaluation of the Offenders

Michael Osterheider, MD, and Andreas Mokros, MSc*, University of Regensburg, Universitaetsstrasse 84, Regensburg, 93053, Germany; Bernd Ottermann, MD*, and Klaus Neudecker, MD*, District Psychiatric High-Secure Hospital Straubing, Lerchenhaid 32, Straubing, 94315, Germany; and Jens Hoffmann, PhD*, University of Darmstadt, Department of Psychology, Germany, Steubenplatz 12, Darmstadt, 64293, Germany*

After attending this presentation, attendees will have gained further knowledge of the etiology of pathological violent and sexual urges and improve their predictive accuracy when altering the security status of inmates in law enforcement, mental health or prison settings.

This presentation will impact the forensic community and/or humanity by demonstrating the need for increased proficiency of law enforcement and mental health professionals when dealing with cases of serious violent sexual crime. Knowledge about the pathways that lead to pernicious forms of paraphilia and attentiveness to the degree of planning and to signature behaviors as an outcome of pathological fantasies will reduce the risk of misclassifications, thus helping to lower the rate of re-offending.

The workshop is laid out according to an interactive format. Upon presentation of case details with audio-visual aids, participants are encouraged to describe the salient features of the offence. Guided by the presenters, participants will as a group reconstruct the likely sequence of events and derive those aspects that are most meaningful in terms of future dangerousness.

Within the workshop, cases of serious violent/sexual crime are presented based on crime-scene information first. Then, the method of behavioral case-analysis is applied to each case, with particular attention being paid to the degree of planning and the extent of paraphilia inherent in the offence. Finally, conclusions for risk assessment are drawn. The case examples comprise offences of sadistic serial homicide, ritualistic homicide, rape, stalking, and necrophilia. Furthermore, an overview on the extant literature on necrophilia is given.

Case Analysis, Psychiatric Evaluation, Risk Assessment

W26 Identification Criteria for Drugs With Mass Spectrometry — Current Recommendations and Prospects for Emerging MS Techniques

Robert Kronstrand, PhD, National Board of Forensic Medicine Department of Forensic Genetics and Forensic Toxicology Artillerigatan 12, SE-581 33, Linkoping, Sweden; J. Rod McCutcheon, BS*, Bexar County Office of the Medical Examiner, Forensic Toxicology Lab, Forensic Toxicology Lab, San Antonio, TX 78229; Frank Peters, PhD*, Institute of Experimental and Clinical Pharmacology and Toxicology, University of Saarland, Homburg, D-6642, Germany; Matthew P. Clabaugh, PhD, Applied Biosystems, Inc. 850 Lincoln Centre Drive, Foster City, CA 94404; and Dennis J. Crouch, MS*, University of Utah, Center for Human Toxicology, Room 490, 20 South 2030 East, Salt Lake City, UT 84112-9457*

After attending this presentation, attendees will understand how to evaluate the selectivity of a chromatographic method coupled to mass spectrometry; will understand and use U.S. and international guidelines relevant to the analytical toxicologist to ensure the quality of an analysis, and how to set up an analytical strategy depending on the general and specific demands in case work.

This presentation will impact the forensic community and/or humanity by providing knowledge and understanding of the demands from professional organizations and courts as well as from customers who are of paramount importance to the forensic scientist. This workshop will provide this within the area of quality control using mass spectrometry as a confirmation technique for drugs in biological matrices.

According to good laboratory practice within forensic toxicology, the presence of a substance in a sample should be confirmed by a second technique. Early it was suggested and decided that GC-EI-MS was the standard for confirmation analysis, and it has also been recommended in several guidelines. Over the years, new techniques such as tandem MS and MS coupled to liquid chromatography have emerged, but have not been incorporated into the guidelines. Also the question whether LC-MS can provide equal selectivity to GC-MS needs to be addressed before using it for confirmative analysis.

This workshop will discuss the properties of different chromatographic methods coupled to mass spectrometry. The power of separation and the total selectivity of methods will be discussed. The requirements for multiple ions and transitions as well as ratios will be discussed in depth.

This workshop will provide knowledge of current guidelines for the use of mass spectrometry. It will also provide support and critique of these as well as proposals for revisions to include the developments of more advanced techniques for identification and quantitation of drugs and poisons in the field of toxicology.

Both U.S. and international aspects will be presented by experts in the field.

Mass Spectrometry, Guidelines, Acceptance Criteria

W27 Forensic Librarian Workshop

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After attending this presentation, attendees will be able to explore three new forensic resources; grasp three new aspects of the Medline database; define the four determinants of the Fair Use Statute; and list three Open Access publishers.

Forensic scientists and librarians value the ability to manage information to obtain, store, retrieve, and share documents. This presentation will impact the forensic community and/or humanity by providing useful information to the attendee regarding searching for, following federal laws about, and publishing forensic information. The workshop is designed to appeal to forensic scientists, both those who have achieved, and those who have not achieved, an information management system; and to forensic librarians.

The forensic community benefits from successfully managing forensic information, including the ability to obtain, store, retrieve and share documents. The Forensic Librarian Workshop will present aspects of information management to forensic scientists and forensic librarians. The information will also be useful to those scientists who do not yet have an organized library or catalog system and who do not have library staff. The workshop will consist of a one day lecture format. Four speakers, who are librarians and/or academic researchers, will present the subjects of forensic resources; copyright law; Medline database searching; and the Open Access publishing concept.

The forensic scientist is interested in finding pertinent forensic information, which involves knowing the resources that are available. Presenters will demonstrate the best solutions to specific information needs, by presenting forensic databases; journals, magazines and newsletters; Web resources; societies, associations and government organizations; and forensic disciplines.

The Medline database is the world's most extensive collection of published medical information, often used by forensic scientists and related specialists. Presenters will introduce the history of the Medline database, present recent changes to the look and function of PubMed; and demonstrate search techniques.

Forensic scientists profit from learning about laws and guidelines that govern the processes of obtaining and sharing information. The 1998 Digital Millennium Copyright Act will be reviewed; why copyright is important to scientists and librarians; what works are protected and for how long; and the Fair Use statute including the Conference On Fair Use (CONFU) guidelines.

The concept of Open Access publishing is of interest to scientists who research, write, publish, and access articles. In recent years the concept of a perpetual right of access to the work of the biomedical research community has been proposed. Faculty will present the concepts, the OA publishers, and the issues surrounding Open Access publishing.

Forensic Resources, Information, Librarian

WS1 Selected Topics in Forensic Pathology: "Respirator" Brain; Postmortem Monocular Indirect Ophthalmoscopy (PMIO)

Jan E. Leestma, MD, Department of Pathology, Children's Memorial Hospital, 1440 North Kingsbury Street, Suite 210, Chicago, IL 60622; and Patrick E. Lantz, MD*, Department of Pathology, Wake Forest University School Medicine, Medical Center Boulevard, Winston-Salem, NC 27157*

Upon completion of the workshort, the attendees should have gained an appreciation for the "respirator" brain phenomenon and its dynamic/complex character. They should also understand that "respirator" brain changes can affect the reliability and confidence for aging and dating brain lesions, interpretation of possible premortem physical injuries and may produce confusing artifacts all with forensic implications. The attendees should also gain an appreciation of the method of postmortem monocular indirect ophthalmoscopy (PMIO) as a valuable adjunctive tool in the autopsy and its implications for specificity of retinal pathologies including hemorrhages in supposedly inflicted head injury (so-called "shaken" baby syndrome).

This presentation will impact the forensic community and/or humanity by demonstrating that each of these topics has major importance to forensic pathology and its primary task, that of determining the cause and manner of death with accuracy and precision. Both subjects address issues of interpretation in matters of injury causality and specificity that which have profound applications to the legal process, especially in the adjudication of cases of alleged child abuse.

Varying degrees of perfusion failure attend “brain death” and the so-called “respirator” brain phenomenon. The conditions that result in this phenomenon may involve natural disease processes, accidental, suicidal, and homicidal circumstances. There are complexities to the phenomenon that may have profound forensic significance. Examples are the confounding morphological and histologic effects of perfusion failure, cerebral edema, increased intracranial pressure, and hypoxia for both radiological and pathological interpretations of apparent causality. “Respirator” brain changes may introduce artifacts that might be interpreted as premortem processes such as axonal injury, subarachnoid and other forms of intracranial hemorrhage, contusions, and spinal cord injury possibly caused by shaking forces. The phenomenon may also interfere with aging and dating of lesions and other typical forensic neuropathological tasks. The pathophysiology of the “respirator” brain will be discussed and illustrated in the context of forensically important situations (alleged child abuse, accidental and homicidal trauma, hydrocephalus and intracranial mass lesions, sudden and unexpected deaths, confirmation of “brain death” in organ harvest scenarios).

Postmortem monocular indirect ophthalmoscopy (PMIO) allows viewing of the decedent’s fundi providing a low magnification, wide-angle, moderate to high resolution view of the posterior retina and equator even when slight to moderate corneal clouding is present. The technique utilizes a surgical headlamp as a bright focal light source and a high plus condensing lens. The condensing lens is held to one side of the decedent’s eye until the pupillary red reflex is established and then moved between the decedent’s eye and the examiner. It is then slowly pulled towards the examiner and away from the decedent’s eye until the image of the fundus fills the lens, usually about 3–5 cm or equivalent to the focal distance of the lens. Presently available aspheric lenses range from +14 to +40 diopters and come in different diameters. Lower power lenses provide higher magnification but offer a smaller field of view and must be held farther from the decedent’s eye, making positioning of the lens less steady. When recording the projected aerial image on a fundal diagram, it is essential to remember that the fundal image is inverted and laterally reversed. A number of postmortem fundal changes such as linear, non-hemorrhagic, hypopigmented retinal folds can be appreciated. Retinal hemorrhages associated with natural and unnatural diseases processes in neonates, infants, children and adults are readily detected. Examples of retinal hemorrhages associated with a variety of diseases and conditions will be presented that were detected by PMIO. These will include retinal hemorrhages associated with birth trauma, resuscitation, spontaneous intra-cranial hemorrhage, cranial gunshot wounds and blunt trauma of the head.

Respirator Brain, Retinal Hemorrhages, Shaken Baby Syndrome

WS2 The Forensic Scientist and Bio-Chemical Terror

Maurice G. Rogev, MD, MBChB, Zamenhof Street 11/1, Tel Aviv, Israel, 64373; and Faruk Presswalla, MD, FCRP*, 407 Villas Court, Chester, VA 23836*

The goal of this workshort is to achieve three objectives: 1. Forensic Science Officers in institutions concerned with the maintenance of law and order will learn how to recognize the different manifestations of the clinical syndromes caused by the exposure to these Bio-Chemical-Radiation agents, 2. In the event of the arrest of a suspected terrorist alleged to be responsible for the terrorist attack, the Forensic Science Officer will be able to assist the legal procedure in an effective manner, and 3. The attendees should be stimulated to review existing procedures for dealing with these types of terror attacks.

Currently the global forensic community is not aware of the inherent danger that exists in this easily available form of mass destruction weapon. This forum will impact the forensic community and/or humanity by providing a significant step in the direction of a wider realization of the serious nature of this danger. Humanity at large would benefit from the knowledge that law enforcement agencies were able to afford the better protection against Bio-Chemical terrorism, because their Forensic Science Officers are well able to act in their protection.

There is the realization that forensic scientists who work in disciplines essential to the preservation of law and order, have most fortunately until recently, never been exposed to the use of this type of terror weapon. This presentation will enable the attendees at this work short to prepare more efficiently to recognize such attacks and to deal more adequately with the consequences that will have forensic relevance.

The terror attacks that have occurred in various countries in the recent past in the course of which bio-chemical weapons were used, have altered the perceptions of society in general and medical and law enforcement agencies in particular . It is now necessary that forensic scientists familiarize themselves with these war weapons of mass destruction, that up to now were banned under various internationally accepted conventions. Terrorists in Japan in 1995 infringed all accepted conventions and attacked underground railway travelers with the war chemical "sarin.”
Again, anthrax spores were distributed through post office mail in various areas of the U.S. in 2001.

These and many other examples demand a more active involvement of forensic scientists in the identification of these agents and thereby contributing to law enforcement activities in these fields.

This work short will deal with the clinical features, the pathological effects caused in various organs of the body, the diagnostic criteria and the testing procedures that are recommended in order to determine the type of bio-chemical or radiation agent. Attention will be paid to the potential use of the "dirty bomb.” This bomb, in addition to explosives, contains a high concentration of radioactive material and would dangerous as a terror weapon.

The following weaponized biological agents will be discussed: Anthrax, Ricin, Smallpox, Staphyloccus enterotoxin B, Plague, Botulism, Brucellosis, Tularemia, and Hemorrhagic virus syndromes. The Chemical Warfare agents such as the following are available: Vesicants (e.g., Sulfur Mustard, .Lewisite) and Nerve agents (e.g., Tabun ,Sarin, Soman, VX)

Terror, Bio-Chemical, Radiation

WS3 Forensic DNA for the Non-Scientist

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After attending this presentation, attendees will be able to understand an electropherogram (a DNA profile), be familiar with basic DNA statistics such as the "random match probability," and be able to read and understand a typical forensic lab report.

DNA evidence is being presented in courtrooms across America, and has become one of the basic tools of human identification. Unfortunately, although the use of DNA in criminal investigations has become routine, its interpretation is still under the realm of experts. Since this science is nearly omnipresent, everyone involved in the justice system should have a working knowledge of basic DNA science. This presentation will impact the forensic community and/or humanity by bringing the novice to that fundamental ability.

DNA fingerprints are discussed daily on television, in newspapers and in the courtroom. While the discussion of DNA evidence is everywhere, a basic understanding of its interpretation is still fairly uncommon. This course is designed for the non-scientist who wants to understand the hows and why of forensic DNA. It is based on a very successful course offered by the presenter to groups of lawyers, teachers, and college students across the country. Topics covered include: forensic sources of DNA, sorting sperm from vaginal DNA, amplification from invisible traces, reading a lab report, understanding a DNA profile (electropherogram), Short Tandem Repeats (STRs), the forensic use of mitochondrial DNA, and basic DNA statistics. This two hour course takes the beginner through basic DNA biology to reading actual case reports. No prior experience or knowledge of DNA is needed.

DNA, STR, Mitochondria

B1 The Application of Laboratory Information Management System (LIMS) in Forensic DNA Database Laboratory

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After attending this presentation, attendees will appreciate DNA technology and forensic biological science.

This presentation will impact the forensic community and/or humanity by sharing experience in automation using a computer system called LIMS in forensic laboratories. The system can handle case related information with database and user interface. The goal is to enhance the efficiency of forensic services and to reduce potential human errors.

Forensic DNA database laboratories have to handle a large amount of reference control samples, such as buccal swabs or blood stain cards for DNA profiling and database application. The DNA results are then compared or searched against crime scene exhibits for forensic investigation. There is a large amount of case related information which has to be recorded and browsed, for example, police related references and offence details. Moreover, technical worksheets or documentation are required to be generated during technical and analytical procedures in accordance with international crime laboratory standards, like ASCLD/LAB. Finally, the expert witness statements also require case information to be included for presentation to the court. The handling of these data and records requires much human resources and is timely to process; case related files with examination and administrative pages also occupy significant amount of physical storage space. As a result, a solution is needed to handle such amount of case related data.

In order to streamline the process and reduce human involvement, a LIMS computer software was designed and tested to automate case information management process in the laboratory. The LIMS software tested was StarLIMS™ and the database software was Oracle™.

The system in the laboratory is basically divided into 5 main parts: 1. data entry at the reception counter; 2. chain of custody records; 3. automated worksheets and statement generation; 4) file export and import for instrument and CODIS communication; 5. statistical report generation.

1. Clerical staff at the reception counter input case related information into the database through the LIMS interface which is connected to a bar code system that facilitates the input process. Moreover, the interface has pre-stored data, such as police stations for selection during input, in order to reduce the typing workload.

2. The chain of custody interface records the transfer of exhibits from delivering to receiving officers.

3. The LIMS system is able to generate technical worksheets and templates for witness statements. It will access the case related data stored in the database and fill-in that data to the templates automatically.

4. The communication between CODIS and instruments to LIMS can be achieved through export and import files that are in either "txt" or "csv" formats. In the application, the LIMS can "capture" the DNA profiles exported by Genotyper™ software, and store it in the database for CODIS import and statement template generation.

5. The system is able to calculate monthly or yearly statistics reports, including total case submitted from police and total case completed within the committed targets. Moreover, the output capacity for each professional staff can also be provided. This is very important for material purchasing and resources allocation in future planning.

In conclusion, the database for LIMS stores all necessary case related information, which can be accessed through workstations in the laboratory. It is protected by RAID and tape backup. The LIMS interface accesses and updates the database; it also generate different worksheets, expert witness statement's templates, export files for instruments and CODIS entry, as well as import result files from various instruments to update itself. The efficiency of a laboratory can be enhanced by such computer aided case information handling system especially for forensic laboratories which handles a large amount of case information. It can also increase accuracy by reducing potential human error and save storage space through decreasing the amount of paper records required in case files.

LIMS, Case Information, DNA Database

B2 Developmental Validation of Reduced-Size STR Miniplex Primer Sets

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After attending this presentation the attendee will be familiar with the results of the developmental validation of the reduced size STR Miniplex Primer sets.

This presentation will impact the forensic community and/or humanity by providing information on the robustness and reliability of the reduced size STR Miniplex kits for forensic casework.

In heavily degraded DNA, poor amplification of the larger sized amplicons (300-500 base pairs) in the standard multiplex typing kits is common. Due to sample decomposition, the DNA template can become highly fragmented, and the yield of template fragments having a complete target sequence is reduced. Thus, a "decay curve" is seen, in which the larger loci have much lower intensity, and often fall below the detection threshold.

New primer sets, known as Miniplexes, have been designed to place the target sequence much closer to the repeat region. This new primer set produces smaller amplicons, and increases the probability of obtaining a usable profile from degraded DNA. These kits were designed for use with difficult (degraded and compromised) samples. These primers were combined to produce five kits of "Miniplexes" of 3-4 loci each (for use with multicolor detection systems). Two of the kits, Miniplex 1 and Miniplex 3 were combined to create a six loci multiplex kit known as "Big Mini." The kits cover 12 of the 13 CODIS loci in the 4 dye detection system, plus three non-CODIS loci. These kits produce a reduction in amplicon size for the loci used in the range of 33-191 base pairs when compared to a commercial kit. The size of the alleles in the Miniplex kits range from 60-284 base pairs.

Developmental validation studies of the Miniplex primer sets had been completed in accordance with the Scientific Working Group on DNA Analysis Methods (SWGDAM) Guidelines, and the validation studies on Miniplex primer sets 2, 4, and Big Mini will be presented. Because the Miniplexes were designed for the analysis of degraded and compromised samples and since low quantities of DNA template are usually recovered in these situations, most of the studies conducted with the Miniplexes were

performed with 100 pg of DNA template per 25 µL of reaction volume (4 pg/µL) and 33 amplification cycles.

A range of tests were performed: primer concentration, extraction technique, cycle number, annealing temperature, matrix, environmental, magnesium concentration, Taq polymerase concentration, reaction volume, mixtures, and non human DNA. Each study was conducted with a range of at least 3 conditions and 3 replicates for each condition.

Using the Miniplex kits, DNA was extracted and successfully amplified from a range of matrices, including denim, leather, wood, metal, and organic matter. DNA was also extracted and successfully amplified after exposure to a range of temperatures from -20 to 50 °C, and sunlight for up to 84 days of exposure. Standard sample tests demonstrated the utility of the kits to amplify samples from blood and saliva from stains and FTA cards. The optimum primer concentrations for the Miniplexes ranged from 0.16 µM to 0.56 µM for the various loci and the optimum cycle number was determined to be 33 cycles for degraded samples with an annealing temperature of 55 degrees. Magnesium concentrations ranged from of 1.5 to 2.5 µM with an optimum of 1.5 µM, and the best Taq concentration was 2U/25 µL. Forensic samples analyzed included blood stains, hair, and bone. The Miniplex sets were tested and found to give satisfactory results in a range of reaction volumes from 10 to 25 µL. In mixtures, the minor component is detected in ratio of 9:1. Non-human DNA was not amplified with the Miniplex primers, with the exception of mouse DNA which amplified outside the size range of human DNA and human DNA. In general the results demonstrate the Miniplex procedure to be a robust and sensitive method for the analysis of degraded DNA.

Degraded DNA, Developmental Validation, Miniplex Reduced-Size STRS

B3 DNA Event Tracking Assists Troubleshooting

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The goal of this presentation is to demonstrate how computer tracking and automation of forensic DNA analysis steps can assist in data interpretation and reduce forensic lab errors.

In addition to eliminating paper copies, documenting audit trail, and reduced man-hours in record keeping, the two major impacts are first to track forensic DNA analysis and interpretation based on techniques derived from proven computer science methodology but not simply utilizing subjective human judgment as the primary instrumentality. Second, by the aid of computer tracking records, prevent, detect, and eliminate both forensic DNA scientists' inadvertent and willful lab errors. The outcome of such simple normal tracking technique is to eliminate the false positive errors without compromising the positive identifications using DNA evidence.

DNA evidence has been used in hundreds of thousands of court cases in the US, not only for conviction, but also exoneration. To further facilitate the application of this powerful tool, available resources need to be used in an efficient, equitable manner. Software can assist in managing the workload by automating the laboratory process, thereby producing consistent data interpretation, reducing lab errors and improving reproducibility and robustness.

The increasing use of DNA evidence as part of crime scene investigations over the past 15 years has produced a substantial growth in the number of DNA results generated. Electronic record keeping, sample portion tracking, batch logging and total event capture are some of the steps that enable analysts and the courts to remain confident of this increasing torrent of lab results. Software can assist analysts by structuring the process to manage standard operative protocols (SOPs), assist with proper result attribution, and document all events related to a result. Minimizing manual steps in data logging, along with capture and analysis of DNA sample batch information (including unique QC sample information), including results, can help to avert the serious consequences associated with lab process failures.

The Crime Lab of the Baltimore City Police Department (BPD) designed a Laboratory Information Management System (LIMS) to assist in tracking and detecting lab events in the handling and analysis of DNA samples. Sample tracking, SOPs, Reagent Inventory, Equipment Monitoring, Maintenance, Repair, Calibration, Batch worksheets, Result Capture and Reporting are all managed within the LIMS. Mock casework examples will be used to demonstrate these features, and illustrate how they combine to ease case management and troubleshooting. Moreover, it will be demonstrated how electronic capture of the regular monitoring of test outcomes with standards and controls allows recognition of gradually emerging problems with reagents, equipment, controls, standards, and overall procedures that might otherwise be overlooked.

Quality Controls, QC Samples, Computer Tracking

B4 mtDNA Validation in a State Laboratory

Pamela G. Jarman, MSc, Sherri L. Fentress, MS, and Daniel E. Katz, MFS, Delaware Office of the Chief Medical Examiner, 200 South Adams Street, Wilmington, DE 19801*

After attending this presentation, attendees will receive a thorough overview of the planning, purchasing, experimentation, and troubleshooting involved in the validation of mitochondrial DNA (mtDNA) testing within a State laboratory that had no prior mtDNA experience.

This presentation will impact the forensic community and/or humanity by demonstrating the mtDNA validation plan, the underlying product research and experimentation outlined in this presentation can serve as a starting point for any State/Local laboratories that are interested in establishing mtDNA testing.

The DNA Unit of the Delaware Office of the Chief Medical Examiner (OCME-DNA Unit) has recently implemented mtDNA processing. The projection was for the OCME-DNA Unit to develop mtDNA testing in order to aide the medical examiners in the identification of remains and also to support criminal investigations involving hair evidence.

Due to the inception of the FBI Regional mtDNA laboratories many do not see establishing State/Local mtDNA processing laboratories as a priority. Conversely, the main focus of National Institute of Justice's (NIJ) Director Hart at the recent 6th Annual NIJ DNA Grantees Workshop was the identification of missing persons and the role of mtDNA in that process. There is a long term need for mtDNA processing that will exceed the capabilities of the FBI Regional mtDNA laboratories and the University of North Texas program, and can be fulfilled by State/Local laboratories. Furthermore, mtDNA testing at the State/Local level will be necessary to support the institution and success of CODIS Missing Persons (MP).

Prior to the validation of mtDNA, the OCME-DNA Unit solely performed autosomal STR analysis. Due to the lack of State/Local laboratories with mtDNA capabilities, the OCME-DNA Unit found itself with no "role model" laboratory to consult with during the validation of mtDNA processing. The OCME-DNA Unit had to develop a validation plan that included examination of the practical aspects of each option, comparing finances, considering time and labor, and tailoring the entire procedure to the projected requirements.

Some decisions and choices were made from extensive product research as it was often cost prohibitive to purchase multiple options and do comparison studies. This was typically applied to decisions concerning equipment or overlying methodology. Options concerning specific techniques for sample preparation were surveyed for maximum yield and/or quality of single-source sequencing results by the OCME-DNA Unit. The

studies to optimize sample preparation methodologies were conducted on bones (bleach washes versus no bleach washes), hairs (micro-tissue grinders versus enzymatic digestion), and teeth (extraction of mtDNA from the entire tooth versus extraction of mtDNA from the dentin). Data and conclusions will be presented from these comparison studies, as well as for other validation studies.

The research, experimentation and thought-processes involved in establishing this mtDNA laboratory from the ground up will be shared and discussed. All results and findings from the validation process and associated studies will be presented, as well as any lessons learned regarding the original decisions.

mtDNA, Validation, State Laboratory

B5 Alkaline Digestion of Head and Pubic Hairs for Nuclear and Mitochondrial DNA Analysis

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After attending this presentation, the attendees will learn the usefulness of utilizing an alkaline extraction technique to obtain genetic information from shed head and pubic hairs.

This presentation will impact the forensic community and/or humanity by demonstrating current forensic examination of shed head and pubic hairs is limited to microscope comparisons with known hairs or to mtDNA sequence analysis. Alkaline extraction of shed hairs is a much simpler means of isolating DNA, as it requires less "hands on" technician time, reducing potential contamination. During the incubation in concentrated sodium hydroxide, DNA remains intact while the hair itself is completely dissolved. Once the DNA is isolated, several routes of genetic analysis can be performed for both mitochondrial and nuclear markers.

Hair is a common form of evidence found at crime scenes, and may be the sole trace evidence to tie a suspect or victim to a location or crime. Hair comparisons via light microscopy are effective for excluding an individual as a source of a hair, but not for identification purposes.

Obtaining DNA data from biological material associated with a crime is invaluable as evidence. Isolating DNA from head or pubic hairs is an attractive means of placing a suspect and/or victim at a crime scene. If the root of a hair is present, STR analysis may be successful, but it is more common that shed (telogen) head or pubic hairs are found at a scene. Nuclear DNA is thought to be degraded or not present in these samples, making STR analysis using commercially available kits difficult or impossible. MtDNA analysis of hair shafts is often successful, but many labs have not validated the method, sending samples out for DNA sequencing can be expensive, and in the end, it is not an absolute identifier.

Likewise, DNA isolation from hair shafts involves laborious extraction techniques, which can increase the likelihood of contamination. An alternative to standard DNA isolation from hair shafts is alkaline extraction, in which keratin from hair is hydrolyzed but DNA is kept intact. In the current study, this method has been used to extract DNA from head and pubic hair shafts. Hairs are washed in an enzymatic detergent, and then rinsed with ethanol and water. The hairs are then incubated in concentrated sodium hydroxide until completely dissolved. Following the incubation, the solution is neutralized and the DNA eluted in TE on a spin column. The suitability of alkaline extracted hair DNA was tested on mtDNA, as well as nuclear markers. MiniSTRs were examined, which have shown a greater chance of successfully amplifying highly degraded DNA. High copy number nuclear loci were tested to compensate for the small amount of nuclear DNA found in hair shafts. Quantitative PCR and nested PCR techniques were also examined.

Alkaline Extraction, Hair Shafts, Degraded DNA

B6 Determining the Quantity and Quality of DNA Using Real Time PCR

Sarah E. Hughes, BSc, and Bruce R. McCord, PhD, Florida International University, 11200 SW 8th Street, Miami, FL 33199*

By attending this presentation, attendees will learn the basics of real time PCR, how real time PCR can be used as a more sensitive method of DNA quantitation than the current slot blot method, and how to determine the level of degradation in DNA by amplifying different length fragments.

This presentation will impact the forensic community and/or humanity by offering a more sensitive method of DNA quantitation which also provides useful information regarding the quality of the DNA present in the sample, thus allowing the analyst to select an appropriate DNA typing method.

DNA extracted from forensic samples such as bone, hair, or fingernail scrapings may not be in optimal condition. Instead, the DNA may be badly degraded or may be present in low copy number. It is important to quantify genomic DNA prior to amplification using human specific probes; however, techniques such as slot blot quantitation can have difficulty in detecting DNA present in degraded and low copy number samples. Real Time PCR offers an alternative method for quantifying such samples. Real Time PCR is a sensitive method of DNA quantitation with a dynamic range of 1 picogram to 16 nanograms of DNA (1). As this technique can detect picogram amounts of DNA, it is perfectly suited to the detection of DNA in low copy number and degraded samples. However, in its present configuration, real time PCR cannot provide information on the quality of a DNA sample.

The goal of this research project was to develop a technique to use real time PCR as a method to probe the quality of the DNA extracted from forensic samples. Previous work from this laboratory has demonstrated that the PCR reaction is sensitive to the size of the DNA template (2). By using several primer sets, each amplifying a different length fragment, the level of DNA degradation can be determined. Since degraded DNA is fragmented into shorter templates, it is expected the primers which amplify the shorter amplicons will detect larger quantities of DNA. The amount of DNA detected using each primer set can be compared to determine the extent of the DNA degradation. Preliminary results have shown that the quantity of DNA detected differs depending on the length of the amplified fragment, with more DNA being detected with the shorter primer set.

In this research project, DNA was extracted from various simulated forensic samples using a phenol chloroform extraction and centrifugal filtration. The level of DNA degradation was assessed using a series of PCR primers which amplify different length amplicons. The DNA was quantitated with real time PCR and three different primer sets were used in the amplification. The amount of DNA degradation was then determined by comparing the quantitation results obtained for each of the different primer sets. The DNA was also typed using both a commercially available STR kit and miniSTR's. The DNA typing results show that by knowing the level of degradation, the success or failure of the DNA typing method can be determined prior to analysis. This allows the analyst to choose an appropriate method – STRs, miniSTRs, mtDNA, or SNPs to analyze the results.

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Real Time PCR, DNA Quantitation, Degraded DNA

B7 Enzyme-Mediated Digestion of Cellulose and Pectin for Enhanced Cell Elution of Sperm Cells From Cotton Swabs

Jessica C. Voorhees, MSc, Kate Manning, Sarah J. Linke, Jerome P. Ferrance, PhD, and James P. Landers, PhD, University of Virginia, Department of Chemistry, McCormick Road, Charlottesville, VA 22901*

After attending this presentation, attendees will learn about the elution of cells from a cotton swab evidence sample collected from a sexual assault victim.

This presentation will impact the forensic community and/or humanity through the development of an improved method for the elution of cells from a cotton swab evidence sample collected from a sexual assault victim.

Genetic analysis of mixed profile DNA samples obtained from vaginal swabs is a well-established technique in the investigation of sexual assault and rape cases. Unfortunately, the procedures involved in a typical forensic DNA analysis require that significant laboratory time be dedicated to a single case, particularly in the sample preparation steps. Because of time and funding constraints involved in the investigation of such cases, a significant backlog exists in many DNA analysis laboratories.

The current protocol used by law enforcement agencies for recovery of cellular material from a cotton matrix involves significant sample handling. Furthermore, it is a time-consuming process, often requiring overnight incubation of a swab sample in buffer that aids in optimal DNA recovery. The extraction solution used in the recovery of DNA from swabs includes proteinase K and a detergent, the combination of which selectively lyses the fragile epithelial cells while eluting sperm cells intact. The solution is then centrifuged to pellet the sperm cells, separating them from the solution containing the DNA from vaginal epithelial cells, allowing independent genetic analysis of male and female DNA.

The time required for forensic DNA analysis can be greatly reduced by performing the electrophoretic separation on microfabricated glass devices. The speed and efficiency of separations on microdevices provide benefits over both conventional slab gel and capillary electrophoretic separations. In addition, these devices allow for the integration of other processing steps, including sample preparation methods. Isolation of separate sperm and epithelial DNA fractions using traditional differential extraction methods requires centrifugation, which is not easily implemented on a microchip; however, a microchip method for isolating male and female cells has been reported[1] which allows independent DNA extraction from the separate cell types. This method relies on recovery of intact cells from sample swabs, therefore, a cell desorption process that reduces extraction time and leaves the epithelial cells intact would be advantageous for developing genetic analysis on a micro-total analysis system (μ-TAS). If this cell elution method could also increase the number of sperm cells recovered from swabs over differential extraction, this method would provide additional benefits in increasing the amount of perpetrator DNA recovered for analysis.

Constituents of cotton include cellulose, a polysaccharide that composes the cotton fibers, and pectin, which acts as a surface adhesive between neighboring plant cells. Microscopic examination of a cotton swab on which a semen sample had been applied and allowed to dry suggested that sperm retention on the swab was due to adhesion of sperm cells on the surface of cellulose strands. Previous studies have shown that enzymes that digest cellulose reduce the time required for sperm and epithelial cells to be released from the swab into solution.[2] In an effort to optimize cellular elution conditions, enzymes that digest either the cellulose or the pectin components of the swab were evaluated separately and in combination. In addition, the effects of adding detergent after enzyme treatment were investigated. Sperm and epithelial cells eluted from each cotton swab sample were counted using a hemacytometer. Results indicate that elution using enzymes improved the recovery of sperm cells without lysing epithelial cells, and sperm cell desorption using a combination of enzyme and detergent is greater than that seen with current elution methods. Optimum cellular elution conditions using the enzymes cellulase and pectinase will be presented. In addition, information regarding the development of a receptacle that interfaces a cotton swab sample with a μ-TAS on a microfabricated glass device will be discussed.

The procedure incorporates enzymes for digestion of the cellulose matrix, resulting in the removal of intact cells, in an effort to improve recovery of sperm cells while circumventing conventional differential extraction. If this cell elution method could increase the number of sperm cells recovered from swabs over differential extraction, it would provide additional benefits in increasing the amount of perpetrator DNA recovered for analysis.

References:
1. Horsman, K.; Barker, S.L.R.; Ferrance, J.P.; Forrest, K.A.; Koen, K.A.; Landers, J.P. *Anal Chem* 2005, 77, 742-749.
2. Voorhees, J.C.; Ferrance, J.P.; Landers, J.P. *Journal of Forensic Science.* 2005, Submitted.

Cell Elution, Enzymes, Differential Extraction

B8 Evaluation and Optimization of mtDNA Hair Extraction Methods

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After attending this presentation, attendees will learn the results of a study designed to compare four methods to recover mtDNA from hair.

This presentation will impact the forensic community and/or humanity by identifying a means to increase hair evidence through mtDNA analysis and enhance efficiency.

Forensic mitochondrial DNA (mtDNA) analysis has proven useful for biological evidence that contains small or degraded quantities of DNA. Extraction of DNA from fresh hair that includes a living root or a tissue tag should yield ample quantities of DNA; however, extraction from hair shaft alone, which contains non-living, keratinized tissue, can be challenging. An optimized protocol should make analysis more efficient without sacrificing data quality and consuming limited evidence samples.

The FBI Laboratory's current standard operating protocol (SOP) for DNA extraction from hair begins by mechanically grinding the hair in extraction buffer using a glass micro tissue grinder. DNA is then released from the disrupted hair by the action of DTT and proteinase K at 56° C during a two hour to overnight incubation period. Following the DNA extraction is a two-step purification process that includes an organic extraction step to remove proteinaceous material and a micro filtration step to further purify the DNA and remove potential PCR inhibitors. Extractions from hair fragments approximately 2 cm in length by this method yield dependable mtDNA analyses. However, the SOP is a time-consuming method with lengthy incubations, exposure of laboratory staff to harmful, volatile organic solvents and requires expensive, singly used glass tissue grinders.

Several commercial kits for extraction of DNA from hair have become available and these were investigated to determine whether any might provide advantages over the SOP. The Hair mtDNA Extraction Kit (Marligen Biosciences) and a user-adapted protocol for hair extraction using the QIAamp DNA Mini Kit (Qiagen) both involve chemical digestion of hair followed by column purification of DNA. The Tissue and Hair Extraction Kit (Promega Corporation) also chemically digests the hair but purifies the DNA using a paramagnetic resin. Each of the commercial methods instruct shorter incubation periods, which could result in a time

savings and therefore allow higher throughput of evidence. In addition, the elimination of mechanical hair grinding should provide a cost savings. Finally, the nonuse of organic solvents would create a safer laboratory environment.

The SOP and the three commercial methods were evaluated for their ability to extract mtDNA from Caucasian head hair specimens. The amount of DNA recovered from hair after processing by each method was assessed by both pre-amplification DNA quantification and post-amplification DNA quantification. Amplicons subjected to DNA sequencing and the resultant electropherograms were evaluated to determine the quality of the derived sequence data. Additional preliminary experiments included incorporation of a hair-grinding step prior to beginning each commercial method and determination of the percent recovery for each method.

These data revealed that the SOP and Qiagen methods provided the best results among all four methods. Therefore these methods were further evaluated by extracting DNA from additional hair types including pubic hair, African American head hair, and dyed and bleached Caucasian head hairs. The resultant pre- and post-amplification quantification data showed that the SOP was the best method. Further evaluation of the SOP through a series of time course experiments showed that extraction for as little as two hours may be sufficient to provide high quality mtDNA.

The commercial methods of hair mtDNA extraction examined showed varied results; however, the SOP provided the best results, or among the best results, for all evaluations conducted. Therefore, despite the potential cost and time savings afforded by the available commercial hair extraction kits, the SOP consistently produces the highest yield of extracted DNA from hair shafts. Furthermore, if the time course experiments confirm initial observations, a reduction to a two-hour initial incubation with the SOP will still result in a substantial time savings and increased evidence throughput without sacrificing DNA yield.

mtDNA, Extraction, Hair

B9 Improvements in DNA Extraction From Bone

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After attending this presentation, attendees will learn of improvements in DNA extraction from bone.

This presentation will impact the forensic community and/or humanity by identifying improvements in DNA extraction methods.

The ability to extract DNA from various tissue types has improved over time, although some tissues continue to present challenges. Extraction of DNA from bone can be especially difficult due to a compact calcified matrix combined with a relatively low cellular content. Interestingly, the same compact calcified matrix feature that complicates DNA extraction from bone also presents a stable and durable tissue that remains intact in environments where no other tissue types survive. For example, ancient skeletal remains recovered from archeological sites often provide the only resource for possible DNA analyses. Similarly, the forensic community frequently uses bone for DNA typing the remains of missing persons as well as those of crime victims. Because of bone's permanence, improvements in DNA extraction protocols from bone are tremendously useful for forensic practitioners.

The predominant inorganic component of bone is hydroxyapatite (HA), a stable calcium phosphate compound that contributes to bone's structure. Nucleic acids have a strong affinity for HA, and DNA likely binds to the HA of bone following cell lysis. To minimize the loss of DNA, current protocols remove the HA prior to DNA extraction using extensive incubations in a high concentration of EDTA to decalcify the bone. While decalcification with EDTA does improve DNA recovery from bone, the process extends the extraction protocol a minimum of eight hours and requires the removal of this potent PCR inhibitor prior to amplification. Furthermore, there is the possibility of DNA loss during this EDTA incubation in some bone samples, particularly with extended periods of incubation. As an alternative to this lengthy decalcification process using EDTA, the possibility of interfering with the interaction between DNA and HA during the extraction step was investigated in this study.

The affinity of the DNA/HA complex can be regulated using various phosphate buffers. Molecular techniques have been established in which DNA elutes from an HA matrix when sodium phosphate (NaP) concentrations exceed a specific threshold. For example, Sambrook and Russell report that double stranded DNA couples tightly to HA and requires phosphate concentrations in excess of 0.4 M for elution.[1] Alternatively, buffers containing sodium fluoride (NaF) may be used to alter the interaction between DNA and the HA matrix. Using this information as groundwork, a modification to DNA extraction protocols from bone that reduces the time required for extraction, while simultaneously maintaining or potentially increasing the yield of DNA recovered, is reported. By adding NaP or NaF to the extraction buffer, the binding of DNA to the endogenous HA of bone is effectively blocked. Consequently, 500 mM of NaP or NaF mimics the effects of decalcification without extensive EDTA incubations prior to DNA extraction. Preliminary results show that this method is appropriate for downstream nuclear and mitochondrial DNA analyses. In summary, this protocol, which requires as little as two hour extraction incubations, dramatically reduces the amount of time required to isolate DNA from bone samples with a potential increase in DNA yield.

References:

1. Sambrook, J. and Russell, D. in Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press; 3rd edition (2001)

mtDNA, Extraction, Hair

B10 Recovery of DNA From Human Blood Bound in Unique Substrates

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The goal of this presentation is to present the use of materials in addition to the materials being used now to gather blood samples from crime scenes, and consider new materials as sources of evidence and/or identification.

This presentation will impact the forensic community and/or humanity by demonstrating a new method for obtaining and storing biological evidence.

There have been two developments in the field of battlefield medicine, hemostatic agents made of unique materials. One of these is the QuikClot® hemostatic agent, made of zeolite, a silicate made from equal parts silicon tetroxide (SiO4) and aluminum tetroxide (AlO4). The other is the Hemcon® hemostatic agent, made from chitosan, a starch found in the shells of shrimp; the chitosan is extracted using a proprietary process.

The mechanisms of hemostasis by the two agents differ, in that QuikClot® adsorbs the liquid from the blood, which is an exothermic reaction; this effect on the hemostatic reaction is unknown (Alam, *et al.,* 974-973, 2004). The Hemcon® agent uses the positive electrical charge of the chitosan molecules to attract the red blood cells to it, forming a clot in an extremely short time period, stopping profuse bleeding and allowing the body's natural healing processes to take hold.

It is proposed to use these two agents in a study to determine the efficacy of recovery of human DNA from blood bound in these two unique substrates. There are 4 areas of interest in this study; the first would be attempted recovery of "naked" DNA immediately after introducing it to the materials. The second would be introduction of human blood samples

(whole blood) to the materials, where first would take place the removal of the bound blood, using various chemical methods, and secondly the attempted recovery of DNA from this blood. The third area of interest would be to store the materials in a -20° freezer for periods of 6 months to 1 year, and attempt recovery of DNA. The fourth area of interest would be to store the materials at room temperature for the same amount of time as the -20° freezer portion of the study and attempt recovery. These last two areas of interest are to simulate the "real-world" situation of a backlog of DNA samples to be extracted and analyzed, and to determine the efficacy of using such material for long-term storage of blood samples for DNA recovery.

It is felt the application of this study has potential for demonstrating a new method of recovering blood at crime scenes for later analysis which would reduce the possibility of exposure to bloodborne pathogens by crime scene and law enforcement personnel. Additionally, there is the potential of using these agents as a means for obtaining DNA samples of suspects, who might use such products in an attempt to "self-treat" wounds received in violent encounters with law enforcement officers in order to avoid situations where the suspects put themselves at risk for detection and arrest, *i.e.*, arriving at a hospital emergency room, seeking treatment for gunshot wounds.

References:
Alam, *et al.* "Application of a Zeolite Hemostatic Agent Achieves 100% Survival in a Lethal Model of Complex Groin Injury in Swine." *Journal of Trauma-Injury Infection & Critical Care*. 56(5): 974-983, May 2004.

Substrate, Recovery, Blood

B11 Development of Scientifically Sound Protocols for the Training of Explosive Detection Canines

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After attending this presentation, attendees will understand scientifically sound protocols for training and maintaining explosive detection canines, in addition to a rapid vapor analysis technique for explosives detection and analysis.

The presentation should allow members of the forensic community who are not familiar with canine detection to become familiar with the abilities and limitations of explosives detection canines, whilst at the same time providing specific scientific suggestions to those in the field who wish to improve upon training and operating practices.

The presentation should allow members of the forensic community who are not familiar with canine detection to become familiar with the abilities and limitations of explosives detection canines, whilst at the same time providing specific scientific suggestions to those in the field who wish to improve upon training and operating practices.

The use of canines as a method of detection of explosives is well established worldwide and those applying this technology range from police forces & law enforcement to humanitarian agencies in the developing world. For those not involved in the legal aspect of explosive detection such as charities and the military whose sole interest in canine detection is to efficiently locate mines and other explosive devices, the anecdotal evidence of canine success is sufficient to justify their use, but for law enforcement and homeland security, far more than anecdotes are required to make it to the courtroom.

Despite the recent surge in publication of novel instrumental sensors for explosives detection, canines are still regarded by many to be the most effective real-time field method of explosives detection. However, unlike instrumental methods, it is difficult to determine detection levels, perform calibration of the canines' ability or produce scientifically valid quality control checks.

Canine detection of explosives relies upon the dogs' ability to equate finding a given explosive odor with a reward, usually in the form of praise or play. The selection of explosives upon which the dogs are trained thus determines which explosives the canines can and potentially cannot find. It follows that one of two possible scenarios is responsible for the canines' selectivity and specificity to explosive odors; (i) that canines alert to the parent explosives regardless of their volatility, or (ii) that canines alert to more volatile, non-explosive chemicals that are present in explosives, and which are characteristic to explosives.

The Bureau of Alcohol, Tobacco, Firearms and Explosives lists over 250 different explosive materials on the Federal Register, not including mixtures and improvised devices. An explosive detection canine must be capable of finding all explosive devices; however, it is impractical to train the dog on every individual odor. Commonly, the training is focused towards high explosives such as TNT and Composition 4 (C-4), and the low explosives such as Black and Smokeless Powders are added often only for completeness. However, powder explosives constitute a major component of explosive incidents throughout the US, and canines trained to detect explosives must be proficient across the entire range of powder products. With the variability in the manufacture and product make-up many smokeless powders do not share common odor chemicals, giving rise to concerns over the extensiveness of canine training.

Through Solid Phase Microextraction (SPME) combined with Gas Chromatography - Mass Spectrometry (GC-MS) and Electron Capture Detection (GC-ECD), it will be demonstrated that many TNT and cast explosives share a common odor signature, and that the same may be said for plasticized explosives such as C-4 and Deta-Sheet. Conversely, smokeless powders may be demonstrated not to share common odors. The implications of the odor differences and similarities on the selection of the optimal explosives upon which to train the canines will be discussed.

Explosives, Canine Detection, Homeland Security

B12 The Effects of Storage Conditions on Human Scent by SPME-GC/MS

Davia T. Hudson, BS, and Allison M. Curran, PhD, Florida International University, University Park Campus, CP 345, Miami, FL 33199; Adee A. Schoon, PhD, Leiden/Canine Unit Netherlands National Police Agency, PO Box 530, Nunspeet, 8070 AM, Netherlands; and Kenneth G. Furton, PhD, Florida International University, University Park Campus, ECS 445, Miami, FL 33199*

After attending this presentation the attendee will learn about making informed decisions about storage materials and conditions for human scent evidence.

This presentation will impact the forensic community by providing a basis for the creation of an optimized storage procedure for collected human scent.

Recent court rulings have determined that canine human scent identifications can be admitted as evidence in U.S. courts. Canines have been used successfully for human scent identification in European countries for over one hundred years. However, in the U.S., human scent identification has only recently gained acceptance. There are two main methods for the collection of human scent for the purpose of scent identification. There is a direct method in which the actual scented object is collected and presented to the canine and an indirect method in which the odor is collected on an absorber and presented to the canine. In Europe, detector dogs are used in "human scent lineups", where an identification is based on a canine matching the human scent collected from a crime scene to a possible suspect under controlled environmental conditions. In the U.S. specialized bloodhounds are used for the purpose of location checks to aid in criminal investigations. However, there is no optimized or standardized methods for the collection and storage of human scent evidence obtained from objects or people across the various agencies.

Solid Phase Micro-extraction - Gas Chromatography / Mass Spectrometry (SPME-GC/MS) has proven to be a viable method for the extraction, separation, and identification of the volatile compounds which comprise human scent. Human scent, as defined by the authors, is the most abundant VOCs identified in the headspace above scent samples. However, other substances may make contributions to human scent. Studies using SPME-GC/MS have aided in identifying optimal storage materials and conditions of human scent for the purposes of instrumental analysis.

This paper will discuss the contributions of various storage materials including glass vials, polyethylene and polypropylene bags as well as aluminized heavy duty bags. The absorber materials used in this study were pre-treated with a methanol-modified supercritical fluid extraction (SFE) method to achieve analytical cleanliness. Storage studies conducted in triplicate for 1, 2 and 5 week periods, have shown glass to be the storage material which contributes the least amount of compounds to the absorbent materials, whereas the aluminized heavy duty bags contribute the largest. It has been determined that materials used for the storage of collected human scent contribute significant compounds to the collection medium, some of which have been reported as compounds found in human secretions. If a storage material contributes compounds found in human scent the possibility of altering the odor profile through contact exists, thus proving to be a limitation for use in instrumental analysis of human scent as well as creating a greater challenge for the canines.

Various storage conditions for hand odor samples will be discussed as well as the stability of the volatile odor signature of these samples when stored under different conditions as determined by SPME-GC/MS. Cotton absorbers used by the Netherlands National Police for their human scent line-ups which have been pre-treated using SFE, were saturated with hand odor through a 20 minute scenting. The collected hand odor was then placed into a glass vial and subjected to different storage conditions, including: temperature and light effects. The resulting effect of the storage conditions on the initial odor profiles will be presented.

Canines, Human Scent, SPME-GC/MS

B13 A Comparison of Real vs. Pseudo Contraband for Reliable Detector Dog Training

Michael S. Macias, BS, Ross J. Harper, PhD, and Kenneth Furton, PhD, Florida International University, University Park, Department of Chemistry and Biochemistry, Miami, FL 33199*

After attending this presentation, attendees will experience the presentation of research and an opportunity to offer feedback as to how they have attempted similar tasks as well as gain information as to a different approach. There will also be an opportunity to gain further knowledge into different aspects and workings of the forensic field while seeing the wide variety of applications to which forensics can extend.

This presentation will impact the forensic community and/or humanity by educating on the differences between chemical odor signatures of real contraband with that of commercially available pseudo-scent training aids. It will show this comparison as a method for demonstrating reliability for training and testing in canine and instrumental detection.

This study presents the differences between chemical odor signatures of real contraband with that of commercially available pseudo-scent training aids as a method for demonstrating reliability for training and testing in canine and instrumental detection. Solid phase micro extraction will be used to analyze the headspace of the various compounds.

Odor detection has become a focused area of research over the past number years because of its importance to the forensic, law enforcement, and legal communities. Despite the abundance of methods for detection of these characteristic chemical odors, the use of trained canines as biological detectors remains widely accepted. Thus, detector-dog response is one of the major applications involved with odor detection studies; both for the determination of the chemical signature of individual odors to which these canines are actually alerting, and to whether or not there is a common element within different items to support the use of contraband mimics.

As an alternative to training on actual explosives and controlled substances, there are agencies that choose to apply pseudo-aids in place of the real contraband, avoiding complicated DEA and ATF regulations. Current commercially available pseudo-aids contain different amounts of either the actual explosive/narcotic or the chemical compound of suspected interest by canine detectors. As a result, there is significant interest in determining the dominant chemical odor signatures of the pseudo-aids, particularly when compared to the genuine contraband material.

The ability of solid phase micro extraction (SPME) to extract volatiles from the headspace of forensic samples has been used in conjunction with gas chromatography/mass spectrometry (GC/MS). The odor chemicals present in the headspace of actual explosive and narcotic contraband parent compounds were compared with those observed emanating from the mimic training aids. The SPME-GC/MS method utilized a 70µm StableFlex™ Carbowax®/Divinylbenzene (CW/DVB) SPME fiber (Supelco). This fiber has been previously determined, experimentally, to meet optimum standards for explosives and narcotics laboratory testing. Double blind field trials using local law enforcement trained explosive and narcotic canine teams were conducted to determine canine interest in the observed odors, and to evaluate the reliability of the pseudo scent.

Limited success was reported using commercially available NESTT (Non hazardous Explosives for Security Training and Testing) products and pseudo scents for explosives and narcotics for the double blind trials; while confirming that these dogs can reliably locate actual contraband. However, for the double blind field tests, promising preliminary results have been observed for alternative controlled permeation devices which show potential for use as reliable non-hazardous detector dog training aids. These alternative devices also show potential in use for calibrants to test the thresholds of odor detection by canines and machines.

Results from these experimentations detailing the dominant odor signature from each specific pseudo-scent as well as that of the real contraband will be presented. A comparison of the headspaces of the pseudo-aids gives the instrumental proof while the resulting alert/no alert dog response gives the verification from the field is also shown.

Pseudo Contraband, Canine Detection, SPME

B14 False Positive and False Negative Rates for Canine Detection of Ignitable Liquids

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After attending this presentation, attendees will appreciate the importance of independent testing of canines used in arson investigation as to their false positive and false negative rates for a variety of liquids. In addition they will learn that continued training of canines with a variety of ignitable liquids is key in minimizing false negatives as well as false positives.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of testing canines used in arson investigation to determine false positive and false negative rates.

Canines have been used with great success by arson investigators in selecting sites for sample collection at suspicious fires. However, there have been court challenges to admissibility of testimony by handlers under *Frye* and *Daubert* regarding the canines' alerts. This is of interest when the

alert is not confirmed by laboratory results. The purpose of this research was to establish the sensitivity of two canines to a variety of ignitable liquids and determine the false positive and false negative rates for each. Ignitable liquids tested included 50% and 90% evaporated gasoline, diesel fuel, lacquer thinner (a blend isopars, ketones and other oxygentated products), turpentine and odorless lamp oil (a normal paraffin product). Levels of each liquid from 0.05 to 5.0 µL in a one-quart lined paint can. Charred chipped foam carpet pad was used as a substrate to provide a low-level pyrolysis product background. An equal number of 'blank' cans containing only charred carpet pad were used to determine false positive rates. The handlers did not know which cans contained which liquid or blank. A series of 6 cans were randomly selected and present to the canine. Each set of six cans was tested with three passes by a canine with rearrangement of the cans between passes. A rest period was allowed between sets. Laboratory confirmation of the presence and identity of the ignitable liquid was made using the passive adsorption on activated charcoal strip (ASTM E-1412-00) and gas chromatography/mass spectrometry (ASTM E-1618-01).

Both canines had been initially trained using a variety of ignitable liquids, but daily training used only 50% evaporated gasoline. Lamp oil being a normal paraffin product should present the greatest challenge to the canines because it lacks aromatics or isopars found in a number of other products. Turpentine is the product of destructive distillation of yellow pine and contains terpenoids that are also found in the pyrolysis products of pine commonly used in home construction, thus, at low levels, would be often present in many fire debris samples. A canine should be trained to ignore low levels of terpenoids to avoid excessive 'false positives'. Laboratory analysis detected and identified all ignitable liquids down to 0.05 µL.

A false negative was observed for 50% gasoline at the 0.5 µL level by one canine, although she correctly alerted to the same liquid at lower levels. Her response was consistent for each of the three passes. A false positive on one pass was noted for one blank sample. Although the cans were a minimum of 24 inches apart, it is possible that odor from a high level nearby may have triggered the false response. The second dog sporadically hit on the lamp oil samples; however, it consistently responded to the turpentine samples except for the lowest level (0.05 µL). This dog was not trained on turpentine. Lacquer thinner was ignored by this dog at all levels. He was not trained on oxygenates so could be expected to miss those in the lacquer thinner; however, isoparaffins were observed in the GCMS analysis which are in some solvents used in his training regime. Toluene was listed on the container as a component, but this was notably absent in the chromatogram. The second dog also had several false positives on two of the blank samples. Lab analysis of this blank sample was incomplete at the abstract deadline.

Canine Detection, Arson, Ignitable Liquids

B15 Inhibition of Seminal Acid Phosphatase Detection by Urine

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After attending this presentation, attendees will learn information that could potentially aid in the analysis of evidence containing semen.

This presentation will impact the forensic community and/or humanity by providing a better analysis of semen test results when urine is in the sample.

Sexual assault evidence is frequently submitted to forensic laboratories for biological screening and subsequent DNA analysis. Periodically, semen-stained evidence with apparent urine stains will yield negative results for seminal acid phosphatase even though spermatozoa are observed from slides prepared from these cuttings. The presumptive test for seminal fluid utilized by the California Department of Justice Central Valley Laboratory calls for 1 drop of thymolphthalein monophosphate (SAP solution #1) in citric acid buffer and 2 to 3 drops of Na_2CO_3/NaOH solution (SAP solution #2). Seminal acid phosphatase cleaves the phosphate group off the thymolphthalein, resulting in blue color when the basic solution is added. Positive results were obtained with 1:10 semen dilutions on cotton underwear using 2 drops of SAP solution #2, but negative results were obtained from 1:10 semen dilutions spotted on neat male urine stains on cotton underwear when 2 drops of SAP solution #2 was used. This demonstrates that the presence of urine can interfere with this presumptive test for seminal fluid by preventing the SAP solution #2 from creating a basic enough environment to detect the thymolphthalein resulting from the cleavage of the thymolphthalein monophosphate by acid phophatase. Testing was done to show that this inhibition could be overcome by using 3 to 4 drops of SAP solution #2.

Semen, Acid Phosphatase, Urine

B16 A Glow in the Dark: Luminol Reaction Enhancement With "Fit" From Former Eastern Germany

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After attending this presentation, attendees will learn systematic variation and double blind testing even of standard procedures – here, a widely used modification of the Luminol test — are helpful to avoid implementing unnecessary laboratory procedures.

This presentation will impact the forensic community and/or humanity by demonstrating wishful thinking can trick even experienced crime scene workers, as shown here. Double blind tests are the best way to avoid this.

Luminol fluorescence often dies down before it can be properly documented on camera. On vertical tiles and other smooth surfaces, the danger of speedy blurring is also prevalent. For years, the criminal police of the former Eastern German city of Rostock reported to have found a way to prolong the duration of the glowing reaction by adding 3 drops of the detergent "Fit" to 1 litre of the final, standard alkaline Luminol reaction mix. "Fit" was one of the major dishwashing liquids available in former Eastern Germany, and is no longer produced. Very few samples survived. A new formula (under the same brand name) was reported to have no effect if used for bloodstain detection with Luminol.

In systematic, double-blinded experiments (against a control and against the new formula), researchers tried to determine which ingredient of the old formula was responsible for the reported effect. Initially, researchers focused on concentration changes of sodium potassium hexa-

metaphosphate/sodium polyphosphate $(NaPO_3)_n$ which is the only ingredient that was used in Eastern German "Fit" but not in the new formula. Since these experiments did not show sufficient results, the systematic variation was expanded to the blood itself (erythrocyte concentrate, fresh human blood, animal blood, both dried and/or diluted up to 1:100, blood wiped off, blood washed off with water, blood washed off with detergent, blood drop, and blood layers; n >350), and to different surfaces (plastic, paper, glass).

The experiments showed that the reported effect was only observed under non-blinded conditions. It is on the border of an illusion, caused by the uncontrolled conditions on real crime scenes. This is especially due to minute fluctuations both of the initial fluorescence intensity as well as of the duration of light emission caused by the Luminol/blood reaction. Polyphosphate alters the course of the reaction, too, but it is unclear if this is just because pH is becoming more neutral (normal reaction: pH 12, with polyphosphate: pH 8).

In the experiments, intensity was slightly increased when "Fit" mixtures were used in glass vials (higher intensity with "Fit": 54.6% vs. higher intensity without "Fit": 18.2% , same intensity: 27.3%, undecided: 0%; n=21) but not in thin layers on plastic foil (higher intensity with "Fit": 0% vs. higher intensity without "Fit": 56.5% , same intensity: 34.8%, undecided: 8.7%; n=10). Under very specific conditions, the originally reported effect was sometimes present, *e.g.* in dry glass vials with erythrocyte concentrate (1:100; higher intensity with "Fit": 100%; n=20). However, the initially higher brightness was followed by a now much shorter duration of light emission (90%; n=20). This contradicted the statement of the police unit who said that the duration - not the initial light emission - should be increased. In diluted fresh blood (1:10), this effect was either reversed, or could be produced with the new formula as well. This means that the reaction intensity does change but cannot neither be predicted for a given crime scene nor for any realistic environment.

In general, the effects were so weak that the observers could hardly determine the possible differences of glowing intensities/durations. For example, no matter if the initial intensity was judged to be equal or different, the duration of the glow was perceived to be increased in 62.5% of all cases (n=24) - *i.e.*, in completely identical samples as well as in actually different solutions. The absence of actual differences seems to be the main cause for misinterpretations.

Our experiments show that external influences play a major role in the Luminol reaction. Also, due to the perception difficulties, 7% — 68.8% of all observations were reported to be different even if the ingredients were identical (*i.e.*, all solutions completely identical and used at the same time). It is, therefore, believed that a highly trained, very experienced Crime Scene Unit was tricked by a psychological effect and wishful thinking. The CSU may have assumed that adding an extra ingredient must have some effect, and may therefore have been biased in their perceptions at the crime scene.

The technically simple, yet very labour-intensive, systematic double blind may have helped to avoid further implementation of a standard procedure that is based on anecdotal crime scene observation only.

It is of course possible that the old "Fit" may have contained an unstable component that did enhance either the initial intensity, or the duration of the fluorescent Luminol reaction. Due to now several years of storage of the remaining old "Fit", and due to a complete lack of production records from the Eastern German production facility, this can not be tested any more. In the light of these experiments, it seems more likely that "Fit" has no predictable effect at all.

Detection of Blood, Luminol Test, Crime Scene Procedures

B17 Dying to Be Thin: An Overview of Casework and Analysis for Dangerous Weight Loss Drugs

Angela S. Mohrhaus, BS, Food and Drug Administration, Forensic Chemistry Center, 6751 Steger Drive, Cincinnati, OH 45237*

After attending this presentation, attendees will have an overview of cases encountered by the FDA's Forensic Chemistry Center (FCC) involving either economic fraud or injuries/death associated with various regimens or "drugs" used for weight loss.

The FCC would like to present these examples as an analytical roadmap for those in the general forensic chemistry community who may lack experience analyzing similar cases. The Learning Objective of this presentation is to present the forensic community with an overview of cases encountered by the FDA's Forensic Chemistry Center (FCC) involving either economic fraud or injuries/death associated with various regimens or "drugs" used for weight loss. This poster will highlight the compounds in question, as well as the analytical approaches employed by the FCC in cases involving various "diet drugs."

The FCC receives evidence from all over the U.S. in cases regarding individuals who have been hospitalized, or even died allegedly from using products in an attempt to lose weight. At the opposite end of the spectrum are cases where a specific drug labeled to be present has not been incorporated into the product. The FCC is tasked with determining exactly what compounds (if any), and how much, was present in products consumed by the individual in question.

America's obsession with thinness has fueled a weight-loss industry that grosses close to $35 billion dollars annually. Today, 55 percent of U.S. adults are overweight, and nearly one in four are obese. These consumers are bombarded with ads touting "lose 30 pounds in 30 days" or the latest dietary supplement promising "to burn fat without exercise."

The weight loss supplements most commonly encountered at the FCC have been those containing ephedrine alkaloids and/or caffeine. With the ban, albeit temporary, of ephedra last year, many companies have looked to other compounds, or at least the "name" of other compounds, to make money. In addition to the ephedra/caffeine submissions, the FCC has received samples containing many other compounds claiming to help the consumer lose pounds, such as 2,4-dinitrophenol, synephrine, usnic acid, tiratricol, and phentermine. The cases presented are ones in which the complainant has suffered ill effects, been hospitalized, or has even died as a result of consuming products containing the aforementioned compounds. The FCC has also received casework where the "touted" chemical is not even present, resulting in higher profits for the manufacturer and no weight loss for the consumer.

These products are marketed to an extremely vulnerable group. In many cases, claims of quick weight loss are made, but the consumer is not aware of the potentially deadly side effects or the fact that the product may not contain the "drug" it is labeled to possess.

The analysis performed at the FCC on these particular cases varies greatly depending on the compound in question. This poster will focus on the various compounds, their physical properties, their potential side effects, and the methods employed to identify and/or quantitate the "active" ingredient. These examples are presented as an analytical roadmap for those in the general forensic chemistry community who may encounter similar cases.

Weight Loss, Death, Economic Fraud

B18 Identification by GC/MS of Aldicarb (Temik) in a Murder for Hire Case

Gary S. Fernandez, BS, and Erik H. Frazure, BS*, Mississippi Crime Laboratory, PO Box 1385, Batesville, MS 38606*

After attending this presentation, attendees will learn from a demonstration of a technique for the analysis of thermally labile compounds by GC/MS.

This presentation will impact the forensic community and/or humanity by expanding the forensic chemist ability to deal with thermally labile compounds.

The forensic chemist is often presented with requests for which their available instrumentation and methodologies do not seem readily applicable. This presentation will demonstrate the ability to identify the thermally labile compound, aldicarb by GC/MS when other technologies such as LC/MS and/or derivitization are not available. To accomplish this, techniques published by L. Chambers et al., Tel Aviv University[1] were modified.

Officers from the Mississippi Bureau of Investigation presented the laboratory with an unknown black granular material contained in emptied amoxicillin capsules. They informed the laboratory that these capsules were part of a murder for hire case in a neighboring county and requested that the laboratory screen for and identify any poison that might be present.

Initial analysis of the material by GC/MS, an Agilent MSD 5973 interfaced with an Agilent 6890N GC with a 30 meter HP5 column, indicated the presence of aldicarb oxime and alicarb nitrile, which are thermal breakdown products of aldicarb, the poison contained in the cotton pesticide "Temik". This GC/MS information along with visual comparison of the unknown with descriptions of the pesticide found on the internet was sufficient for law enforcement to obtain an arrest warrant for the suspect.

"Temik" is a pesticide produced by Bayer CropScience containing aldicarb as the active ingredient. Other trade names for aldicarb include ENT 27093, OMS 771, Sanacarb, UC 21149, and Ambush. It is used as a pesticide in various applications on a variety of plants from cotton and soybeans to peanuts and potatoes. Aldicarb is an extremely hazardous Category I carbonate poison with an LD 50 of 1 milligram per kilogram. Given the amount contained in the two capsules was 1.4 grams and "Temik" is 15% aldicarb by weight, it was determined that there was 210 milligrams of aldicarb present in the two submitted capsules. This would be a sufficient amount of the poison to easily kill an average 70 kilogram individual. A sample of aldicarb (Temik) was obtained from a local farm chemical supply house to use as a standard. As aldicarb (Temik) can be absorbed dermally, orally or by inhalation, distribution of the pesticide is handled by a sealed *Lock & Load* system which minimizes human contact with the material.

Upon studying the methodology of L. Chambers et al., confirmation of the parent compound was done by installing a short 4 meter HP5 column on a Hewlett Packard GCD II, increasing the carrier gas flow rate and lowering the injector and column temperatures. These conditions allowed us to identify aldicarb by limiting the compound's time within the column and getting it through the system before it was thermally degraded. Retention time and mass spectra from the standard material was compared to that in the unknown and allowed us to positively identify the submitted material. The mass spectra of the standard sample and unknown also matched that of published standard spectra for aldicarb.

The usual method for analyzing thermally labile compounds makes use of LC/MS or derivitization. When these are not available application of the techniques in this presentation offers the forensic chemist other options for analysis of such compounds.

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Aldicarb, Analysis, GC/MS

B19 Quantitation of Methamphetamine Laced Paper Discovered Within a Correctional Facility

Robert A. Dilley, BA, Marshall University, 2007 Buffington Avenue, Apartment 217, Huntington, WV 25703; and Charles Gould III, BS, Greenwood Police Department, 186 Surina Way, Greenwood, IN 46143*

Attendees will be presented with a case report involving methamphetamine-laced paper.

This presentation will impact the forensic community and/or humanity by educating the community on a unique case of methamphetamine-laced paper that was apparently smuggled into a correctional facility.

We report a case of methamphetamine-impregnated paper discovered at the Jackson County jail in Seymour, Indiana. Various sized sections of stained construction paper were confiscated from a prison inmate and analyzed by the Greenwood Police Department Crime Lab. The paper was found to be positive for methamphetamine by reaction with marquis reagent and confirmed by GC-MS. GC-FID was then used to quantitate the concentration of methamphetamine on the paper by internal standard method. Twenty random single-hole punches were selected for sampling and extracted into organic solvent by basic extraction. The paper was found to contain an average concentration of 12.64 μg/cm^2 of paper (15.25 mg methamphetamine per 8.5" x 11" sheet of paper) with a peak concentration of 20.24 μg/cm^2 (24.42 mg per sheet). Law enforcement should be aware that methamphetamine laced paper is a viable method for transporting and smuggling the controlled substance into a correctional facility.

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Methamphetamine, Methamphetamine Quantitation, Paper Methamphetamine

B20 Microchip-Based Volume Reduction and Sample Concentration of Crude Sample Digests for Micro-Solid Phase DNA Extraction

Joan M. Bienvenue, BS, MS, Carmen Reedy, John Wass, University of Virginia, Department of Chemistry, McCormick Road, Charlottesville, VA 22904; Jerome P. Ferrance, PhD, Susan Greenspoon, PhD, and James P. Landers, PhD, University of Virginia, Department of Chemistry, McCormick Road, Charlottesville, VA 22904*

After attending this presentation, attendees will learn of lysates for DNA extraction on microdevices.

This presentation will impact the forensic community and/or humanity by reducing the large volume crude sample lysates for DNA extraction on microdevices.

This research presentation describes the development of a microchip-based method for reduction of large-sample volumes and sample pre-concentration for downstream micro solid phase extraction (SPE). This research would enable a more facile transition from currently existing forensic protocols for DNA extraction to microchip-based methods, enabling faster, high-efficiency recovery of DNA.

As the forensic community continues to explore new technologies and analysis techniques to improve/supplant current methods, microdevices have an increasing appeal as an alternative platform to costly time- and reagent-consuming analyses. Microdevices are now readily utilized to carry out PCR amplification and DNA separations with reduced volumes/analysis times, and the application/testing of these devices for forensic genetic analysis is now underway. In addition, sample preparatory steps, such as DNA extraction, have also been miniaturized, again with a concomitant reduction in sample size, reagents consumed, and time. However, current sample preparation methodologies for forensic DNA analysis often require the creation of a cell lysate or a cell suspension before the extraction procedure is performed which can involve the solubilization of material in 0.5 mL or more of solution. Indeed, larger volumes of solution (0.5 to >1 mL) are often required to effectively elute nuclear DNA from samples with large surface areas or samples such as fabric cuttings, cotton swabs, and other materials, due to their bulky, absorbent nature. In addition, it has been demonstrated that larger extraction volumes can enhance DNA yields from contaminated sources, diluting potential PCR inhibitors prior to DNA extraction and increasing the likelihood of recovering intact, amplifiable DNA. However, many microchip platforms, limited by the volumes that they can accept, cannot adequately accommodate volumes of this size without adding extensively to the time frame for extraction and/or the cost, while increasing the potential susceptibility of the system to contamination. As a result, new methods are required to provide high efficiency, high purity extractions (free from PCR inhibitors) that can both recover and concentrate small amounts of DNA from complex and potentially contaminated mixtures for forensic analysis.

The research presented here describes a microchip-based method being developed for reduction of large sample volumes and sample pre-concentration for downstream micro solid phase extraction (SPE). This method, designed as a crude extraction prior to a more stringent SPE will simultaneously reduce sample volume, removing some contaminants and inhibitors, while providing a high-concentration, small volume eluate for subsequent purification. A device designed to accomplish this volume reduction solid phase extraction (vrSPE) in less than 30 minutes is presented. A method for vrSPE is described, with details on the translation from the macro- to micro-scale. In addition, preliminary studies defining the capacity and extraction efficiencies of these devices are reported. Also described:

1) the use of the device to recover small amounts of DNA from volumes typically encountered in forensic analysis (0.5 to 1 mL) with successful STR amplification,

2) elution profiles showing recovery of sample with a 10-fold reduction in volume (and 10-fold increase in sample concentration),

3) a method and device integrating vrSPE with previously established μSPE methods for complete purification of DNA.

These results represent the successful transitioning of macro-scale volumes required for recovery of DNA from commonly encountered samples down to micro-scale systems for rapid sample purification.

DNA Extraction, Microchip, Volume Reduction

B21 Microdevice Solid Phase Purification Utilizing Dual Pressure/ Electro-Elution for Concentration and Enhanced Recovery of DNA

Joan M. Bienvenue, MS, Natalie Duncalf, BS, James M. Karlinsey, BS, Jerome P. Ferrance, PhD, and James P. Landers, PhD, University of Virginia, Department of Chemistry, McCormick Road, Charlottesville, VA 22904*

After attending this presentation, the attendee can expect to learn about these advancements and enhancements to microchip solid phase extraction of DNA.

This presentation will impact the forensic community and/or humanity through the potential enhancement of DNA recovery by the inclusion of an electric field during the elution step of solid phase DNA extractions in microchip. This will improve the overall yields of these extractions and the potential increase for successful downstream analysis.

A shift from organic solvent-based extractions to solid-phase extractions on silica (or ion exchange resins) for DNA purification has made the process more efficient, allowing for purification of DNA from samples from which successful isolation of DNA would not previously have been possible. In addition, these newer methods are more amenable to incorporation into microchip-based devices. Glass microdevices packed with solid phases such as silica beads, sol-gel immobilized silica beads, or sol-gels alone have demonstrated utility as potentially low-cost alternatives for highly efficient and reproducible extraction of DNA. Solid phase extraction (SPE) in microdevices reduces the time, volume of reagents, and sample volumes necessary for successful purification of genomic DNA.

Currently, DNA extractions in microdevices are carried out in a pressure-driven mode, using a standard syringe pump to control flow through the device. Solid phase extractions provide the benefits of reproducibility and high extraction efficiency, while also yielding highly purified, PCR-ready DNA in a reasonably small volume. These SPE methods are not only effective for DNA purification, but in self-contained microdevices provide a tremendous advantage for forensic analysis by inherently removing many potential sources of contaminants. However, DNA is typically eluted from these devices in a volume of 15-35 μL. For evidentiary samples containing a relatively small amount of DNA, this volume reduces the overall concentration of DNA (per μL) that can be used in subsequent PCR reactions, compromising the ability to amplify DNA from these sources. In addition, as with all solid phase extraction protocols, a small amount of DNA is irretrievably lost to the solid phase, thus lowering overall extraction efficiencies and reducing the ability to recover small amounts of DNA from low copy number samples. These problems are further exacerbated when integration of SPE with downstream microfluidic processes (such as PCR) is considered. With typical volumes of microchambers in PCR devices on the order of hundreds of nanoliters, the volume incompatibility between SPE and PCR becomes of critical concern.

This research demonstrates the use of an electric field during the DNA elution phase of the SPE to enhance recovery and provide a more concentrated sample for downstream genetic analysis. A glass device designed with dual pressure/electro-elution capabilities is described, with results from preliminary testing detailed. The device, containing embedded electrodes, allows for continuous, syringe-driven flow to be accomplished, while a low voltage electric field is applied. Using this device, a typical solid phase extraction (sample load, protein wash, DNA elutions) using pressure-driven flow is accomplished, with the electric field imposed during the final elution step to both trap DNA as it exits the device as well as to enhance DNA recovery. The ability to trap and retain DNA at the anode during flow is a demonstration of precision DNA elution from the microdevice following termination of applied field. Retrieval and concentration of DNA from a silica-based solid phase using the dual purpose

design is demonstrated and elution profiles both with and without the application of field are presented. The results of STR analysis using concentrated vs. non-concentrated samples are depicted and the reduction in volume as it relates to current microchip PCR methods is discussed.

DNA, Extraction, Microchip

B22 Multiplexed Forensic Biomarker Analysis of Body Fluids and Stains

Dax Rice, BS, Thomas Scholl, PhD, Benoit Leclair, PhD, Timothy Kupferschmid, MS, and Del Price, MS, Myriad Genetics Laboratories, 320 Wakara Way, Salt Lake City, UT 84108*

After attending this presentation, attendees will gain an awareness of new biotechnology applied to forensics.

This presentation will impact the forensic community and/or humanity by demonstrating the increased efficiency and quality of evidentiary body fluid/stain analysis and characterization.

Efficient characterization of biological stains, with instrumentation tailored for automation, is of interest to the forensic community. While technology to analyze DNA from a stain cutting has progressed remarkably in the last decade, body fluid stain identification/characterization still relies on technology pre-dating the development of PCR based analysis or recently developed immunological methods, requiring relatively large amounts of evidentiary material and labor intensive techniques. Results from a pilot study investigating the feasibility of applying Surface Plasmon Resonance (SPR) to multiplex forensic biomarker analysis will be presented. Minimal amounts of evidentiary material are necessary to identify common body fluids of forensic importance with this approach.

SPR, Immunoassay, Body Fluid

B23 Development of a Speedy Rape Kit Screening Method

Ashley Hall, PhD, University of Central Florida, PO Box 162367, Orlando, FL 32816; and Jack Ballantyne, PhD, National Center for Forensic Science, PO Box 162367, Orlando, FL 32816*

After attending this presentation, attendees will be aware of a method for the rapid screening of rape kit evidence.

This presentation will impact the forensic community and/or humanity by demonstrating information about optimal sampling devices and conditions for the collection of intimate samples from rape victims, and will offer a protocol for the rapid screening of rape kit evidence.

Every two minutes, someone in America is the victim of sexual assault. As recognized by the U.S. Department of Justice, forensic DNA evidence plays a critical role in the resolution of many of these cases. The current backlog of unexamined rape kits is estimated to be 180,000 but the true number may be as high as 500,000. This is a significant public health issue. Women are being raped and much of the evidence is either not examined or not examined in a timely manner. As a result, many rapists who may otherwise be identified by DNA are able to perpetrate additional crimes.

As one approach to reducing the backlog, a speedy rape kit screening method has been developed. Briefly, a minute portion of an intimate swab is cut and subjected to a simplified direct lysis nucleic acid extraction protocol, resulting in an admixed male/female sample. The extract is then analyzed for the presence of Y-chromosome DNA using a real-time PCR assay or Y-STR haplotyping. Post-coital samples ranging from 0 hours to 4.5 days post-coitus have been analyzed using both the direct lysis procedure and a standard differential organic protocol, allowing for an assessment of the accuracy of the former in predicting typing success in the latter. Both a positive real-time result and a Y-STR haplotype were obtained from the direct lysis extracts up to 4 days post-coitus. Analysis with an autosomal multiplex subsequent to an organic extraction proved to be less sensitive, with a male profile obtainable only up to 24 hours, but in each of these cases, a positive direct lysis result was predictive of typing success. Using these procedures, information can be obtained within 6 hours, allowing for a rapid screening of large amounts of evidence.

An additional focus of the project arose during the development of the direct lysis procedure. It was observed that if a cotton swab cutting from which DNA was extracted was subjected to a second direct lysis extraction, a significant quantity of DNA could still be obtained. This indicates that the standard cotton swab used for sampling possesses a high degree of adsorptivity for sperm. A search was commenced for alternative-sampling devices comprised of different swab materials and whose properties included high absorbtivity but low adsorptivity for sperm. Also the efficacy of swabs with different sizes and shapes was evaluated. Initially thirty pseudo-post coital swabs (created by immersing vaginal swabs from a single donor in liquid semen and drying them) were compared. As a result of this initial screen, five swab types were selected for further testing. Using these alternative sampling devices, *bona fide* post-coital swabs were collected in duplicate. The success of a swab was gauged by its performance in the direct lysis analysis (real-time PCR and Y-chromosome haplotyping), as well as in standard organic and differential extractions (autosomal and Y-chromosomal haplotyping).

This presentation will provide information about optimal sampling devices and conditions for the collection of intimate samples from rape victims, and will offer a protocol for the rapid screening of rape kit evidence, rape kit analysis, Y-chromosome, real-time PCR

Rape Kit Analysis, Y-Chromosome, Real-Time PCR

B24 Development of an Automated Sperm Detection System for the Identification of Sperm on "Christmas Tree" Stained Slides

Luigi Armogida, BS, B&B Microscopes, Ltd., 535 Rochester Road, Pittsburgh, PA 15237; Dale L. Laux, MS, Attorney General Jim Petro's Office, Ohio Bureau of Criminal Identification, 4055 Highlander Parkway, Richfield, OH 44286; Erin Fetzer, MS, Attorney General Jim Petro's Office, Ohio Bureau of Criminal Identification, 1560 State Route 56 SW, London, OH 43140; and Gabriel Feltner, BS, Attorney General Jim Petro's Office, Ohio Bureau of Criminal Identification, 1616 East Wooster Street, Suite 18, Bowling Green, OH 43042*

After attending this presentation, attendees will learn that slides can be examined automatically at the microscopic level for the presence of spermatozoa.

This presentation will impact the forensic community and/or humanity by demonstrating that the identification of sperm has been and remains to this day the single, most confirmatory test for the determination of sexual activity. Unfortunately, the microscopic examination of slides is one of the most tedious and time-consuming activities in the forensic biology laboratory. A new product, KPICS Sperm Finder™, examines slides automatically, freeing the analyst for other forensic duties.

The system scans, photographs, processes, and maps features within the slides for confirmation later by an analyst. KPICS Sperm Finder™, developed by B&B Microscopes, Ltd, is currently being validated jointly by the Ohio Bureau of Criminal Identification and B&B Microscopes, Ltd for use in forensic laboratories. The system is designed to assist the analyst by automatically locating sperm and moving the sperm into view under the microscope. This design conforms to current protocols while dramatically decreasing the time an analyst spends searching for sperm.

KPICS (Kernechtrot-Picroindigocarmine Stained) Sperm Finder™ has been developed to scan multiple "Christmas Tree" stained slides, automatically focus, capture, and analyze mapped images. After processing, any cell, identified as a sperm, can be displayed on screen as well as under the microscope for confirmation by an analyst. The data is saved as a map that can be loaded for re-analysis of the slide at a later date. Each sperm has a stored location mapped to a file associated with the slide allowing the computer to consistently move to each location of a sperm.

Although analysts can easily identify sperm using the "Christmas Tree" stain, imaging systems of the past would not accurately identify the cells under typical conditions. B&B Microscopes, Ltd combined the latest technology available with custom modifications designed by B&B Microscopes, Ltd enabling the introduction of this new tool to the forensic community. Over 100 algorithms are applied within moments to allow the computer to identify sperm in a process similar to the human brain. Moreover, the system applies identical processing to each field in a repeatable manner that automatically adjusts to the nuances in the "Christmas Tree" stain. Although staining protocols must be strictly followed, KPICS Sperm Finder™ adjusts for normal variations. Over-staining, under-staining, minimal cell number and additional debris are processed in a similar manner compared to the way the brain compensates for these variations.

The major advantage of the KPICS Sperm Finder™ is that the computer sorts through the mundane task of identifying the presence of sperm within a smear and then directs an analyst to those locations. As a rare event locator, the system also reduces eyestrain by bringing positive cells to the analyst via the motorized three-axis stage. The ergonomic advantages of reducing the repetitive motion of constant manual scanning and reducing the time needed to view through a microscope will be discussed in more detail during the presentation.

KPICS Sperm Finder™ has been developed both to recognize sperm heads lacking tails, a common finding encountered in casework, and sperm with tail still intact. In addition to analyzing thousands of fields automatically, the system can be used to document key locations of intact sperm in three-dimensional space (X, Y, Z coordinate system) for reports as well as automatically move to marked locations at a later time. Furthermore, the system can also be used as a standard microscope for color microscopic photo documentation in both manual and semi-automatic modes.

A demonstration of the versatility of KPICS Sperm Finder™ in automatic, semi-automatic, and manual modes will be available at the conference.

Automated, Sperm, Identification

B25 Presumptive Mathematical Model of Capillary Electrophoresis Processes Involved in STR Analyses Based on Observations at the Biotechnology Center, Shadow Lane Campus, University of Nevada Las Vegas

Walter E. Goldstein, MBA, PhD, Biotechnology Center, UNLV, 1001 Shadow Lane, MS 7401, Las Vegas, NV 89106-4124; Willem A. Schreuder, PhD, Principia Mathematica, Inc., 575 Union Boulevard, Suite 320, Lakewood, CO 80228; and Tracy R. Welch, BS, Biotechnology Center Shadow Lane Campus, University of Nevada Las Vegas, 1001 Shadow Lane, MS 7401, Building B, Las Vegas, NV 89106-4124*

After attending this presentation, attendees will have increased knowledge about the potential of applied mathematics to analyze and process data involved in forensic DNA fragment analysis.

This presentation will impact the forensic community and/or humanity by demonstrating the capillary electrophoresis process to separate short tandem repeat DNA fragments for analysis is complex and involves many factors that influence results. This method may lead to new insights in review of forensic DNA data.

This work is intended to explore the possibility that a specialized mathematical model (based on chemical engineering principles) can be used to depict physiochemical factors and their changes to allow another quantitative measure of influences on results important in DNA fingerprinting. The potential impact on forensic casework could be significant.

The DNA Fingerprinting process involves use of a sensitive capillary electrophoresis instrument and associated software for separation and analysis of Short Tandem Repeat DNA fragments. The capillary electrophoretic process is subject to a multitude of physicochemical effects that critically impact on results obtained. Such effects include slow changes in polymer that fills the capillary to control flow, changes in the coating on the capillary wall that may disturb the flow of DNA molecules passing through the capillary as examples. Understanding these processes to a greater extent through use of mathematical modeling and their potential impact on DNA Fingerprinting profiles may be helpful in interpretation of DNA Fingerprinting patterns and nuances. Progress on this subject will be reported in this paper.

STR Fragment Separation and Analysis, Mathematical Model, UNLV

B26 Random Match Probabilities and Database Search Estimates Provide Different Answers for Different Questions

Bruce Budowle, PhD, and F. Samuel Baechtel, PhD, FBI Laboratory, 2501 Investigation Parkway, Quantico, VA 22135*

After attending this presentation, attendees will learn how forensic scientists might better articulate the bases for statistical estimates of DNA profile frequencies: what are the proper questions to be answered, and what approach best addresses a particular question.

This presentation will impact the forensic community and/or humanity by demonstrating recent misrepresentations that have lead to confusion in the legal arena regarding the best approaches for estimating the rarity of a DNA profile when the suspect is identified first by a database search. This presentation will bring clarity to this issue, demonstrate that there is general acceptance of current practices, and point out that the perceived debate is nothing more than an application of wrong answers to proper questions.

Recent misrepresentations have lead to confusion in the legal arena on the best approaches for estimating the rarity of a DNA profile when the suspect is identified first by a database search. This presentation will bring clarity to this issue, demonstrate that there is general acceptance of current practices, and point out that the perceived debate is nothing more than an application of wrong answers to proper questions.

When a comparison of DNA profiles derived from evidence and reference samples fails to exclude an individual as a contributor of the evidence sample, the weight of the evidence is determined using a statistical assessment. For forensic applications, it is important that the statistical conclusions be conveyed meaningfully. To derive appropriate statistical inferences the question to be answered must be properly formulated. One particularly useful question for the fact finder is how common or rare is an evidence profile (calculated by either the random match probability or by using the likelihood ratio). Because evidentiary profiles are routinely being searched for matching profiles in felon databases another question may be raised: What is the probability of finding the DNA profile in the database searched? This latter question could have investigative value and addresses a different issue than that of the rarity of the profile. The scientific bases for

the estimates for each question are the same. That is the profile frequencies can be estimated by multiplying allele frequencies and correcting for substructure and sampling error. There is little dispute today about such fundamental practices. Recent court deliberations (*e.g.*, U.S. v Jenkins 2005), there has been confusion regarding an answer to the question of profile rarity with the database statistical search estimate. The NRC II Report (1996) advocates using the formula $1/(N\ p_x)$, where N is the size of the database and p_x is the random match probability, for the database search estimate. Proponents of applying this calculation as the true random match probability erroneously cite the language of the NRC II Report for supporting their contention. The report written by the NRC committee must be read in its entirety to appreciate the proper application. Clearly, on page 40 (Recommendation 5.1) the report defines the proper question as: "If one wishes to describe the impact of the DNA evidence *under the hypothesis* (Italics added) that the source of the evidence sample is someone in the database, then the likelihood ratio should be divided by N." Thus, the above formula was never meant to supersede the random match probability estimate. It should also be obvious that the different questions produce different answers and should not be construed as a conflict. In reality, there is no issue regarding general acceptance of the random match probability approach.

Another approach to contest the use of the random match probability is to focus on differences of opinion on how best to calculate the database search estimate. An alternate treatment to that of the NRC II report suggests that the evidentiary weight is underestimated. Again, this estimate does not address the question of how rare is the profile, and thus a debate on what questions to ask becomes an interesting academic exercise for some.

To appreciate better the subtleties of these various positions, examples will be provided to demonstrate the erroneous practice of proffering incorrect answers to meaningful forensic questions. These include the approaches already described by the DNA Advisory Board (Statistical and Population Genetics Issues Affecting the Evaluation of the Frequency of Occurrence of DNA Profiles Calculated From Pertinent Population Database(s), Forensic Science Communication, July 2000 Volume 2 Number 3) and other simple models.

This presentation will help forensic scientists articulate the bases for statistical estimates of DNA profile frequencies, what are the proper questions to be answered, and what approach best addresses a particular question.

Statistics, Database Search, Random Match Probability

B27 The Forensic Uses of SNP Profiles

Bruce S. Weir, PhD, Amanda B. Hepler, PhD, and Amy D. Anderson, PhD, North Carolina State University, Bioinformatics Research Center, Campus Box 7566, Raleigh, NC 27695-7566*

After attending this presentation, attendees will know of the recent availability of massive SNP datasets that can help forensic scientists understand population structure and estimate relatedness between the donors of two or more DNA profiles.

This presentation will impact the forensic community and/or humanity by demonstrating how although the forensic community has a large investment in STR genetic markers, current work in human genetics has shown that SNPs are the markers of choice. These markers have much to offer forensic science.

Current efforts in human genetics, such as the International HapMap project, have made available population data on over one million single nucleotide polymorphisms (SNPs). Data are publicly available for various African, African-American, Asian and Caucasian populations. These very large datasets have made it possible to provide new information relevant to the forensic uses of DNA.

The ability to average over many SNPs in the same region of the genome has led to much more reliable estimates of the population-structure parameter theta that is central to the calculation of match probabilities for both single-contributor and multiple-contributor stains. When this estimation is done it becomes clear that different values should be used for the CODIS STR markers. Recent publications in population genetics have suggested that the usual population-average values of theta be replaced by population-specific values, and when this is done for regions around the CODIS markers it appears that some of these regions may have been affected by natural selection. This, in turn, may require larger values of theta than would otherwise have been used. Numerical values will be shown.

The large number of SNP markers that can now be typed simply and cheaply means that it is possible to provide direct estimates of the degree of relatedness between a set of remains and a living person, or between two sets of remains. This would be an attractive alternative to using likelihood ratios of the probabilities of two profiles under alternative hypothesized relationships and prior probabilities of those relationships. The numbers of SNPs needed to distinguish among classes of relatives is very large, but large numbers are now available. Numerical results will be shown.

It can be expected that very dense SNP datasets will hasten the day when phenotypic attributes can be predicted from DNA profiles.

DNA SNP Profile, Population Structure, Relatedness

B28 A New Expert Systems Software Package for Rapid STR Data Analysis

Curtis D. Knox, BS, Kimberly Huston, BS, and Joseph Bessetti, MS, Promega, 2800 Woods Hollow Road, Madison, WI 53711*

After attending this presentation, attendees will have information regarding a newly released expert systems software package, including detailed information on the unique features offered by this software.

This presentation will impact the forensic community and/or humanity by highlighting a new tool for the DNA laboratories.

The goal of this presentation is to describe a newly released expert systems software package, including detailed information on the unique features offered by this software.

With the advent of automation and other solutions to reduce backlogs in sample processing from extraction to amplification and typing, data review has now become a bottleneck that laboratories need to address. Software-directed allele calls do not address the actual quality of the data; therefore, at least a short manual review of the data for each sample is necessary. An expert systems software package not only provides a second set of independent allele calls, but also gives the analyst the confidence to not examine sample data that the software has judged to be of high quality. This allows analysts to more efficiently spend their time concentrating on "problem" samples.

In addition to evaluating data for quality, there are other review functions that are time consuming or difficult to perform. Mixture analysis is labor intensive, and potential bias is a concern of both the DNA analyst and the attorney. A software package that has the ability to perform two-person mixture deconvolution in an unbiased, efficient fashion will free up analysts' time and will provide a validated method for laboratories to rely on in court.

Sample-to-sample contamination is also of considerable concern to DNA typing laboratories, especially in light of advancements in automation that utilize open-well plates for various steps of the typing process. Examining blank samples for the presence of types is an important step in this process, but this does not account for the possibility of minor DNA components being introduced into samples that already contain DNA. A software package capable of comparing every sample within a batch to every other sample in the batch will aid laboratories in checking for potential contamination events and provide a further level of analyst confidence when presenting data in court.

The FSS-i^{3TM} ("i-cubed") expert systems software consists of three functional components integrated into one package. The first component, "i-STRess," provides confirmation of previous allele calls as well as an extensive analysis of the quality of the data. The second component, "i-STReam," performs the mixture analysis, and the third component, "i-ntegrity," performs the within-batch contamination check. The software allows the user to optimize a large number of settings to best suit the laboratory's unique DNA interpretation protocols.

Given the need for data tracking and validation of any new software that is implemented in a forensic laboratory, strategies for performing the validation and automatically generating audit trails will be discussed in this presentation. Functionality of the software, basic optimization procedures for the individual user, and potential workflow enhancements that a laboratory may realize upon adoption of the software will also be presented.

Expert Systems, STR Data Analysis, DNA Mixture Analysis

B29 Development, Validation and Application of a High Throughput System for Detection of Human Male DNA in Screening for Rape Kits

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After attending this presentation, attendees will be provided information regarding a novel screening system for detection of human male DNA in forensic samples.

This presentation will impact the forensic community and/or humanity by demonstrating a novel screening approach that fills the gap between current technologies for detection of human male DNA. Current screening methods are targeted to detect seminal fluid proteins or sperm cells and, therefore, provided false positive and negative results when the samples were processed for STR analysis.

Screening of sexual assault evidence samples for the presence of sperm or semen is generally the first step in forensic DNA analysis. Y-Detect is a novel screening system for the detection of male DNA in all types of forensic samples. The method is based on PCR amplification of an *Alu* insertion fixed within the Y chromosome. The *Alu* family of interspersed repeats is the most successful of the mobile genetic elements within primate genomes, having amplified to a copy number of greater than 1,000,000 per haploid genome. *Alu* repeats are unique nuclear markers that are ideally suited for human identity testing. Individual *Alu* repeats are approximately 300 bp in length and are thought to be derived from the 7SL RNA gene. Y-Detect is a two-plex PCR system that achieves amplification of human male and Avian DNA. Simultaneous amplification of Avian DNA enables monitoring for the presence of possible PCR inhibitors in each tube. The primers for human and Avian DNA are labeled with FAM and JOE generating fragments of 156 and 202 bp, respectively, that are separated on 310 or 3100 Genetic Analyzers. The developmental validation studies were performed according to the DNA Advisory Board's (DAB) Quality Assurance Standards. Unlike currently used methods such as seminal protein p30, acid phosphatase and microscopic examination for presence of sperm, the Y-Detect system enables screening of all types of evidence biological samples. Further, individual assays can be performed using a 96 well format to facilitate high-throughput screening. The Y-Detect assay is a sensitive, valid and robust multiplex system for the screening of biological samples for the presence of human male DNA.

Over 100 rape kits were screened using the Y-Detect system and p30. Findings from this study will be presented.

Screening, Y-Detect, Forensic Casework

B30 DNA Typing and the Families of the Asociaciòn Pro-Bùsqueda (Pro-Search Association) de Niñas y Niños Desaparecidos (of Disappeared Children) in El Salvador

Nicole Inacio, BS, California Department of Justice, Bureau of Forensic Services, 1001 West Cutting Boulevard, Suite 110, Richmond, CA 94804; Lance Gima, BS, and Cristian Orrego, PhD, California Department of Justice Bureau of Forensic Services, 1102 Q Street 6th Floor, Sacramento, CA 95814;and Brian Harmon, PhD, Forensic Analytical, 3777 Depot Road, Suite 409, Hayward, CA 94545*

After attending this presentation, attendees will learn of a protocol for collecting DNA samples, typing, creating a database, and using the information to help reunite family members separated by war or mass disaster To realize that DNA typing is a powerful tool for human identification and kinship determination. Not only can DNA typing be used along with traditional means of identification such as anthropology and odontology but it can be utilized to help reunite families. The Learning Objective is to demonstrate a methodology that can easily be adapted at the local and state law enforcement agencies working with missing persons programs. This presentation will impact the forensic community and/or humanity by demonstrating how the setting of a procedure in place can expedite identifying human remains as well as collect DNA from families to assist and relocate missing children that may have been separated from their families. In the early 1980's, a violent twelve yearlong civil war surged throughout the country of El Salvador. As a result, many children were taken by the military and brought to orphanages or given to top military officials often with scarce documentation. Many of these children, now young adults, are still alive.

In 1994, the non-governmental human rights organization Asociación Pro-Búsqueda (Pro-Search Association) de Niñas y Niños Desaparecidos (of Disappeared Children) was established to assist the families in El Salvador looking for their children. In the fall of 2003, Lance Gima, Bureau Chief, Bureau of Forensic Services, California Department of Justice (CAL DOJ) and Criminalist Cristián Orrego established a collaboration with the Human Rights Center (HRC) at the University of California, Berkeley and the Boston-based group, Physicians for Human Rights (PHR) to assist Pro-Búsqueda, founded by Father Jon de Cortina, to develop and implement procedures for collecting DNA samples (buccal) from the registered families.

In April 2004, a team of volunteers from the Bureau of Forensic Services (BFS), CAL DOJ and from PHR, traveled to El Salvador to assist Pro-Búsqueda with this task. The team was composed of Bureau Chief Lance Gima, Criminalists Lara el Khazen (Santa Barbara Laboratory), Nicole Inacio and Brian Harmon (both from the Jan Bashinski DNA Lab), and forensic anthropologist Ms. Henriette Stratmann, along with computer scientist Mr. Lorenz Kenter (both based in the Netherlands and affiliated with the Forensic Program of PHR).

The team provided Pro-Búsqueda with training on procedures for collecting DNA samples and on the implementation of software specifically designed with Pro-Búsqueda to store the information obtained from the family interviews. The team collectively developed a process from sample collection and eventual kinship analysis consisting of four phases.

Phase One is the interview and sample collection of approximately 1,300 family members, from 721 requests (496 registered families), and entry of the information from the interviews into the database. This phase is to be completed by the end of 2005, with 694 samples collected to date.

Phase Two is DNA analysis of the samples, conducted by qualified volunteers at the CAL DOJ Jan Bashinski DNA Lab with the permission of the Office of the Attorney General Bill Lockyer and with materials and reagents costs funded from grants received from HRC and PHR (152 samples typed to date).

Phase Three is the construction of a DNA database, which will be the exclusive property of Pro- Búsqueda. This phase includes the training of a

scientist affiliated with Pro-Búsqueda on computational kinship analysis using DNA-VIEW, the software package designed by forensic mathematician Dr. Charles Brenner. In the meantime, in late August of 2004, volunteers from the Jan Bashinski DNA Laboratory received training on DNA-VIEW from Dr. Brenner, with particular emphasis on running kinship simulations to determine the best choice of relatives, of those available to collect from, who would be the most informative to analyze. This training has allowed the CAL DOJ team to provide Pro-Búsqueda with ongoing decisions on collection strategy given a certain family composition, which eventually could best match a child to a family, should that child become available for DNA typing.

Phase Four is the Missing Children Sample Analysis, which includes searching for and reporting kinship matches using the database of family profiles. Should a match be recorded, the Pro-Búsqueda scientist will evaluate the match and write a report.

The goal of this collaboration is to work directly with the relatives of the victims and human rights organizations in their efforts to reunite families. This collaboration may provide a guide for volunteer work from the forensic science community to assist families searching for their loved ones torn apart from war, and still in fear or distrust of their government.

El Salvador, Pro-Busqueda, Missing Children

B31 A Series of Bank Robberies Linked by DNA From Handled and Worn Items

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After attending this presentation, attendees will understand the importance of educating the criminal justice community to the potential value of "non-traditional" DNA evidence. This presentation will illustrate how the analysis of DNA recovered from, handled and worn, items was used to link a series of thirteen bank robberies and identify eight individuals to the crimes. Seven of these eight individuals have been linked with DNA evidence to at least two cases.

This presentation will impact the forensic community and/or humanity by creating greater awareness of the value of "non-traditional" DNA evidence.

Southern California is often referred to as the bank robbery capital of the world due to the large number of these crimes. Orange County, California, recently experienced a series of take-over bank robberies that exhibited similar modus operandi (MO) in the way the crimes were carried out. The perpetrators wore masks and gloves, preventing visual identification by witnesses and preventing identification by latent fingerprints. Stolen vehicles were used as the get-away vehicle in each of the incidents and were abandoned a short distance from the bank. Black knit caps with excised eyeholes, gloves, screwdrivers, and other miscellaneous items which may have been handled or worn by the perpetrators were left behind in the abandoned vehicles. Swabs of the steering wheels and door handles of the vehicles were also collected. The evidence items were sampled for DNA based upon how they would have been used or handled (history-directed collection). The knit caps, used as masks, were sampled by cutting or swabbing the approximate mouth area of the interior of the mask. The gloves were also sampled by cutting or swabbing the interior surfaces. The screwdrivers, apparently used to start the stolen vehicles, were swabbed along the handles for potential DNA from the individuals who utilized them.

The typing results obtained from these items included single source profiles, mixtures with an easily discernable major contributor, and complex multi-contributor mixtures. As more profiles were developed and entered into a local DNA database, case-to-case matches were made. This demonstrated the value of this type of evidence, which, until then, had infrequently been submitted for DNA analysis. This also prompted investigators to re-examine similar cases that had been set aside as unsolved. As of August 2005, thirteen cases had been linked by DNA between May 2000 and October 2003.

The profiles obtained from the recovered evidence have led to three matches in California's convicted offender database. An additional five profiles were matched to five individuals through traditional investigative means. All of the individuals belong to a street gang from a neighboring county. One unidentified male profile was obtained from evidence in two of the thirteen cases. In order to keep the statute of limitations from expiring on those two cases, a John Doe warrant was filed on this DNA profile. A second John Doe warrant was filed on a profile obtained from additional cases believed to be part of this same series.

The results obtained from the DNA analysis of the evidence in this series of bank robberies demonstrate the importance of informing the criminal justice community (investigators, crime scene personnel, prosecutors, forensic scientists, etc.) of the value of examining worn and handled items for DNA. As a result of the success of these examinations, evidence recovered from bank robberies is now routinely being accepted for DNA analysis.

DNA, Bank Robbery, Handled/Worn Items

B32 Mixed Buccal Cells in a Paternity Case

Luis J. Martinez-Gonzalez, MS, Esther Martinez-Espin, MS, Javier Fernandez-Rosado, MS, Carmen Entrala, PhD, J. Carlos Alvarez, PhD, Jose A. Lorente, MD, PhD, Miguel Lorente, MD, PhD, and Enrique Villanueva, MD, PhD, University of Granada, Department of Legal Medicine, AV. Madrid, 11, Granada, 18012, Spain; and Bruce Budowle, PhD, FBI, Laboratory Division, Quantico, VA 22135*

After attending this presentation, attendees will learn that tampering and manipulation of DNA reference samples can occur and establish procedures to reduce such from occurring. Forensic scientists should be cognizant that

This presentation will impact the forensic community and/or humanity by demonstrating the importance of knowing that intentional contamination of reference samples, in this case saliva, could happen, and all preventive measures and protocols must be established especially when taking samples for databases.

An atypical result was obtained in a DNA analysis of a paternity case. One of the samples (from the alleged father) showed contamination. After investigation, it was concluded that the donor introduced into his mouth saliva from another person a few seconds prior to buccal cell collection by swabbing.

A paternity trio (alleged father, mother, and child) submitted to DNA analysis in a paternity dispute. Following standard operation procedure, donors where placed in separate rooms, and once properly identified, each signed the informed consent form. Before sampling, donors were asked to rinse their mouths with mineral water. Then, buccal swabs were taken by trained personnel and the cellular material was transferred onto FTA® paper (Whatman, Florham Park, NJ). The samples subsequently were sent to the laboratory, and DNA analysis was performed using autosomal STR loci (Identifiler®, Applied Biosystems, Foster City, CA).

The electropherogram (ABI-310 Applied Biosystems, Foster Cit, CA) from the alleged father (AF) showed extra peaks at most of the loci, strongly suggesting a mixed sample that could be the result of tampering, laboratory contamination, or some biological phenomenon. There was a predominant profile in the mixture, possibly originating from one person, but because of the presence of a clear second profile, any possible interpretation and further conclusions were not carried out.

Mother and child profiles displayed as single sources and were consistent with a biological relationship. All procedures and positive and negative controls used during the amplification of the AF sample were double checked, and no mistakes were found. DNA extraction, quantitation and amplification were repeated by another technician, and identical results were obtained.

Since the swabs and the FTA® paper were clean and other support media from the same lots showed no problems, it was then suspected that the sample was somehow contaminate. One plausible explanation because nothing unusual was observed during collection, was that the donor introduced into his mouth some biological product (most likely saliva from another person) in the short time that elapsed between rinsing his mouth with water in a small bathroom and the sampling of the buccal cells. The AF was called back to the laboratory and it was explained to him that a very atypical result was obtained found and that another sampling was needed. After that explanation, he agreed to provide more buccal cells. However, he unexpectedly admitted that he had introduced into his mouth a small plastic bag with saliva from another person (his wife) in an attempt to create a false conclusion from the DNA analysis. He wanted to be excluded as the biological father of the child (from an extramarital affair). Results showed extra alleles (intentional contamination) in the AF row. The predominant profile in the mixed sample was the same as that of the AF. The other profile could not be confirmed at that of his wife (as he claimed); she was not involved in the case and no sample could be obtained from her. The results did not exclude the AF as the biological father (PI = 157415). While this is a very atypical case, the DNA lab managers and the personnel collecting samples should be aware that it is possible to mix biological fluids in the mouth attempting to thwart the DNA analysis or to delay results. Mechanisms to prevent such tampering should be considered when collecting samples, especially for felon databases. Although intentional contamination resulting in a mix of biological fluids in a reference sample should never cause an error (as some might suggest), unusual situations such as this one should be considered when atypical results are obtained.

STRs, Paternity, Intentional Contamination

B33 DNA Identification of Human Remains From the Crash of American Airlines Connection Flight #5966, Kirksville, MO, October 19th, 2004

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After attending this poster presentation, attendees will understand DNA field sampling techniques and laboratory efforts necessary to produce DNA results capable of aiding in positive identification and re-association of casualties from fragmented and charred human remains in a mass fatality incident.

This presentation will impact the forensic community and/or humanity by illustrating the ability of DNA laboratories to successfully generate DNA profiles from human remains subjected to post-mortem fire.

The opinions and assertions expressed herein are solely those of the authors and are not to be construed as official or as the views of the U.S. Department of Defense or the U.S. Department of the Army

On October 19th, 2004, at approximately 7:50pm, a twin-engine turboprop plane designated as American Airlines Flight #5966 traveling from St. Louis International Airport to the Regional Airport in Kirksville, MO, crashed on final approach killing both crewmembers and 11 of 13 passengers. Although two passengers survived the incident the remains of the fatalities were severely burned due to post-crash fire rendering fingerprint identification impossible. Under the Aviation Disaster Family Assistance Act, the Adair County Coroner and the National Transportation Safety Board (NTSB) called in the assistance of the Federal Emergency Management Agency's (FEMA) Disaster Mortuary Operation Response Team (DMORT) and the Armed Forces DNA Identification Laboratory (AFDIL) to aid in identification of the fatalities.

AFDIL joined the DMORT operation in Kirksville, MO, for post-mortem identification and collected blood, tissue, and bone specimens for DNA testing. Most of the fatalities had been exposed to extensive burning due to a post-crash fire that produced intense heat sustained by airplane fuel for a significant period of time. The overall condition of the remains ranged from total body thermal changes with extensive charring to completely charred remains with extensive loss of bone and soft tissue. Family references were collected from appropriate members for comparison. The human remains samples and family references were hand-carried to AFDIL in Rockville, MD, to expedite the analysis process.

A total of 25 post-mortem specimens and 16 family references were tested by AFDIL. Laboratory testing was accomplished using PowerPlex®16. Post-mortem DNA specimens were submitted to AFDIL within six days of the incident and DNA analysis results were reported back to the Adair County Coroner within 14 days of the incident. All 13 casualties were successfully identified by DNA testing. In those instances where other conventional forms of identification (such as dental comparisons) were used as a basis for identification, DNA results from those remains were used as identification confirmation. The success of this undertaking illustrated that even when human remains exhibit severe post-mortem charring DNA testing can resolve identity issues in mass fatality incidents.

Mass Fatality Incident, Charred Human Remains, DNA Analysis

B34 Study on Mutation Rate of CODIS 13, D2S1338, D19S433 and X STR Loci and its Influence to CPI Value

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After attending this presentation, attendees will understand that the mutation rate of STR profiling should be considered in paternity examinations.

This presentation will impact the forensic community and/or humanity by demonstrating mutation rate of STR profiling should be noticed when building paternity.

Paternity determination is conducted according to the Mendelian Inheritance laws by examining STR genotypes between child and alleged father or mother. This is currently tested at the STR systems CODIS 13, D2S1338, D19S433 and 7 X STR loci. But when mutations occur at those loci, it will interfere with the judgment of paternity or non-paternity between individuals.This study was concerned about mutation rate in these STR loci and the influence to the value of CPI in paternity test.

We observed total 737 cases containing 633 duo cases and 104 trio cases. In 12,150 parent/child allelic transfers (meioses) at CODIS 13, D2S1338, D19S433 and X STR loci, 33 isolated STR mismatches were observed.

Paternal meioses mutation rates:

D3S1358 and FGA were 0.00469

vWA, D8S1179 and D19S433 were 0.00313

CSF1PO, D13S317, D7S820, D21S11 and D18S51 were 0.0015

No paternal meioses mutations were observed in TH01; TPOX; D5S818 and D16S539.

Maternal meioses mutation rates only observed in D5S818, D8S1179, D21S11, and D16S539 with the value of 0.00498.

X STR linked mutation only observed in DXS10011, DXS7132 and AR loci with the value of 0.02174, 0.01538 and 0.01961 respectively. Null alleles were observed in D8S1179 locus only.

CPI value of 97 real parenthood trio cases and 33 single mutation cases were calculated according to published formula. This study suggested that?

1. If one single STR mismatch was observed and concluded that the inconsistency was a mutation, then the mutation result must be also incorporated into the reported results.

2. Using the mutation rate divided by the average probability of exclusion to calculate the mutation loci paternity index (PI) according to AABB annual report summary 2003

3. For the duo cases (mother didn't want to be tested or she didn't want to pay), it was suggested that mother should be sampled for further tests if in a low CPI or mutation situation.

4. With regards to null allele cases, the sample could be tested with other commercial kits and the null alleles might be revealed.

Forensic Science, STR, Mutation Rate

B35 The Spanish Phoenix Program: Update on the DNA Missing Persons Identification Program (1999-2005)

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After attending this poster presentation, attendees will understand the strategies and results of the Spanish national missing person's identification program, also known as the Phoenix Program. How the program was established, its characteristics and criteria, and the experiences accumulated to date will be presented so that others may benefit when developing a missing persons database and identification program. Participants will receive updated data on the protocols currently established and operating as well as the identifications performed.

This presentation will impact the forensic community and/or humanity by demonstrating how forensic scientists might utilize the strategies followed in Spain to implement the first database of its kind in the world.

In November 1998, the Spanish Ministry of the Interior supported an initiative from the University of Granada and the Guardia Civil (the largest law enforcement agency in Spain) to implement a National Program to attempt to identify cadavers and bones from missing persons. The program, named the "Phoenix Program" based on classic Greek mythology, became operational in 1999 and yielded its first results in 2000.

The Phoenix program contains two independent databases that can automatically compare DNA sequences to identify matching or related profiles, such that identifications of unknown remains may be possible. One of the databases is the Reference Database (RD). The RD contains mtDNA sequences from maternally related relatives of missing persons. The reference samples are provided voluntarily. To generate the data, two bucal swabs are obtained from at least 2 relatives (when available). The second database is the Questioned Database (QD). The QD is comprised of mtDNA sequences obtained from bones or cadavers that cannot be identified or that were not identified by routine and standard procedures; such as fingerprints, anthropology, odontology, x-rays, etc.

From 1999 until 2001 only mitochondrial DNA analysis (HV1 & HV2) was routinely performed on the samples. When mtDNA matches were found, a second and independent analysis was performed as part of the quality control mechanism. STR analysis (13 CODIS loci) was performed only when mtDNA results showed a match. In 2002, systematic analysis of mtDNA and STRs was enacted for all cases and samples. STR typing was conducted on those samples analyzed prior to 2002. As of July 14, 2005, over 2,200 relatives of missing persons have contactedtheprogram. Of these, 526 persons donated biological samples; 507 mitochondrial DNA sequences and 389 STR profiles thus far has been generated. In the QD, 581 mitochondrial DNA sequences and 560 STR profiles from human remains have been entered into the database. In total, 97 persons have been identified using a genetic approach. Some of these remains had been buried and marked as "unknown" for many years, and without the DNA technology their identification would have been impossible. The missing person's database is exemplary of the social benefits of DNA identification.

Missing Persons, DNA, Database

B36 The Use of AFLP Technology to Prove the Genetics of Patented Varieties of Sutera

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After attending this presentation, attendees will have an understanding of how forensic botany and plant DNA testing can be applied to civil casework.

This presentation will impact the forensic community and/or humanity by illustrating how forensic botany and, in particular, plant DNA testing can be used to individualize samples and answer forensically relevant issues.

AFLP, or amplified fragment length polymorphism, testing has been used for the genetic analysis of many organisms including plants, animals, insects and bacteria. This form of DNA testing requires a minimum of twenty nanograms of high quality plant DNA and can be used on any plant species. Since it is a multilocus test system, band patterns can become quite complex, therefore, it is simplest to make AFLP data interpretation from nonmixed samples (*i.e.*, single plant sources). Using only a single PCR primer set and a limited number of markers, one can easily determine if samples do not match. Additional PCR primer sets are used to confirm matches by increasing the number of markers observed and compared to approximately one hundred in total. The basic AFLP process involves restriction enzyme digestion of the plant DNA, followed by addition of adaptors (*i.e.*, short DNA sequences used for PCR primer recognition), two rounds of PCR amplification to reduce the complexity of DNA fragments to a manageable number of bands to interpret, separation of fluorescently labeled fragments on a capillary electrophoresis platform and a final interpretation of the data using Genescan® and Genotyper® software programs. Previous work has described validation studies on a model plant, marijuana, to determine if AFLP may be useful for tracing drug distribution patterns based on the detection of clonally propagated plants (cloned plants, like identical twins, have the same genetic profile).

The authors were approached by an attorney representing a plant breeder that believed his patented variety of *Sutera*, an ornamental landscaping plant, had been illegally propagated and was being distributed by a major seed company. The seed company, Ball Seed, was positive that no illegal propagation could have occurred. The plant breeder claimed that the only way Ball seed could have achieved plants with the particular flower color they exhibited was by crossing their variety with his patented variety based on the genetic information listed on the patent applications.

To resolve this issue, AFLP technology, was used to screen the different plant samples and determine if they shared the same or different AFLP-DNA profiles. Seven different plant samples (EU10396 Giant Cloud, Giant Snowstorm, Lavender Storm, Blizzard, Cabana, Giant Snowflake and SC-1) plus controls (positive, negative) were tested with two different selective PCR primer sets. These data were sufficient to determine which samples were consistent with a matching versus a mismatching AFLP-DNA profile. Ultimately, it was determined that the Giant Cloud variety of *Sutera* was not genetically the same as SC-1 and that no intentional patent violation had occurred. In fact, additional AFLP testing resolved the matter by sorting out a seed sample that had been misidentified on the original patent that explained the ultimate discrepancy between the genetics and the flower color.

The application of AFLP technology to civil cases to resolve questions of plant patent infringement is illustrated well by this case. While both parties were initially adamant about what they believed had occurred, the use of plant DNA testing by AFLP was able to quickly and efficiently resolve the situation and provide a rationale explanation for the plant flowering trait that was observed. This type of case was particularly amenable to AFLP typing since it used fresh plant material to generate the DNA for further testing. Previous work with marijuana has shown that the starting plant DNA needs to be of sufficient quantity and quality for AFLP to be useful.

Forensic Botany, AFLP Testing, Plant DNA

B37 Examination of Additional Y-STR Loci for Increased Resolution of Common Haplotypes

Amy E. Decker, BS, Peter M. Vallone, PhD, Margaret M. Kline, MS, and John M. Butler, PhD, NIST, 100 Bureau Drive, Gaithersburg, MD 20899*

After attending this presentation, attendees will have a method for examining new Y-STR loci in order to determine an optimal set of markers to use for increased resolution of common haplotypes and also for distinguishing between related males.

This presentation will impact the forensic community and/or humanity by demonstrating methodologies used for examining new Y-STR loci.

The need for more Y-STR loci has become increasingly important as the potential forensic uses of Y chromosome testing are revealed. One major challenge in forensic investigations has been the recovery of genetic information from perpetrators in sexual assault cases involving low amounts of male DNA mixed with high levels of female DNA. While several commercial Y-STR kits have been developed to focus on this issue, additional loci could assist in increasing the power of discrimination between closely related male lineages. At the same time, new Y-STR loci may also help to separate related males, such as fathers and sons.

We have examined 27 Y-STR loci across approximately 660 U.S. Caucasian, African American, and Hispanic samples (1). A guide for evaluating these loci will be described including examples of the distribution of allele frequencies among these populations and their gene diversity values. In addition, a subset of these Y-STR loci is in full concordance with previous studies using in-house multiplex assays and commercial Y-STR kits.

Potential new Y-STR loci were selected from the 166 new Y-STR loci described by Kayser et al. (2). The loci were mapped using PCR primers present in the Genome Database (GDB) (3). Primer pairs were checked in sets of three for primer-dimer and hairpin structures using the AutoDimer program (4). The loci were combined into 5 multiplex sets and characterized for all 660 population samples. From this information, at least two alleles for each Y-STR locus were chosen for sequencing in order to determine repeat number and to assist in nomenclature decisions. Once the repeat number was established, allele frequencies were determined for the loci. Gene diversity values for the individual loci in the population samples were examined as well as a collection of haplotype information.

Twenty-seven (27) additional Y-STR loci have been studied and characterized and at least 20 of these have been found to have high variation and genetic diversity values in three major U.S. population groups.

An approach for looking at new Y-STR loci has been established. Future studies will investigate other Y-STR loci that may be of forensic value to potentially supplement commercially available Y-STR loci kits. These loci will also be evaluated on their ability to distinguish between father/son pairs.

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Short Tandem Repeat, Y-Chromosome, DNA

B38 A Criminal Paternity Case Involving a Molar Pregnancy

Meghan E. Clement, MS, Shawn M. Weiss, BS, A. Dwayne Winston, BS, Matthew Hill, BS, Michael Mooney, BS, Kelly Pegram, MS, and Marcia T. Eisenberg, PhD, Laboratory Corporation of America Holdings, Inc., 1912 Alexander Drive, Research Triangle Park, NC 27709*

After attending this presentation, attendees will understand the difference between a complete and partial molar pregnancy, the results the molar pregnancies will produce during development of a DNA profile and interpretation considerations in relation to questions of paternity issues.

This presentation will impact the forensic community and/or humanity by demonstrating that many cases there is limited information provided by the investigating agency to the laboratory, especially in criminal paternity situations. Therefore, being aware of unusual results such as those obtained with molar pregnancies can assist laboratory personnel in drawing conclusions of paternity inquiries.

A criminal paternity case was submitted involving a 12-year-old female who presented at a local hospital with acute vaginal hemorrhage. It was determined she was miscarrying and she was subsequently taken into surgery during which, uterine tissue samples were collected. The pregnancy was a result of an alleged sexual assault and the sample submitted had previously been sent to an alternate laboratory for DNA analysis. The original analysis resulted in "a mixture of phenotypes that could not be interpreted".

A tissue block as well as known reference samples for the victim and suspect was included in the submitted samples. An STR DNA analysis was performed at the 13 CODIS loci. The tissue sample revealed only a haplotype profile with very minor additional activity at the D3S1358 locus. The victim could not be excluded as the source of the minor additional activity, but was excluded as the source of the major haplotype profile. Since these results were unusual, an additional sample was taken from the tissue block for a pathology consult. The pathologist confirmed that fetal material was present in the tissue block as well as placental material and also determined that the fetal tissue was from a molar pregnancy. A second section, designated by the pathologist as containing mostly fetal material, was analyzed and again a major haplotype profile was obtained with minor additional activity being observed at various loci.

The reasons behind the haplotype results will be discuss in this case study, as well as the subsequent conclusions that were drawn. Additionally, complete and partial molar pregnancies will be defined and the expected DNA analysis results for each instance will be presented.

Paternity DNA Testing, Molar Pregnancy, Forensic Casework

B39 The Analysis of Latent Fingerprints Using Y-STR, Mitochondrial, and SNP Analysis

Cassie L. Johnson, MS, Robert C. Giles, PhD, and Rick W. Staub, PhD, Orchid Cellmark, 13988 Diplomat Drive, Suite 100, Farmers Branch, TX 75234*

After attending this presentation, attendees will learn the results of several types of DNA analyses of fingerprints.

This presentation will impact the forensic community and/or humanity by demonstrating fingerprint samples are very often collected at crime scenes, but are rarely submitted for DNA analysis. Optimizing ways in which fingerprint samples can be analyzed for DNA may provide investigative leads for law enforcement personnel.

Fingerprints are commonly collected by police officers and investigators at crime scenes such as burglaries and homicides. Although the ridge patterns of these samples are often examined using AFIS (the Automated Fingerprint Identification System), they are rarely analyzed using DNA technology due to smudging or the anticipation of low DNA content. The present study utilized fingerprints from males that were collected on different substrates and extracted using different techniques. The samples were both untreated and treated with a variety of fingerprint powders and subsequently subjected to Y-STR or mitochondrial, and/or SNP analysis. The results of this study will be presented.

Fingerprint, DNA, Forensic

B40 Real Time PCR for Distinguishing Degraded Samples

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After attending this presentation, attendees will develop a real-time PCR assay to detect template degradation in forensic samples.

This presentation will impact the forensic community and/or humanity by outlining a strategy to distinguish intact mtDNA template from challenged mtDNA samples. Obtaining this information prior to amplification would prevent the need to repeat the amplification with different primers sets, avoiding excessive consumption of precious evidence.

Forensic mitochondrial DNA (mtDNA) testing is a lengthy and labor-intensive procedure. Tools being developed to assist in mtDNA analysis include real-time PCR assays, primers for amplification of mini-amplicons, and improved extraction methods. For example, there has been developed and validated a real-time PCR assay for quantitation of mtDNA in sample extracts which can be run alongside Quantifiler, a nuclear DNA quantitation assay, to determine whether STR analysis of nuclear DNA or sequencing of mtDNA should be performed. Although this simultaneous assay provides a rapid and objective estimate of mtDNA quantity, it does not provide information about mtDNA template size.

The current project focuses on developing an additional assay that can provide information about the size of intact mtDNA in the sample. This real-time PCR assay should be capable of distinguishing samples with degraded DNA from samples with mostly intact DNA. This information about mtDNA template size will allow the analyst to determine which set of amplification primers should be used with extracts from challenged samples, such as hair and bone, which frequently have degraded DNA. Depending on the size of the available template DNA, mtDNA can be analyzed using amplicons of ~400bp, ~200bp, or ~ 100bp. Obtaining this information prior to amplification would prevent the need to repeat the amplification with different primers sets, avoiding excessive consumption of precious evidence.

The assay design involves a partially nested primer design which amplifies two different sized mtDNA control region fragments (99 and 461 bp) and two minor groove binding (MGB) probes, each labeled with a unique fluorescent tag for detection of these amplicons. In addition, the assay includes primers and probe specific for an internal positive control (IPC) to monitor the quality of reagents and equipment, as well as the presence of PCR inhibitors in the sample extract. The absence of the longer amplicon in the presence of both the shorter fragment and the IPC is indicative of degraded DNA, while the occurrence of the IPC amplicon in conjunction with the lack of both mtDNA amplicons signals intense degradation.

Primer and probe concentrations have been optimized with intact mtDNA. Currently, this assay is being evaluated using intact DNA as well as degraded template generated by an array of DNA damage inducing procedures including controlled cleavage by restriction enzymes and exposure to UV, sunlight and bleach. In addition, the sensitivity of this assay has been evaluated.

This assay, in conjunction with Quantifiler, will provide information on nuclear DNA quantity, mtDNA quantity and mtDNA template size. This data will allow the analyst to determine the most efficient and effective method to analyze DNA extracts.

Mitochondrial DNA, Real Time PCR, Degraded DNA

B41 SNPs by MALDI-TOF MS: A New Tool for Highly Degraded DNA Samples?

Elizabet Petkovski, Bertrand Ludes, MD, PhD, Christine Keyser-Tracqui, Sylvain Amory, and Remi Hienne, PhD, Codgène, 11, rue Humann, Strasbourgh, 67000, France*

After attending this presentation, attendees will have information regarding the Matrix Assisted Laser Desorption Ionization Time-of-Flight Mass Spectrometry (MALDI-TOF MS) method of DNA typing.

This presentation will impact the forensic community and/or humanity by demonstrating to the forensic community the advantages but also the limits of a relatively innovative technique in the field of the DNA typing.

DNA profiling technology has revolutionized the analysis of crime scene evidence, allowing the establishment of genotypes even from minute amounts of biological material. Nowadays, forensic experts are more and more often confronted with the task to obtain results from highly degraded DNA samples, which is difficult with the commonly used STR markers. In this context, efforts have been made in the development of new methodologies implying the SNPs. Today, several technologies are used to perform SNP genotyping among which the Matrix Assisted Laser Desorption Ionization Time-of-Flight Mass Spectrometry (MALDI-TOF MS).

In order to test the potential of this method in the study of highly degraded DNA, 50 autosomal SNPs were selected on the basis of conservation, localisation, lack of phenotypic expression, and allelic frequencies in different populations. A single nucleotide sequence difference between the amelogenin genes carried by the sexual chromosomes has also been selected for sex determination. These 51 SNPs were analysed and validated on a French representative population comprising 21 inclusionary, 3 exclusionary paternity cases and a total of 81 unrelated individuals. This approach to SNP typing is a multiplex PCR based amplification followed by simultaneous detection by primer extension (PEX). Product analysis is accomplished by Matrix Assisted Laser Desorption Ionization Time-of-Flight Mass Spectrometry (MALDI-TOF MS).

The selected SNPs showing independent inheritance and giving clear results in paternity and identification testing (and being therefore suitable as markers in the field of forensic genetics), the usefulness of this approach was investigated on highly degraded samples, the real target of these devel-

opments. The results obtained by these assays revealed some difficulties, notably in the reproducibility of the results obtained due to steps which are not entirely controllable. Thus, the aim of this work was to determine whether these obstacles were due to the multiplexing approach or to the degraded nature of the target DNA.

The presentation lists the problems encountered with the development of this new SNP typing method and tries to answer the following question: to what extend is the applied technology a step forward in the analysis of highly degraded samples?

Single Nucleotide Polymorphism, Degraded DNA, Maldi-Tof MS

B42 Taq/Proofreading Enzyme Combinations: A Method to Enhance Degenerate Oligonucleotide Primed- PCR Results in Forensic DNA Analysis

Lindsay P. Thompson, BS, Denise N. Rodier, BS, Kristen E. Lewis, MS, Kristin M. Meyer, MS, and Tracey D. Cruz, PhD, Virginia Commonwealth University, 1000 West Cary Street, PO Box 842012, Richmond, VA 23284*

After attending this presentation, attendees will have information regarding Degenerate Oligonucleotide-Primed PCR (DOP-PCR), one WGA technique, in which a degenerate primer is used to amplify different regions across the entire genome to provide overlapping DNA fragments for theoretical full genome coverage.

This presentation will impact the forensic community and/or humanity by providing a tool that utilizes current laboratory personnel, equipment, and procedures with minimal additional costs and modifications in order to achieve successful multiplex STR amplification of degraded, aged, or otherwise compromised biological evidence.

It is expected that by adding a proofreading enzyme (*i.e.*, Pyrococcus furiosus, Thermococcus gorgonarius) in a small ratio to the Thermus aquaticus enzyme currently used with Degenerate Oligonucleotide-Primed PCR (DOP-PCR), the efficiency of the amplification reaction will be increased due to the ability of the proofreading enzyme to correct base pair mismatches and maintain elongation through minor errors that normally occur when using Taq alone.

Whole genome amplification (WGA) is being actively researched in the forensic DNA community in order to achieve successful multiplex STR profiles from low quality/low copy number samples that were not amplifiable using standard STR amplification techniques. Currently, WGA is commonly being used in various non-forensic fields in order to amplify a single locus of a low copy yield sample, or multiple loci of higher yield samples. In Degenerate Oligonucleotide-Primed PCR (DOP-PCR), one WGA technique, a degenerate primer is used to amplify different regions across the entire genome to provide overlapping DNA fragments for theoretical full genome coverage. Previous reports indicate that after DOP-PCR, the resulting DNA yield is increased significantly compared to the original sample. However, results thus far have shown some preferential amplification and allele/locus drop out in the subsequent multiplex STR amplifications. It is expected that by adding a proofreading enzyme (*i.e.*, *Pyrococcus furiosus, Thermococcus gorgonarius)* in a small ratio to the *Thermus aquaticus* enzyme currently used with DOP-PCR, the efficiency of the amplification reaction will be increased due to the ability of the proofreading enzyme to correct base pair mismatches and maintain elongation through minor errors that normally occur when using *Taq* alone. It is necessary to continue use of *Taq* and not convert to a reaction that solely uses a proofreading enzyme because *Taq* provides the increased rate necessary for full elongation and the poly-A addition quality that proofreading enzymes typically lack – all of which is required for the standard STR analyses that is conducted in most forensic laboratories. It is believed that these modifications will greatly reduce the preferential amplification and allele/locus drop out currently seen in multiplex STR amplifications that use DNA from the standard (*Taq*- only) DOP-PCR reaction.

In this study, the initial approach previously described (amplification by traditional DOP-PCR methods, concentration of post-DOP-PCR products, followed by inputting this high yield, high molecular weight DNA into the multiplex STR amplification) was used with several modifications. First, real-time PCR using ABI's Quantifiler® kit was used to achieve more accurate quantitation of pre- and post-DOP-PCR products. Following the initial quantitation, input DNA amounts ranging from 0.25 nanograms to 7.5 picograms were tested in DOP-PCR setups using enzyme combinations including *Pfu* and *Tgo* in a 16:1 ratio with *Taq*. All post-DOP-PCR DNA was visualized by agarose gel electrophoresis and human DNA was quantitated using Quantifiler®. Preliminary results indicate an increase in both size range and DNA yield, up to several thousand-fold for low input DNA samples. Following the analysis of DNA yields and size, STR analysis was performed using an ABI 3100-*Avant* for DNA separation and detection. The STR results from the enzyme combination experiments showed that an increased number of loci can be recovered in the samples with an initial DNA input of 0.25ng and 0.125ng when utilizing a *Taq*/proofreading enzyme combination. However, the number of loci recovered decreases with decreasing DOP-PCR DNA input amounts.

Further research will evaluate the ability of DOP-PCR products produced with the enzyme combination from even lower input DNA amounts to generate a correct profile with distinct and balanced peaks at *all* multiplexed STR loci with minimal stochastic variation. In addition, other WGA techniques such as MDA and LCN techniques (increased cycle number for thermalcycling) will also be evaluated in a similar manner in order to make a comparison to the optimized *Taq*/proofreading enzyme DOP-PCR method.

DNA, STR, WGA

B43 Specific Haplotypes and Population Analysis of 17 Y-Chromosome STR Loci in Taiwan

Tsun-Ying Huang, MS, Yi-Tzu Hsu, MS, and Jui-Ming Li, BS, Institute of Forensic Medicine, Ministry of Justice, 16, Lane 175, Tong-Hwa Street, Taipei, 106, Taiwan, ROC*

After attending this presentation, attendees will understand the population frequencies (genetic polymorphism) and mutation of 17 Y-chromosome STR loci and specific haplotypes in the population in Taiwan.

This presentation will impact the forensic community and/or humanity by demonstrating that some specific haplotypes are found in the population in Taiwan, this information is important for a precise estimation of the frequency of duplicated mutated Y-STR alleles in forensic practice.

Y-Chromosomal short tandem repeats (Y-STRs) have been increasingly used, during the past few years, in the study of human evolution and human identification in forensic casework. Many commercially available kits have been adapted for forensic applications. This study was designed to establish the haplotype database in the Taiwanese population for the set of 17 Y-STR loci adapted by the AmpFLSTR Yfiler™ PCR Amplification Kit (Applied Biosystems, Foster City, CA, USA).

Two-hundred-three unrelated male Taiwanese were analyzed for the haplotypes in these 17 Y-STRs loci (DYS19, DYS385a/b, DYS389I/II, DYS390, DYS391, DYS392, DYS393, DYS438, DYS439, DYS437, DYS448, DYS456, DYS458, DYS635 (Y GATA C4), and Y GATA H4) using the kit purchased from Applied Biosystems. The haplotype frequencies in these loci, gene diversities and the power of discrimination for each Y-STR locus were estimated. Mutation rates of these 17 Y-STRs were also examined by comparing the genotypes obtained from the father/son sample pairs.

One-hundred-ninety-two haplotypes were observed in the 203 unrelated males. No Y-STR mutation was found in 38 father/son pairs. Gene diversity (GD) and discrimination power (DP) values observed in these loci ranged from 0.399 (DYS 391) to 0.956 (DYS 385) and 0.397 (DYS 391) to 0.952 (DYS385), respectively. The GD values of five loci (DYS 389 II,

DYS 458, DYS 635, DYS 392 and DYS 448) were higher than those reported in the study including three different populations in the U.S., *i.e.*, African-American (N = 333), Caucasian (N = 254) and Hispanic (N = 175). The GD values of DYS 391 and Y GATA H4 were lower than that reported by this same U.S. study. These results indicated that the AmpFLSTR Yfiler™ PCR Amplification Kit has improved minimal haplotype diversity and DP of the Y-specific haplotypes in the population studied and is suitable for forensic DNA analysis in Taiwan.

Of particular interest was the observation of one sample with four peaks at the DYS 385 locus (a duplicated locus). A pedigree showing triple alleles at the DYS 385 locus without allelic discrepancy between the father and son has been reported in a study on Japanese population. Double peaks for a single locus were also reported from Bahia (Brazial) including DYS 389II, DYS 437 and DYS 439, presumably because of a duplication event followed by a mutation. Thus, the presence of double, triple or four alleles at one locus does not always implicate multiple male profiles.

Y-STRs, Gene Diversity, Discrimination Power

B44 Forensic Glass Analysis by LA-ICP-MS: Assessing the Feasibility of Correlating Windshield Composition and Supplier

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After attending this presentation, attendees will have a statistical context in which to interpret trace elemental data for glass, automotive windshield homogeneity, and population variation and batch consistency will be discussed as well.

This presentation will impact the forensic community and/or humanity by providing practical information as to the typical variation of trace elements in a discrete sample of float glass, a large number of float glass samples and multiple samplings of three float glass manufacturers. With this information, the forensic community can address the question: How individualized is the chemical composition of glass?

This poster will show the potential utility of compositional data in correlating recovered automotive glass fragments to a particular manufacturer. Recently, much attention has turned to the use of chemical analysis in differentiating glass fragments of varying sources, which may appear similar by conventional methods of forensic analysis such as refractive index (RI) measurement. A thorough characterization of chemical composition provides the possibility to discriminate between glasses that do not share a common source, despite a common basic history of manufacture. In particular, the trace elemental profile of glass seems the most discriminating characteristic available to forensic analysts. Trace elemental analysis for this study is accomplished using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS).

Trace elemental data for automotive windshields is presented to show the potential of associating trace elemental profiles and glass manufacturers; this study also provides a statistical basis for associating glasses of similar compositions. This sample type was chosen because information regarding the date and location of manufacture is readily available. Additionally, automotive windshields belong to a class of glass commonly encountered in trace evidence – float glass.

To be addressed in this study is the elemental variability observed: (1) within a single windshield; (2) among windshields produced by a single manufacturing plant; (3) among windshields produced by various manufacturing plants; and, finally, (4) within three sets of float glass manufacturing batch samples. Each impacts the level of discrimination available to forensic glass analysts, and the potential of developing a searchable database of automotive glass compositions. Such a database would greatly aid in the investigations of automobile-involved crimes, where no information can be obtained as to the make and model of the vehicle used in the offense. Of more practical use is the potential for the database to serve in a bookkeeping capacity. As more glass is profiled, the uniqueness of any one profile can be tested.

Glass Analysis, LA-ICP-MS, Trace Element Profiling

B45 The Analysis of Commercial Blasting Agents by Laser Induced Breakdown Spectroscopy (LIBS), With Emphasis on Methods for Heterogeneous Samples

Katie L. Vomvoris, BS, Candice Bridge, BS, Zachary M. Parker, Jean Mac Innis, PhD, and Michael Sigman, PhD, National Center for Forensic Science, PO Box 162367, Orlando, FL 32816-2367*

The goal of this presentation is to demonstrate the importance of sampling techniques that should be considered when analyzing heterogeneous samples using Laser Induced Breakdown Spectroscopy (LIBS), and for the purpose of sample discrimination.

This presentation will impact the forensic community and/or humanity by emphasizing the importance of multiple shot averages that are necessary for heterogeneous samples, such as the blasting agents used in this study, to insure LIBS spectra acquired are representative of the sample composition.

LIBS is a technique that analyzes samples by elemental emissions (both atomic and ionic emissions), which has been utilized the scientific community since the 1980's. Only in recent years has this technique attracted the attention of the forensic science community due to advantages such as the ability for fast data analysis, little sample preparation, and high signal to noise ratio. The twenty-two (22) heterogeneous blasting agents used in this study are comprised of slurries, water gels, and emulsions. All data was collected using an Ocean Optics LIBS 2000+ system. Experimental parameters included a 1064 nm laser excitation using a Big Sky model CPR200 Nd-YAG at approximately 81mJ/pulse and a detection delay of 5µs, which was determined to be an optimal delay for the majority of the twenty-two samples.

When LIBS spectral averaging is utilized for heterogeneous sample analysis, several factors must be considered in order to achieve a representative average spectrum. These factors include the number of spectra averaged, the heterogeneity of the sample, and other experimental parameters such as laser power, detection delay time, and sample atmosphere. In order to reduce the complexity of the experimental system, a "homogeneous" sample consisting of a glass microscope slide, was first analyzed. The influence of sample atmosphere (air versus argon), and number of spectra averaged on the reproducibility of average spectra was investigated. Results suggested that air can provide a better sampling atmosphere for these samples.

The influence of sample heterogeneity was investigated though the analysis of 22 commercial blasting agents. These materials often contain glass micro balloons, metal particles (*i.e.*, Aluminum), potassium nitrate prills, and other more homogeneously distributed organic and inorganic components. Samples were prepared as thin layers spread on copper supports. Spectra were collected and averaged at a number of locations on the sample and the number of spectra was varied. Spectra were compared by a variety of techniques including full spectral correlation, selected line correlations and spectral line ratioing. Results will be presented describing the utility of each data analysis method for sample discrimination and the potential efficacy of LIBS for heterogeneous sample analysis.

LIBS, Heterogeneous Sample, Blasting Agents

B46 Elemental Profiling of Paint Samples by ICP-MS and LA-ICP-MS

Joseph V. Gagnon, BS, BA, and José R. Almirall, PhD, Department of Chemistry and Biochemistry and the International Forensic Research Institute, Florida International University, 11200 SW 8th Street, Miami, FL 33199*

After attending this presentation, attendees will have an understanding of the principles and techniques used in the elemental analysis and comparison of paints and their application in discrimination studies for the forensic analysis of paint evidence. The benefits of quantitative analysis of trace elements in the differentiation between similar paint samples will also be presented. Those attending this presentation will be informed as to the use of Laser Ablation versus solution based sample introduction for Inductively Coupled Plasma Mass Spectrometry analysis of paint systems.

This presentation will impact the forensic community and/or humanity by demonstrating the ability to quantitatively analyze trace elements from a complex and highly variable matrix. Also, this research will aid in strengthening the evidential value of trace evidence paint transfer commonly associated with automotive "hit and run" as well as a variety of other potential crime scenarios.

The quantitative elemental profile of a material has been demonstrated to provide for an excellent means to discriminate between otherwise similar paint samples (same organic composition). The research presented in this poster applies the principles and techniques utilized for the quantitative elemental analysis of materials such as glass towards the elemental profiling of the more complex and compositionally varied matrix materials of latex and automotive paint systems.

The analytical procedure included a solution based microwave digestion using concentrated Nitric acid. The same samples were also analyzed by a standardless method recently developed for glass, which utilizes Laser Ablation. This method eliminates the need for matrix-matched standards to obtain quantitative analysis. This is a great benefit to the analysis of paint samples due to the complexity and diversity of paint matrices.

An element menu (along with detection limits for target elements in latex paints) was determined and will be presented. A method to standardize the analysis of paint samples using a standard addition of target metals to the latex paint system enables the quantitative determination of a menu later used for discrimination between paint samples. The utility of the discrimination between paints using this method is presented. Approximately 15 white latex paints from varying manufacturers were analyzed.

The compositional heterogeneity within a single can of paint was examined and the results are presented. The heterogeneity was determined from the analysis of 10 separate samples from the same can of paint. This information was obtained for standard white latex paint as well as several popular colors of latex paints. Separate element menus were developed for each color.

Each sample was analyzed by a solution method of sample introduction as well as Laser Ablation. The benefits, as well as the disadvantages, of both techniques were evaluated. A standardless method of analysis was utilized for the quantitative analysis of paint, sampled by Laser Ablation, which eliminated the need for a matrix-matched standard. The reproducibility, accuracy and ease of use for each technique are presented.

These techniques were also applied to the analysis of multiple layer samples of latex paints as well as automotive paint systems. The complexity of conducting elemental analysis on multiple layers with minimal sample contamination between the layers is addressed with a novel approach to sampling each layer using LA-ICP-MS.

This research is very pertinent to the forensic community through its demonstration of the ability to quantitatively analyze trace elements from a complex and highly variable matrix. Also, this research will aid in strengthening the evidential value of trace evidence paint transfer commonly associated with automotive "hit and run" as well as a variety of other potential crime scenarios.

Paint, ICP-MS, Laser Ablation

B47 Casework Investigations for Tapes, Polymers, Ink, and Paper Using IRMS and (LA-) ICPMS Studies

Andrew J.J. van Es, PhD, Shirly Montero, PhD, Wim Wiarda, Ing, Peter de Joode, Ing, and Gerard J.Q. van der Peijl, PhD, Netherlands Forensic Institute, Ministry of Justice, Laan van Ypenburg 6, PO Box 24044, Hague, 2490 AA, Netherlands*

After attending this presentation, attendees will appreciate the strong potential of Isotope Ratio Mass Spectrometry (IRMS) and Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-)ICPMS for a wide spectrum of forensic investigations.

This presentation will impact the forensic community and/or humanity by demonstrating new interesting forensic applications of the (LA-)ICPMS and IRMS elemental and isotopic techniques have been developed and are demonstrated to result in much more discriminating methods for forensic applications. The subject in the present presentation touches on a limited number of investigations but is very useful in demonstrating the relevance of these techniques. Results are presented for various casework investigations using the IRMS (Isotope Ratio Mass Spectrometry) and LA-ICPMS techniques that are still used infrequently for investigations within the forensic community.

Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-)ICPMS and Isotope Ratio Mass Spectrometry (IRMS) method development studies for various materials has been previously presented at the AAFS meeting. These techniques are use for a wide variety of forensic material casework investigations (various tape types, glass, XTC, paper, sawdust, ink, bullets, brass and other metals, rope materials, cables, polymeric jerrycan remains in arson residues, human materials for tracing geographic origin unidentified human victims). For forensic LA-ICPMS glass investigations a validated and accredited routine method has been developed (http://www.forensicinstitute.nl/documents/Glass_validation_report.pdf). For a selected number of general casework investigations experiences are shared and general trends and aspects discussed.

The general trends and aspects of LA-ICPMS and IRMS casework investigations mostly center on material comparisons, *i.e.* does this piece of material as found at the crime scene and similar material as found with the suspect originate from one source? As one hypothesis the materials are therefore considered to originate from one source (*i.e.* roll of tape). Most of the investigated materials are industrially produced in production batches. As alternative hypotheses, researchers would typically consider that materials are from the same production batch or from another production batch but the same producer or from other random producers. Weighing of the evidence is based on scientific literature results and Netherlands Forensic Institute, part of Ministry of Justice (NFI) investigations on limited numbers of samples to test literature information applicability for the Dutch situation. An interactive process is used in reporting. Mostly (fast, softer) forensic intelligence is generated for the police investigation phase. For the court evidence phase in first instance the findings are reported as of that moment and mention possible follow-up studies. Dependent on the court response some aspects of the first investigation may be further substantiated in a follow-up study.

Brown packaging, gray or black duct and PVC tape types were investigated in some fifteen casework investigations, mostly in relation to serious crimes. Tapes were always first investigated using classical techniques such as FT-IR and visual (microscopic) comparison. Mostly tapes were contaminated with dust and other debris. Sometimes tapes had been treated chemically to visualize fingerprints. Laser Ablation Quadrupole Inductively Coupled Plasma Mass Spectrometry (LA-Q-ICPMS) was used in all cases for both backing and adhesive layers. Often, results were corroborated using Laser Ablation High Resolution Inductively Coupled Plasma Mass Spectrometry (LA-HR-ICPMS) experiments. IRMS was used where appropriate but was hindered in some instances by contaminated (adhesive) surfaces, limited sample size or plasticizer in (PVC)

backing material that was partly extracted upon removal of the adhesive layer. In general, earlier tape comparison results were confirmed and conclusions strengthened using these more discriminating techniques. Some tape samples were discriminated. If possible, material composition results were combined with physical fit investigation results and led to stronger conclusions.

Bullet fragments and traces were successfully linked together or to specific bullets in shooting incident reconstructions (*i.e.* shoot-out in bar with police officers). If fragments are large enough elemental composition was measured with Inductively Coupled Plasma Atomic Emission Spectrometry (ICP AES). Lead isotope ratios (LIR) are used for bullet traces (*i.e.* lead trace on buckle or window). In a background LIR ICPMS and ICP AES study on 24 Dutch NFI collection bullets (9 mm FMJ) all bullets were discriminated using LIR alone.

Ink and paper forensic investigations become more important because of *i.e.* terrorism aspects such as threat letters to prominent public figures. LA-ICPMS is used for ink comparisons. In the ablation process a combination of ink/paper is ablated and differences in the process are observed using different paper substrates. Most of the elemental spectrum is dominated by the paper elemental spectrum. In general, only a few elements will be characteristic for the printer ink. These characteristic elements vary between inks and may partly be attributed to the printing process itself. Using (LA-)ICPMS good discrimination is obtained in paper investigations. IRMS is also a very important technique to discriminate paper. The combination of (LA-)ICPMS and IRMS again is a powerful strongly discriminating set of forensic techniques.

Insulation layers of electricity cables and polypropylene rope materials were investigated using LA-ICPMS and IRMS after visual and FT-IR investigations were unable to discriminate between samples. LA-ICPMS sufficed to discriminate between cable insulation samples and a combination of LA-ICPMS and IRMS investigations was used to polypropylene rope materials. Polyethylene jerrycan remains in arson residues from various arson investigations were compared using LA-ICPMS and IRMS to establish links between investigations.

Polymers, ICPMS, IRMS

B48 Elemental Analysis of Bone, Nail and Hair by ICP-MS and LA-ICPMS

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After attending this presentation, attendees will have the results for the elemental analysis of bone, nail and hair using solution digestion and laser ablation coupled to both unit resolution and high resolution ICP-MS instruments.

This presentation will impact the forensic community and/or humanity by demonstrating the utility of both solution and LA sampling of bone, nail and hair to determine the elemental profile of these materials when analyzed by either unit resolution or high resolution ICP-MS.

The utility of trace elemental analyses and comparisons of glass and paint fragments by sophisticated methods such as laser ablation inductively coupled plasma (LA-ICP-MS) has been shown to offer a high degree of discrimination between different sources of these materials. Elemental analysis can be used to associate materials originating from the same source with a high degree of confidence based on the excellent discrimination observed between different sources. ICP-MS and LA-ICP-MS methods have been developed and validated through intra-laboratory and inter-laboratory trials, published in the scientific literature, and even used in actual criminal prosecution proceedings in Europe and in the US.

An analytical protocol for the determination of trace elemental profiles in bone, nail, and hair by two methods, ICP-MS and LA-ICP-MS, has been developed and is presented. The NITECRIME network, an international effort associated with validating the protocols for sample preparation and analysis of trace metals in various matrices, has conducted inter-laboratory trials for the analysis of bone, nail, and hair. One application, where such elemental profiling may be utilized, involves drawing an association of buried remains to a particular burial site, associating remains to a geographic region (where the subject previously resided), and discriminating between sets of bones that have been co-mingled in a burial site. Such profiling is made possible through the measurement of the geo-chemical markers found in bone as trace elements. Similarly, the elemental profile in nail and hair can be used to associate individuals to geographic markers, acquired through diet and other means.

The analytical protocol for solution analysis, via two different digestion methodologies (open vessel and microwave) is described. A comparison conducted in terms of precision, accuracy, time, and ease of analysis, is presented. These matrices/samples were also sampled using LA-ICP-MS to simplify the sample preparation step; LA has proven to offer many advantages over solution-based methods. A Perkin Elmer DRCII quadrupole ICP-MS and a Thermo Element 2 High Resolution magnetic sector instruments were used to measure the determined elemental menu for each of the sample matrices. Standard reference materials (NIST 1400, NIST 1486, CRM 397, ICP02H06, ICP03H06 and ICP01N01) and actual bone, nail and hair samples were analyzed and the results of the analyses by the different combinations of the methods and instruments are presented. This work demonstrates the utility of both solution and LA sampling of bone, nail and hair, as used to determine the elemental profile of these materials by either unit resolution or high resolution ICP-MS.

Bone/Nail/Hair, ICP-MS, Elemental Analysis

B49 Forensic Analysis of Organic and Inorganic Components of Black Powder Substitutes by Ion Chromatography (IC) and Capillary Electrophoresis (CE)

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After attending this presentation, attendees will be introduced to two newly developed methods for the detection of ascorbic acid in black powder substitutes.

This presentation will impact the forensic community and/or humanity by demonstrating how the information gained from using these methods for the analysis of black powder substitutes can serve as an investigative lead for law enforcement personnel in the event these types of powders are used in the commission of an illegal act, such as the construction of an Improvised Explosive Device (IED).

Black powder substitutes are alternative propellants that have several advantages over traditional black powder: they are not classified as explosives, making them easier to purchase; they generate less smoke when fired; and they are less corrosive to the gun barrel. These powders come in a variety of formulations and grain sizes, but generally contain inorganic oxidizers and organic fuels. Depending on the formulation, the oxidizer may consist of KNO_3 and/or $KClO_4$. Typically, charcoal is selected as the fuel component, but in recent years, several manufacturers have instead turned to the fruit sugar ascorbic acid. This compound has the advantages of water solubility and a reduced smoke output when burned. These characteristics of ascorbic acid result in less fouling of the gun barrel, leading to a faster reloading time.

Previously, no published methods existed whereby both ascorbic acid and the inorganic oxidizer anions ClO_4^- and ClO_3^- could be visualized during the same run on a capillary zone electrophoresis (CZE) or an ion

chromatography (IC) system. To that end, methods were developed for the analysis of ascorbic acid, perchlorate, chlorate, and chloride by capillary electrophoresis and ion chromatography. Concurrent use of these two methods resulted in a presumptive identification of the compounds of interest.

A CZE method was developed that used dual-indirect photometric detection to visualize both the organic and inorganic components. Separation was carried out on fused-silica capillaries with 75µm i.d. x 40 cm total length. Samples were injected in the hydrodynamic mode for 7s. The applied voltage was held constant at -12kV. The running buffer was 5 mM benzoic acid at an optimum pH of 7; benzoic acid served as the background electrolyte. The wavelength of detection was optimized to be 225 nm and 240 nm. The total run time was approximately fifteen minutes. The analytical method for the ion chromatography system utilized an isocratic elution with indirect photometric detection and conductivity detection in series. A weak anion exchange resin was used to separate sample components. An isophthalic acid buffer served as the UV-absorbing eluent; indirect photometric detection occurred at 280 nm.

The two methods described above were applied to the analysis of several black powder substitutes that contain ascorbic acid as the fuel component. Both burned and unburned powder samples were analyzed. Both the organic and inorganic components of interest were successfully isolated using the optimized instrumental methods. While the IC and CZE methods were only applied to powders known to contain ascorbic acid in this experiment, they are also applicable to powders that contain charcoal in place of fruit sugars.

Ion Chromatography, Capillary Electrophoresis, Ascorbic Acid

B50 Examining Candidate DNA Quantitation Standards With Real-Time Quantitative PCR Assays

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After attending this presentation, attendees will have information regarding the evaluation of commercial and in house real-Time PCR assays for the development of a human DNA reference material.

This presentation will impact the forensic community and/or humanity by demonstrating how the application of qPCR methods for the estimation of human genomic DNA is increasing. The reproducibility and ability to automate qPCR assays is an attractive characteristic for use in a forensic laboratory is of importance to understand the effects different qPCR assays and their standards have on the intended result: the ability to obtain quality signal from a human identity typing kit.

Numerous real-time quantitative PCR (qPCR) methods have been developed in the last several years for use with forensic DNA samples. Ten different qPCR methods were used to evaluate DNA samples distributed in the NIST Interlaboratory DNA Quantitation Study 2004 (QS04). The target DNA concentrations of the QS04 samples were from 1.5 ng/µL to 50 pg/µL. About one-fifth of all QS04 results were from qPCR methods. These data show differences among the qPCR methods, both with regard to precision and bias. It is unclear from these data whether the observed differences are inherent to the methods or reflect differences in the standards used in their calibration.

The evaluation of several qPCR methods using six different human DNA calibration materials will be presented. All of the qPCR methods are either commercially available or have been published recently. Three of the calibration materials are commercially available; three are derived from in-house purified single-donor blood samples. This study is being used to direct development of candidate Standard Reference Material 2372, Human Genomic DNA Quantitation Standard.

A total of 5 methods for quantifying human genomic DNA were examined. The assays were run on the ABI 7500 instrument platform. All of the 5 methods were run in duplicate using six different human DNA calibration materials. Three of the human DNA standards were commercially obtained and three were prepared in house and quantified by a UV measurement (wavelength = 260 nm). The genomic DNA standards were examined by serially diluting a range of 10 ng down to 0.41 ng. The prescribed analysis thresholds and baseline values were applied and linear standard curves for the DNA standards were generated. Cross comparisons of the DNA standards and assays were made.

Standard curves for all six DNA standards were generated for the 5 assays. This allowed a comparison between different genomic DNA standards as well as the 5 qPCR assays. Variation in the relative amounts of DNA in a "standard" is illustrated by way of a practical example; running an autosomal STR test.

The application of qPCR methods for the estimation of human genomic DNA is increasing. The reproducibility and ability to automate qPCR assays is an attractive characteristic for use in a forensic laboratory. It is of importance to understand the effects different qPCR assays and their standards have on the intended result: the ability to obtain quality signal from a human identity typing kit.

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Quantitative PCR, DNA Quantification, Real-Time PCR

B51 9-plex MiniSTR Assay to Increase Successful Human Identification From Compromised Samples

Julio Mulero, PhD, Chien-Wei Chang, PhD, Robert Lagace, BS, Lisa Calandro, MPH, and Lori K Hennessy, PhD, Applied Biosystems, 850 Lincoln Centre Dr, Foster City, CA 94404*

After attending this presentation, attendees will learn about the development of a new multiplex STR assay for degraded and inhibited DNA samples.

This presentation will impact the forensic community and/or humanity by presenting results which will provide additional information to forensic scientists on the development of a mini-STR multiplex assay that can be utilized as valuable tool for analysis of compromised DNA samples. The goal of this presentation is to share preliminary results on the development of a mini STR multiplex assay containing 8 STR loci and the sex-determining locus Amelogenin.

Multiplex short tandem repeat (STR) genotyping assays using fluorescent detection and capillary electrophoresis represent the most popular method of human identification due to the highly polymorphic nature of STRs and their small fragment size. Although the STRs are relatively small (~100-500 bp), DNA degradation may occur as the result of sample decomposition due to environmental exposure producing DNA templates that are highly fragmented. This leads to a reduction in the yield of intact target fragments resulting in genetic profiles with allele and/or complete locus dropout. The problem is exacerbated when large multiplex STR reactions are used due to the wide fragment size range of the amplified PCR products *e.g.* the largest STR loci fall below the detection limit due to preferential amplification of the smaller loci.

To solve this problem and recover information from degraded and/or inhibited DNA samples, the amplicon size of the largest eight STR loci in the AmpFlSTR® Identifiler® PCR Amplification Kit (D7S820, D13S317, D16S539, D21S11, D2S1338, D18S51, CSF1PO, FGA) were reduced by moving primers closer to the STR repeat region. Five of these loci (D16S539, D21S11, D2S1338, D18S51 and FGA) also represent five of the largest loci in the AmpFlSTR SGM Plus® kit. Size reduction of the STR amplicons ranged from 33 to 208 bp. However, reducing the amplicon size caused an overlap of the STR loci, which prevented simulta-

neous separation by capillary electrophoresis (CE) and limited the number of loci that could be simultaneously multiplexed using 5-dye labeling technology. To resolve this problem mobility modifiers were coupled to the dye-labeled primers used in the PCR. The sizes of selected amplified fragments were increased using these mobility modifiers. This technology enabled simultaneous CE separation of DNA fragments of similar length and creation of a larger miniplex. In this presentation preliminary results of a miniplex assay containing 8 STR loci and the sex-determining locus Amelogenin will be described. The miniplex assay was compared to current commercially available STR kits for sensitivity, genotype concordance, and performance with simulated inhibited and degraded DNA samples.

The results presented will provide additional information to forensic scientists on the development of a mini-STR multiplex assay that can be utilized as valuable tool for analysis of compromised DNA samples.

miniSTRs, Multiplex PCR, Genotyping

B52 A Single Assay for Human-Specific Quantification of Less Than One Picogram DNA and Detection of the Presence of PCR Inhibitors in Forensic Samples

Maura T. Costello, MFS, and James W. Schumm, PhD, The Bode Technology Group, 7364 Steel Mill Drive, Springfield, VA 22150*

After attending this presentation, attendees will gain an improved method for quantification of human DNA that will detect less than one genome.

This presentation will impact the forensic community and/or humanity by demonstrating the how the application of the method described will lead to increased success in DNA analysis of samples containing very little DNA. Furthermore, the method will facilitate detection of sample components that inhibit amplification. This combination will provide critical information on first use of the sample (*e.g.*, dilution vs. using more sample), an especially critical choice when evaluating samples containing very little material.

This presentation describes the development, validation, and application of a duplex real-time PCR assay for human-specific quantification of DNA samples containing as little as 0.5 pg/µl of DNA. The assay simultaneously detects PCR inhibitors within the sample.

It is important to include human-specific quantification of DNA in casework sample analysis to insure successful DNA amplification and profiling. Much recent research has focused on the use of real-time quantitative PCR to achieve this goal. This approach is less labor intensive, less time consuming, more accurate, and lends itself to automation better than previous methods such as slot-blot hybridization (1). This work builds on that described by Nicklas and Buel (2), Richard et al. (3), and the commercially available Quantifiler™ Kit (Applied Biosystems, Foster City, CA). Researchers combined the sensitivity and human specificity of *Alu*-based real-time quantification with the presence of an internal positive control allowing detection of PCR inhibitors in the sample.

Alu sequences are short, repeated elements that are interspersed throughout the primate genome in upwards of 500,000 copies. The Yb8 subfamily of *Alu* genes was selected because of its sequence specificity to higher primates (4). Using this target, primers and a fluorogenic probe were developed for a quantitative real-time PCR assay (5). The assay also contains an internal positive control (IPC) system that is multiplexed with the *Alu* quantification system, consisting of a fixed quantity of non-human DNA template added to each reaction well, and a second set of primers and fluorogenic probe specific for the non-human template. The combination of human DNA quantity data from the *Alu* system and DNA quality data from the IPC system provides the analyst with substantial information to aid in deciding dilution or concentration schemes prior to STR amplification, thereby significantly reducing the number of samples that need to be re-evaluated following initial profiling.

Validation work indicates the assay is accurate and precise in the range of 50 ng/µl to 0.5 pg/µl. Thus less than one human genome equivalent can be detected accurately. Species specificity tests indicate the assay is at least 5000 times more specific for higher primate DNA than any other species tested. The IPC system is very sensitive to inhibition observed with addition of hematin, indigo, or humic acid. The assay has been successful with a variety of non-probative sample types.

The features of this assay will allow us to apply it very effectively to evaluation of touch evidence samples. With so little sample available in these situations, it is critical to make the right decision to use more (with limiting amounts) or less (with inhibitors present) extracted DNA in the first profiling test.

References:

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2. Nicklas, J.A.; Buel, E.; Development of an ALU-based, Real-time PCR Method for Quantitation of Human DNA in Forensic Samples. *J Forensic Sci*. 2003; 48(5):935-44.

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Quantification, Low Copy Number, Inhibition

B53 The Limitations of Real Time Quantitative PCR (QPCR) in Forensic DNA Analysis

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After attending this presentation, attendees will understand the limitations of QPCR methodology for DNA quantitation. As well as address the potential for protocol change to include BSA in reaction.

This presentation will impact the forensic community and/or humanity by demonstrating the limitations of QPCR methodology following 2 years of laboratory experience. Protocols may be altered in light of this experience to allow more accurate determination of the amount of DNA in samples and more efficient interpretation of results.

This paper will present to the forensic community the findings after more than 2 years of casework experience performing QPCR with a variety of forensic DNA samples. The protocols used at the Centre of Forensic Sciences for DNA quantification by QPCR are described and interpretation of results while considering the following relevant information; sample type, purity of the DNA extract, concordance of replicate analyses and morphology of the QPCR amplification plot is discuss.

The Centre of Forensic Sciences (CFS) has been performing QPCR analysis in forensic casework since August 2003. The laboratory employs the in-house developed CFS-HumRT QPCR assay[1], which utilizes a custom designed TaqMan®-MGB sequence specific probe and the ABD 7900HT Sequence Detection System. The forensic community's STR-PCR experience, has shown that samples encountered in forensic biology,

such as bloodstains on clothing, can be affected by PCR inhibitors. Such inhibitors also have an impact on QPCR, typically causing inaccurate quantification by recording less DNA than is actually present or by yielding a false negative result. The potential of the QPCR system to detect amplifiable DNA rather than total human DNA is considered valuable. Identifying problematic samples prior to STR amplification not only saves the laboratory time and resources but also offers an opportunity to consider how a sample might best be treated in order to secure a DNA result. Nevertheless accurate determination of the quantity of human DNA in a sample is a must, and thus additional safeguards must be incorporated into the QPCR process in order to identify and resolve the issue of inhibitors.

At the CFS, reference bloodstains and buccal swabs are quantified using 1µl of neat sample extract. However, for all unknown forensic samples, an additional QPCR test of a 1/5 dilution of sample with 3.2µg BSA is performed, in order to address the potential issue of a PCR inhibitor. Sample data are reviewed for concordance between the neat and diluted test results, in addition to examining the amplification plot morphology. Where non-concordance is observed or the QPCR amplification plot morphology is atypical, additional testing is conducted. This may include further dilutions of the DNA extract or additional purification of the DNA extract.

Based on QPCR analysis of over 25,000 forensic DNA samples, a small proportion of samples yielded quantification results that indicated a PCR inhibitor is present in the sample. In approximately 90-95% of cases, STR-PCR analysis proceeds immediately following DNA quantification, with no need for further sample purification or additional QPCR testing of dilutions. Of the small percentage of DNA samples that needed further analysis, it was noted that many exhibited colored extracts. As a routine practice for all samples with colored extracts, an additional test of a 1/10 dilution is incorporated, to be performed simultaneously with the neat and 1/5 dilution tests. Cigarette butts, swabs of drinking containers, swabs of knife blades/handles, swabs of condoms, clothing such as jeans, hats, bandannas containing dark dyes, are some of the sample types that may demonstrate QPCR inhibition. Also of great importance is the choice of the DNA extraction method utilized. Techniques that yield the highest quality/purity of DNA extract are preferred, since carryover of contaminants (*i.e.*, proteins, dyes, phenol) can severely impact QPCR analysis by inhibiting the reaction.

The inclusion of a DNA dilution with BSA into the QPCR process has proven to be an effective method of resolving most quantification inaccuracies associated with inhibition. However, this approach does have its limitations, specifically when working with DNA samples of low concentration (<100pg/µl). Inhibitors associated with these samples might effectively be reduced through sample dilution, but the concentration of DNA in these samples is also reduced, possibly beyond the lower limits of reliable detection. Other assays that utilize an Internal Positive Control (IPC) to identify inhibited samples, rather than a dilution with BSA, are also prone to the same limitation because the true quantity of DNA in the sample is still undetermined. Being aware of these limitations and considering all relevant sample information when interpreting results is a necessary component of any QPCR system particularly when assessing the possibility of a false negative.

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QPCR, Limitations, Forensic Science

B54 Comparative Analysis of Human-Specific DNA Quantitation Techniques

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After attending this presentation, attendees will have information regarding how the reproducibility of three commonly used methods—real-time PCR (Quantifiler™), slot blot (QuantiBlot®), and AluQuant®—was compared by having a single analyst perform each technique with sample dilutions covering the dynamic range of each method.

This presentation will impact the forensic community and/or humanity by demonstrating the advantages and disadvantages of each DNA quantitation method, all of which may be used to highlight the best quantitation method available to suit an individual laboratory's needs.

In the forensic science community, quantitation of human DNA in a forensic sample is an important step in generating the short tandem repeat profile for that sample. Forensic laboratories employ many different technologies to perform quantitation analysis. Unfortunately, many of the methods used can result in variations over time or between analysts and also can have wide ranging costs and analysis times. Many laboratories are actively pursuing new methods and technologies to implement for more efficient, accurate, and reproducible quantitation of human DNA. In this study, the reproducibility of three commonly used methods—real-time PCR (Quantifiler™), slot blot (QuantiBlot®), and AluQuant®—was compared by having a single analyst perform each technique with sample dilutions covering the dynamic range of each method.

Reproducibility was evaluated in terms of standard deviation over four time points—within month, within week, within day, and within run. Although QuantiBlot® quantitation gave fairly reproducible results within a limited concentration range, the method consistently failed to produce quantifiable results for samples at the upper and lower ends of the stated dynamic range. Overall, Quantifiler™ and AluQuant® methods performed similarly with increasing reproducibility as the sample dilutions decreased across their dynamic ranges. While AluQuant® quantitation proved more reproducible when measured within month and within week, Quantifiler™ quantitation performed best when samples were repeatedly measured within a day. Consistency between analysts was also evaluated by having three technicians perform quantitation of the same set of samples using the Quantifiler™ and QuantiBlot® methods. Overall, QuantiBlot® produced more consistent results than manually performed Quantifiler™, demonstrating the increased susceptibility of the latter method to human error and subtle pipetting differences. However, it should be noted that QuantiBlot® quantitation is only useful for measuring DNA over a very narrow dynamic range and automation of the Quantifiler™ method would likely increase the consistency of this method beyond that of QuantiBlot® and other manual techniques.

Lastly, other factors that may be of concern to forensic laboratories regarding quantitation techniques, including time and cost per sample, were evaluated. As expected, QuantiBlot® took significantly more time to perform and analyze per sample. In addition, automated AluQuant® required less time for quantitation than manual Quantifiler™; however, automation of the latter method would likely make them comparable. Further, unlike automated AluQuant® quantitation, automated Quantifiler™ would require no analyst intervention until the review of the analyzed data that is generated, possibly making it more efficient when adapted to an automated platform. In the cost comparison, QuantiBlot® was the least expensive method of the three, while AluQuant® was cheaper

per sample than Quantifiler™ due to the higher cost of reagents for Quantifiler™.

In conclusion, since AluQuant® and Quantifiler™ perform similarly in reproducibility studies, forensic laboratories should carefully prioritize and consider other pertinent factors in deciding which quantitation method to use, including throughput needs of the laboratory, and availability of personnel, workspace, and funding for implementation, equipment purchase, and reagent acquisition. It is hoped that the results of this study may impact forensic DNA laboratories by displaying the advantages and disadvantages of each quantitation method, all of which may be used to highlight the best quantitation method available to suit an individual laboratory's needs.

DNA, Quantitation, Real-Time PCR

B55 Potential Use of Microbial DNA Profiling in Soil Forensics

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This presentation will acquaint the audience with the profiling technique called amplicon length heterogeneity-polymerase chain reaction (ALH-PCR) that has been widely accepted in various scientific disciplines. The potential application of ALH-PCR to the forensics field, particularly soil discrimination by microbial DNA profiling will be discussed. The discriminatory power of ALH-PCR will be compared with soil macronutrient and trace element analyses.

This presentation will impact the forensic community and/or humanity by demonstrating that soil is a ubiquitous material that is transferred easily from one place to another and is highly variable, making it physical evidence of significant value. Increasing the tools available for forensic soil comparison as well as their power and ease of use will provide forensic investigators with a simple approach to use this type of evidence which is otherwise seldom used to assist in forensic investigations.

Soil is ubiquitous material that is transferred easily from one place to another and is highly variable, thus making it useful for forensic trace evidence. Increasing the tools available for forensic soil comparison as well as their power and ease of use will provide forensic investigators with a simple approach to use this type of evidence, which is otherwise seldom used in forensic investigations. The authors propose that soil types drive the microbial community structure inherent to them. If this is true, microbial community profiles obtained from soils at body dump sites and/or crime scenes can be used to link a suspect to a crime.

Standard soil nutrient analyses (total carbon and total nitrogen) were performed on pristine samples collected seasonally, from three of the six Florida Miami-Dade County soil types as described by the United States Department of Agriculture (USDA). The chemical profiles of elements commonly found in soils (Al, B, Ca, Cu, Fe, K, Mg, Mn, Na, P, S, Si and Zn) were obtained using inductively coupled plasma optical emission spectroscopy (ICP-OES). ICP-OES applies sufficient heat to the sample to ionize it and separate the elements present based on their optical emission capacity. The microbial profiles were obtained using ALH-PCR analysis of a molecular marker, namely 16S rRNA gene. The ALH technique uses the natural genetic variability of microorganism 16S rRNA genes to produce different fingerprint patterns based on the length of amplicons. The generation of these profiles can be considered as a "microbial signature" of a particular soil type. The entire nutrient, chemical and microbial profiles were subjected to statistical analysis of similarity (ANOSIM) to test for significance at the $p < 0.01$ level.

Data comparison suggested that microbial DNA analyses were better suited than other analyses as a forensic marker for soil discrimination. Nutrient analyses were non-discriminative, whereas the chemical data was able to discriminate between some soil types but was not as consistent as the microbial data.

Soil characterization by 16S rRNA eubacterial amplicon length comparisons using the ALH technique is a simple, relatively fast, method that combines state-of-the-art equipment and basic DNA profiling knowledge to obtain profiles that can be used by forensic scientists to establish possible sources of origin of soil samples or more importantly, a match of soil evidence to a crime scene.

Amplicon Length Heterogeneity (ALH), Microbial Forensics, Soil Forensics

B56 Utility of Soil Microbial DNA Profiling Using Terminal Restriction Fragment Length Polymorphism

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After attending this presentation, attendees will have an understanding of the utility of TRFLP analysis for forensic soil comparisons.

This presentation will impact the forensic community and/or humanity by demonstrating the utility of microbial DNA profiling for the analysis of soil samples, given spatial and temporal variation in these materials.

Soil can be of wide-ranging evidentiary value, in that a soil sample collected from a shoe, tire, clothing, or other material may help associate a victim or suspect with a crime scene. Traditional soil analyses include description of soil type (sand, loam, clay, etc.), particle size and shape, substances in the soil, chemical features such as pH and organic content, and trace elements. While these allow differentiation of soil types to some extent, and may act to exclude a questioned sample as having originated from a site, few objective or statistical analyses exist that can help trace questioned soil back to a specific location. In addition, these methods are very diverse and time consuming, meaning the analyst should have specialized experience in geology and soil analysis for them to be applied to casework.

Beyond the chemical and physical features mentioned above, soils differ in other attributes, including the microorganisms, particularly bacteria, they contain. These represent a complicated flora that can help define a soil, and are extremely important in determining both local and regional features. Differences in bacterial composition have the potential to help delineate a soil, and thus act as a biological 'signature' that may be useful for forensic purposes. However, the utility of bacterial fingerprinting for soil identification is dependant upon several factors, including the uniqueness of any given soil's bacterial composition, as well as how that uniqueness varies spatially and temporally. If two soil samples from different areas have essentially the same bacterial makeup, as might happen if they share a common usage (*e.g.*, a garden), it cannot act as a unique (or even strong) identifier. Likewise, if a single site has a large level of local heterogeneity, soil identification might also be impossible; it is unlikely that the known (exemplar) soil sample will have the exact same origin as the one in question. Finally, the known sample will necessarily be collected after the crime occurred, which may be days, weeks, months after the fact. If the site's bacterial components change during this time, as is quite possible given weather and seasonal variation, the questioned sample may differ greatly from the known.

Though several different methods can be utilized for microbial DNA profiling (*e.g.*, Denaturing and Temperature Gradient Gel Electrophoresis, Single Strand Conformation Polymorphism, Amplified Ribosomal DNA Restriction Analysis), Terminal Restriction Fragment Length Polymorphism (TRFLP) is a useful technique because it can be performed on equipment found in most forensic laboratories. TRFLP is a widely used method for assaying bacterial communities, with its utility spanning from plant root analysis to mammalian intestinal disease. In the current study, TRFLP was used to profile five sites over a one-year period. The method takes advantage of a universal region of the bacterial 16S ribosomal RNA gene that is PCR amplified using a 5' fluorescently labeled primer. The pool of 16S amplicons is digested with the restriction enzyme MspI, the products of which vary in length based on species. These products are separated by capillary electrophoresis, resulting in a multi-fragment TRFLP profile, which can be compared within or among species, resulting in a similarity index for each.

Soils from five venues: a yard, a woodlot, a sandy woodlot, an agricultural field, and a marsh edge, were sampled at the beginning of each month for a one-year period. Each was tested via TRFLP, and the variability among sites assayed. The resulting similarity indexes indicate the uniqueness of each location, and thus the utility of the technique for identifying different soil types. Every third month the same soils were collected, as well as samples from 10 feet in all directions (N, E, S, and W), to assay local heterogeneity, and the effect this had on soil identification accuracy. Finally, through monthly testing over a year's time, temporal variation within each site was measured. Taken together, the results demonstrate the utility of TRFLP for forensic application.

Soil Comparison, DNA and Microbial Profiling, TRFLP

B57 Avian Mitochondrial Typing For Forensic Identification

Joy L. Halverson, DVM, QuestGen Forensics, 29280 Mace Boulevard, Davis, CA 95616*

After attending this presentation, attendees will have an awareness of how tools developed for human DNA testing can be scientifically broadened and applied beyond cats and dogs to the identification of exotic pet species and individuals.

This presentation will impact the forensic community and/or humanity by demonstrating how the DNA analysis tools developed for human forensic identification have a broader scientific context. These tools can be creatively applied to address animal-derived evidence and may contribute to crime scene investigations in novel and exciting ways.

Disputes involving the individual identification of lost or stolen birds are frequent. Exotic pets such as birds have a high monetary value. The temptation to keep a lost bird is profound, especially if the bird is socialized toward humans and has behaviors requiring years of patient training. Identification is difficult because birds of the same species have few, if any, distinguishing physical characteristics. Even the gender of most parrots is not obvious; most species don't exhibit external sexual dimorphism. Owners often hope their pets will recognize them or perform characteristic behaviors but birds are generally uncooperative in strange environments.

In a recent case Tallulah, an African Gray Parrot escaped from the apartment of David DeGroff and William Milan in Arlington, VA. A visitor had walked into and knocked out a sliding screen door. Startled, the bird flew out the doorway and into the trees below. DeGroff and Milan ran quickly outside and searched but to no avail. They papered the neighborhood with flyers and called all the local veterinary clinics and animal shelters. Then they waited, devastated and worried. The couple had raised Tallulah from a chick and had owned him for eleven years (interestingly, the bird had been sexed as a male by DNA analysis some years before. It is not uncommon for closely bonded bird owners to retain their bird's original name.). Besides his affectionate nature, he was very intelligent and an excellent mimic. He was the couple's child substitute.

A month later DeGroff called the D.C. Shelter again and was told that an African Gray Parrot had just been adopted. Using the Freedom of Information Act, he compelled the shelter to provide the contact information of the adopter, Nina Weaver. When called, Weaver refused to let DeGroff and Milan see the bird and rebuffed the couple's offer to buy another African Gray if the bird turned out to be Tallulah. DeGroff then embarked on his pursuit of justice. He hired an attorney and, through his veterinarian, contacted QuestGen Forensics. DeGroff had saved molted feathers from Tallulah for many years but otherwise had no biological sample. As with animal hair, mitochondrial typing was a possible option for linking Tallulah with the parrot held by Nina Weaver.

The attorney's job was to get a court order allowing a witnessed blood collection from the disputed bird. Over a year later, Ms. Weaver submitted a blood sample from a parrot she called "Toby" but the collection was not witnessed so the sample was set aside. After another six months, a witnessed sample collected from "Toby" was submitted. DeGroff was dying in a hospice; Mr. Milan attended but the bird was too stressed to allow meaningful recognition.

Sixteen sequences of the mitochondrial control region from African Grey Parrots were downloaded from Genbank, aligned, and invariant portions selected as primer sites for amplification and DNA sequencing. The primers successfully amplified a 460 base pair sequence with considerable individual sequence variation. In addition to DNA extracted from Tallulah's feathers, the witnessed "Toby" sample, and the non-witnessed "Toby" sample, DNA from sixteen African Grey parrots (routine gender testing samples from Zoogen) were sequenced and compared.

Twenty-five mitochondrial types were identified in the Genbank sequences and Zoogen samples combined. The Zoogen samples showed 11 types; one type was common (29%) suggesting a genetic bottleneck of African Gray Parrots caused by importation. The two samples reputedly from "Toby" had different mitochondrial types; only the first non-witnessed sample matched the feathers from Tallulah. The results suggest that a different bird had been brought to the witnessed collection so that DeGroff and Milan would not recognize Tallulah.

As of August 2005, Tallulah is still in Ms. Weaver's possession. David DeGroff died in April 2005 before hearing of the test results. Exhausted from the ordeal of his friend's death and in debt for legal fees, William Milan was considering whether to continue David's pursuit of justice as a tribute to his friend and Tallulah.

Mitochondrial Typing, Forensic Identification, Avian

B58 Why the Forensic Sciences Need Public Policy Analysis

Garry J. Bombard, PhD, Forensic Institute for Research, Science, and Training, 3400 West 111th Street, Suite 116, Chicago, IL 60655*

The goal of this presentation is to introduce public policy analysis and discuss the current trends and impacts to forensic science.

This presentation will impact the forensic community and/or humanity by providing an overview of the public policy analysis process by a forensic scientist and public policy analyst. The presentation concludes with starting-point recommendations for the forensic science community. The presentation is timely and applicable based upon several national presentations melding forensic science and public policy analysis.

Public policy analysts create several types of documents, develop the supporting data, to create and/or justify policies and programs. The documents are divided into three major areas: comprehensive planning; policy/program development and implementation; and policy/program evaluations. The documents are used by public officials at all levels of government, federal, state, and local, to publicly support and fund the policies

and programs. The supporting data are developed by an array of specific methodologies in the policy analyst's toolkit.

Comprehensive planning is a long-range (six to nine years) plan in a specific format. From a policy analyst's viewpoint, the recent 180-day report to Congress is the forensic sciences' comprehensive plan.

Policy and program development and implementation are a multi-step process in the rationale planning model. Four main criteria are used in the development and selection of policies and programs.

Public policy and program evaluations are the creation of evidence-based policies and practices. Recently, the National Institute for Justice (NIJ) is advocating the use of evidence-based policies and practices. Specifically, the NIJ is seeking cost orientated evaluation approaches and measurement of benefits in non-scientific terms. The NIJ suggests using cost effectiveness and cost efficiency methodologies.

The forensic community needs to embrace and understand the public policy analysis discipline and incorporate this discipline in current and future projects, such as the National Forensic Science Commission. The inclusion of this discipline will further support the forensic sciences at all levels of government.

The presentation will provide further information on the melding of forensic science to public policy analysis. The presentation will discuss the four (4) main criteria for development and selection of policies and programs. The four (4) types of public policy evaluations are reviewed. The presentation concludes with starting-point recommendations for the forensic science community.

Public Policy Analysis, Comprehensive Planning, Policy/Program Development and Implementation

B59 Certification in Criminalistics: Where It Was, Where It Is, and Where It Is Going

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After attending this presentation, attendees will be briefed on the certification in criminalistics.

This presentation will impact the forensic community and/or humanity by providing understanding of the past, present, and future of certification in the criminalistics field.

Perhaps the idea of professional certification was captured best in the Hippocratic Oath of antiquity…"I will preserve the purity of my life and my art." Today, doctors, nurses, C.P.A.s, information technology professionals, and a host of other professionals are certified. As applied to forensic science, certification is a voluntary process of peer review by which a practitioner is recognized as having attained the professional qualifications necessary to practice in one or more disciplines of criminalistics

The Past: Certification in the field of criminalistics began with the Criminalistics Certification Study Committee (CCSC). From 1975 to 1979, there were more than 25 individuals from all regions of the U.S. and Canada who were active in the CCSC; however, they were not able to establish a formal certification program. The American Board of Criminalistics (ABC) was incorporated in 1989 in response to a need perceived by many criminalists for a national certification program. Since incorporation, more than 50 persons have served on the Board and the Examinations Committee, and almost 200 forensic scientists have served on Peer Groups, and Examinations or Proficiency Committees. The first ABC examinations were given in Boston in February of 1993 and by 2005, over 600 persons have been awarded ABC Diplomate status, and over 100 Fellow and Technical Specialty status. In 1998, the ABC program of professional certification was extended to include a new category of certification: Technical Specialist. The Technical Specialist certification – first offered in early 2000 – recognizes the changing nature of forensic laboratories throughout the world. Consistent with the emphasis and need for accreditation, ABC became the first forensic science certification organization to be accredited by the Forensic Specialties Accreditation Board (FSAB) of the American Academy of Forensic Sciences (AAFS) in 2004.

The Present: A review of the data collected from ABC test takers over the past several years reveals some critical information with regard to certification. Statistical analysis of demographic (including education, experience, geographic region, personnel) and test score data reveals correlations and relationships important to the understanding the larger context of certification in criminalistics. The analysis begins to answers the questions of the importance of experience, and the relevance of specialized forensic science courses and training.

Part of these analyses address the importance of the relationship of certification testing with forensic science education programs. ABC began work in 2005 with the Forensic Science Program Accreditation Commission (FEPAC) to implement a national Forensic Science Aptitude Test (FSAT) to assess the academic competency of forensic science students. Continued refinement of the FSAT is expected to show strong correlations with the content of forensic science curricula, and this will certainly be the subject of additional research in the future.

The Future: ABC is also targeting 2007 for redesigned versions of the specialty exams in the disciplines of forensic biology, drug chemistry, fire debris, trace evidence, and nearly created general criminalistics discipline. Also, ABC is continuing to evaluate workshops and training seminars for continuing education and double points for ABC recertification. The relationship between forensic science educators, primarily through FEPAC, and ABC will continue to strengthen through the design and use of the FSAT. This will help to ensure the continuous improvement of the quality of forensic science education and eventual certification.

As some forensic laboratories are requiring certification for their employees, and more courts and attorneys are acknowledging the importance of professional certification, certification like many other quality initiatives has become part of the forensic science landscape. Many of the forensic science disciplines, including toxicology, anthropology, odontology, pathology, and fingerprint identifications to name a few, support the view that some form of professional certification has become an integral and necessary part of the forensic science world.

Certification, Criminalistics, American Board of Criminalistics

B60 An Informal Survey of Personnel Status in Forensic Science Laboratories

Max M. Houck, BS, MA, West Virginia University, Forensic Science Initiative, 886 Chestnut Ridge Road, Suite 309, Morgantown, WV 26506-6216; and Earl Wells, BS, South Carolina Law Enforcement Division Forensic Laboratory, 4400 Broad River Road, Columbia, SC 29221*

After attending this presentation, attendees will learn the range of personnel status (sworn, civilian, or mixed) among forensic science laboratories in the U.S.

This presentation will impact the forensic community and/or humanity by providing a better understanding of why laboratories may retain sworn personnel or prefer civilian personnel.

Organizational culture is the personality of the organization. It is the emergent result of the continuing negotiations about values, meanings and proprieties between the members of that organization and with its environment. What is valued, the dominant leadership style, the language and symbols, the procedures and routines, and the definitions of success that characterizes an organization are all a part of an organization's culture. Scientists, police, and lawyers have struggled to design the juridical intersection where law and science cross paths. The success of forensic science in the 21st century largely depends on the participants' proper understanding of the crossroads at which science and the law meet.

An informal survey of local, regional, state, and Federal forensic science laboratories was carried out to determine which laboratories' personnel were sworn officers, civilian scientists, or had a mix of the two. Forty eight laboratories in 29 states and the Federal system responded. Twenty four were state laboratories, 13 were county or regional laboratories, and 7 were city laboratories. Of the responding laboratories, 28 (59.6%) had civilian personnel, 15 (31.9%) had a mix of sworn and civilian personnel, and only 4 (8.5%) had all sworn personnel.

	State	County	City	Fed
Civilian	14	7	4	3
Mixed	8	4	3	0
Sworn	2	2	0	0

In the states with mixed personnel status, the sworn personnel were typically the Director and specific supervisors, such as Crime Scene or Evidence/Property. Several of the mixed states were in the process of converting to all-civilian status, largely as part of incentives to assign more sworn personnel to active street duty and as a cost savings.

Succession planning is a crucial managerial process but it can become difficult when it crosses boundaries between personnel categories. Employee retention in mixed status laboratories also requires a clear view to what motivates employees of both categories.

Personnel, Staffing, Forensic Science Laboratories

B61 Ethical Considerations in Forensic Science

Robin T. Bowen, BS, West Virginia University, 886 Chestnut Ridge Road, PO Box 6216, Morgantown, WV 26506-6216*

After attending this presentation, attendees will be given an overview of ethical issues and the problems they cause in the forensic science field.

This presentation will impact the forensic community and/or humanity by enabling the forensic science community to observe patterns of unethical behavior in the various fields of forensic science. This data will answer questions such as what should one do if one suspects a colleague is being unethical? Which actions are unethical? Who judges what is unethical? By looking into such studies, forensic scientists will gain information important to all scientists, particularly forensic scientists. Observing the forensic science community enables the information to be most beneficial to the people who need it most.

This paper will present the work done at West Virginia University to determine what ethical issues are most prevalent in the forensic science community. Proper ethical behavior is required by scientists making complex decisions about the interpretation of data, about which problems to pursue, and about when to conclude an experiment, all which help to improve the quality of forensic science. Important skills gained by studying ethics include improved ethical awareness, knowledge of relevant standards (AAFS, IAI, ASCLD, etc.), skill in ethical decision making, and appropriate ethical actions. Scenarios will be presented and the ethical considerations involved with each discussed. Also, ethical considerations forensic scientists should be aware of will be discussed.

Ethical considerations are an important part of science. Having a code of ethics assures an organization, its members, and its affiliates that the highest quality of professional and personal conduct will be promoted. It is important to cooperate with others within the profession, promote improvement through research, and disseminate such advancement in an effort to make more effective analyses. Proper scientific ethics includes refraining from providing any material misrepresentation of education, training, experience or area of expertise. It also includes refraining from exercising professional or personal conduct adverse to the best interests and purposes of the forensic science community.

The research presented is an excerpt from a free online course offered at West Virginia University. Through a grant provided by the National Institute of Justice (2001-RC-CX-D003 and 2003-RC-CX-K001), the course is geared toward all forensic professionals. It covers topics such as the history of ethics, science and research, forensic ethics, unethical behavior, and the future of ethics in criminal investigations. This presentation will hopefully encourage attendees to look at themselves and their work environments to determine if they are facing ethical dilemmas. Solutions are provided to deal with ethical dilemmas in the workplace.

This research will enable the forensic science community to observe patterns of unethical behavior in the various fields of forensic science. This data will answer questions such as what amshould one do if one suspects a colleague is being unethical? Which actions are unethical? Who judges what is unethical? By looking into such studies, forensic scientists will gain information important to all scientists, particularly forensic scientists. Observing the forensic science community enables the information to be most beneficial to the people who need it most.

Ethics, Research, Falsification

B62 The Implementation and Evaluation of a Blind Proficiency Testing Program

Darren E. Haliniewski, MS, Demris Lee, MSFS, Suzanne M Barritt, MS, and Brion C. Smith, DDS, Armed Forces DNA Identification Laboratory, 1413 Research Boulevard, Building 101, 2nd Floor, Rockville, MD 20850; and Mark Leney, PhD, and Thomas D Holland, PhD, Central Identification Lab, Joint POW/MIA Accounting Command, Hickam Air Force Base, Hickam, HI 96853*

After attending this presentation, attendees will learn how to implement a blind proficiency testing program.

This presentation will impact the forensic community and/or humanity by demonstrating the potential development of proficiency testing more applicable to specialized laboratories.

The participation in proficiency testing is a critical part of a forensic DNA laboratory. In fact, it is a requirement of the American Society of Crime Lab Directors Laboratory Accreditation Board (ASCLD/LAB) and FBI Quality Assurance Standards (QAS) that every DNA scientist in an accredited laboratory be tested biannually for the techniques in which they have been trained and use regularly, while other forensic scientists are required to be tested annually. Each scientist should be evaluated to ensure that they are following the correct procedures and can determine the correct conclusions. There are several ASCLD/LAB accredited proficiency test vendors that are suitable for this requirement, providing database samples and samples mimicking those found at a crime scene. However, for laboratories that generate DNA profiles from atypical forensic samples, proficiency testing can be a challenge.

The disadvantages of the commercial proficiency testing kits for a laboratory such as the Armed Forces DNA Identification Laboratory (AFDIL) is that most of the in-house scientists process skeletal remains using mitochondrial DNA (mtDNA) analysis for which no commercial kit is available. In addition, these skeletal remains are usually highly degraded due to being subjected to harsh environments for over 30 years. The assays required to achieve successful testing require the analyst to push the envelope of the system which is highly dependent on good technique, contamination control, and strict interpretation guidelines. In order to test the protocols, the AFDIL has been participating in a blind proficiency testing program in collaboration with the Joint POW/MIA Command - Central Identification Laboratory (JPAC-CIL) for the past eight years. For these tests, JPAC-CIL submits a sample that has been previously processed by the AFDIL with a known sequence. The sample is sent and processed as a regular submission with only the primary DNA Manager of CIL knowing which sample is intended as a proficiency test. Once processing is complete and reported, the DNA Manager informs the technical leader of the mtDNA section and the laboratory director of the results.

The mtDNA blind proficiency testing program has been so successful that an in-house blind proficiency testing program has been created for the nuclear DNA Section. This section primarily processes fresh tissue samples to aid in the identification of soldiers lost during current military incidents. Due to the nature of the incident, intense pressure is placed on the analysts to complete a case within 48 hours of receipt. This sort of pressure and expeditious testing is not required for traditional vendor proficiency tests nor are tissue samples provided. The blind testing for this section includes samples submitted through the medical examiner system as both regular and stat cases, to simulate the urgent need to generate an accurate profile. While the program is still in its infancy, the early results are highly promising.

As more forensic laboratories explore the potential of DNA for both identification of missing persons and the conviction of criminals, generation of profiles from atypical sources of evidence will come more to the forefront. There will be a real need for laboratories to accurately test their resident scientists in the treatment and testing of samples they see daily. Designing an in-house or shared blind proficiency testing program is one avenue to explore. The advantages, implementation, and results of AFDIL's program will be presented, as well as suggestions to other laboratories that focus on specialized samples for the implementation of their own blind proficiency testing program.

The views expressed herein are those of the authors and not The Armed Forces Institute of Pathology, The U.S. Army Surgeon General, nor the U.S. Department of Defense.

Proficiency Testing, DNA, QA/QC

B63 Forensic Atlases: Mirrors With Memories

Richard E. Bisbing, BS, John G. Delly, MS, and David A. Wiley, BS, McCrone Associates, Inc., 850 Pasquinelli Drive, Westmont, IL 60559*

The goal of this presentation is to demonstrate the value of atlases to the forensic scientist and the application of new atlas technology useful to trace evidence examiners.

This presentation will impact the forensic community and/or humanity by demonstrating the value and usefulness of on-line atlases for the identification of materials of interest to criminalists.

Compilations of images and descriptions of various materials into an atlas have been useful to scientists for several centuries. Atlases are needed because it is, in fact, normal and necessary to forget. Therefore, it is normal that an atlas is useful. An atlas is a volume of tables, charts, or plates that systematically illustrates a particular subject with images, drawings, photographs and descriptions; they are compilations of mirrors with memories.

The first atlases of forensic interest pictured physiognomy, a medieval pseudoscience for determining a person's character and criminality based on their facial features. In the 19th Century, atlases such as photographs in a Rogues Portrait Gallery and those with additional descriptions and mug shots that evolved from Bertillonage were popular. They were supplanted, eventually, by fingerprinting at the end of the 19th Century. The sole purpose of these forensic atlases was to remember something seen before, whether a criminal's face or his fingerprints. These atlases also chronicled the events surrounding the plates and images with accompanying descriptions. Therefore, a forensic atlas can be better defined: a compilation of images and descriptions whose purpose, in addition to learning something new, is to remember something seen before, whether people or traces.

Scientific knowledge is mostly memory of past experiments and data shared through the scientific literature and cataloged into searchable atlases. Fortunately, new technologies produce searchable digital atlases for the library and spectral atlases as part of an instrument. Using new technologies, forensic science was gifted with two excellent examples of forensic atlases at the end of the 20th Century: AFIS and IBIS. Both contain images and descriptions that are searchable. Trace evidence examiners also need atlases, but of microscopic particles.

The first atlas of microscopic particles was Robert Hooke's *Micrographia* in 1665. The Victorians in the late 19th Century were rabid social microscopists and atlases proliferated during their era resulting in scores of beautiful color atlases for the microscopist. The forensic value of forensic atlases became apparent in the early part of the 20th Century with Glaister's atlas (published in 1932) entitled *A Study of Hairs and Wools*, which contained 1700 photomicrographs.

McCrone published *The Particle Atlas* in 1967, a photomicrographic atlas, with one short paragraph (caption) for each photomicrograph. Between 1973 and 1980 McCrone Associates produced six new volumes ultimately with more than a thousand photomicrographs. The six volumes were subsequently converted into a word-searchable digital version on CD ROM in 1992. Dennis C. Ward (FBI) and John W. Colby (www.xk.com) developed a Spectral Library Identification and Classification Explorer (SLICE) in 2000 to answer these questions about microtraces: what are the structural and chemical characteristics; could items have come from the same source; what is it, and has it been seen before?

In the 21st Century, the World Wide Web provides new opportunities for atlases of microscopic particles with technologies that can serve all of the forensic sciences with expanded memory. Images, data and descriptions can be put into a relational database using a browser based front-end application from which reports can be generated from the database to track sample progress, to perform a data peer-review, and to audit data for change control and data security. The images and descriptions are uploaded to another database which is part of the hosting environment and is connected to a web server which displays all the relevant data and images for a given sample.

In 2005, McCrone Associates launched a new online atlas for forensic microscopists, the *McCrone Atlas of Microscopic Particles* (www.mccroneatlas.com). The particle characterizations include images, interpretations and observations, and data from PLM, SEM, EDS, FTIR, RAMAN, and TEM; and, the search algorithm uses keyword, particle name, particle type, a classification system, and elemental composition. The real utility of the site is seen once a particle of interest is found but without the memory to verify its identity; like all atlases, its greatest use is as a means to confirm possible identifications. Although forensic atlases have been useful since medieval times, the internet will increase their value to the 21st-Century forensic scientist through extensive sharing of memory.

Atlas, Microscopic, Particles

B64 Trace Evidence: Alive and Well in New Jersey

Thomas A. Brettell, PhD, Ajit Tungare, MS, Frances Gdowski, MS, Andrew J. Nardelli, BS, George W. Chin, BS, and Vincent J. Desiderio, MS, New Jersey State Police Office of Forensic Sciences, 1200 Negron Road, Hamilton, NJ 08691*

After attending this presentation, attendees will learn of the practicality of not only having a trace evidence section but also expanding it to suit the needs of the law enforcement community.

In stark contrast to the current trend of expanding DNA facilities and diminishing trace evidence services, trace evidence is alive and well in the state of New Jersey. Over the course of the past three years, the New Jersey State Police Office of Forensic Sciences has opened a new laboratory, hired numerous personnel and acquired new instrumentation. A large portion of the efforts to accomplish these achievements has been devoted to strengthening and expanding the role of trace evidence in criminal investigations throughout the state of New Jersey. The implementation, progress, and accomplishments of this ambitious plan will impact the forensic community and/or humanity by serving as a template for other laboratories that may pursue similar objectives in the future.

This paper presents an overview of the recent expansion of the New Jersey State Police Office of Forensic Sciences and the services provided at their new Central Laboratory.

In the not so recent past, the advent of DNA analysis in the forensic sciences revolutionized the way forensic laboratories handle evidence. During this forensic revolution, laboratory emphasis shifted away from what has been viewed as subjective forms of analysis, *i.e.* trace evidence, towards this new, relatively objective technology. As this shift occurred, so too did the financial needs of laboratories. As budgets and personnel requirements for DNA laboratories surged, many laboratory systems contracted or cut their trace evidence sections altogether. Such cutbacks failed to consider the value of trace evidentiary examinations. Amongst other things, trace evidence can provide valuable investigative leads, confirm or refute accounts of events that transpired, and, in the absence of biological transfers, establish contact between suspect and scene, victim and scene, and suspect and victim.

In stark contrast to the trend discussed above, not only is trace evidence alive and well in the state of New Jersey, it has played an expanding role in assisting the various state and local law enforcement agencies serviced by its state laboratory system. Over the course of the past three years, the New Jersey State Police Office of Forensic Sciences has opened a new laboratory, hired numerous personnel and acquired new instrumentation. A large portion of the efforts to accomplish these achievements has been devoted to strengthening and expanding the role of trace evidence in criminal investigations throughout the state of New Jersey.

This presentation will provide a brief history of the laboratory system prior to the recent transformation, describe the steps that were taken during the transformation, and discuss the results that were obtained. Emphasis will be placed on the construction of the new facility, the acquisition of new instrumentation, the addition of new personnel, the challenges faced during the training of new scientists, and the administrative system that has been set up to ensure that the laboratory provides service of irrefutable quality in a timely fashion on behalf of the citizens of the state of New Jersey. Additionally, an overview of the trace related services that the system offers, both current and projected, will be provided.

Trace Evidence, Expanding Role, Investigative Leads

B65 Can Trace Evidence be Individualized? A Review of the Basic Principles of Individualization and Identification

Eric Stauffer, MS, 1222 Jefferson Drive, Atlanta, GA 30350*

After attending this presentation, attendees will learn the fundamental principles of individualization and identification of different types of (trace) evidence in forensic sciences and the process leading to the individualization of evidence.

This presentation will impact the forensic community and/or humanity by assisting every attendee to become current in their knowledge of the fundamental concepts behind the science of criminalistics, which will greatly help in interpreting evidence in the most scientific, proper, and efficient manner.

"Criminalistics is a science of individualization" is a famous quote from one of the great contributors to the field of criminalistics: Paul Kirk. Every forensic scientist is familiar with this statement, but are all forensic scientists really aware of the principles behind the individualization and identification of evidence in forensic sciences? When an object or a person is identified as the origin of a certain trace, it means that all other potential sources have been excluded; only this object or this person could have contributed to this trace.

The concept of class and individual characteristics should be known by every single forensic scientist. While class characteristics are shared among different objects/persons from a same group, individual characteristics are created in a random fashion and are particular to one and only one object/person. These different levels of characteristics are easily discernable with fingerprints or shoeprints. But what about with paint, fibers, and glass, for example? What are the class and individual characteristics of such types of evidence? These types of trace evidence typically do not present individual characteristics; they only exhibit class characteristics, to which certain discrimination weight or value can be attributed.

There are two types of evidence in forensic sciences from an identification point of view: those leading to individualization (individual evidence) and those leading to group classification (class evidence). Fingerprints, shoeprints, earprints, and toolmarks are some examples of evidence that can be individualized. This means that it is possible to conclude that only one source contributed to a particular trace. However, DNA, fibers, glass, and ignitable liquid residues cannot be individualized to this date. It is only possible to attribute the origin of the trace evidence to a certain group of objects. Thus, a match between a potential source and a trace evidence of the class type does not establish an exclusive common origin; there are other sources in the population that could have contributed to this trace evidence. Because class evidence does not exhibit any observable individual characteristics, it is not possible to exclude all other existing sources. At this point, the question that everyone would like to answer is "How many of these other sources could have contributed to that trace?"

While the interpretation of individual evidence is usually straightforward and does not permit misunderstanding, it is not quite the case with class evidence. The interpretation of such evidence is a much more complex process that requires the use of statistics, or at least, qualifiers in the weight attributed to the match between the evidence and the putative source. Normally, the more characteristics that are analyzed, the more discriminatory the results become. Also, as an alternative to many analyses or examinations, it is possible, in some instances, to reduce the starting group of possible sources depending on the circumstances. This would increase the likeliness of a trace to originate from a particular source.

The attendees will learn the fundamental principles of individualization and identification of different types of (trace) evidence in forensic sciences. The process leading to the individualization of evidence will be described in a logical and pertinent manner. Then, a discussion of the (non-)individualization of trace evidence will be presented. At the end of the presentation, every attendee will be current in their knowledge of the fundamental concepts behind the science of criminalistics, which will greatly help in interpreting evidence in the most scientific, proper, and efficient manner.

Identification, Individualization, Trace Evidence

B66 Cathodoluminescence Microscopy in Forensic Science

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The goal of this presentation is to provide an introduction to the principles and practice of cathodoluminescence with a specific focus on the visual and spectroscopic information that can be obtained from forensic samples and the applicability of CL to cases of comparison, authentication, and provenance.

Cathodoluminescence (CL) is a microscopical technique applicable to a range questions involving the forensic analysis of trace evidence. This presentation will impact the forensic community and/or humanity by providing visual and spectroscopic information provided by CL microscopy which can aid in comparison, authentication, and provenance examinations of soil, building materials, paints, duct tape, and glass.

Cathodoluminescence (CL) refers to the emission of visible (or near visible) light from a sample that has been bombarded by an electron beam. CL is observed in many materials routinely encountered in the forensic analysis of trace evidence (*e.g.*, soil, building materials, glass, pigments, and filler/extenders). CL results from the presence of trace elements or structural defects in materials, which are characteristic of either the geo-

logical environment of formation or the manufacturing process (for a synthetic luminescent material). The variation in luminescence for a particular mineral can therefore be used to discriminate among samples from different sources or, in certain cases, provide information about the provenance of a sample. While a multitude of established techniques exist for the analysis of trace evidence, CL offers a widely-applicable alternative technique that provides a unique means for visualization and identification of trace elements and structural defects in a sample.

Within the category of geological evidence (*e.g.*, sand, soil, and concrete), many of the most abundant minerals are luminescent (*e.g.*, quartz, feldspar, and carbonate minerals). Traditionally, these mineral components have been difficult to use for forensic discrimination or sourcing due to their presence in nearly all samples; however, the variation in luminescence within a given mineral type provides a new prospect for improving the significance of geological evidence. CL provides a relatively fast method to screen soil samples through visual identification of luminescent minerals (*e.g.*, identification and classification of feldspars), the ability to determine if multiple populations of a given mineral exist (*e.g.*, quartz from different sources) and a means to estimate the relative abundances of luminescent minerals in a sample. Surface information including zoning (*i.e.*, compositional changes within a crystal), textures and coatings can provide additional information about the origin of a sample. For example, fragments of biogenic carbonates can be morphologically identified. For other minerals such as quartz, the visible luminescence color can be broadly correlated with a geological formation condition (*e.g.*, metamorphic, volcanic, authigenic). In addition to visual observation, CL spectroscopy can offer more detailed information about specific activators (defects and trace elements responsible for luminescence) in a given mineral. In feldspar minerals, the chemical composition can be estimated on the basis of the Fe^{3+} emission band. In heavy minerals such as zircon, monazite, and apatite, rare earth element activators, typically present at 1-500 ppm, can be identified spectroscopically. Together, visual and spectroscopic examination of mineral components can be combined to provide a variety of information about soil and sand samples that complement more traditionally used analytical techniques.

Many synthetic or anthropogenically modified minerals such as pigments and filler/extenders also luminesce (*e.g.*, anatase, wollastonite, zincite, and talc). Such minerals are utilized in the manufacturing of a variety of materials commonly encountered as forensic evidence including paint and duct tape. In both materials, CL provides a means to visualize details of the layer structure. In white architectural paints, for example, CL can be used to identify multiple layers that may not be visible by light microscopy. The three main components of duct tape, adhesive, backing and reinforcing fibers (*i.e.*, scrim) all luminesce. Within a given layer of paint or duct tape, CL can also be used to classify the major inorganic filler/extenders and pigments, estimate the size of the inorganic component and observe its distribution in a sample.

This talk will provide an introduction to the principles and practice of CL with a specific focus on the visual and spectroscopic information that can be obtained from geological and anthropogenic samples and the applicability and limitations of CL in cases of comparison, authentication, and geographic sourcing.

Cathodoluminescence, Geology, Soil

B67 Microscopical Hair Examination - Why it is Ethically Irresponsible to Eliminate These Examinations

Amy L. Michaud, BS, Bureau of Alcohol, Tobacco, Firearms, and Explosives, 6000 Ammendale Road, Ammendale, MD 20705*

After attending this presentation, attendees will gain knowledge of the benefits of microscopical hair examination as well as the benefits and shortcomings of the different types of DNA analyses on hair evidence.

This presentation will impact the forensic community and/or humanity by demonstrating that microscopic hair examinations have their place in forensic analysis and by not conducting these exams, the forensic scientist is not providing the best evidence, and worse yet, they may be missing crucial evidence completely. It is ethically and fiscally irresponsible to skip over this examination.

Many laboratories today have stop performing microscopical hair examinations. They claim that it is their ethical responsibility to eliminate these examinations in favor of utilizing today's more reliable sciences – DNA. They also claim that eliminating these exams will assure that the laboratory will deliver the most scientifically valid results in a more timely fashion, thus using their resources in the wisest fashion.

Eliminating microscopical hair examinations is ethically irresponsible because information can be gained from microscopical hair examinations that cannot be gained in any other way. For example, hairs that come from a decomposing cadaver will many times show post-mortem root banding, which can easily be seen by microscopical examination. In a case where the victim and suspect were known to be in contact on a regular basis (*e.g.* husband and wife, roommates) it would be important to know if a hair found on the suspect or on one of their possessions had a root showing this characteristic or not. Laboratories that just cut off the root to run nuclear DNA would never have this information if no hair examination is conducted.

It is also important to know that most hairs (in this examiner's experience, well over ninety percent of the hairs seen in casework) do not have enough cellular material present at the root to run nuclear DNA analysis. This makes sense, since hairs that are actively growing (anagen phase) are secured tightly into the follicle and would require force to remove them, along with the root sheath which is rich in the nucleated cells required to do nuclear DNA. On the other hand, hairs that are done growing (telogen phase) are sitting loosely in the follicle. It is these hairs that are commonly found at the crime scene, and these hairs rarely have tissue adhering to their roots; these telogen hairs would be suitable for mitochondrial DNA analysis. Mitochondrial DNA analysis does not provide a positive association to an individual; much like microscopical comparison does not provide a positive association. It is possible for two people to have the same microscopic characteristics present in their hair. Studies have even been conducted using identical twins head hairs and they can easily be discriminated from one another by microscopical hair examinations. Mitochondrial DNA cannot discriminate between maternal relatives even several generations apart. Using the microscopical examination and comparison along with mitochondrial DNA analysis is the best method and provides the strongest hair association possible when nuclear DNA cannot be obtained.

Eliminating hair examinations is also fiscally irresponsible. The non-hair examiner may think that the average case consists of one or two hairs which can easily be analyzed for DNA. In reality, one case may have thousands of hairs. Labs that do not perform hair examinations will look at the hairs macroscopically, and if they see hairs on the victim that look grossly different or if they find hairs on the suspect that look grossly like the victim, then those are chosen for DNA analysis. In reality, it is not so uncommon for victims to have hairs that look like the suspect's hair when examined with the naked eye. Microscopical examinations and comparisons of hair will always be able to determine the hairs most likely to yield DNA results, in addition to providing visual, phenotypic information. In the event that nuclear DNA cannot be obtained, microscopic hair examinations and comparisons, together with the mitochondrial DNA, provide the best possible evidence in a case.

This discussion will go into further detail regarding the benefits of microscopical hair examination by utilizing actual case examples.

Microscopical, Hair, DNA

B68 Assessment of Hair Roots for Nuclear DNA Analysis

Barbara Doupe, MS, Johanne Almer, MS, and Roger Frappier, MS, Centre of Forensic Sciences, 25 Grosvenor Street, Toronto, ON M7A 2G8, Canada*

After attending this presentation, attendees will learn how to effectively determine whether or not a hair root will yield a DNA STR profile.

This presentation will impact the forensic community and/or humanity by potential saving time and money by correctly identifying whether or not a hair root will yield a DNA STr profile prior to attempting the analysis

This presentation will outline the results of a study, whose purpose was to evaluate the accessibility of nuclear DNA of hair roots in the catagen/telogen transition growth stages. Morphological characteristics were assessed to determine cost effective screening of hair root suitability for nuclear DNA analysis.

Hairs proceed through a growth cycle consisting of three phases: anagen, catagen and telogen. Determination of the phase of a hair's growth cycle is used to assess the suitability of the hair root for nuclear DNA analysis. Hair roots in the actively growing anagen phase are an excellent source of nuclear DNA, while hair roots in the resting telogen phase lack sufficient nuclear DNA. The likelihood of obtaining nuclear DNA declines in the catagen phase as the hair nears the telogen phase, thereupon increasing the reliance on mitochondrial DNA analysis.

The morphological characteristics of roots belonging to the anagen and telogen phases are readily identifiable, as the typical ribbon root and club root. However, the morphological characteristics of roots in the transition from the anagen phase to the catagen phase and into the telogen phase, are not. The Centre of Forensic Sciences (CFS) has yet to establish an effective screening method for determining the accessibility of nuclear DNA analysis of those hair roots. This has led to a costly hit and miss scenario, whereby, a root may or may not provide sufficient nuclear DNA for analysis.

This study examined scalp hair roots in the transition from the anagen phase to the catagen phase and into the telogen phase. Specifically, roots were chosen with club roots that had folicular tags and partial club roots with germinal nipples. Various morphological characteristics were measured to determine if there was a correlation with amount of nuclear DNA obtainable. The hair shaft width, and the length and width of the club root, germinal nipple and folicular tag were measured employing a stereoscopic microscope with calibrated graticule in one eyepiece at magnifications of 40x to 100x. These roots were subjected to nuclear DNA analysis. The quantity of nuclear DNA obtained and resulting DNA profiles were assessed.

A sample of 51 hair roots were measured and analyzed. The sample contained 34 club roots with germinal nipples and 17 club roots with folicular tags. The majority of the hair roots (n=40, 78.4%) did not have sufficient nuclear DNA to proceed with amplification (minimum threshold 240pg). Six club roots with germinal nipples did proceed on to amplification and four generated profiles. Five club roots with folicular tags also processed for amplification and three generated profiles. Therefore, 11.8% of club roots with germinal nipples gave profiles and 17.6% of club roots with folicular tags. No linear correlation was seen between the morphological dimensions measured and amount of nuclear DNA obtained. However, it is of note that DNA profiles were only obtained in germinal nipples longer than 132µm and in folicular tags longer than 30µm.

Based on this study, the expectation of obtaining nuclear DNA from a catagen/telogen root with a germinal nipple or folicular tag is low, but measuring the length of germinal nipples or folicular tags may be useful in determining the likelihood of obtaining sufficient nuclear DNA.

Hair Root, Screening Method, Morphological Characteristics

B69 The Acceptance of Human Scent as Evidence in the U.S. Court System

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After attending this presentation, attendees will learn about the instrumental analysis human scent for forensic purposes and the application of human scent evidence in criminal investigations.

This presentation will impact the forensic community and/or humanity by demonstrating how human scent evidence can be a valuable investigative tool which is capable of being admitted as evidence in criminal cases.

The ability of canines, *Canis familiaris,* to locate items of forensic interest such as controlled substances and explosives has long been accepted in the law enforcement community. Of late, canines are being employed to identify individuals based upon a scent match to scent collected from a crime scene. Human scent evidence and scent identification canines have become more commonly used by the law enforcement community in the United States, yet have been used successfully in European countries for over a hundred years. Solid phase micro extraction combined with gas chromatography / mass spectrometry (SPME-GC/MS) analysis of the volatile compounds present in human scent and the use of the relative amounts of these compounds for the instrumental differentiation of individuals has aided in the acceptance of canine human scent identification in the U.S.

The most recent US court ruling pertaining to canines and human scent was a Kelly hearing conducted in late 2004, prior to the prosecution of the State of California V. Benigno Salcido, GA052057, an attempted murder case. The courts questioned the reliability of the STU-100, a scent collection vacuum; whether human scent is unique; how long scent will remain at a location; how long scent captured on a gauze pad will remain and a number of other issues. In this case the odor was collected from the inside of an open window and a bloody knife at the crime scene using the Scent Transfer Unit 100 (STU-100) which uses dynamic air flow to trap the odor on sterile gauze. The collected odor was presented to a specialized bloodhound and the canine led investigators from outside the rear door of the victim's house to a nearby residence. Later collected odor was presented to the bloodhound at the police station where it trailed through the hallways an identified an occupant of the previously identified house.

Specialized bloodhounds provide a yes or no response to the handler at the start of a trail to indicate the presence or absence of a matching scent trail. Canine scent identifications indicate an association between scent collected from a suspect and scent collected from the crime scene. During the Kelly hearing, the court heard arguments as to the use of the Scent Transfer Unit 100 (STU-100) for the collection of human scent, the "uniqueness" of human scent, and the durability of human scent after collection on a gauze medium. This paper will discuss the case itself and the research which was presented to answer to court's inquiries about human scent.

SPME-GC/MS has been effectively utilized for the extraction, separation, and identification of the components of collected human scent samples. These volatile odor signatures have proved to be stable for an individual through weekly scent collection and evaluation, and distinguishable when compared among people. Comparison of scent profiles among people has revealed that the headspace above collected scent samples contain common compounds which differ in relative peak area ratios across individuals, yet are relatively stable for a single subject. Compounds which are common among individuals include: 2-furanmethanol, phenol, nonanal, decanal, hexanedioic acid-dimethyl ester and 6,10-dimethyl-5,9-undecadien-2-one. The relative ratios of the common compounds along with compounds which differ make discrimination possible.

The ability of an absorber material to retain human scent is also an area of the court's interest. A study into the dissipation of human scent collected on gauze absorbent mediums will be presented. It has been shown that there is a measurable amount of human scent weight still present on gauze up to 84 days after a 15 minute scenting period. The ability for different types of absorbers and to retain scent weight when exposed to varied conditions such as temperature and light effects will also be discussed.

Canines, Human Scent, SPME-GC/MS

B70 Color Analysis of Apparently Achromatic Paints by Visible Microspectrophotometry

Kristin A. Kopchick, MS, Drug Enforcement Administration, North Central Laboratory, 536 South Clark Street, Chicago, IL 60604; and Christopher R. Bommarito, MS, Michigan State Police Forensic Science Division, 7320 North Canal Road, Lansing, MI 48895*

After attending this presentation, attendees can expect to learn about the chromatic nature of modern achromatic automotive paints and implement visible microphotometric techniques into analysis schemes of this type of evidence.

This presentation will impact the forensic community and/or humanity by demonstrating research which applies currently employed techniques to evidence which was previously rarely examined in this manner. Incorporating a spectral analysis into achromatic automotive paint schemes will ideally reduce false inclusions and strengthen associations of known and questioned evidence. Improving the effectiveness of trace analyst conclusions in regards to paint evidence will positively affect the forensic science community.

Chromatic secondary pigments are utilized in achromatic automotive paints to create unique or enhanced paint systems. These pigments may or may not be observable in reflected light; however, by utilizing visible microspectrophotometry (MSP) discriminating data may be gathered. This presentation will present a study which analyzed 160 apparently achromatic automotive paints via polarizing light microscopy and visible MSP for visual and spectral evidence of secondary pigmentation. Positive spectral results were attained in the black and grey/silver topcoat sample set while the white topcoat and grey undercoat set yielded no spectral data. These results suggest that paint analysis schemes should incorporate visible microspectrophotometry for black and grey/silver samples. The presentation will review achromatic paint chemistry and experimental design along with instrumental parameters and results.

Visible Microspectrophotometry, Automotive Paint, Achromatic

B71 In Situ Identification of Nickel Titanate and Chrome Titanate in Automotive Paints Using Extended Range FT-IR Spectroscopy (4000-220cm-1) and XRF Spectrometry

Edward M. Suzuki, PhD, and Martin X. McDermot, MS, Washington State Crime Laboratory, 2203 Airport Way, South, Suite 250, Seattle, WA 98134*

After attending this presentation, attendees should be able to identify two inorganic pigments, Nickel Titanate and Chrome Titanate, which are used in automotive paints. This can be usefully for both identification of automotive paints and for distinguishing between finishes having similar colors.

This presentation will impact the forensic community and/or humanity by assisting forensic paint examiners who are fully utilizing infrared spectroscopy in their analyses (that is, those examiners who make an effort to identify the binders and pigments in their paint samples based on the characteristic absorptions of these components, as opposed to those using infrared spectrum in a strictly comparative mode without regard to the paint composition).

The identification, analysis, and occurrence in U.S. automobile original finishes (1974 to 1989) of Nickel Titanate and Chrome Titanate are described in this presentation. These two inorganic pigments have lemon yellow and golden yellow-orange hues, respectively. The titanate pigments are based on the rutile (titanium dioxide) structure and there are only minor differences between the infrared absorptions of rutile and the titanates. Titanate pigment absorptions in paint spectra can thus be easily mistaken for those of rutile. However, each of the titanates contains two elements in addition to titanium that can serve to distinguish those using elemental analyses. Extended range FT-IR (4000 – 220 cm^{-1}) and XRF instruments were thus used in combination for the in situ analysis of the titanates.

In addition to titanium, nickel, and antimony, the three main detectable elements comprising Nickel Titanate, all of the commercial products of this pigment that were examined by XRF (using a tin secondary target) contained impurities of zirconium, niobium, and usually lead. These elements were also detected in most of the paints in which Nickel Titanate was identified, as well as in the Chrome Titanate pigments and paints. The relative levels of these elements vary, particularly the zirconium to niobium ratio, and this can serve to distinguish further paints containing a specific titanate pigment. These impurities arise primarily from the ores that are used to produce anatase, which in turn is used to produce the titanates. Additional zirconium may result from degradation of the dispersion beads that are used in the manufacture of the paint, if zirconium oxide beads are used.

Nickel Titanate is a relatively common pigment that was identified in nearly three dozen U.S. automobile yellow nonmetallic monocoats (1974 to 1989) from the Reference Collection of Automotive Paints (Collaborative Testing Services). Chrome Titanate appears to have been used in only a few yellow and orange nonmetallic monocoats. The use of the titanate pigments likely increased after this time period as they were replacements for lead chromate pigments, which were last used in a U.S. automobile original finish in the early 1990s. Titanates likely also become more common after 1989 because of the increasing prevalence of basecoat/clearcoat finishes. Heavy pigment loads are required with the titanates to achieve the vivid colors typical of many automotive finishes, and this makes it difficult to achieve a high gloss finish in a monocoat. However, this is not a problem with a basecoat/clearcoat finish.

Paint, FT-IR, XRF

B72 Identification of Organic Pigments in Automotive Coatings Using Laser Desorption-Mass Spectrometry (LD-MS)

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After attending this presentation, attendees will be aware of an alternate instrumental technique (LD-MS) for the analysis of automotive coatings for the presence of organic pigments.

This presentation will impact the forensic community and/or humanity by providing the possibility of using laser desorption-mass spectrometry (LD-MS) as a complimentary technique for the identification of benzimidazolone, quinacridone, and phthalocyanine class organic pigments in automotive coatings. LD-MS can provide lower detection limits and molecular weight data so that certain pigments may be conclusively identified. This technique will also provide for the separation of the organic

components from the inorganic components thereby eliminating the spectral overlap issues that occur when using FTIR.

The goal of this presentation is to offer the forensic community an alternate way to analyze automotive coatings for the presence of organic pigments and presents the possibility for an alternate means to identify organic pigments in automotive coatings.

Automotive coatings frequently play an important role in investigations of vehicular hit and run incidents. Be it a vehicle hitting an individual, another vehicle or an inanimate object, some portion of the suspect vehicle's paint is often left behind. This evidence can serve two purposes: 1) If a suspect vehicle is located, a comparison of any questioned paint from the scene or victim to the known paint from the vehicle can be performed; and 2) If a suspect vehicle is not available, any paint left at the scene or on the victim may be useful for developing investigative leads. Of the two possibilities listed above, this paper is primarily concerned with the latter.

In order to provide investigative leads, the questioned paint must be chemically analyzed in such a way so that as many of its individual components as possible can be identified. The results would then be compared to a comprehensive database so that ideally, a possible make, model and year of suspect vehicle may be obtained. The collaborative efforts of the Royal Canadian Mounted Police (RCMP) and Federal Bureau of Investigations (FBI) have provided the forensic community with such a database in the form of the Paint Data Query (PDQ).

The PDQ is based on the input of data obtained from visual, elemental and spectroscopic analysis of questioned samples. Generally, as more components of questioned paints are identified, the discrimination potential of such evidence increases. With recent shifts away from inorganic pigments which often contain heavy metals such as Pb and Cd, organic pigments have become more prevalent in automotive coatings. Therefore the identification of organic pigments would be advantageous in generating a shorter list of possible suspect vehicles.

In its current state, the PDQ does not include organic pigments in its identification scheme. This absence may be due in part to a lack of research in this area. It has recently been shown that organic pigments can be identified in automotive paints using Fourier Transform Infrared Spectroscopy (FTIR). However, in certain instances the relatively low concentrations of organic pigments typically found in automotive coatings may make it difficult to make an identification using FTIR alone. In addition to the low concentrations of organic pigments, automotive coatings frequently contain inorganic pigments, flakes and fillers that tend to overlap with the characteristic spectral features of organic pigments when using FTIR.

The purpose of this research is to explore the possibility of using laser desorption-mass spectrometry (LD-MS) as a complimentary technique for the identification of benzimidazolone, quinacridone, and phthalocyanine class organic pigments in automotive coatings. LD-MS can provide lower detection limits and molecular weight data so that certain pigments may be conclusively identified. This technique will also provide for the separation of the organic components from the inorganic components thereby eliminating the spectral overlap issues that occur when using FTIR.

Organic Pigments, Automotive Coatings, Laser Desorption-Mass Spectrometry

B73 The Analysis of Pigmented Inks

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After attending this presentation, attendees will learn the chemical composition of pigmented inks, how pigmented inks are analyzed, and the aging characteristics of pigmented inks.

This presentation will impact the forensic community and/or humanity by enabling questioned document examiners to know how to analyze pigmented inks

Pigmented inks contain organic or inorganic colorants suspended in a solvent or solvents. These differ from older pen inks in that their colorants are dissolved in a solvent. Pigmented inks are now widely used in ink jet computer printers and in some types of gel pen. They exhibit excellent stability, go on smoothly and are resistant to aging. They also come in many colors and give faithful reproductions of images. Because of the popularity of ink jet printers on computers today, pigmented inks are becoming involved in increasing levels of crime and civil misdeeds.

This project involves the evaluation of a number of methods of analysis of pigmented inks. These include pyrolysis gas chromatography/mass spectrometry, laser desorption mass spectrometry, liquid chromatography/mass spectrometry, thermogravimetry and differential scanning calorimetry. The goal is to be able to identify and differentiate various ink jet pigmented inks and to determine if they display chemical characteristics that would enable examiners to track their aging. All studies will be done using ink on paper. These documents will be sampled using tiny, syringe punches as is done in real cases.

Inks, Pigmented Inks, Questioned Documents

B74 The Effect of Electron Beam Irradiation on Writing Inks

Robert S. Ramotowski, MS, United States Secret Service, 950 H Street, NW, Suite 4200, Washington, DC 20223; and Erin M. Regen, BS, University of Michigan, Department of Psychology, 1012 East Hall, 530 Church Street, Ann Arbor, MI 48104*

After attending this presentation, attendees will learn that the irradiation of mail by the U.S. Postal Service does not appear to alter the dye/pigment content of writing inks on questioned documents.

This presentation will impact the forensic community and/or humanity reassuring forensic document analysts that the electron beam irradiation process currently being used by the U.S. Postal Service does not appear to induce changes of writing inks.

After attending this presentation, attendees will understand the procedure for performing ink analyses, the electron beam irradiation process, and the effects of this form of irradiation on inks and paper. After the October 2001 anthrax letter attacks, the U.S. Postal Service began to irradiate mail destined for certain postal codes. Because of the high dosages of radiation involved in this type of processing, reports quickly began to surface of damage to the contents of irradiated envelopes and packages.

Several recent studies by the Smithsonian Institution's Center for Materials Research and Education reported that the irradiation process did have an effect on writing inks. Since the U.S. Secret Service routinely performs chemical analyses of writing ink samples on questioned documents, a decision was made to investigate what effects the irradiation process would have on such examinations. The study involved selecting 97 different black, blue, red, green, and yellow writing inks. A mixture of ink types was selected, including ballpoint, felt-tip, plastic-tip, gel, and rollerball. Thirty-five additional samples (taken from the group of 97 inks) that had been deposited on Whatman filter paper at various times within the past 26 years were also chosen to study the impact of the irradiation process on aged ink samples.

The effects of the irradiation process on inks were evaluated using thin layer chromatography (TLC) and well as optical spectroscopy. Two different solvent systems were used for the TLC analyses. Two different paper types were used in this study, including plain photocopy and blue lined notepad paper. For operational security reasons, the exact radiation dosage and conditions are not provided. Optical spectroscopy (absorptance curves) was performed using a Foster & Freeman Video Spectral Comparator 2000 high resolution. Optical properties of the inks were eval-

uated before and after irradiation processing, including infrared reflectance and infrared luminescence. Any changes in the ultraviolet fluorescence of the paper were also recorded.

The authors will present the overall results from this study, which indicate that (unlike recent previous studies performed by the Smithsonian Institution) the irradiation process did not appear to cause any significant detectable changes in any of the ink samples. This may be due to changes in the radiation dosage levels used by the U.S. Postal Service since October 2001. Neither the chemical (TLC) nor the optical analyses showed any unexplainable differences. Also, neither the age of the sample (up to 26 years old) nor the choice of solvent system caused any detectable changes in the samples. However, there was a significant decrease in the intensity of the ultraviolet fluorescence of the plain photocopy paper samples.

Ink Analysis, Irradiation, Thin Layer Chromatography

B75 Capillary Electrophoresis/Mass Spectrometry for the Forensic Analysis of Dyes Extracted From Fibers

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After attending this presentation, attendees will be briefed on the use of capillary electrophoresis/mass spectrometry on textile fiber dyes.

This presentation will impact the forensic community and/or humanity by increasing discrimination between forensic fiber evidence

The goal of this presentation is to use capillary electrophoresis-mass spectrometry (CE-MS) for the analysis of dyes extracted from forensically relevant fiber samples to increase discrimination between evidence fibers.

Fiber evidence is frequently used in forensic science to associate a suspect to a victim or crime scene. The fibers are found as trace evidence in crimes of personal contact such as homicide, assault, sexual offenses, and hit-and-run accidents. In forensic fiber comparison, fibers are screened by visual inspection using optical microscopic techniques such as polarized light microscopy (PLM) and by spectroscopic methods such as UV-Vis and fluorescence microspectrophotometry. If spectra of the known and questioned fibers are consistent, the hypothesis that the fibers originate from a common source should not be rejected. The premise of the current research is that additional discrimination may be achieved by extraction of the dye from the fiber, followed by trace analysis by a high resolution separation technique. A sensitive and selective technique such as capillary electrophoresis/mass spectrometry (CE/MS) is needed to analyze the small amount of dye (2-200 ng) present on forensically relevant fiber samples (2-5mm). CE/MS can separate extracted dye components and provide semi-quantitative estimates of dye amounts as well as qualitative information to identify the dye present (via the molecular weight and mass spectra).

Three capillary electrophoresis methods have been developed for the direct separation and identification of extracted dye. The separation of acid, direct, reactive, and vat dyes, extracted from nylon and cotton fibers is performed using 5 mM ammonium acetate in acetonitrile-water (40:60, v/v), pH 8.7. Extracts from acrylic fibers containing cationic dyes can be analyzed using 80 mM ammonium acetate buffer in acetonitrile-water (40:60, v/v), pH 5. Due to the insolubility of disperse dyes in water, a non-aqueous capillary electrophoresis (NACE) method with diode array detection (DAD) was developed for analysis of disperse dyes. This is also first report of CE analysis of disperse and vat dyes.

Extraction and subsequent analysis of dye components from fibers allows for enhanced discrimination of trace fiber evidence. A prototype decision tree for extraction of unknown dyes from textile fibers is presented. Three capillary electrophoresis methods with diode array detection (DAD) have been developed for the separation and identification of dyes from the six major textile dye classes. The separation of acid, direct, reactive, and vat dyes, extracted from cotton and nylon fibers, can be achieved using 5 mM ammonium acetate in acetonitrile-water (40:60, v/v), pH 8.7. Extracts from acrylic fibers containing cationic dyes can be analyzed using 80 mM ammonium acetate buffer in acetonitrile-water (40:60, v/v), pH 5. Separation of hydrophobic disperse dyes can be completed using a non-aqueous CE method consisting of 80 mM ammonium acetate in acetonitrile-methanol (75:25, v/v), pH 7.5. CE-MS of small molecules has often employed sodium acetate or phosphate buffers with cationic surfactants or cyclodextrins as buffer additives. However, because of the requirements of the electrospray ionization process, non-volatile buffers and buffer additives should be avoided in CE-MS system. CE-MS methods were developed and analyzed in positive ion mode for the analysis of basic dyes extracted from acrylics fibers.

Although this approach is destructive to the sample, automated micro-extractions offer the forensic analyst the potential of reproducible and complete removal of dyes from small quantities of a questioned fiber. The combined extraction CE-MS system is capable of achieving both highly discriminating and highly sensitive identification of fiber dyes. The subsequent quantitation of the relative amounts of these extracted dyes may also provide enhanced discrimination of trace fiber evidence.

Discrimination of Fiber Dyes, Capillary Electrophoresis, Mass Spectrometry

B76 Environmental Effects on Textile Fibers

Stephen L. Morgan, PhD, Brandi L. Clelland, BS, Amy R. Stefan, BS, Tony Trimboli, BS, and James E. Hendrix, PhD, University of South Carolina, Department of Chemistry and Biochemistry, 631 Sumter Street, Columbia, SC 29208; and Edward G. Bartick, PhD, FBI Laboratory, Counterterrorism and Forensic Science Research Unit, FBI Academy, Quantico, VA 22135*

After attending this presentation, attendees will learn about the changes that occur in textile fibers as a result of exposure to environmental conditions.

This presentation will impact the forensic community and/or humanity by demonstrating the improvements in fiber examinations.

This research addresses the need of forensic fiber examiners to understand changes that occur in textile fibers as a result of exposure to environmental conditions. Fabric samples of the most commonly used fiber types, containing commonly used dyes, were subjected to a variety of environmental conditions and subsequently analyzed to determine the effects of these treatments. Environmental conditions explored include washing, bleaching, sunlight, heat, accelerated weathering, and exposure to natural weather conditions. Samples of acrylic (dyed with basic dyes), cotton (dyed with reactive dyes), nylon (dyed with acid dyes), and polyester (dyed with disperse dyes) will be employed. Analyses at selected time intervals of exposure to environmental conditions were performed using fluorescence microscopy, UV/visible and fluorescence microspectrophotometry, and infrared microspectroscopy. Chemical changes in a representative sampling of the environmentally exposed samples were also assessed using extraction, capillary electrophoresis, and mass spectrometry to elucidate the chemical changes observed after environmental exposure. For example, experiments were performed to address whether fibers from the same source, which have been treated differently through laundering, can be discriminated based on fluorescent brighteners from detergents. Detergent manufacturers add fluorescence brighteners to improve "whiteness" by masking yellowness. During the wash cycle, fibers pick up the fluorescent brighteners. The presence of additional fluorescent brightener alters the fluorescence from the brighteners applied by textile dyers.

Items of clothing, bedding, curtains, upholstery, carpets, and auto interiors are typically comprised of dyed and finished textile fibers. These items are subjected to a broad array of environmental conditions during use. For instance, auto interiors may become extremely hot in the summer and very cold in the winter, while the environment may range from arid to humid. Auto interiors, curtains, carpeting, and items of apparel are exposed to sunlight throughout their useful lives. All items within about five miles of the coastline are exposed to ozone. Carpets and upholstery get spot-cleaned, while items of apparel are laundered or dry-cleaned many times. During these exposures and cleaning cycles, collectively termed 'environmental exposures,' dyes and finishes may be degraded or otherwise changed in chemical form, or they may be partially or completely removed. The items may also pick up various contaminants, such as soils and body fluids, and deposition of refurbishment chemicals may occur during the cleaning process (soaps, fabric softeners, and fluorescent brighteners). As a result of these environmental exposures, fibers from the same source may, over time, show differences that the forensic trace evidence examiners may need to explain.

The designed experiments performed in this project, combined with analytical characterization of chemical changes, may suggest improvements in fiber examinations for casework. Explanations by trace evidence examiners for observed differences in textile fibers as a result of environmental exposure will be more convincing if accompanied by insight into possible chemical or physical mechanisms. Using these techniques, the scientist are not only able to assess the level of changes induced by environmental exposure, but also gain insight into the chemical natures of the degradation and deposition products. This chemical understanding will also assist in interpretation of spectral data and enhance the forensic significance of the results.

Forensic Fiber Examination, Environmental Effects, Fiber Dyes

B77 Multivariate Statistical Approaches for the Discrimination of Textile Fibers by UV/Visible and Fluorescence Microspectrophotometry

Stephen L. Morgan, PhD, Brandi L. Clelland, BS, Amy R. Stefan, BS, Anthony R. Trimboli, BS, Alexander A. Nieuwland, PhD, and James E. Hendrix, PhD, University of South Carolina, Department of Chemistry & Biochemistry, 631 Sumter Street, Columbia, SC 29208; and Edward G. Bartick, PhD, FBI Laboratory, Counterterrorism & Forensic Science Research Unit, FBI Academy, Quantico, VA 22135*

After attending this presentation, attendees will be briefed on the use of multivariate statistics applied to a validated UV-visible and fluorescence database to visualize differences between groups of fiber spectra, to confirm the statistical validity of that discrimination, and to assess the match of questioned fibers with pristine-condition "known" fibers presumed from the same source.

This presentation will impact the forensic community and/or humanity by demonstrating how fibers and associated spectra in the database, in combination with validated computer programs, represent an extensible tool for fiber comparisons in casework and should also be of value in quality control and training of analysts.

Trace evidence has taken on a role of increasing importance in forensic investigations. The principle that "every contact leaves a trace" establishes the potential value of minute traces of evidence found at the crime scene, or found on a victim or suspect. Fiber evidence is class evidence (*i.e.*, not unique), because many fibers from different sources could be indistinguishable. The discovery of a fiber and its identification as a particular fiber type (*e.g.*, acrylic, cotton, nylon, polyester) may not, of itself, provide much support for a forensic investigation. The probative value of particular fibers found at a crime scene depends on their uniqueness relative to the background of fibers normally encountered at that location in the absence of the crime. What is often required is information that makes the trace evidence more specific and discriminating.

Ultraviolet-visible (UV-visible) and fluorescence microspectrophotometry of mounted fibers offer direct, relatively inexpensive, and informative means of characterizing dyed and finished fibers. These studies were initiated to improve the forensic discrimination of fibers by providing both protocols for the most discriminating analytical approaches and validated data analysis methods. In support of these goals, the authors have developed a database of over 1,500 dyed textile fibers collected from commercial sources. Over 25,000 spectra, consisting of UV-visible absorbance spectra and fluorescence spectra taken at four excitation wavelengths (365, 405, 436, and 546 nm), were also acquired. The database was recently extended to include spectra from a variety of single-color and tri-color fibers that have been exposed, using systematic designed experiments, to different environmental weathering conditions, including detergent washing and natural weathering.

Principal component analysis (PCA) and linear discriminant analysis (LDA) produce visually interpretable maps of spectral similarity. Both UV-visible and fluorescence spectra provide discriminating information, depending on the particular dyed textile fibers under comparisons. UV-visible microspectrophotometry, by itself, is most discriminating. The discriminating power of fluorescence MSP approaches that of UV-visible MSP, and appears to add considerable discrimination beyond that provided by absorbance measurements. For colored fibers, the higher excitation wavelengths (405, 436, 546 nm) provide the best discriminating power. Additional discriminating power can be achieved by using combined UV-visible and fluorescence data in fiber comparisons.

Besides facilitating rapid identification of outliers in spectral data sets, PCA and LDA are of great utility in visualizing differences between groups of spectra, and in confirming the statistical validity of discrimination using appropriate statistical hypothesis tests. Changes in UV-visible and fluorescence spectra as samples are exposed to environmental weathering can also be tracked. For example, after detergent washing of cotton and nylon fiber samples, changes in fluorescence due to the presence of fluorescent brighteners in detergents can increase discrimination. Multivariate statistics can also provide rapid comparison of spectral differences. The fiber examiner may then be able to correlate spectral differences with known photodegradation processes in dyes and other physical changes in fibers that result from the specific environmental exposure. Another focus area involves assessing the ability to match weathered fibers with pristine-condition "known" fibers from the same source.

The fibers and associated spectra in the database, in combination with validated computer programs, represent an extensible tool for fiber comparisons in casework and should also be of value in quality control and training of analysts.

The support of the Federal Bureau of Investigation is acknowledged. Mention of commercial products in this presentation does not imply endorsement on the part of the Federal Bureau of Investigation or the University of South Carolina.

Fiber Examination, Microspectrophotometry, Statistical Analysis

B78 "Blood Brothers": A Case of "Identical Non-Twins"

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The goal of this presentation is to discuss the scientific, practical and ethical implications of clinical procedures, such as bone marrow transplants between relatives or anonymous donors, in human identity testing in forensic casework.

This presentation will impact the forensic community and/or humanity by increasing the success of clinical procedures and improved prognosis and life expectancy for patients undergoing bone marrow transplants brings in its wake scenarios that challenge the assumptions prevalent in forensic human identity testing. It is likely that this type of scenario will be encountered more often and essential that the forensic community be aware of the impact of such procedures on genetic profiling, such as the potential for alternate possibilities when a 'match' occurs.

On November 12, 2004, the Alaska Scientific Crime Detection Laboratory received a case involving the sexual assault of a 21 year old female. Short Tandem Repeat (STR) analysis, using the Promega PowerPlex® 16 multiplex amplification system, was performed on the following items: vaginal swabs from the victim, a known blood sample from the victim, and a known buccal swab from the suspect. The genetic profile obtained from the sperm fraction of the vaginal swabs matched the genetic profile obtained from the suspect's buccal sample. The results were reported to the submitting agency and the genetic profile of the vaginal swabs sperm fraction was entered into the Alaska State Combined DNA Index System (CODIS). A subsequent database search yielded a high-stringency 13-locus match ('hit') to a genetic profile obtained from a convicted offender blood specimen already in CODIS.

When a CODIS 'hit' occurs, the laboratory routinely verifies that the convicted offender and the suspect in the assault case are the same person (or, occasionally, a set of identical twins) and the CODIS 'hit' is dispositioned as a conviction match. In this case, although the convicted offender and the suspect in the assault case were found to have the same last name, their first names, birth dates, and birthplaces were different. They appeared to be neither the same person nor identical twins, as the matching STR profiles would suggest.

The next step was to eliminate the possibility of an analytical error or a mislabeled sample. Fortunately, the laboratory had a duplicate blood sample on file from the same convicted offender. This sample was typed with PowerPlex® 16 and Applied Biosystem's AmpFlSTR® Identifiler® multiplex PCR amplification kit. The vaginal swab sperm fraction was also typed with the Identifiler® kit, thus increasing the total number of matching STR loci to 17. Driver's license photographs and fingerprint cards of both individuals were also examined to confirm that these were two different individuals who were not identical twins.

With the possibility of one individual impersonating another during sample collection and the identical twin scenario ruled out, other explanations were considered to account for the identical DNA profiles. It was determined that the two individuals were biological siblings and that the convicted offender had received a bone marrow transplant from his brother, the suspect in this case. A buccal swab was then collected from the convicted offender and typed with PowerPlex® 16. This genetic profile did not match the profile obtained from his blood sample, excluding the convicted offender as a possible source of the spermatozoa in the vaginal swab. The second STR profile for the convicted offender was also entered into CODIS.

The ramifications of the increasing success of clinical procedures and improved prognosis and life expectancy for patients undergoing bone marrow transplants should be considered with reference to forensic human identity testing. A successful bone marrow transplant will change the genetic profile of the recipient's blood with several possible consequences:

1. A bone marrow transplant recipient will have two different genetic profiles (unless the donor and recipient are identical twins). Therefore, both blood and an oral sample should be collected from such individuals for CODIS purposes.

2. A bone marrow donor and recipient can both be potential contributors of a questioned bloodstain.

3. The presence of two different DNA profiles at a crime scene may not necessarily indicate that they were contributed by two different individuals.

4. A suspect who has received a bone marrow transplant can only be eliminated from being the source of a DNA profile if the known reference sample is comparable to the questioned profile, *i.e.* blood to blood, or buccal to buccal, saliva or sperm sample.

5. Amelogenin results from an unknown bloodstain may not accurately reflect the gender of the contributor in cases where the donor and recipient are not gender matched.

6. Medical histories of the individuals involved in a case may not be known, and caution must be used in reporting conclusions, especially with respect to source attribution.

STR Analysis, CODIS 'Hit', Bone Marrow Transplant

B79 DNA Profiles From Contact Lens Fluid – Bloodstain Patterns From a Possible Case of "Curbing": A Case Study

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After attending this presentation, attendees will learn about the distinctive aspects of a blood stain pattern arising from an unusual circumstance, and the potential to extract and generate a DNA profile from contact lens fluid.

This presentation will impact the forensic community and/or humanity by providing awareness of an unusual bloodstain pattern event. Additionally, this presentation will provide awareness of the potential to derive a DNA profile from an unlikely substrate.

This presentation will describe distinctive aspects of the DNA profiling and bloodstain pattern analysis in a homicide investigation in Toronto in 2003.

The deceased teenage male was found naked in the water near the shore of Lake Ontario. He had been severely beaten, suffering blunt force injury to his head, neck and torso, with the most serious injuries being to his mouth and oral cavity, including loss of his upper teeth, and hemorrhage in the strap muscles of the neck and pharynx walls. The pathologist could not rule out drowning as the terminal event.

The previous night, the deceased had attended a house party, at which witnesses stated there had been an altercation. Four males were seen entering the nearby brush but only three returned, about an hour later. This area between the house and Lake Ontario, approximated 140m, consisted of brushland and railway tracks. Investigators examined this area for the path that the deceased took, as well as evidence of the perpetrators.

The outdoor nature of the scene necessitated the examination of samples such as a rock, which required additional pre-processing to produce partial DNA profiles.

Two contact lens cases were also found in the vicinity of the deceased's clothing. The cases contained fluid but there were no lenses in the compartments. It was unclear if the cases belonged to the deceased or to a perpetrator. The fluid and compartments were sampled for DNA analysis. A mixed partial DNA profile was developed from one case. The deceased could not be excluded as one of the contributors. Male DNA (amelogenin) was detected in the second case but there were no results at the other Profiler Plus™ loci. Other methodologies for improving the likelihood of obtaining profiles from these types of samples will be discussed.

Blood stain patterns on the deceased's clothing included two distinctive tread patterns on the shoulder areas of his T-shirt. There was a single area of blood staining on the vertical portion of the inside surface of a railway track, appearing as a relatively large area of projected blood with accompanying spatter. Curbing (curb stomping) cannot be excluded as the reason for this pattern. Curbing describes a situation where a victim receives blows to the back of his head after being positioned so that he is lying on his stomach facing a curb, or in this case, a railway track, with his mouth open and surrounding the edge of the track.

Bloodstain Pattern, "Curbing", STR Analysis

B80 Analysis of California's Unidentified Remains – Lessons From the Lab

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After attending this presentation, attendees will learn how some of the obstacles presented by challenging human remains samples have been overcome with the implementation of the herein described techniques and how these time-saving techniques have allowed for the analysis of large numbers of samples.

Identifying human remains using DNA is an important and yet often very difficult and time-consuming task. After analysis of hundreds of remains, new techniques have been learned through the California Department of Justice Missing Persons DNA Program that will be useful to the forensic science community, whether in dealing with day-to-day cases or mass disasters. This presentation will impact the forensic community and/or humanity by sharing these techniques which will provide a significant contribution will be made to the critically important task of returning unidentified remains to their families.

Analysis of remains that have been burned, buried or submerged in water for a number of years, treated with lime (calcium hydroxide) or formalin-fixed and paraffin-embedded can be extremely challenging. The analysis of such samples is very time consuming and often results in only a partial STR DNA profile, making conclusive identifications difficult if not impossible. After analysis of hundreds of unidentified remains as part of the California Department of Justice Missing Persons DNA Program, new techniques have been developed and implemented to improve efficiency and increase the number of overall STR profiles obtained from unidentified human remains. Such improvements offer the additional benefit of ready preparedness for large numbers of samples in the event of a mass disaster.

New techniques such as an in-house developed and validated quantitative polymerase chain reaction (PCR) assay have decreased the time taken for quantification of the DNA from remains. This qPCR assay is a duplex amplification allowing for simultaneous quantitation of human-specific mitochondrial and nuclear DNA. This assists in assessing upfront the best approach for sample processing. Furthermore, determining whether a sample is degraded or inhibited is often critical in assessing the next step in a difficult case analysis, especially when DNA quantity is limited. An in-house degradation assay allows for the assessment of the relative sizes of nuclear target and the possible presence of inhibitors by incorporating an internal positive control. The assays will be briefly presented along with case examples illustrating their application.

A modified amplification technique has allowed for a more efficient amplification of samples containing PCR inhibitors. Introduction of both additional Bovine Serum Albumin Fraction V (BSA) and AmpliTaq Gold™ DNA polymerase to nuclear DNA amplifications has been shown to have synergistic effects on overcoming inhibition. Enhanced PCR yield has been observed in varying samples and thus the technique is applicable to a variety of sample types (*e.g.*, bone, samples deposited in soil, etc.). Application of this technique to cases allowed for the identification of remains where initially no STR profile was obtained. Case examples will be presented.

Finally, in some jurisdictions all that remains of unidentified bodies from some of the older cases are formalin-fixed and paraffin-embedded tissues. Methods for enhancing extraction efficiency from these types of tissues have been explored and will be discussed.

Enhanced Amplification, Quantitative PCR, Human Remains

B81 The World Trade Center DNA Special Projects Team

Sheila E. Dennis, MS, Zoran Budimlija, MD, PhD, and Jose Pineda, BS, New York Office of the Chief Medical Examiner, Department of Forensic Biology, 520 First Avenue, New York, NY 10016; Bianca Brandon, MA, Staten Island Technical High School, 485 Clawson Street, Staten Island, NY 10306; and Mechthild K. Prinz, PhD, New York Office of the Chief Medical Examiner, Department of Forensic Biology, 520 First Avenue, New York, NY 10016*

The goal of this paper is to discuss scenarios where outsourced high throughput DNA testing needed to be supplemented by optimized and fast in house analysis in order to respond to rush requests or resolve quality assurance issues for the World Trade Center Disaster.

This presentation will impact the forensic community and/or humanity by assisting the forensic community in learning how to handle rush requests or resolve quality assurance issues for DNA identification during a mass disaster. They will also hear about lessons learned from this team as a result of this mass disaster.

The World Trade Center (WTC) DNA Special Projects was formed in order to perform optimized and expedited DNA extraction and testing on post-mortem and reference samples. While the majority of samples were extracted and tested in large batches (on site and by contract laboratories) there was a need to either re-test samples with previously negative or partial profiles, resolve quality concerns such as labeling or commingling issues, or quickly confirm identifications made by other means. The group consisted of four members of the NYC OCME Forensic Biology Laboratory and received special requests from OCME administrators, anthropologists and the DNA identification team. Four examples of special projects cases are described below.

Case Study 1 (quality assurance issue) consisted of two bone fragments with very similar case numbers. The correct case number for each sample could not be determined because each tube had two printed barcode labels one with each case number. The case number of each of these bone samples was established by re-sampling from the remains and additional DNA testing.

Case Study 2 (expedited identification and commingling) consisted of a mandible identified by dental x-ray with associated remains that were not articulated. All of the remains were found inside the member of service (MOS) uniform. Members of service notified the family before the identification of the additional remains had been established. Since the family was aware that their missing person had been found, testing was expedited in order to be able to release the remains. DNA testing was completed and confirmed that 4 out of the 5 samples in the uniform matched the MOS. A bone sample from the foot did not match the victim.

Case Study 3 (expedited identification) involved a bone possibly from a child. The OCME anthropologist contacted the WTC DNA Special Projects team with a tentative name after performing an anthropological exam. The toothbrush from this child had been previously submitted and multiple attempts at testing gave no results. The child's father had submitted buccal swabs, but the mother was also a victim, identified by dental x-ray. Therefore a tissue sample from the mother's remains was tested as a family reference. The child's bone sample had to be extracted tested several times in order to yield enough STR data for adequate kinship statistics.

Case Study 4 (commingling, split case) was an individual whose major remains consisted of a right foot, left hand, right and left femur, and portions of an arm. DNA testing linked additional body parts to this individual. Upon anthropological review, the additional remains included another right foot. The Special Projects team sampled bones from the major remains and split them into new, separate case numbers. The team also sampled bones from the two right feet. DNA testing was performed on all original and new case numbers. The right foot from the additional remains was linked to the first individual. The right foot from the major remains was linked to a second individual. Seven of the fourteen new case numbers were linked to the original individual, while the rest were linked to the second individual.

Mass Disaster, DNA, World Trade Center

B82 The Armed Forces DNA Identification Laboratory mtDNA Testing Program for Missing Military Personnel: An Update

Mark J. Wadhams, MS, Suni M. Edson, MS, Suzanne M. Barritt, MS, James P. Ross, BS, and Brion C. Smith, DDS, Armed Forces DNA Identification Laboratory, 1413 Research Boulevard, Building 101, 2nd Floor, Rockville, MD 20850*

After attending this presentation, attendees will learn of new advances in forensic sciences that focus on the generation of mtDNA sequence information from degraded human skeletal remains. Attendees will be able to return to their laboratories with this information on new protocols and bioinformatics and perhaps implement some of them into their own protocols and practices, thereby increasing their efficiency in identifying missing persons.

This presentation will impact the forensic community and/or humanity by providing the forensic community with information on the integration of bioinformatics and laboratory processes in a laboratory specializing in DNA analysis of degraded skeletal remains. The increase in efficiency at AFDIL due to this integration will provide other laboratories within the forensic community with a model for handling these types of remains.

Since 1991, the Armed Forces DNA Identification Laboratory (AFDIL) has been aiding the Joint POW/MIA Command's Central Identification Laboratory (JPAC-CIL) to identify remains from soldiers missing from previous military conflicts such as World War II, the Korean War, and the Southeast Asia conflict through mitochondrial DNA (mtDNA) testing. Significant technological advances have been made since the creation of AFDIL, resulting in an increase in the efficiency, quality, and overall success rate of the testing. Due to the aging population of the family members of the missing and the desire for fullest possible accounting, the demands on mtDNA testing has risen from processing 200 skeletal elements per year to 800 specimens per year. Most of these specimens have been exposed to the elements for over 30 years. In addition, many of the cases involve a high velocity aircraft impact in which the remains were subjected to fragmentation upon impact and subsequent high temperatures due to burning fuel. A typical case may consist of one small fragment of long bone fractured, degraded with only 3g of shaft remaining. In this scenario, an anthropological analysis is not possible, and DNA becomes the primary source of scientific information, combining with circumstantial evidence to support identification.

This presentation will include the preparation for the successful escalation to process 800 osseous specimens in a single year, as well as the processing and maintaining a reference database of mtDNA sequences consisting of over 8,000 family members. Typically, these reference materials consist of blood or saliva; however, if the service casualty officer is unable to locate a suitable living maternal reference, an alternate reference such as baby hair or tooth, envelopes, biopsy specimen, razor, watch or other personal effects from either the decedent or a maternal relative may be submitted for testing. Several of these cases have proven to be successful and have resulted in an identification of a missing service member. The impact mtDNA analysis has on the mission will continue to increase as more degraded specimens are tested and the presence of anthropological data is limited.

This vast undertaking would not be possible without the implementation of a tracking system for both evidence and laboratory processes. Numerous laboratories have explored or are utilizing some form of laboratory information management system (LIMS). Future Technologies, Inc. (FTI), has created for AFDIL their own LIMS system which includes numerous unique features such as automated laboratory notes during processing; automated tracking of high-throughput specimens; a specialized mtDNA searching tool to aid in population database searching, evidence to evidence comparisons, evidence to reference comparisons, staff profile searches, and contamination tracking; web access for clients; and standard operating procedure management. This system has been paramount to the success of bringing home the heroes of this nation and providing closure to families long awaiting answers. Continuing advances in both bioinformatics and laboratory processes that will increase the efficiency and efficacy of using DNA analysis to identify missing soldiers will be discussed.

The views expressed herein are those of the authors and are not the Armed Forces Institute of Pathology, The US Army Surgeon General, or the US Department of Defense.

mtDNA, Degraded Skeletal Remains, Bioinformatics

B83 Mitochondrial DNA Screening Tests: Issues and Alternatives

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After attending this presentation, attendees will give careful consideration to the appropriateness of doing a full or partial mitochondrial DNA analysis on candidate evidentiary samples, and learn about alternatives for partial screening tests.

This presentation will impact the forensic community and/or humanity by assisting mitochondrial DNA practitioners in being better able to choose probative samples with an understanding of the advantages and disadvantages of performing partial v. full sequencing analyses.

Forensic mtDNA analysis has the reputation of being difficult, costly, and time-consuming. Common evidentiary samples are shed hairs and hair fragments. To save time and money, a particular "theory of the crime" may entice a laboratory to screen hair evidence with a partial SNP-like analysis to attempt to include or exclude a suspect or victim. However, often the suspect *du jour* is replaced in time with equally likely suspects. When a screening approach is used, there is concern that the partial mtDNA profile that eliminates an early suspect may be the only available result on evidence when a new suspect appears months to years later, especially if the hair has been consumed. For this reason, it is most appropriate to generate a full mtDNA sequence profile on highly probative evidence at the time of DNA extraction.

Screening is not necessary in most cases. Because mtDNA is not a unique identifier, sample choice is a critical step in mitochondrial DNA analysis. The screening of dozens of marginally relevant hairs (for example, all the hairs collected from a public restroom floor) may result in the false inclusion of an individual who is unrelated to the crime. Instead, microscopic evaluation combined with careful consideration of the probative value of a sample (for example, the hair found in the victim's hand), will usually minimize the number of samples. Highly probative samples will often match victims, family members and even crime scene personnel, and relate to the crime scene in informative ways. Full profiles on these samples, including those of the known individuals, will be required to confirm these matches. On the other hand, a highly probative hair with a mtDNA sequence that matches no obvious person may eventually take on great significance as the case matures, and its full profile should be developed.

Screening methods such as the Roche Linear Array identify common but not especially informative or unique polymorphisms. When a failure to exclude occurs with these methods, full sequencing of HV1 and HV2 must follow to confirm the match. However, the Roche system requires additional equipment beyond that normally required for a sequencing analysis, and also needs laboratory-specific internal validation studies. The rate-limiting steps of a quality mtDNA analysis are extraction and amplification of an individual sample in parallel with its accompanying extraction blanks and PCR controls. Screening methods supplant the sequencing step only, and then only in the approximately 50% of samples that are excluded. As noted below, an alternative to screening with linear arrays is readily available as an intermediate step in a standard sequencing analysis.

In the rare case where sample screening is desired, one may sequence a single amplicon in the specific case. The choice of amplicon is determined by a search for informative, and even lineage-specific, polymorphisms in the known samples. With this approach, sample extraction, PCR amplification and cycle sequencing of the amplicon occur in a single day. If this initial screen indicates that a full sequence profile is necessary for the sample, the remaining ¾ of the profile can be completed the second day. Keeping mtDNA analysis limited to extraction, amplification, and sequencing obviates the need to validate any alternative system such as the linear array, with its associated equipment. This approach also provides the flexibility to use many different primers, which is especially useful in the event that the mtDNA in the evidence is minimal or degraded.

Using a case example, an attorney requested analysis of multiple hairs collected from a homicide victim's hand. A microscopic analysis had suggested that all the hairs had come from the same individual (and might well be the victim's), but the attorney wanted confirmation that no hairs could represent a perpetrator who was not the current suspect. Mitochondrial DNA analysis was performed on the victim and suspect and the HV1 region between 16160-16400 was selected for screening evidence hairs due to several highly informative polymorphisms that characterized and distinguished the two known individuals. Ten evidentiary hairs were analyzed individually at this region by amplifying and sequencing the same region. Per laboratory protocol, the samples were not batched, and each hair was extracted, amplified, and sequenced in a single day. All hairs were found to match the victim. A database search was then performed to estimate the frequency of the partial type, which was low.

Mitochondrial DNA, DNA Sequencing, Screening Tests

B84 Comparison of DNA Polymerase Products for Use in Forensic mtDNA Identifications

Colin R. Steven, MS, Kristen N. Sundling, BS, Timothy P. McMahon, PhD, Suzanne M. Barritt, MS, and Brion C. Smith, DDS, Armed Forces DNA Identification Laboratory, 1413 Research Boulevard, Rockville, MD 20850*

After attending this presentation, attendees will learn the practical value of different DNA polymerase products in the processing of degraded skeletal remains for mtDNA analysis.

This presentation will impact the forensic community and/or humanity by demonstrating the improvement of amplification specificity, sensitivity and fidelity for processing of degraded skeletal remains for mtDNA analysis.

This presentation will describe the assessment of several commercially available DNA polymerase products for use in forensic mitochondrial DNA (mtDNA) applications. Attendees will be aware of which DNA polymerase products offer properties that can improve the fidelity, sensitivity and robustness of mtDNA amplification in the forensic DNA laboratory.

The mitochondrial DNA section of the Armed Forces DNA Identification Laboratory (AFDIL) is charged with assisting the Joint POW/MIA Command, Central Identification Laboratory (JPAC-CIL) in the identification of the remains of US service members lost in previous military conflicts (*i.e.*, Southeast Asia, Korea, and World War II) through the application of mtDNA sequencing. Identifications are achieved by compiling physical, anthropological, dental, circumstantial, and mtDNA evidence; however, some rely solely on mtDNA sequence information. A significant proportion of the samples that AFDIL processes are considered challenged or highly degraded due to the age, nature, and exposure conditions of the recovered remains. The degraded nature of the DNA extracted from these samples makes them susceptible to "*Taq* errors" or the *Taq*-mediated insertion of a non-authentic base during amplification.

Recent discoveries and advancements in the engineering of DNA polymerases have resulted in the commercial availability of enzymes or enzyme blends with properties favorable to the forensic mtDNA investigator. These properties include increased thermostability, sensitivity, processivity and fidelity compared to *Taq* DNA polymerase. An improved DNA polymerase has the potential to allow an investigator to glean more informative sequence data from a limited quantity of probative evidence by reducing or eliminating Taq errors, reading through problematic polycytosine stretches, and producing stronger amplicons from low quality DNA extracts.

AFDIL reviewed the amplification abilities of several commercially available DNA polymerase products. The three selected products include the Expand High Fidelity PCR System (Roche Applied Science, Mannheim, Germany), Accuprime™ *Taq* DNA Polymerase High Fidelity (Invitrogen, Carlsbad, CA), Phusion™ High Fidelity DNA Polymerase (Finnzymes, Espoo, Finland) and GoTaq® Green Master Mix (Promega Corporation, Madison, WI). The Roche and Invitrogen enzymes kits offer increased fidelity, primarily by the addition of a proofreading enzyme to the normal *Taq*-polymerase mediated amplification reaction. Phusion™ DNA polymerase is a unique Pyrococcus-like enzyme that has both 5'-3' DNA polymerase and 3'-5' exonuclease (proofreading) activities. GoTaq® Green Master Mix contains only native Taq DNA polymerase without any special proofreading abilities. Instead it offers greater streamlining of the amplification process by containing everything needed for amplification (except DNA template and primers) as well as agarose-gel loading dyes and a density increasing compound that allow for direct loading of amplification product on agarose gels.

The abilities of the tested DNA polymerase products to amplify low quality, low quantity and known error prone DNA extracts is compared to that of AmpliTaq Gold® (Applied Biosystems, Foster City, CA), a chemically inactivated, hot-start DNA polymerase with no proofreading ability. AmpliTaq Gold is the DNA polymerase product currently employed by AFDIL. The selected DNA polymerase systems were evaluated for sensitivity, robustness, and ease-of-use. The results of these comparisons are presented.

The views expressed herein are those of the authors and not necessarily those of the Armed Forces Institute of Pathology, the U.S. Army Surgeon General, nor the US Department of Defense. Mention or discussion of any specific product does not connote endorsement of said product.

DNA Polymerase, mtDNA, Comparison

B85 A Single Step Multiplex PCR to Identify Mammalian Species in the United Kingdom

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After attending this presentation, attendees will be introduced to a new technique, based on the cytochrome b gene of the mitochondrial genome, to determine mammalian species present from trace evidence without the need to sequence the products.

This presentation will impact the forensic community and/or humanity by allowing for the identification of evidence that could not previously be analyzed by conventional means. In addition, the test will allow for the quick identification of species from highly degraded or powdered samples such a Traditional Chinese Medicine, will be able to identify the components of a mixture, and can also be expanded to include other animals such as those found on the CITES appendices.

Genes within the mitochondrial genome have many advantages for species testing when compared to those in the nuclear genome. The high copy number of the mitochondrial genome per cell relative to the one in the nucleus will allow for detection of mitochondrial DNA from trace bio-

logical materials. Mitochondrial DNA will also be able to survive degradation longer than nuclear DNA due to the strong protein membrane. These factors are important as frequently the sample to be tested is poor quality or may be as a powder with no morphological characteristic. The trade in Traditional Chinese Medicines is one such example where the sample to be analyzed will be pulverized bone or hair and conventional DNA testing may not be possible.

The further reason to use the mitochondrial genome is that genes on the mitochondrial genome have a higher evolutionary rate when compared to their counterparts in the nuclear genome and this increases the genetic variation. For a gene to be of value in species testing it must exhibit little intra-species variation and sufficient inter-species variation to permit differentiation of closely related species. The cytochrome *b* gene is one of the most commonly used genes used for both taxonomic purposes and species identification. Within the cytochrome *b* gene there are domains of highly conserved DNA sequences, which permit the design of universal primers. These universal primers will bind to any mammalian species known to date. In proximity to these highly conserved regions there are domains of sequence that show greater variability allowing for the design of species specific primers. The universal primer in conjunction with the species-specific primer will produce a product of a particular size only if the species is present. Fluorescent dyes are attached to the universal primers to allow for designation of species with overlapping size. By attaching the dyes to the universal primers the cost of the test is reduced.

A multiplex has been designed for 15 mammalian species using universal and species-specific primers. These include donkey, horse, sheep, goat, cow, pig, cat, human, rabbit, red deer, rat, guinea pig, dog, fox and hedgehog. For each species there are multiple species-specific markers leading to unambiguous identification. There is scope for the addition of many more mammalian species and with the expansion to other gene loci on the mitochondrial genome more markers will be introduced to the multiplex reaction. The test has already been used in two criminal cases in the UK. In one case it was alleged that dog and human would be present on a sample taken from a victim of an alleged assault. Direct sequencing of the cytochrome b gene would have produced a mixture if both species were present, but the multiplex test was able to identify the presence of human but indicate that no dog was present. In a second case it was alleged that a male had illegally killed a red deer. Blood on the trousers of the accused male was tested and found to be a mixture of human and red deer supporting the allegation.

The ultimate goal of the test will be to identify the species present from any biological trace material for both common and protected species. The same approach can be used for the identification of CITES protected species.

Species Identification, Cytochrome b, Mitochondrial DNA

B86 Integrated Microfluidic Sample Preparatory Systems: Towards a Fully Automated Genetic Analyzer

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The goal of this research project is to integrate the methods associated with forensic genetic analysis into microdevices capable of multiple sample processing steps. The attendee can expect to learn about recent advancements made in microfluidics for forensic genetic analysis.

This presentation will impact the forensic community and/or humanity by highlighting advancements in microchip technology, providing insight into potential applications for genetic analysis in the forensics community. Integration of multiple sample processing steps into a single, automated device will allow for less expensive, faster analyses, with less risk of contamination, potentially having a positive impact on current casework backlogs.

With a view towards more rapid and cost-effective analysis methods, microdevices become an increasingly more viable option for improving forensic DNA analysis. Microdevices have the potential to drastically reduce the time, reagents, and cost required to perform a wide variety of the processes associated with genetic analysis, including DNA extraction, PCR amplification, and separation and detection of STR amplicons. Inexpensive glass microchips are being developed and tested to improve the efficiency, reproducibility, and automation of the current time-consuming bench-top processes. A fully-integrated, microchip capable of performing the steps normally carried out at the bench would not only reduce the time required to perform these tasks, but would also eliminate user intervention and potential sources of contamination, preserving more of the sample for future analysis.

PCR and high-resolution DNA separations are now readily carried out on-chip, as well as solid-phase extraction (SPE) of DNA from a variety of clinical, biohazardous, and forensically-significant samples. With successful microchip adaptation of these processes now commonplace, research focus has shifted towards integration of these methods with other sample processing steps (cell sorting, volume reduction, DNA quantification)—the first step towards creation of a stand alone device with full-genetic profiling capabilities. Due to the multi-step nature of the DNA analysis process, careful consideration of solution compatibility, sample size, and fluidic interfacing must be taken in order to seamlessly integrate these technologies. As a result, attention is now being paid to device design and concept, and multi-component microchip analysis is now becoming a reality.

The research presented here describes the advancement of integrated sample analysis in microfluidic devices for forensic application. With a focus on the fabrication and implementation of integrated glass microdevices for extraction, PCR amplification, and separation of DNA (as well as other analysis steps), particular attention is devoted to device design and sample handling considerations. Patterned using standard photolithographic techniques, these devices include elastomeric valves for fluidic control of solution flow throughout the device, through each functional domain; development of methodologies for on-chip pumping and sample isolation are also presented. DNA extraction is accomplished using a silica solid phase followed by PCR amplification using IR-mediated, non-contact thermocycling and temperature detection. Methods for integrated DNA extraction and PCR amplification of STRs from forensically-relevant samples are discussed. The work reported here highlights the applicability of integrated microdevices to a variety of sample types, with data presented to demonstrate the versatility of these designs, as well as their easy manipulation to handle a wide-variety of sample sources. This work represents the advancement of fully integrated microdevices capable of total systematic DNA analysis.

PCR, DNA Extraction, Microchip

B87 Acoustic Differential Extraction: A Novel Alternative to Conventional Differential Extraction

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The goal of this presentation is to introduce a novel means for analysis of sexual assault evidence. In addition, the audience will be introduced to a unique aspect of microchip technology for forensic DNA analysis.

This presentation will impact the forensic community and/or humanity by demonstrating the acoustic differential extraction method presented has the potential to significantly alter the means by which sexual assault evidence is processed in crime laboratories. This method is one step of a totally integrated, automated microchip format for forensic DNA analysis.

Differential extraction, the conventional method for isolating male and female fractions of DNA, is a time-consuming sample preparation step in the forensic DNA analysis of rape kit evidence. In addition, it is not easily amenable to automation. The development of a novel alternative for isolating male and female fractions of biological material from sexual assault evidence through the use of acoustic forces in microfabricated devices, termed acoustic differential extraction (ADE) has been completed. Since differential extraction is only one processing step of forensic DNA analysis, replacing it with a microdevice method provides a distinct advantage with the possible integration of several sample preparation steps, including DNA extraction, DNA quantitation, PCR amplification, and separation of PCR products on a single device. In addition, the method presented here will be shown to be versatile (accommodating microliters to milliliters of sample), automatable, and highly amenable to multiplexing.

This novel method for obtaining isolated male and female fractions of DNA on a microfabricated device uses a mild lysis buffer, as in the conventional differential extraction method, to selectively lyse the epithelial cells. The sperm cells are then selectively captured from the cell lysate, using acoustic forces to trap the sperm in the microchannel, while free DNA (including that from the lysed epithelial or other cells) passes through the trap and is directed to an outlet reservoir for collection and analysis. The trapped sperm cells are then released and directed down another microchannel for recovery and subsequent analysis of the sperm cell fraction.

ADE utilizes a glass microfabricated device with defined microfluidic channels in contact with a piezoelectric transducer to form an ultrasonic resonator. Upon generation of ultrasonic waves by activation of the piezoelectric transducer, a standing ultrasonic wave is generated in the microchannel, and cells are trapped in the standing wave depending on cell type and the separation medium, see equation 1. The force on the cell, F_r, is dependent on the amplitude of the applied acoustic pressure, P_0, the volume of the cell, V_c, and the compressibility and density of both the cell and the separation medium. Hence, the force acting on the sperm cells is much greater than that on free DNA, resulting in the trapping of sperm in the acoustic wave, while free DNA is carried with the fluid.

$$F_r = -\left(\frac{\pi P_0^2 V_c \beta_w}{2\lambda}\right) \cdot \Phi(\beta, \rho) \cdot \sin\left(\frac{4\pi z}{\lambda}\right) \qquad (1)$$

Digital video microscopy was utilized to visualize the cell trapping and demonstrate the purity and efficiency of the process. The optimized frequency and amplitude of the ultrasound were determined for most efficiently trapping the sperm cells. Using mock sexual assault vaginal swabs, the cell separation product obtained on the microdevice resulted in a clean sperm cell fraction. DNA from the isolated cells was extracted with a commercial extraction kit, amplified with a Profiler® PCR kit, and analyzed on an ABI 310 commercial CE, yielding the profile of the male sperm donor. Efficiency and purity measurements were also obtained using real time PCR.

Acoustic Trapping, Differential Extraction, Microchip Technology

B88 ABI Prism® 3100 Genetic Analyzer Instrument to Instrument Variation

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After attending this presentation, attendees will learn improved methods to obtain reproducibly high quality STR results.

This presentation will impact the forensic community and/or humanity by demonstrating improving the quality of STR results obtained in the first testing of DNA, and will cut the effort required to obtain DNA profiles, thus increasing ability to identify more criminals.

In a high throughput sample processing environment it is important to eliminate as many variables as possible in order to process samples efficiently and achieve the highest possible quality of results with each sample. In pre-amplification stages, it is possible to standardize sample input with DNA extraction, quantification, and normalization of sample DNA concentration. It is also possible to standardize aspects of the post-amplification process.

We observed that the same amplified product run on different ABI 3100 Genetic Analyzers produced noticeably different peak heights for the same alleles. Some instruments were reproducibly "stronger" and others reproducibly "weaker". It was decided to perform a variability study with all 11 3100 instruments used for STR genotyping analysis.

It was observed that average peak height intensities for entire samples or across allelic ladder alleles can vary as much as two fold across the 11 genetic analyzers. This compares with an inter-color variation that was as high as six-fold on some instruments, but not others. The relative instrument intensity tended to correlate with instrument age, but not specifically with laser age. Two "middle-aged" instruments have had laser replacements. This did not make them stronger with regard to relative RFU intensity.

To counteract this effect, it was determined that injection conditions can be modified to overcome the instrument variability. To a first approximation, in the typical ranges used, a combination of injection voltage times injection time (*i.e.*, kV-sec) is directly proportion to RFU strength for an individual instrument. Thus increasing the combined kV-sec used for injection on weaker instruments or decreasing it on stronger instruments allows adjustment so that all instruments provide approximately equivalent performance.

The results of implementation of this approach as well as the corresponding effect on ability to improve the quality and reproducibility of first-run samples will be discussed.

STR, 3100, Variation

B89 Establishing mtDNA Database and its Application on Forensic Examination

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After attending this presentation, attendees will be briefed on the development of the mtDNA database and its application to forensic samples.

This presentation will impact the forensic community and/or humanity by demonstrating how mtDNA used on degraded samples is very efficient and its discrimination power is enough to suggest the positive identification

Mitochondrial DNA analysis is useful for the analysis of bones, hairs, and especially helpful for highly degraded specimens when no information could be obtained from nuclear STR analysis. In contrast to nuclear DNA, mtDNA follows maternal inheritance patterns. Therefore, mtDNA haplotypes are inherited from generation to generation through the maternal line, and owing to its resistance to degradation, it was widely used in the research of evolution and also in forensic examination. It provides enough information and could be recognized as an assistant role to CODIS 13 STR. MJIB (Ministry Justice Investigation Bureau) uses mtDNA techniques to match the degraded bones of the unidentified bodies to the families and to confirm the identification of drug abusers by analyzing urine mtDNA.

Samples of 825 unrelated individuals living in Taiwan were collected; DNA from blood or saliva was analyzed to get the sequences of HV I and

HV II. There were 751 haplotypes found in the 825 individuals, the DP (Discriminating power)?0.9985, GD (Genetic diversity)?0.9997, the data showed that the mtDNA system with high DP and GD would be a good auxiliary system to currently most popular CODIS 13 STR systems for human identification, especially for the non-first-degree blood relative confirmation cases. Besides, 278 bone related forensic DNA examination cases from 2001 to 2002 that MJIB investigated, 19 in 40 cases which could not be STR typed were mtDNA sequenced. There was a 92% success rate for urine samples stored in room temperature from 1 month up to 22 months. The successful situation provided the confirmation of the mtDNA's advantages to STR typing in this type of degraded samples. In conclusion, owing to the high resistance to degradation and high discriminating power, mtDNA is very suitable for forensic examination.

Forensic Science, mtDNA, Degraded Urine

B90 An Evaluation of Mitochondrial DNA Variation: From Linear Arrays to Whole Genome Sequencing

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After attending this presentation, attendees will learn about the assessment of genetic variation in the control and coding regions of the entire mitochondrial DNA (mtDNA) genome. This will be discussed in relation to Linear Arrays and the identification of coding region polymorphisms for increased forensic discrimination of common types.

This presentation will impact the forensic community and/or humanity by enhancing the knowledge of the forensic community in regards to mitochondrial DNA genetic variation and its impact on mtDNA Linear Array and coding region analyses.

Forensic mtDNA analysis of highly degraded materials, or samples lacking sufficient quantity of nuclear DNA for STR testing (*e.g.*, shed hairs) has found an important niche in DNA testing. Recent research has focused on two of the limitations for mtDNA testing: the cost of mtDNA testing and the low power of discrimination associated with common mtDNA types. To overcome the cost prohibition of mtDNA testing, Linear Arrays have been evaluated as a screening tool (1, 2). The identification of polymorphic mutations in the mtDNA coding region has also been proposed as a way to increase the forensic discrimination of common mtDNA types (3, 4).

An evaluation of mtDNA Linear Array data compared to the control region sequence information from 666 population samples were analyzed to determine the underlying source of null alleles (blanks). An examination of coding region variation in a global dataset of mtDNA genomes has also been studied to determine the feasibility of sequencing segments of the mtDNA genome for increased forensic discrimination.

Linear Array analysis for over 600 population samples from self-described Caucasian, African American, and Hispanic individuals were conducted (1). Control region sequences were generated at the Armed Forces DNA Identification Laboratory (Rockville, MD) using established, published protocols (5). An assessment of coding region variation for increased forensic discrimination utilized published data from the literature available at the mtDB website (http://www.genpat.uu.se/mtDB/). Haplogroup associated polymorphisms were determined from the literature.

Most of the null alleles observed in Linear Arrays were created by mutations associated with mtDNA haplogroups rather than private polymorphisms. This suggests that null alleles can provide useful information in Linear Array analysis. In addition, most of the "highly polymorphic" mutations in the coding region, potential targets of increased discrimination, are sites associated with mtDNA haplogroups. These sites would therefore be uninformative for forensic discrimination since much of this information is redundant with sequence information determined from the control region.

An appreciation of mtDNA haplogroups can be useful for mtDNA screening using linear arrays for HV1 and HV2, and for avoiding highly redundant, uninformative polymorphisms in the mtDNA coding region.

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5. Edson, S.M., Ross, J.R., Coble, M.D., Parsons, T.J. and Barritt, S.M. (2004) Naming the dead — confronting the realities of rapid identification of degraded skeletal remains. *Forensic Science Reviews* 16(1): 64-89.

Mitochondrial DNA, Linear Array, mtDNA Discrimination

B91 Using the 2100 Bioanalyzer as the Platform in Rapid and Inexpensive PCR-Based STR Genotyping for Discrimination of Biological Specimens Recovered in Transportation Accidents

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After attending this presentation, attendees will understand the application of a rapid genotyping assay with application to small sample sizes that is designed for in house use with the Agilent 2100 Bioanalyzer.

This presentation will impact the forensic community and/or humanity by demonstrating the application of the genotyping assay to a case study for discrimination of small population pools will demonstrate the practical use of the method. Additionally, this provides the forensic scientist access to an inexpensive method using universally recognized loci for rapid genotyping.

In fatal accidents, there is the potential for misidentification of samples at an accident site. Results of toxicological or other biochemical testing of samples that are in conflict with the preliminary identification suggest sample misidentification but are not definitive. Genotyping can serve as an additional and independent test for correct sample identification; however, depending on the method used, genotyping can be expensive and requires instrumentation and software for analysis that is generally available only from external services. This suggests a need for more accessible and inexpensive methods for accurate differentiation of small population pools.

A protocol will be presented describing a qualitative method of genotyping using the Agilent 2100 Bioanalyzer as the platform for separation of PCR products amplified from STR loci. The presentation will demonstrate the use of primers and PCR conditions from the well established CODIS STR primer sets and information found at STRBase (http://www.cstl.nist.gov/biotech/strbase/) and the novel use of the Bioanalyzer for rapid, inexpensive electrophoresis and analysis of CODIS STR PCR products for genotyping.

Results of a case study will be discussed where toxicological results did not correspond to the stated identification of the specimens. An expensive external service had been used to perform fluorescent-based capillary electrophoresis for genotyping. In-house analysis using inexpensive unlabeled primers for PCR and less expensive instrumentation and software was utilized for electrophoresis and analysis. Initial evaluation of the Bioanalyzer-based method revealed that electrophoresis using the DNA500 chip gave sufficient separation of PCR products from a variety of tissues and blood to discriminate between three control subjects using 8 STR loci and amelogenin, a sex determination locus. Furthermore, the observed presence of homozygous alleles at different loci was sufficient for unambiguous identification of each individual's specimens.

Five samples from a case study were examined using the Bioanalyzer protocol. The results confirmed the toxicological results and provided correct specimen identification. In this study, the presence of homozygous alleles at three loci showed one of the five samples to be unique and differentiated this sample from the remaining four. Two of the remaining samples were found to be homozygous at identical alleles for two loci. The expected occurrence of homozygosity at these loci in two individuals was determined to be approximately 1%, which in a small population is sufficient to suggest that the samples were from the same individual. The overlay of the electropherograms and comparison of products sizes for the PCR products from the remaining loci was sufficient to complete identification and suggest that the five case study samples were from three individuals, confirming the toxicological analysis.

The protocol presented is inexpensive, rapid, uses techniques and instrumentation readily available in many forensic labs, and does not require specially trained personnel. The analysis was conducted with the Bioanalyzer software and accomplished quickly by determining the presence of homozygous alleles and overlays of size-separated PCR products. The protocol takes advantage of the well-characterized CODIS primer sets such that a large body of literature is available regarding characterization and use of the STR loci for genotyping. The application illustrated here relies on relative comparison of electrophoretically separated products. Therefore, absolute identification of the specific alleles is not necessary further adding to analytical simplicity.

DNA Typing, Short Tandem Repeats, 2100 Bioanalyzer

B92 Y-SNPs Typing in a Japanese Population Using Allele Specific Hybridization Method and Luminex® 100™ System

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The goal of this presentation is to evaluate the forensic usefulness of commercially available Y-SNP detection kit with Luminex® 100™ flow cytometer.

This presentation will impact the forensic community and/or humanity by demonstrating Y –SNP typing is considered to be a useful tool for the prediction of population of origin from forensic materials.

Single nucleotide polymorphisms on Y chromosome (Y-SNPs) are regarded as valuable male specific genetic markers. As the haplogroups which Y-SNP markers define are highly non-randomly distributed among population, Y-SNP analysis is considered to be a useful tool for human migration and evolutionary study. As analysis of Y-SNPs markers is effective for prediction of racial and/or geographic origin of evidential sample, Y-SNPs typing could be applied for forensic purpose.

Forty-two (42) Y-SNP markers were analyzed with allele specific hybridization method using commercially available Y-SNP detection kit, Signet Y-SNP Identification System (Marligen Biosciences, Inc., Ijamsville MD). Forty two Y-SNP loci and amelogenin locus are amplified in five different multiplex reactions and are detected using x MAP suspension array technology on Luminex 100 flow cytometer. Five (5) Y-STR markers were also examined using PowerPlex Y (Promega) and the results were compared to those of Y-SNP markers.

Peripheral blood samples were collected from 100 unrelated Japanese males. The DNA samples were extracted from the blood samples using QIAamp DNA Blood Mini Kit according to the manufacturer's protocol (QIAGEN). The variation 42 Y-SNP markers and amelogenin locus were detected using Signet Y-SNP Identification System kit in according to manufacture's protocol. ?Y-SNP types were generated using a computer software DNAsis Call (Mirai Bio). Allele calls of the biallelic marker were made based on comparison of signal intensity which was detected by Luminex 100 flow cytometer.

In order to examine the minimal quantity of template DNA for allele call, 0.1ng, 1ng and 5ng of male 9948 DNA were amplified and florescent signal intensity which was detected from each Y-SNP locus was compared. Allele calls were successfully made with 1 ng DNA for Y-SNP markers in Multiplex 1, 2, 4 and 5. As 1 ng of DNA template the signal intensity was too small and insufficient for allele calls of Y-SNP markers in Multiplex 3, above 5ng of DNA template was required in order to obtain sufficient signal intensity for complete allele calls.

Because PCR product of allele specific primer is relatively small in size, an allele call of Y-SNP type is considered to be successful from slightly decomposed forensic samples containing degraded DNA. Y-SNP typing was examined using degraded DNA extracted from aged blood stain samples which have been stored 17 to 26 years at room temperature and the haplogroup could be successfully determined from 26 year old blood stain sample.

Forty two Y-SNP markers were examined using 100 Japanese DNA samples with Signet Y-SNP Identification System. The derived alleles were observed in all Japanese samples for M42, M94 and M168 loci. Variation was observed for only 5 SNP loci, M175 , M89 , M130 , M174 and SRY+465. Only 4 different haplogroups were observed, and the haplogroup frequencies in the Japanese sample were O*=16%, O2b=35%, C=13% and D=36%.

Y-STRs were typed from the Japanese sample using PowerPlexY, allele distribution of DYS438, DYS437, DYS392, DYS393 and DYS390 loci were characteristic relation to haplogroups defined by Y-SNP markers.

As Case work samples, tissue of victims of bombing case were analyzed using Y-SNP markers in order to evaluate the presumptive capacity of ethnical of victims. Seventeen male victims including one Japanese victim were analyzed. Eleven victims were classified into haplogroup R (R, R1a and R1b) and 3 victims were classified into haplogroup O1. Three victims were unique haplogroup, C,O2b and O*. It was suggested that the Japanese male was included in these three victims.

In conclusion, allele specific hybridization method for Y-SNPs detection using Signet kit and Luminex® 100™ system was an easy and rapid system to detect the variation on Y-SNP markers and haplogroup. However, above 10 ng of template DNA is required for detection of haplogroup, this system was considered to be not suitable for analysis of trace evidence. It might be useful for analysis of degraded forensic sample such as tissue of victim of mass disaster.

Y-SNPs, Luminex, Japanese

B93 Use of the SPEX 6750 Freezer Mill® for Extraction Preparation of Limited DNA Samples

Sherri L. Fentress, MS, Pamela G. Jarman, MSc, and Daniel E. Katz, MFS, Delaware Office of the Chief Medical Examiner, 200 South Adams Street, Wilmington, DE 19801*

The goal of this presentation is to provide insight into the potential benefits of the SPEX 6750 Freezer Mill® for practical application in forensic DNA analysis.

This presentation will impact the forensic community and/or

humanity by demonstrating how the use of the freezer mill would decrease the time needed for sample preparation for DNA extraction and could increase the product yield for limited DNA sample sources.

The DNA Unit of the Delaware Office of the Chief Medical Examiner (OCME) is currently validating several procedures at different stages of the DNA analysis process. The project described in this abstract focuses on the preparation aspect of the extraction procedure for nuclear DNA samples. It investigates the use of the SPEX 6750 Freezer Mill® to potentially increase the efficiency and/or yield for extraction. The freezer mill uses extreme cold temperature and magnetic force to reduce any sample to a fine powder in a matter of seconds. For example, preliminary validation studies for mitochondrial bone and tooth extraction have revealed that this can occur in as little as 30 seconds. Though the major benefit of the procedure is the decrease in the time and sample handling involved with extraction preparation (especially for bone samples), another important benefit is the optimization of extraction yield due to increasing the surface area that is exposed to the extraction reagents.

This project will examine the application of freezer mill grinding to a variety of problematic and/or limited DNA sample sources and the potential to improve the DNA yields of these samples. Samples tested will include but are not limited to condoms, swabs of touch transfer, microscope slides, stains on multiple types of fabric, bone, latex gloves, and hair clumps without roots. The optimal grinding time for each type of sample and the amount of ground sample to extract will be determined. One should keep in mind that not all sample types will be evaluated for freezer mill use because it may be neither practical nor necessary for some samples.

Organic and non-organic extraction systems will be compared, and real-time PCR will be used for quantitation of all extractions. Amplification and typing will be performed using the Powerplex® 16 system on the ABI Prism® 310 Genetic Analyzer® platform. Results will be evaluated for yield and quality of profile.

The presentation will compare the results for each of the extraction procedures (with and without the freezer mill) and give an overall evaluation for each of the sample types used including the optimal grinding times and extraction amounts.

Freezer Mill, DNA Yield, Limited Sample

B94 Integration of Cell Sorting and Solid Phase Extraction on a Microchip

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The goal of this presentation is to highlight the use of an integrated microdevice that combines sedimentation-based cell sorting and solid phase extraction (SPE) of DNA from the sorted cells, two of the procedures necessary for analysis of sexual assault evidence where male and female DNA must be separately identified.

This presentation will impact the forensic community and/or humanity by demonstrating the application of microchip technology to forensic casework analysis.

The focus of this project is to integrate the rapid separation of sperm and epithelial cells with DNA extraction in a single microdevice compatible with subsequent STR analysis.

Microchip technology offers a rapid, cost-effective alternative to conventional DNA analysis methods. The research presented will highlight the use of an integrated microdevice that combines sedimentation-based cell sorting and solid phase extraction (SPE) of DNA from the sorted cells, two of the procedures necessary for analysis of sexual assault evidence where male and female DNA must be separately identified. This presentation will have a significant impact on the forensic community by demonstrating the application of microchip technology to forensic casework analysis.

The proven utility of forensic DNA evidence has led to an increase in demand for DNA analysis services. Although conventional analysis techniques are effective, they are time-consuming and laborious, which has contributed to an overwhelming backlog of forensic casework samples with possible biological evidence. Research efforts have focused on the development of more rapid and efficient analytical methods, as well as the automation of existing methods, to reduce the time and cost of forensic analysis as well as the existing casework backlog. Techniques performed on microchips are particularly advantageous because they can be integrated with downstream analytical steps on a single microfluidic device in the form of a micro-total analysis system (i-TAS). These integrated systems, which combine all of the sample processing steps required for forensic DNA analysis, will reduce analysis times, and, therefore, the forensic casework backlog.

A successful microchip method for separating sperm and epithelial cells has previously been demonstrated.[1] This method exploits the different physical properties of sperm and vaginal epithelial cells, which allow for selective sedimentation of epithelial cells in the inlet reservoir of a glass microdevice. Initiation of pressure-driven buffer flow causes sperm cells to migrate towards the outlet reservoir, resulting in an effective separation of the two cell types. This method circumvents the most time-consuming step in DNA analysis of sexual assault evidence, the conventional differential extraction procedure. In addition, microchip-based SPE has previously been demonstrated[2] on a variety of biological materials Microchip SPE utilizes a silica matrix, comprised of silica beads immobilized using a tetraethyl orthosilicate (TEOS) sol-gel, to bind DNA in the presence of a chaotropic salt. Proteins and other contaminants are then removed in an isopropanol wash step, and DNA is released in a final elution step.

The research presented here describes an integrated microchip for cell sorting and independent solid phase extraction of DNA from the sorted cells. The functionality of the device is described, including the results of amplification of genomic DNA isolated from cells sorted from a mixed cell sample. The microdevice, fabricated using standard photolithographic techniques, was designed with a domain for cell sorting and two separate SPE regions. Cells from a mixed sample were separated according to their physical properties and retained against the individual SPE matrices. The sperm and epithelial cells were then lysed on-chip in their separate areas, followed by isolation and purification of their respective DNA fractions. Following cell separation and SPE on the microdevice, DNA amplification and separation were performed using conventional laboratory methods. The presented work represents a major step towards the development of a fully integrated microdevice capable of total DNA analysis for forensic casework.

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DNA, Cell Separation, Solid Phase Extraction

B95 Cost Effective Protocol for Automated Buccal Specimen Extraction Using DNA IQ™ Resin on the Biomek® 2000

Chris Macaraeg, BS, Pace University, 1 Pace Plaza, New York, NY 10038; and Ewelina J. Bajda, BS, Mechthild Prinz, PhD, and Theresa A. Caragine, PhD, Office of the Chief Medical Examiner of the City of New York, 520 First Avenue, New York, NY 10016*

After attending this presentation, attendees will learn cost effective, automated exemplar extraction using DNA IQ (Promega) resin with yields consistently sufficient for direct amplification and without low level DNA

contamination.

This presentation will impact the forensic community and/or humanity by demonstrating a cost effective protocol for automated buccal specimen extraction using DNA IQ (Promega) resin on the Biomek 2000 with yields consistently sufficient for direct amplification and without low level DNA contamination.

This presentation will demonstrate a cost effective protocol for automated buccal specimen extraction using DNA IQ™ (Promega) resin with yields consistently sufficient for direct amplification and without low level DNA contamination.

According to the manufacturer's recommended protocols, the use of the DNA IQ™ kit provides a consistent recovery of DNA so that quantitation is unnecessary prior to amplification. The kit has also shown to be easily implemented for automation on the Biomek® 2000 (Beckman Coulter). However, laboratory studies demonstrated that the yield varied from tissue and blood samples; moreover, low-level contamination was found. In order to resolve these issues for exemplar extraction, the authors optimized the protocol and redesigned the layout as well as robotic program for the Biomek® 2000.

In order to use Promega's DNA IQ™ kits more efficiently, the resin was titrated to 0.5 µL with the lowest amounts of the resin tested for point of saturation. One microliter gave similar results to the recommended seven microliters for up to 100 ng of DNA, even though it was found that only fifty percent of the input DNA was recovered for both of the conditions. Although using the suggested volume of resin did produce a greater yield for 150 ng than lower amounts of resin, this amount far exceeds the required amount of template DNA for amplification; therefore, the use of 1 ul of resin is sufficient for exemplar typing.

The adjustments in sample size, digest and elution volume were made in order to deliver uniform DNA yields. The decisions were formulated based on the quality and the completeness of the profiles generated on the ABI's Prism® 3100 Genetic Analyzer using 1-kV and 22-second injection parameters and 2 µL of the sample amplified using AmpFlSTR® Identifiler™ PCR Amplification Kit (ABI) for 28 cycles. High Sensitivity amplification protocol was used, which includes a two-minute annealing temperature and half reaction volume. Using 50 µL of the digest from half of a swab and 100 µl of its elutant produced full profiles. Some peaks from a few samples were below threshold (75 RFU); nevertheless, with the application of more voltage (3kV) these peaks were resolved. Alternatively, more amplification product could have been injected.

Previous studies with the DNA IQ™ recommended protocol on the Biomek® 2000 demonstrated low level contamination in checkerboard pattern with alternating negative wells. Similarly, the use of seal with the Biomek® 2000's current configuration precluded tip touch, which ultimately led to increased occurrence of spurious alleles. Although it may be impossible to eliminate all sources of contamination, several aspects can be addressed such as aerosols created by shaking, and dripping during DNA transfer, for example when excess DNA is moved to the waste reservoir from the sample and resin mixture. Therefore, the pipetting as well as shaker parameters were modified, and the layout of the Biomek was rearranged. These modifications permit a 96-well plate to be used in its entirety for sample extraction without the need for alternating blanks, as no alleles were determined with the High Sensitivity 31-cycle amplification.

Therefore, 50 ul of a buccal specimen digest with 1 uL of resin and 100 ul of the resultant elutant generate robust, reliable profiles. With a minor modification in the digest volume, this program can be applied to bloodstain exemplars. In this manner, the developed methodology is cost effective and significantly improves laboratory throughput without compromising sample quality.

DNA Extraction, Automation, Buccal Swabs

B96 The Application of Ultraviolet Irradiation to Exogenous Sources of DNA in Plasticware and Water for the Amplification of Low Copy Number DNA

Jeannie Tamariz, BS, Department of Forensic Biology, Office of Chief Medical Examiner of the City of the New York, 520 First Avenue, New York, NY 10016; Kristina Voynarovska, Virginia Commonwealth University College of Humanities and Sciences, 900 Park Avenue, Richmond, VA 23284; and Mechthild Prinz, PhD, and Theresa Caragine, PhD, Department of Forensic Biology, Office of Chief Medical Examiner of the City of the New York, 520 First Avenue, New York, NY 10016*

The goal of this presentation is to describe a technique to eliminate amplification of exogenous DNA from plastic ware and water used in PCR applications without compromising the detection of Low Copy Number DNA.

This presentation will impact the forensic community and/or humanity by providing a fast and cost effective means for sterilization of contaminants present in plastic ware used for PCR detected under Low Copy DNA amplification Methods.

Using High Sensitivity Forensic STR PCR DNA typing methods, it was determined that contamination of presumably sterile plastic ware and water can be present in low concentrations not previously detected by standard PCR methods. One technique commonly used to eradicate the presence of DNA is ultraviolet irradiation; the authors optimized such a protocol used in the treatment of water, tubes, plates, and tips for Low Copy Number DNA (LCN) amplification.

Ultraviolet light from a Stratalinker 2400 (Stratagene, La Jolla, CA) was administered to 0.2mL tubes, 1.5mL tubes, and PCR plates containing up to 500pg of DNA. They were subsequently quantified with an ALU based real time PCR method using the Rotorgene 3000 (Corbett Research, Sydney, Australia) (1, 2). Overall, there was a decrease in concentration of DNA recovered as the duration of treatment increased. Nonetheless, following 45 minutes of irradiation of a PCR plate with 500 pg of DNA, 5.7 pg was still apparent. However, when the plate was raised within an inch of the UV source, less than 0.24 pg of DNA was detected. Additionally, lining the area around the samples with aluminum foil reduced the amount of time necessary for irradiation, as only 30 minutes was necessary to eliminate the presence DNA in the raised PCR plate. Similar experiments were conducted with respective concentrations of DNA in water for 50mL tubes, 15mL tubes, and 1.5mL tubes with comparative results. It is plausible that the aluminum foil increased the amount of reflection in the area thereby enhancing penetration of ultraviolet rays through the walls of the plastic ware.

This protocol was tested for the possibility of inhibitors produced from irradiation of plastic tubes (3). Since these protocols require less irradiation time than previous studies, PCR sensitivity was not affected. Moreover, the lifespan of the ultraviolet lamps was extended. The findings demonstrate that this method is useful as an additional precautionary measure to prevent amplification of extraneous DNA from plastic ware and water without compromising the sensitivity of LCN DNA amplifications.

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Contamination, Ultraviolet Irradiation, Low Copy Number DNA

B97 Beyond Cotton, Nylon and Polyester:

The Emergence of New Types of Fibers and Yarns

Sandra L. Koch, MFS, FBI Laboratory, Trace Evidence Unit, 2501 Investigation Parkway, Quantico, VA 22135*

After attending this presentation, attendees will learn about the new fibers and yarns in the market that fiber examiners need to be aware of in case they show up in their casework.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of staying current in new developments in fiber manufacturing.

Watching the yarn stores, direct mail companies and the internet, Forensic scientists can keep up with fiber innovations previously only reported in the industry journals that are now making it in the marketplace and therefore might end up in casework. While cotton, nylon and polyester are still the most common fiber types produced and sold in the US and world markets, new fibers like soy silk are emerging into the marketplace as well as new and different combinations of fibers in yarns. Stainless steel "threads" are being twisted in with silk strands to make a very strong yarn which is also very soft and pliable. Linen is being molded into flat sheets and then twisted around cotton cores. Hemp themed stores are springing up featuring clothing that is made from 100% hemp or hemp-blends. Bamboo fibers are being promoted for their natural antibacterial properties as well as for being a renewable fiber source. Lurex fibers and non-woven fabrics are currently found making up portions of yarns. Knowing the characteristics of these fibers is essential to maintaining proficiency in fiber examinations so new or unusual fibers won't be misidentified in casework. An overview of the microscopic characteristics and the optical and chemical properties of these fiber types and yarn will be presented because familiarization with the current trends in textile and yarn production is essential for forensic fiber scientists.

Fibers, Yarns, New

B98 Detection and Identification of Personal Care Products in Sexual Assault Cases

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The goal of this presentation is to detect the presence of personal care products on submitted evidence in sexual assault cases. To chemically identify key ingredients in the personal care products so as to demonstrate an association between the victim and suspect in the assault.

This presentation will impact the forensic community and/or humanity by demonstrating an evidentiary link between a victim and a suspect in sexual assault cases when there is no DNA evidence available.

Personal care products, such as ointments, creams, lotions, and personal lubricants, used by assailants in sexual assault cases may serve as important evidence when there is no DNA present. Detection and subsequent identification of key components of personal care products on clothing and in sexual assault kits may also provide supportive case evidence and corroborate victim/suspect statements.

A representative sample of sixteen personal care products, including hydrophobic petrolatum based ointments, water based lotions, sunscreens, face and hand creams, were examined in this study. These products were smeared onto clothing and cotton swabs to simulate case evidence. A flowchart used for the detection of smears and analysis of key components of each type of personal product will be presented.

This study describes the detection of smears on clothing and cotton swabs using a combination of visual observation, short and long wavelength ultraviolet light, the forensic light source, and attenuated total reflectance Fourier transform infrared (ATR-FTIR) spectroscopy. In addition, polarized light microscopy (PLM) is used to detect anisotropic smear components.

This study also describes protocols for the extraction of smears from the substrates and the identification of key components using various analytical methods, including Fourier transform infrared spectroscopy (FTIR), gas chromatography/mass spectroscopy (GC/MS), scanning electron microscopy /electron dispersive X-ray spectrometry (SEM/EDX), capillary electrophoresis, and/or high performance liquid chromatography (HPLC).

Personal Care Products, Sexual Assault, GC/MS

B99 Trace Laboratory Gunshot Residue Contamination Study

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After attending this presentation, attendees will become familiar with gunshot residue analysis by scanning electron microscopy (SEM), the persistence of gunshot residue (GSR) particles, potential for the presence of GSR contamination, and the need for effective and practical QC procedures in order to eliminate contamination concerns.

This presentation will impact the forensic community and/or humanity by serving as an example of a method to ensure that established QC procedures are effective as a primary means to guard against potential contamination.

The preferred analytical method of GSR analysis is by SEM. This analytical method is a highly sensitive and highly specific method to identify particles characteristic of GSR. Characteristic particles can be detected and confirmed to the sub-micron size. However, the sensitive and specific nature of SEM as an analytical method also introduces a strong potential for GSR contamination.

Characteristic GSR particles consist of a single particle containing three elements included in the majority of ammunition primers. These elements include lead (Pb), Antimony (Sb), and Barium (Ba). These three elements are recognized as heavy metals and are known to be very persistent with very little degradation under normal conditions. For this reason, it is commonly accepted that characteristic GSR particles readily transfer from surface to surface, either by secondary or tertiary conditions. Contamination and false positives have been associated with suspect holding areas, police vehicles, brake pads, and fireworks. Also, as with many analytical methods in any laboratory, contamination may occur with poor evidence handling.

This study identified several areas as potential contaminants. For the purpose of the study, these areas included items such as law enforcement officer's hands, analyst's hands, and evidence technician's hands as well as areas such as laboratory evidence rooms and the trace evidence laboratory. The study also includes various common area surfaces throughout the laboratory including, doorknobs and elevator buttons. Finally, the study was expanded to identify the possibility of airborne contamination in a GSR laboratory. Each item was sampled using a GSR collection kit utilizing a carbon adhesive tab. Collection was conducted in a random manner over a period of approximately 15 months. The samples were examined using an automated GSR analysis system on a scanning electron microscope with electron detector system (EDS). Also, the collection occurred with no prior notification to individuals being tested.

The results of this study identified several sources of potential contamination throughout the laboratory building. These areas included exterior doorknobs, elevator buttons, and evidence packages. A minimal amount of GSR (one to two particles) was found on each of these items at various time intervals. The nearby Harris County Sheriff's Office (HCSO) Firearms

Laboratory was identified as a source of contamination as well. However, no GSR contamination was identified inside the trace section of the laboratory. Additionally, no airborne particles of contamination were identified in the stubs set out in the trace laboratory. The results obtained in the contamination study were consistent with laboratory expectations based on existing literature. Further, the study established several QC procedures being practiced by the trace laboratory as being appropriate and practical.

This study will impact the forensic community by serving as an example of a method to ensure that established QC procedures are effective as a primary means to guard against potential contamination.

In conclusion, this study confirms the Harris County Medical Examiner's Office Trace Evidence Section produces accurate, reliable, and repeatable gunshot residue analysis despite the persistence of GSR particles and the potential for contamination.

Gunshot Residue, Contamination, Scanning Electron Microscopy

B100 The Effects of Environmental Exposure on Human Scalp Hair Root Morphology

Alison C. Domzalski, MS, and Peter R. De Forest, DCrim, John Jay College of Criminal Justice, 445 West 59th Street, New York, NY 10019*

After attending this presentation, attendees will gain a greater understanding of the manifestation of hair root degradation from isolated anagen and telogen hairs as a result of environmental exposure.

This presentation will impact the forensic community and/or humanity by shedding light on the fact that hairs from different growth phases are indeed susceptible to changes from environmental exposure. This will add an element of understanding about the interpretation of hair root degradation to microscopic hair examination. It also underscores the importance of hair as evidence in criminal investigations when it comes to classification of certain degradation patterns as being postmortem root bands or patterns resulting from environmental exposure.

The relevance of hair roots as evidence has long been established by forensic scientists, especially in areas of trace evidence examination and molecular biology. It has been shown that microscopic examination of a hair root can reveal information about the hair's growth phase, determine if it may have been unnaturally shed, or show evidence of decompositional changes. Other types of analyses with hair roots include sex-typing and nuclear DNA extraction to yield short tandem repeat profiles, which aid in identifying the subject possessing the hair. In order to glean this information from hair roots, it is important that the root be intact and not extensively altered by the external environment. Unfortunately, there is a dearth of work on hair root degradation. Some of the work that has been done includes examination of postmortem hair samples to assess the frequency of root banding patterns, as well as experimentation with conditions that give rise to decompositional changes in the root. This project explores the results of exposure to different experimental environments on hair root morphology.

In this study, a set of experiments examined the effects of environmental exposure on the morphology of human scalp hair roots taken from follicles in the anagen and telogen growth phases. Anagen phase represents active hair growth and is characterized by amorphous morphology and incomplete keratinization of the root end. Telogen phase represents the quiescent phase of hair growth, distinguished by complete keratinization of the root end. Human scalp hairs, submitted by volunteers, were examined and classified as being from follicles in the anagen or telogen growth phase. They were subsequently exposed to experimental environments of air exposure (negative control), soil burial, and pond water immersion. Examination of these hairs was performed with brightfield light microscopy. Because of the incomplete keratinization of anagen roots, it was postulated that they would be more susceptible to changes from environmental exposure. The results showed more advanced morphological alteration in anagen versus telogen roots in the soil and water environments. The initial experiment revealed certain patterns of change that arose after environmental exposure in four different subjects. The patterns consisted of banding, darkening, shriveling, and fraying. There was also evidence of adhering debris, including the presence of microorganisms, to the roots. Further experiments examined the progressive changes in hair root morphology over time in soil and water exposure. Changes in anagen roots often initially began as apparent shriveling and advanced to erosion of root structure, banding, or complete obliteration of the root structure. This progression began as early as 24 hours of exposure and was advanced at 4 days of exposure. Telogen roots were minimally affected by exposure, yielding only slight fraying and darkening of the root bulb even with the longest exposure times. In later experiments, sterilization of hairs and environments was introduced to determine whether nonsterile conditions produced earlier and more advanced degradation in hairs as compared to sterile conditions. The results showed that they did, suggesting that hair root morphology changes are at least partly attributable to microbial activity from the environment.

This study demonstrates the vulnerability of anagen roots to degradation after soil and water exposure. Certain patterns of change arose in these roots that suggested a breakdown in the structural integrity of the hair at the proximal end. While the causes for these degradation patterns are unknown, preliminary work here has demonstrated that microbial action is a contributor. Banding patterns that have arisen in isolated anagen hair roots exposed to certain environments bear a resemblance to published images of postmortem root banding. Since this issue has arisen in legal cases, there is a need for further research to determine the detailed causes of this banding pattern arising from microbial activity on isolated anagen hairs and on anagen hairs remaining *in situ* in scalp tissue from deceased individuals.

Hair Root Morphology, Environmental Exposure, Degradation

B101 Single Fiber Dye Analysis by Liquid Chromatography Mass Spectrometry (LC-MS) With SWGMAT Dye Extraction Protocol

Derek M. Dorrien, BS, and Michael Sigman, PhD, National Center for Forensic Science, PO Box 162367, Orlando, FL 32816*

The objective of this presentation is to demonstrate that the dye from a single fiber can be extracted following the SWGMAT protocol and then subsequently analyzed by liquid chromatography mass spectrometry (LC-MS) with an electrospray interface in series with a single wavelength UV/VIS absorbance detector, monitoring at a wavelength previously determined by microspectrophotometry.

This presentation will impact the forensic community and/or humanity by providing forensic laboratories with an additional technique for discriminating between single fibers when all other non-destructive methods of comparison fail to discriminate the two.

Textile fibers are encountered frequently in forensic casework and comparison of questioned and known fibers occurs regularly. A single fiber represents the smallest evidentiary unit for which robust analytical methods must be available. There are several non-destructive techniques (*e.g.* polarized light microscopy, fluorescence microscopy and microspectrophotmetry) which are currently employed to discriminate between questioned and known single fibers. When these methods fail to discriminate, alternative techniques such as dye extraction, ultraviolet-visible range (UV/VIS) spectroscopy and liquid chromatography-mass spectrometry (LC-MS) offer a different, yet destructive approach. LC-MS offers advantages over other separation techniques such as thin layer chromatography (TLC) because LC-MS will not only provide separation, but also mass fragmentation unique to the dye. An LC-MS can also be coupled in series with a UV/VIS detector to aid in the detection of conjugated compounds.

The UV/VIS detector can monitor a single wavelength (user defined) and will nondestructively detect compounds that absorb at the specified wavelength. This detection system can facilitate the analysis of single fiber extracts where the dye concentration may be very low. The signal to noise ratio for dilute dyes under LC/MS analysis may be below the limit of detection without the aid of UV-visible absorbance monitoring. If the dye absorbs at the specified wavelength, the UV/VIS detector will aid in determining the retention time. Preliminary analysis by microspectrophotometry will provide a viable maximum absorbance wavelength to monitor when performing the chromatographic separation. A SEE model 1100 microspectrophotometer was used to obtain a visible absorption spectrum for each fiber sample examined in this research.

Previous work has shown that fiber dyes can be extracted using methanol as a solvent and then analyzed by LC-MS (1); however, methanol extraction does not offer the dye classification information afforded by the SWGMAT protocols. Five fiber samples previously analyzed by methanol extraction (1) were reanalyzed following the SWGMAT dye extraction protocol. Each dye was extracted from the fiber with high efficiency. A thread of each sample was analyzed separately to confirm the single fiber results (*e.g.* retention time, mass spectral fragmentation). All separations were performed on a C18 reverse phase column and the instrumentation used was an Agilent 1100 Series LC-MS with an electrospray ionization source and a variable wavelength UV/Visible absorbance detector. Control blank samples consisting of the extraction solvent(s) were analyzed in each case.

Overall, LC-MS proves to be a convenient yet sensitive technique for the analysis of single fiber dye extracts, and is compatible with SWGMAT dye extraction protocols. All single fiber extracts were detected using both the single wavelength detector and the mass selective detector. Single fiber analysis would benefit by incorporating this technique into the investigative routine due to the techniques high discriminating power.

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LC-MS, Fiber Analysis, Fiber Dyes

B102 The Development of Microfluidic Approaches to the Detection of GHB

Maiko Kusano, BA, and Bruce R. McCord, PhD, Florida International University, Department of Chemistry, 11200 SW 8 Street, Miami, FL 33199*

The goal of this poster is to provide the forensic community with novel indirect detection methods of GHB using capillary electrophoresis, and further to develop microfluidic approaches to the detection of GHB in biological samples. The development of microfluidic devices for rapid isolation and detection of GHB and other drugs of abuse will provide a simple, inexpensive, and disposable "mini-instrument" with wide ranging forensic applications.

This presentation will impact the forensic community and/or humanity by showing the forensic community the importance of developing rapid, sensitive, and reproducible detection methods of GHB and other drugs used in drug-facilitated sexual assault. Indirect fluorescence detection eliminates the need of derivatization of the drug prior to analysis. Development of the microfluidic approaches to this detection method will allow extremely rapid detection and isolation method with minute amount of sample.

The increasing abuse of illicit drugs over the past years has raised the demand for forensic laboratories and researchers to develop faster and more sensitive analytical methods of detection. With the rise of illicit drugs used for recreational purposes and drug facilitated sexual assault, there is a constant push for the development of better detection techniques. This is especially true with the popular "date-rape drug" gamma-hydroxybutyrate (GHB), as incidents of GHB abuse and GHB-related emergencies and deaths have become frequent.

Several issues exist with GHB detection. The small size and polar nature of the GHB molecule makes the drug difficult to separate from biological specimens. Gas chromatography, coupled with various modes of detection, has been employed as the analytical methods of detection and quantitation of GHB. However, in order to perform GC analysis, the GHB molecule must be derivatized prior to injection, as its polar nature results in thermal instability at the heated injection port of the gas chromatograph. Capillary electrophoresis (CE) has become a viable alternative to the traditional screening methods such as gas chromatography and immunoassay due to its simplicity and sensitivity. CE has very high efficiencies, permitting a complex array of molecules to be separated simultaneously. CE system also requires only minute amounts of the sample and can be used as a quantitation tool with minimal pre-treatment of the sample, which is ideal for forensic analysis. Furthermore, CE is a good candidate for miniaturization that could be applied to the microfluidic systems.

The main goal of this research is to develop a rapid, sensitive, and reproducible detection method of GHB using indirect fluorescent detection techniques with capillary electrophoresis. Indirect fluorescent detection eliminates the need of derivatization, the most time-consuming step in the analytical method. This research utilized eosin, a fluorescent dye, as an indirect anionic probe. Since most drugs do not naturally fluorescence, when a drug is present in the detection zone, the drug displacing the fluorescent electrolyte produces a negative response.

Previous studies have been published on the indirect fluorescent detection of inorganic and organic anions, arsenic compounds, fatty acids, and polysaccharides. However, this method has not yet been extended to the detection of acidic drugs such as GHB. In this study, a Beckman Coulter P/ACE MDQ CE system was used. The capillary used was an uncoated fused silica with an inner diameter of 75µm. Argon-ion laser was used for indirect laser-induced fluorescence detection (excitation at 488nm). Samples were injected electrokinetically and the analytes were separated using 12kV. The run buffer contained sodium borate, boric acid, DETA, and eosin as the fluorescent probe. Anion standards have been detected using the eosin buffer, and small acidic drugs such as GHB are expected to show similar effects. In addition, the potential for performing the indirect fluorescent detection on the microchip was investigated. The microfluidic device used was the Micralyne Microfluidic Tool Kit instrument consisting of high-voltage power supplies coupled with a Nd:YAG diode-pumped solid-state laser detection system (532nm). Eosin dye in TBE buffer was successfully detected, demonstrating its compatibility with the green laser system in addition to the argon-ion laser system. The dye was then used as the background fluorophore in the microfluidic system.

GHB, Microfluidics, Indirect Fluorescence

B103 Development of 8 New STR Miniplexes for Their Usage in the Improved Analysis of Degraded DNA Samples

Carolyn R. Hill, MS, Michael D. Coble, PhD, and John M. Butler, PhD, National Institute of Standards and Technology, 100 Bureau Drive, Gaithersburg, MD 20899*

After attending this presentation, attendees will learn the importance of the development of these 8 new STR miniplexes within the forensic community and their value in the analysis of degraded DNA will be discussed, as well as the approach used in their development.

This presentation will impact the forensic community and/or humanity by enhancing the knowledge of the forensic community in regards to methodologies used in the development of 8 new STR miniplexes for their usage in the improved analysis of degraded DNA samples.

The loci in each of the 8 miniplexes (3) loci per miniplex for a total of 24 new loci) were chosen based on their size and location on certain chromosomes. The candidate loci are all either located on chromosomes that differ from the 13 CODIS core loci or are at least ~ 50 Mb apart from an existing CODIS loci on the same chromosome, and therefore unlinked from that particular marker. New autosomal STR loci are being examined because many of the CODIS core loci have large allele ranges (*e.g.*, D21S11 and FGA) that make it impossible to create small PCR products. A number of studies have demonstrated that successful analysis of degraded DNA samples improves with smaller sized polymerase chain reaction (PCR) products (1). In addition, by moving PCR primers closer to the STR region, it is possible to decrease the possibility of allele or locus-dropout that may occur in degraded samples.

The characterization of the 24 miniSTR loci used in the 8 new miniplexes will be discussed along with the various processes used throughout their development. The first two miniplexes were previously characterized (2). The process for their development and characterization form the basis of the current work. The remaining 18 miniSTR loci to be tested were determined based on certain properties including size and location of the marker (*e.g.* from the literature, Genbank sequences, and human BLAT searches) (3). It was then necessary to design the forward and reverse primers for each locus using Primer3 software. These primers were then tested in the AutoDimer software (4) to determine the compatibility of the primers used in multiplex. Next, the optimal concentrations of primers must be empirically determined for balanced dye signals, eliminating bleed-through from one dye to another. The primers were separated into 6 new multiplexes in addition to the 2 multiplexes that were previously developed and were evaluated across more than 600 samples representing the three major populations in the U.S. Caucasian, African Americans, and Hispanic. Several alleles from each locus were sequenced to define the number of repeats. From this information, bins and panels were created for each locus in the GeneMapper ID, version 3.2 software. The population data was then genotyped, and by using the PowerMarker data analysis software, allele frequencies and population statistics within each locus were determined. Finally, allelic ladders were created for each of the miniplexes using the appropriate population samples.

These 8 new miniplexes with 24 different loci in total have all been designed and are currently being evaluated using population samples.

Eight novel miniplexes have been developed to improve analysis of degraded DNA samples and complex forensic paternity cases where the 13 CODIS loci are insufficient.

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Short Tandem Repeat DNA Typing, Degraded DNA, Reduced Size PCR Products

B104 Detection of Drugs Implicated in Drug-Facilitated Sexual Assault on a Microfluidic System

Carla E. Turner, BS, and Bruce R. McCord, PhD, Florida International University, 11200 SW 8th Street, CP 175, Miami, FL 33199*

After attending this presentation, attendees will understand the way microfluidic systems operate and how they can be applied to the highly sensitive detection of multiple drugs in DFSA.

DFSA is violent crime which deeply impacts victims, their families, and the community. It is currently difficult to prosecute due to low quantities of drugs present in both seized and biological samples. This presentation will impact the forensic community and/or humanity by demonstrating the need for a sensitive and easy to use system for the detection of DFSA drugs and why microfluidic systems have the potential to achieve such a result.

Victims of drug-facilitated sexual assault (DFSA) must not only face the same issues as all rape victims, but they are also robbed of their memories, making it more difficult for them to recover psychologically. As a result they are less likely to report the assaults and when they do the cases are harder to prosecute because the victim is often unable to recall and recount the actual events. The difficulty of prosecuting DFSA cases is compounded by a lack of physical evidence. Only low doses of a drug are needed to bring about the desired disabling effect, and many of these compounds are metabolized very rapidly. Many of the drugs used to incapacitate victims may also render them unconscious. Often, by the time a victim can be examined, her body has eliminated most of the drug. The low concentration of drugs in the body at the time of analysis can make it difficult to obtain a quantitative result. In addition, many laboratories do not have the specialized equipment or protocols necessary to analyze such samples.

The goal of this research is to develop inexpensive screening systems for the detection of DFSA drugs in seized and toxicological samples using microfluidic systems. Microfluidic detection systems are recently developed analytical tools that perform electrophoretic separations in miniature channels etched onto glass or plastic chips. The systems and utilize minute (μL) quantities of solvents and samples are coupled to a laser for fluorescence detection. The high sensitivities obtained by these devices allow them to rapidly detect low sample concentrations with a high s/n ratio. This presentation will demonstrate how microfluidic systems operate and their application to the detection of multiple drugs.

Many drugs of abuse are basic and contain amine functionalities which can easily be targeted by fluorescent derivatizing agents. For example, techniques have been developed for demethylating and derivatizing opiates with fluorescein isothiocyanate (FITC).[1] These procedures have been adjusted to use rhodamine ITC which is compatible with the 532nm Nd:YAG laser coupled to the microfluidic system. Rhodamine dyes are extremely brilliant and very small concentrations are needed to produce a strong signal. These types of derivatizations are easily performed on primary and secondary amines and tertiary amines can be derivatized as well following a demethylation procedure.[2] Alternatively, since derivatizing can take hours to complete, basic drugs that are cationic at low pH can be detected via indirect LIF. Current work involves the demethylation and/or derivatization of amphetamines, opiates, and other basic drugs with RITC as well as indirect detection of these same drugs in a rhodamine buffer.

The goal is to develop a small, inexpensive, and portable system that will require minimal sample preparation. The ideal system will incorporate all the steps of an analysis, from sample preparation to detection on a single microchip, and be versatile enough to analyze multiple types of drugs. Hospital employees and law enforcement officers would then be able to conduct rapid analysis of samples on the spot without the need for extensive training. The sensitivity of the system also ensures that prosecutors will have access to reliable results even if they are taken days after an attack has occurred.

References: [1] Alnajjar, A. et. al., *Electrophoresis* 2004, 25, 1592-1600.
[2] Olofson, R.A., Pure appl. Chem. 1988, 60, 1715-1724.

DFSA, Microfluidic, Fluorescence

B105 Removal of Calcareous Deposits From Firearms Artifacts From

the Fetterman Battlefield Site

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After attending this presentation, attendees will learn how to remove calcareous deposits from firearms evidence recovered from semi-arid environments.

This presentation will impact the forensic community and/or humanity by presenting to the forensic science community a method for successfully cleaning metallic artifacts (*e.g.* bullets and cartridge cases) preparatory to microscopical examination.

A variety of firearms-related artifacts were recovered from the site of the 1866 Fetterman Battle, which occurred in what is now northern Wyoming. These artifacts include expended cartridge cases and bullets representing from three models of Spencer repeating carbines, .58 cal. Springfield rifled muskets, and expended percussion caps from .58 cal. Springfield rifled muskets, and bullets fired from a variety of pistols. A preliminary examination of the artifacts revealed that almost all were heavily coated with calcium carbonate deposits that would interfere with microscopic comparisons of firing pin impressions and rifling marks. It was therefore necessary to develop a method for cleaning these artifacts that would not damage the microscopic details on the surfaces of the artifacts. Ultrasonification was rejected because of the brittle condition of many of the copper cartridges. Therefore chemical cleaning methods were considered. Two commercial products designed for the removal of lime deposits from cooking ware were tested: CLR (Jelmar, Skokie, IL) and Lime-A-Way (Reckitt Benckiser, Inc., Parsippany, NJ). These products are widely available in hardware and grocery stores. A 10% (w/v) aqueous solution of sodium metaphosphate was also tested. Museum conservators recommend the use of sodium metaphosphate solutions for removal of calcareous deposits from metal artifacts such as coins.

Eighteen expended Spencer cartridges recovered from an area southwest of the battle site (and hence not believed to have been fired during the battle) were selected for a comparison of the three cleaning solutions. The cartridges were randomly divided into three groups of six cartridges each. The base, including the firing pin impression, of each cartridge was photographed prior to cleaning. Each cartridge was treated in the following manner: (1) the base of the cartridge was gently swabbed with a cotton-tipped applicator saturated with one of the cleaning solutions until it appeared that no more calcareous deposit was being removed; (2) the base of the cartridge was then rinsed with water and acetone; and (3) a thin layer of paste wax was then applied to the base of the cartridge to prevent further corrosion. The cartridges were then photographed as described above. The photographs of each cartridge were compared before and after treatment to assess the degree of removal of the calcareous deposits.

None of the cleaning solutions appeared to damage the microscopic detail of the firing pin impressions. Lime-A-Way was found to work the best in cleaning the cartridges: it worked the fastest and removed calcareous deposits best from the microscopic features of the firing pin impressions. CLR did not remove all of the calcareous deposits from the microscopic features of the firing pin impressions. CLR is more expensive per unit volume than Lime-A-Way. Sodium metaphosphate did not perform satisfactorily, in that it left significant amounts of deposits in the firing pin impressions.

Firearms, Archaeology, Microscopy

B106 Examination of Gunshot Residue Patterns on Dark Clothing Using the Video Spectral Comparator 2000 for Firing Distance Determination

Christina S. Atwater, MFS, 3550 Ruffin Road, #185, San Diego, CA 92123*

After attending this presentation, attendees will gain a greater understanding of the effect of this research on the functioning of forensic scientists and investigators.

This presentation will impact the forensic community and/or humanity by leading to a wider use of the Video Spectral Comparator 2000 by firearms examiners in gunshot-residue detection and firing distance determination. My findings demonstrate that this method is more efficient and economical than conventional chemical and infrared photographic techniques.

Determination of the muzzle to target distance is often a critical factor in criminal and civil investigations involving firearms. When possible, firearms examiners use the suspect firearm and the same type of ammunition to make test fires from different distances into targets. This enables them to approximate the gunshot residue pattern dimensions found on the clothing and/or body of the victim. However, if the clothing worn by the victim is dark and/or bloody it may be difficult to see and record the gunshot residue pattern. In 1988, Frank Trostle of the Madison Wisconsin (USA) Police Department published an article "Photographic Examination of Gunshot Powder Burn Patterns Through the Use of Infrared Film" [JFI, 1988; 38(2); 57-61] discussing a solution to this problem. Trostle stated: "By extending the photographic spectrum to record the effects of reflected invisible infrared radiation, an investigator can sometimes obtain evidence that is not normally visible due to the faintness of the stain or dark color of the fabric being examined." This poster will show that an instrument that is routinely used by forensic document examiners, the VSC 2000 (Foster & Freeman Ltd, Evesham, Worcestershire, UK), can quickly and easily visualize gunshot residue patterns without any specialized film and with immediate viewing, saving, and printing of the image.

Firing Distance Determination, Infrared Imaging, Gunshot Residue Patterns

B107 Methods of Calculating a Firing Distance by Atomic Absorption Analysis of Lead From the Area of Target

Roberto Gagliano-Candela, and Anna Pia Colucci, PhD, University of Bari, Dipartimento Medicine Interna Medicina Pubblica, Policlinico, Piazza G. Cesare n.11, Bari, 70124, Italy*

After attending this presentation, attendees will be briefed on the identification of gunpowder residues has a great importance in the resolution of forensic science problems and especially in legal medicine, for shooter recognition or shooting distance determination.

This presentation will impact the forensic community and/or humanity by assisting individuals interested developing methods of calculating a firing distance by atomic absorption analysis of lead from the area of target.

In a previous study, metallic gunpowder residues distributions were visualized on targets at different distances after their treatment with a specific colorimetric reaction. Relationships between the residues amount and the firing distance were demonstrated and the distribution of the residues appeared in concentric circles around the entrance hole. The diameter of the circles depended on the weapon type, propellant, and distance. Among metallic elements on the target, lead was chosen because it is always present in modern primers.

In the present study, test shots were made with a Colt 38 Special at 5, 10, 20, 25, 30, 35, 40, 45, 50, 60, 80 and 100 cm target distances. The target was created with sheets of Whatman n. 1 paper on a polystyrene support.

Each target was subdivided into three annuli carefully cut out (with diameters of 2, 3, and 4 cm, respectively). Each sample of residue was placed in a test tube and 20 ml hydrochloric acid 0.1 N was added. Test tubes were capped and placed at 45°C in a bain-marie. After dilution, 25 mcl of extracts were analyzed by graphite furnace atomic absorption spectrophotometry.

Lead analysis performed for each annulus yielded a linear relation between the firing distance (cm) and the logarithm of lead amounts (mcg/cm^2) in definite target areas (areas 2 +3):

$$[\ln d\mathrm{Pb}_{2+3} = a_0 + a_1 l],$$

where $d\mathrm{Pb}_{2+3}$= lead mcg/cm^2 of area 2+3; a_0 and a_1 are experimentally calculated; l = distance in cm.

Firing Distance, Lead Residues Analysis, Spectrophotometry Atomic Absorption

B108 Environmental and Forensic Application of Isotopic Ratio Mass Spectrometry (IRMS)

Sung Woo Park, PhD, Chungnam National University, 220 Gung-dong Yusung-gu, Daejeon, 305-764, Korea; Ji Sook Min, Sang Cheol Heo, and Jong Seo Park, National Institute of Scientific Investigation, 331-1 Shinwol7-dong Yangcheon-gu, Seoul, 158-707, Korea; and Paul R. Philp, PhD, University of Oklahoma, Norma, OK 73019

The goal of this presentation is to discuss IRMS and the identification of oils.

This presentation will impact the forensic community and/or humanity by demonstrating the technique which can be used to compare samples on the basis of their isotopic ratio, which is mostly used for lighter elements such as H, C, N, O and S. Through physical, chemical and biological processes, isotopic ratios of these elements can change, introducing interesting features to material batches that can be used in comparison investigations.

Isotope ratio mass spectrometry can be used to compare samples on the basis of their isotopic ratio, which is mostly used for lighter elements such as H, C, N, O and S. Through physical, chemical, and biological processes, isotopic ratios of these elements can change, introducing interesting features to material batches that can be used in comparison investigations. Forensic scientists work on cases which have a need to establish a firm relationship between a source and spilled product, to identify the inflammables which have been contained in collected residues at the fire scenes of the arson with ones originating from suspects, and to identify engine oil on the victim of a hit and run incident with suspected vehicles'. The results obtained by gas chromatography (GC) and GC-mass spectrometry (GC/MS) may be ambiguous or misleading because of weathering of the oils. Products such as gasolines, even if heavily weathered through evaporation, will still maintain their original isotopic signature in the weathered residue. In this manner, even though the GC fingerprints of a suspected source and product in the environment will appear very different, the isotopic composition of individual compounds in the two samples will still be able to show whether the samples are related or not. Oil samples from hit and run accident victims would be another application whereby it would be possible to relate oil spots on the victim with oil samples taken from the suspected vehicle through a combination of the isotopes and GC and GC/MS. This paper will present an overview of the techniques used to obtain carbon isotope data (bulk ä13C) for individual samples in gasolines and engine oils. S-oil was distinguished from others (HD and SK) in gasolines and engine oils regardless of weathering. Conclusively, this technique will be a powerful tool in particular cases involving a variety of environmental and forensic applications.

IRMS, Engine Oil, Identification

B109 Compounds Present in Human Scent: A Population Study

Paola A. Prada, BS, Allison M. Curran, PhD, Florida International University, University Park Campus, CP 345, Miami, FL 33199; Adee A. Schoon, PhD, Leiden University, Canine Unit, Netherlands National Police Agency, PO box 530, Nunspeet, 8070 AM, Netherlands; and Kenneth G. Furton, PhD, Florida International University, University Park Campus, CP 345, Miami, FL 33199*

After attending this presentation, attendees will the understanding of key volatile organic compounds found in human hand odor samples reinforcing the individual odor theory across a population study.

This presentation will impact the forensic community and/or humanity by demonstrating the usefulness of human scent as a viable method for differentiation among individuals.

The ability of canines to distinguish humans based on their scent is well established. When a suspect is identified, human scent collected from a crime scene can be compared to that of odor collected from the hands of a suspect through use of a canine line-up. The majority of scientific research into human odor has been conducted on sweat collected from the armpit area and the feet; however, forensically hand odor is of greater interest. The scent collected from a crime scene is usually (collected from) an object that was handled by the perpetrator. The collection of scent from suspects in criminal investigations is most often collected from the palms of the hands. Different regions of the body vary in the presence and amount of secretory glands and thus the odor produced from different areas may also vary. Hand odor is said to be a combination of the influence of both the sebaceous and eccrine glands, whereas odor collected from the armpit also contains influence of apocrine gland.

Headspace solid phase micro-extraction in combination with gas chromatography / mass spectrometry (SPME-GC/MS) has been employed for the analysis of hand odor collected from a population of sixty people consisting of thirty males and thirty females ranging in age from seventeen to twenty-eight. The collection process consisted of washing the hands and forearms using an olive oil based fragrance-free soap, air drying, rubbing the hands over the hair on the forearms, and then holding a piece of pretreated gauze for 10 minutes between the palms of the hands. The pretreatment of absorbers consisted of a methanol-modified supercritical fluid extraction (SFE) and ensured the analytical cleanliness of the collection material prior to use. This process yielded a combination of secretions from both the eccrine glands present in the palms of the hands and sebaceous glands from the hair follicle on the forearms. These samples were allowed to sit for 24 hours, and then analyzed using a divinylbenzene/carboxen on polydimethylsiloxane SPME fiber chemistry.

The evaluation of sixty subjects shows that volatile profiles among individuals express qualitative similarities with stable quantitative differences between individuals, as well as stable qualitative differences among individuals. The detected compounds consist mainly of five groups by functionality: alcohols, aldehydes, alkanes, acid esters and ketones. Some of these compounds were detected across the population with a high frequency, such as phenol, nonanal, and decanal which were present in 100% of the subjects. 6,10-dimethyl-5,9-Undecadien-2-one and hexanedioic acid-dimethyl ester are express in approximately 80%, whilst other compounds including heptanal and octanal are seen in less than 30% of the population.

Previous work has shown the ratio pattern of compounds present in the headspace of collected armpit odor samples from males to be relatively stable for an individual and discernable among a population, yet the stability of female armpit profiles proved more difficult. However, hand odor collected from females has shown to be relatively stable in weekly samplings across a month. An explanation for this may be that hand odor is produced without contributions of the apocrine gland which is influenced by the menstrual cycle in females. This study demonstrates that compounds present in the volatile profiles obtained from collected hand odor samples can also be differentiated among a population, and thus supports the individual odor theory suggested through canine human scent discriminations. The relation of the components of hand and armpit odor is

important in establishing the compounds present in the overall odor of an individual and will also be discussed.

Human Scent, SPME-GC/MS, Canines

B110 Quantitative Analysis of Morphine in Urine by GC/MS with Deuterium Internal Standards

Chao-Hsin Cheng, MS, and Hsien Ming Wu, MS, Scientific and Technical Research Center, Ministry Justice Investigation Bureau, 74, Chung-Hua Road, Hsin-Tien City, Taipei County 231, Taiwan, Republic of China*

Traditional extracting procedures have too many steps to get the metabolites of opiate that makes unpredictable variation; therefore, the authors tried to simplify the procedure by using appropriated amount of Ammonium hydroxide to make the heated acidic urine becoming a suitable buffer for extraction, directly. The easier procedure makes the examiner accomplishing the more routine works, and decreases the unnecessary variation from the manual operating. Meanwhile, deuterated internal standards replace nalorphine as the internal standard to identify the retention time and selected ion. The deuternated morphine and codeine can correct the response for with the abundance of the morphine and codeine; therefore, the analysis of quantitation got good reproducity for each run on the GC/MS.

Morphine, Urine, GC/MS

B111 Quantitation of Amphetamines, Ketamines, and Opiates in Human Drug Hair by GC/MS

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Human hair subjects of chronic drug abuse (20-32 ages) in Taichung female prison were analyzed for morphine (MO), codeine (CO), 6-acetylmorphine (6-AM) , amphetamine (AM) , methamphetamine (MA) , 3,4-methylenedioxyamphetamine (MDA) , 3,4-methylenedioxymethamphetamine (MDMA) , and 3,4-methylenedioxyethylamphetamine (MDEA) by GC/MS. Due to the determination of ketamine which has been abused as party drug is critical need, additional criminal cases were analyzed for simultaneous quantitation of AM, MA, MDA, MDMA, MDEA, Ketamine (KT) and Norketamine (NK). After wash procedure was performed, the extraction method included hydrolysis in alkaline or methanol depending on stability of drugs, following with solid-phase extraction or liquid-liquid extraction and derivatization. 6-acetylmorphine was determined in heroin addicts. AM and MA were all found but MDMA in methamphetamine abuse from Taichung prison cases, party drug MDA, MDMA, as well as ketamine and norketamine were simultaneously found in most of criminal cases.

Human Hair, Chronic Drug Abuse, Wash

B112 Re-Evaluation of a Contamination Threshold: Mixture and Contamination Detection Limits Redefined During the Validation of the ABI 3100® Genetic Analyzer

Kerry L. Maynard, MFS, Timothy P. McMahon, PhD, Robert S. Oliver, MSc, Chad M. Ernst, BS, Suni M. Edson, MS, Suzanne M. Barritt, MS, and Brion C. Smith, DDS, Armed Forces DNA Identification Laboratory, 1413 Research Boulevard, Building 101, Rockville, MD 20850*

After attending this presentation, attendees will learn the applicability of re-defining their laboratories own contamination thresholds when implementing new and potentially more sensitive techniques.

Each forensic laboratory must have a contamination threshold that is deemed sufficient to control for extraneous profiles. This presentation will impact the forensic community and/or humanity by demonstrating why re-evaluation of such thresholds should occur when new technologies are implemented into standard procedures to insure that the standards set for sample quality are still being met and that the integrity of the reported profile is not called into question.

Contamination in forensic DNA laboratories is a constant threat. Each laboratory must examine its own guidelines and requirements for generating DNA profiles in order to ensure that the authentic sequence is being reported. In 'ancient' or low-copy number (LCN) DNA labs, this is especially critical as the target DNA can be difficult to acquire and is easily overwhelmed by 'modern' DNA.

At the Armed Forces DNA Identification Laboratory (AFDIL), numerous steps are taken to ensure the reporting of an authentic mtDNA profile. These steps are covered quite thoroughly in Edson, et al. (2004) and will not be revisited here. What is of import to this current presentation is the usage and detection of extraction and amplification controls. Negative controls are commonly used in a forensic setting to evaluate potential contamination in amplification. At AFDIL, it is standard operating procedure for non-criminalistic casework to not carry these controls through sequencing unless a visible product band is produced on a 2% agarose gel stained with ethidium bromide (EtBr). To evaluate the Scientific Working Group on DNA Analysis Methods' (SWGDAM) 2003 recommendation that all laboratories handling DNA samples process all amplification controls, AFDIL undertook at two-month trial period. During this time all controls were sequenced irrespective of results on a product gel. Over these two months, 2097 controls were processed on the ABI PRISM® 377 DNA Sequencer from hypervariable region, primer set and mini-primer set amplifications. Results demonstrated that zero out of 1306 hypervariable region primers or primer sets controls produced readable sequence; and that 10 out of 791 (1.26%) mini-primer sets controls produced readable sequence. In no instance did the contamination negatively affect the results of the cases. This study cost the laboratory an additional $77,000, or $37.00 per sample, not including the cost of manpower.

However, in the spring of 2005, the ABI 3100® Genetic Analyzer and a novel sequencing approach were validated for processing ancient skeletal remains at AFDIL. As this system is purported to be more sensitive to low concentrations of DNA, part of the validation included defining the thresholds of the 3100 for mixture and contamination detection. To evaluate contamination detection thresholds, a total of 47 negative and reagent blank controls generated during the course of normal casework were examined. One out of the 47 controls produced a visible band on an EtBr stained agarose gel, and was not sequenced. After sequencing and analysis on the 3100, two out of the 46 other controls (4%) produced low quality data. This suggests that the ABI 3100® Genetic Analyzer may be more sensitive than the older 377 platforms.

Further supporting this hypothesis was the evaluation of the 3100 for mixture detection thresholds. To evaluate these, sample extracts from both high and low quality DNA amplicons were mixed in various ratios (9:1, 7:3, 5:5, 3:7, and 1:9), then sequenced and analyzed on the 3100. Mixtures were detected at a 1:9 ratio.

Based on the initial results garnered from the validation, it was

decided that for the first six months of processing casework samples on the ABI 3100®, all negative controls and reagent blanks irrespective of agarose gel product results will be processed in order to reset the contamination threshold. This presentation will discuss the contamination and mixture results obtained during the validation of the 3100 as well as the contamination thresholds defined during the 6-month evaluation of all amplification controls on the 3100.

Each forensic laboratory must have a contamination threshold that is deemed sufficient to control for extraneous profiles. Re-evaluation of such thresholds should occur when new technologies are implemented into standard procedures to insure that the standards set for sample quality are still being met and that the integrity of the reported profile is not called into question.

The views expressed herein are those of the authors and not necessarily those of the Armed Forces Institute of Pathology, the U.S. Army Surgeon General, nor the U.S. Department of Defense.

Contamination Threshold, mtDNA, Validation

B113 The Applicability of Microchip Electrophoresis in Developing Methods for Low Copy Number Short Tandem Repeat DNA Profiling

Henrietta Margolis-Nunno, PhD, JD, Ewelina Bajda, BS, Miriam Cohen, BS, and Lawrence Kobilinsky, PhD, John Jay College of Criminal Justice, C.U.N.Y., 445 West 59th Street, New York, NY 10019*

After attending this presentation, attendees will learn about the applicability of the Agilent 2100 Bioanalyzer as an instrument that can be used for research and technique development in the analysis of short tandem repeats in low copy number DNA samples commonly found at crime scenes.

This presentation will impact the forensic community and/or humanity by demonstrating how the forensic community performing DNA analysis research may adopt the use of this instrument as a screening tool prior to performing lengthier, laborious, and more expensive techniques.

The Bioanalyzer utilizes microfluidic technology for the separation, sizing and quantitation of DNA fragments by capillary electrophoresis (CE). It is fully automated, uses unlabeled primers, requires less sample volume and has shorter run times than standard CE and gel electrophoresis. This study was performed to evaluate the usefulness of the Bioanalyzer in STR DNA analyses of low copy number (LCN) DNA samples. The Bioanalyzer was first examined for its ability to resolve heterozygous STR alleles and for the reproducibility and accuracy of its sizing calls. Resolution studies, employing commercial STR triplex primers and DNA with known STR alleles, demonstrate that the Bioanalyzer is capable of distinguishing heterozygous STR alleles that are 7-8 base pairs apart as two distinct peaks, and homozygous alleles as a single sharp peak. Heterozygous alleles differing by 4 base pairs are frequently distinguishable as well. Fragment sizing accuracy and reproducibility studies, using STR fragments of known sizes, and DNA standards and ladders, show that although certain STR loci consistently show relatively larger sizing errors than others, all results are reproducible with low values for coefficient of variation and all are within an error range of 5%. In studies using DNA concentrations that included those found in LCN DNA, Bioanalyzer profiles of STR triplex PCR products show DNA concentration dependent differences and a ten-fold increase in sensitivity when the number of PCR cycles is increased from 30 to 34. In addition, the type of stochastic variation that is common to the amplification of LCN DNA is easily visible with the Bioanalyzer; variations in allele or locus drop out and imbalance, and stutter allele drop in were all seen when LCN DNA concentrations of 25 and 2.5 pg were amplified for 34 cycles. Thus, although allele sizing is not as precise as with standard capillary electrophoresis (CE), the ease and speed of the Bioanalyzer coupled with its resolution of heterozygous alleles, the reproducibility of its results, and the sensitivity of its profiles to initial DNA concentration and LCN stochastic variation, make it an ideal instrument for preliminary research and technique development in the analysis of STRs in LCN DNA samples.

Capillary Electrophoresis, Short Tandem Repeats, Low Copy Number

B114 Recovery of DNA From Secondary Transfer to Weapons

James Sebestyen, BS, Marian G. Acevedo Álvarez, Ewelina Badja, BS, Jeannie Tamiriz, BS, Mechthild Prinz, PhD, and Theresa A. Caragine, PhD, Office of the Chief Medical Examiner of the City of New York, Department of Forensic Biology, 520 First Avenue, New York, NY 10016*

The goal of this presentation is to demonstrate that although DNA is detected from secondary transfer, probative profiles are only generated from primary transfer.

This presentation will impact the forensic community and/or humanity by suggesting that the presence of DNA from secondary transfer does not compromise the profile determined from the primary DNA donor.

Studies have demonstrated DNA recovery from cellular material deposited on objects through handling. However, the resultant DNA profiles often consist of DNA from more than one donor; these individuals touched the object directly (primary transfer) or their DNA was transferred through contact with the primary donor (secondary transfer). When the object handled is a weapon or another item associated with a crime, the implications of secondary transfer of DNA are significant. Therefore, DNA transferred to weapons, from primary as well as secondary transfer was measured, and the profiles generated were evaluated for the presence of the secondary donor.

Nine pairs of individuals each touched a screwdriver, a glass bottle, a wooden bat, a metal rod, a metal handle of a knife, a plastic (wood appearing) handle of a knife, a plastic scissors handle, a handgun treated with gun cleaner or an untreated handgun for sixty seconds. The subjects then shook hands for three seconds with their partner of another gender and touched the same weapon that had been thoroughly cleaned. According to the protocols and interpretation guidelines developed by a high sensitivity laboratory for low copy number DNA, the samples were collected and processed. The DNA recoveries from those weapons handled after handshaking were consistently higher than from those subjected only to primary transfer. All of the samples tested for secondary transfer produced mixtures, and although the DNA alleles of the secondary donors were apparent in every sample, they were always the minor contributor.

Alternatively, the partners shook hands before the primary DNA donor touched the weapon, and after cleaning, ten minutes later, the primary donor touched the weapon again. In a third experiment, a weapon was divided into three clean areas and was touched three times by the primary donor following a handshake. In this manner, the persistence of secondary transfer could be calculated. The DNA yield varied from trial to trial, even between replicate scenarios with respect to sequential recovery. Neither the sequence of the handling or the gender of the primary donor appeared to be a contributing factor to the detection of the secondary component, which was the minor contributor.

For all experiments, the alleles of the major component were always those of the primary DNA donor and often produced a probative profile. Even for partial profiles such as one from an amplification of 4 pg of DNA, the primary donor was included in the major component. Regardless of gender or shedding potential, the minor component was consistently the secondary donor. This minor component could only be deduced at the more robust loci and those containing exclusively heterozygotes. Moreover, some samples consisted of multi-component mixtures, and the

alleles of the secondary donor were occasionally the same height as spurious alleles. Therefore, no conclusions could be drawn regarding the profile of the minor component, the secondary donor.

Low Copy Number DNA, Secondary Transfer, Weapons

B115 The Effect of PCR Inhibitors on the Amplification of Low Concentrations of Template DNA Using Reduced-Size STR Primer Sets

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After attending this presentation, attendees will be familiar with the affect of single and mixed PCR inhibitors on the amplification of low concentrations of human template DNA, as well as the effect of amplicon length on PCR inhibition.

This presentation will impact the forensic community and/or humanity by providing information on how various inhibitors affect DNA amplification at different template concentrations. This information may affect how amplification of low concentration samples will be approached in the future with respect to dealing with inhibitors.

The presence of source contaminants commingled with DNA template presents a challenge in forensic human identification. The effects of these compounds on the PCR reaction can vary from attenuation to complete inhibition of the amplification reaction. PCR inhibitors can be endogenous or exogenous to the reaction. Endogenous contaminants usually originate from insufficiently purified DNA template, and the inhibitor is co-extracted with the target DNA during the extraction or purification step. Exogenous contaminants arise due to improperly controlled hygienic or laboratory conditions.

This project covers the effect of inhibitors on the reduced size STR Miniplex primer sets at different template concentrations. The Miniplex primer set produces smaller amplicons, and increases the probability of obtaining a usable profile from degraded DNA. The size of the alleles in the Miniplex kits range from 60-284 base pairs. Since the presence of inhibitors can affect the amplification efficiency of any primer set, studies were initiated to determine if the decreased amplicon size would affect the level of inhibition or the concentration at which it occurs.

For this study, inhibitors which may be present in the sample itself were examined. These inhibitors can commingle with the DNA sample upon exposure to different environmental conditions. Although a wide range of PCR inhibitors have been reported, six common PCR inhibitors known to affect forensic samples were chosen for these studies: 1) hematin, found in blood; 2) indigo, a dye found in denim; 3) melanin, a pigment found in skin and hair; 4) humic acid, found in soil and other environmental samples; 5) collagen, found in bone; and 6) calcium, another component of bone samples. The inhibitors were tested singularly and in combinations which are likely to be present in forensic samples.

Five concentrations of each inhibitor were tested with each Miniplex kit to determine the threshold inhibitor concentration (TIC) at high template concentration (500 pg/25 µL for Big Mini and 250 pg/ 25 uL for Mini 2 and Mini 4). The TIC was defined as the lowest concentration of inhibitor that removed the signal from at least one locus in three replicate measurements. This threshold inhibitor concentration and slope of the curves obtained for different inhibitor concentrations were then compared for each inhibitor and each Miniplex. Initial results show a wide variation in threshold concentration and that their effect appears to be independent of amplicon length. In addition, different loci show variations in threshold levels for inhibition.

Studies were also performed to determine the effect of lower template concentrations on the threshold inhibitor concentration. Three concentrations of inhibitors were tested on different levels of DNA template for each of the Miniplex primer sets (500, 250, and 125 pg/25 µL for Big Mini, 250, 125 and 63 pg/25 µL for Mini 2 and Mini 4). The level of inhibition for each locus and each concentration was calculated and the results were compared. The rate of inhibition for each individual locus was also determined. Finally, combinations of inhibitors which could be found in forensic samples were studied. These were used on different template concentrations and the level of inhibition was calculated and compared between sets and loci.

PCR Inhibition, DNA Template Concentration, Miniplexes

B116 Laser Microdissection: Low Copy Number Analysis of Sperm From Mixtures

Christine T. Sanders, MS, Emily Reisenbigler, BS, and Daniel A. Peterson, PhD, Rosalind Franklin University of Medicine and Science, Department of Neuroscience, 3333 Green Bay Road, Noth Chicago, IL 60064*

After attending this presentation, attendees will learn about the use of laser microdissection for recovery of minute amounts sperm cells from a semen/epithelial cell mixture for low copy number analysis.

This presentation will impact the forensic community and/or humanity by demonstrating how the development of improved methods for cell separation and tools for the recovery of limited amounts of available sperm cells in evidentiary samples are necessary to overcome problems in genotype interpretation from mixtures with incomplete separation.

The goal of this presentation is to present the results of recent research in the area of mixture separation utilizing laser microdissection for recovery of minute amounts of sperm cells from an epithelial cell mixture. STR analysis has become a routine tool in identifying the source of biological stains in the investigation of sexual assault crimes. Difficulties in analysis arise primarily in the interpretation of mixed specimens or when only a small number of target cells are available for analysis. Development of improved methods for cell separation and tools for the recovery of limited amounts of available sperm cells in evidentiary samples are necessary to overcome these current problems.

Laser microdissection technology (LMD) has emerged as a method to capture single cells or a group of cells of interest from heterogeneous tissue. This technology is typically employed on histological tissue cryosections to collect specimens for further DNA, RNA or protein analysis. The purpose of this research is to use LMD on biological smears to identify sperm and epithelial cells while selectively dissecting and recovering the cells of interest for forensic DNA analysis.

In the study presented, mixtures of male semen and female oral epithelial cells were prepared onto plastic-foiled glass microscope slides. Stained spermatozoa were identified, dissected, and recovered through the semi-automated Leica AS LMD instrument. Collections of 10, 20, 40, and 80 sperm cells were recovered in Lyse-N-Go™ reagent (Pierce) for DNA isolation, and amplified using the AmpfISTR® Profiler Plus kit (Applied Biosystems) with separation by capillary electrophoresis. DNA was subjected to PCR amplification at 34, 38 and 42 cycles.

The results of STR typing show pure genotypes from the male donor without carryover from the female donor. Although allelic drop-out from the haploid cells was observed, genotyping was achieved from as little as 10 sperm cells

The laser microdissection method presented physically dissects target cells without the contamination of adjacent foreign cells in a mixture then collects the target cells for direct DNA isolation and PCR. This bypasses the multi-step, high-manipulation process of a preferential lysis procedure and traditional human DNA quantification. Thus, LMD can facilitate the pure recovery of sperm cells for low copy number analysis.

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DNA Typing, Laser Microdissection, Cell Separation

B117 Biochemical Repair and Lesion Bypass of Damaged DNA

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After attending this presentation, attendees will be introduced to strategies for the repair of damaged DNA templates derived from forensically relevant samples.

This presentation will impact the forensic community and/or humanity by demonstrating that it is possible to biochemically repair DNA damage introduced by a variety of insults, leading to the recovery of a profile from previously intractable samples.

The use of DNA typing techniques has revolutionized the forensic analysis of biological evidence. DNA typing now plays a critical role within the criminal justice system. Numerous individuals have been convicted and falsely accused individuals exonerated based on DNA evidence, and increasing use is being made of databases of DNA profiles for criminal intelligence information. However, one of the limiting factors of the technology is that DNA extracted from forensic samples is often so damaged that is not possible to obtain a genetic profile from it due to the presence DNA polymerase stalling lesions, including single base modifications, adducts, and breaks, both single and double stranded. To date, there has been no reliable method for the repair of such damage to facilitate the recovery of a genotype from intractable samples. The development of repair methods able to do just this has been the focus of this research.

Forensic samples are subject to a myriad of insults including heat, light, humidity, and microorganism growth, which can induce a variety of types of damage. Therefore, a single repair strategy is not sufficient. Previous work has shown that one of the primary causes of the inability to type damaged DNA is the presence of strand breaks. To deal with single strand breaks and gaps, a modified base excision repair (BER) strategy has been developed in which a cocktail of repair enzymes is allowed to react with damaged DNA. Such a strategy is able to manage the modified, non-extensible or ligatable ends found in damaged DNA, fill in short gaps, and ligate the finished product. However, due to the presence of other base modifications and adducts, this is not sufficient for the recovery of a profile from many forensic samples.

Coupling BER gap repair with another strategy – direct bypass of lesions – has proved successful for the repair of damaged DNA templates. A new class of translesion DNA polymerases has recently been discovered. These distributive enzymes are thermostable and, due to relaxed constraints at their active sites, can form non-canonical base pairs, allowing the bypass of lesions that would typically stall a DNA polymerase. Adjusting the PCR conditions, including buffer constituents and cycling conditions, has allowed the inclusion of these polymerases in a PCR reaction with a standard processive thermostable DNA polymerase. The resulting blend of enzymes facilitates the bypass of DNA damage as well as the accurate amplification of desired genetic loci.

***in Vitro* DNA Repair, Translesion Polymerases, Base Excision Repair**

B118 The Utility of Whole Genome Amplification in Forensic DNA Analysis

Amy L. Barber, MS, and David R. Foran, PhD, Michigan State University, 560 Baker Hall, East Lansing, MI 48824*

After attending this presentation, attendees will understand the theoretical and practical limitations of two methods of whole genome amplification (WGA) for use with forensic samples will be presented, specifically focusing on the effects of poor DNA quality and/or quantity.

Although techniques used to analyze DNA have progressed greatly in the past decade, limited DNA template can still hinder analysis. An ideal solution to this problem would be the amplification of the entire genome, prior to PCR, so that any locus could be examined as needed. This presentation will impact the forensic community and/or humanity by raising awareness about the advantages of using whole genome amplification in forensic DNA laboratories.

The theoretical and practical limitations of two methods of whole genome amplification (WGA) for use with forensic samples will be presented, specifically focusing on the effects of poor DNA quality and/or quantity.

Forensic biologists are often confronted with issues of limited DNA that may restrict their ability to generate a complete genetic profile, while reserving sample for future analysis or repeat analysis by the defense. The polymerase chain reaction (PCR) is commonly used to amplify specific loci, effectively alleviating some issues of low quantities of starting DNA. However, limited DNA template can still hinder analysis, especially if additional assays are requested such as Y-chromosome analysis, mtDNA sequencing, or private defense examination.

An ideal solution to this problem would be the amplification of the entire genome so that any locus could be examined as needed. WGA is a process which is capable of replicating an entire sample, reducing the chance of entirely consuming evidence. WGA of high quantity clinical material has been studied extensively, but few investigations characterizing WGA for forensic use have been reported. Specifically, WGA has not been widely tested on forensically relevant samples, most importantly those containing DNA that is limited in quantity or degraded. The objective of this project was to characterize well-developed WGA methods—Improved Primer Extension Preamplification (I-PEP) and Multiple Displacement Amplification (MDA)—on samples commonly seen in forensic laboratories including those with low DNA quality and quantity.

For this research, control and artificially degraded DNA, as well as DNA from hair, fresh and aged blood, and aged bone, was amplified using both WGA methods. Differences in the suitability of untreated and WGA treated samples were compared for use in downstream analysis. Nuclear and mtDNA were PCR amplified to test maximum amplicon lengths and to examine WGA yields. Amplification of the single copy nuclear gene amelogenin was undertaken using primers designed to generate 200 or 400bp product. Multilocus STR profiles were generated using the ABI AmpFLSTR® Identifiler® PCR amplification kit. A variety of mtDNA control region amplicon sizes were also tested.

For high molecular weight DNA, product yield could be increased 20 to 2000 fold by I-PEP and 1000 to 10,000 fold by MDA. However, substantial differences were observed in the maximum PCR product length of untreated and whole genome amplified product, particularly from degraded material. MDA tests on low quality samples were generally unsuccessful and often resulted in extensive non-target DNA amplification. Overall, I-PEP and MDA increased the product yield of high quality DNA, but these methods had limited success on highly degraded samples.

Whole Genome Amplification, DNA Amplification, Degraded DNA

B119 Age Determination by RNA Profiling: Validation of a Newborn Child-Specific Real-Time PCR Assay

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After attending this presentation, attendees will be informed of the specific requirements, applications and limitations of two real-time PCR duplex systems which determine if a bloodstain originated from a newborn baby.

This presentation will impact the forensic community and/or humanity by setting forth the requirements for accurate and reliable real-time PCR results in relation to the reproducibility, sensitivity and specificity of the assays to newborn individuals, and the extent of their cross-reactivity with other nonhuman species and non-blood body fluids. Also the applicability of this method to aged bloodstains will be described.

It is now a matter of routine for the forensic scientist to obtain the genetic profile of an individual from DNA recovered from a biological stain deposited at a crime scene. Potential contributors of the stain must either be known to investigators (*i.e.* a developed suspect) or the questioned profile must be searched against a database of DNA profiles such as those maintained in the CODIS National DNA database. However, in those instances where there is no developed suspect as yet or there is no match with any database sample, the DNA profile *per se* presently provides no meaningful information to investigators, with the notable exception of gender determination.

To aid in these investigations another useful biometric that could provide important probative information is the age of an individual. For example, the ability to provide investigators with information as to whether a DNA donor is a newborn baby, an adolescent teenager or an elderly individual could be useful in certain cases, particularly those involving young children such as kidnapping or in providing additional intelligence during terrorist investigations. Currently no reliable validated molecular tests are available for age determination. The lifecycle of humans comprises a number of developmentally recognized stages. As the human proceeds through these developmental stages, sub-sets of the 30-50 thousand human genes will be differentially expressed. Theoretically, and given sufficient knowledge of developmental genetics, a determination of the global gene expression profile could reveal constellations of genes whose expression is correlated with a specific age.

It has been previously reported that it is possible to determine if a bloodstain originated from a newborn baby. Two novel hemoglobin isoforms were discovered and shown to have an expression pattern which was restricted to newborn individuals. Based on this information two duplex real-time PCR (qPCR) assays were developed to determine if a bloodstain originated from a newborn baby. The two duplex qPCR assays have undergone a developmental validation study that evaluated their reproducibility and specificity to newborn individuals, species specificity, body-fluid specificity, sensitivity and ability to analyze environmentally-aged bloodstains.

The reproducibility of the two duplexes to positively identify newborn individuals was determined by testing newborn and infant individuals, aged 1 hour to 9 months (n=20). The specificity of the assays for the accurate identification of newborns was determined by testing male and female individuals, aged 1 hour to 102 years (n=76). Human specificity was tested against blood obtained from various animal species. The ability of these assays to positively identify newborns in other commonly encountered body fluids was also examined to determine if the assays are blood specific. Saliva, semen, vaginal secretion and menstrual blood samples were obtained from multiple individuals of varying ages and examined. The sensitivity of the method was determined by varying the concentrations of genomic DNA and cDNA, input into the qPCR reaction. Finally, stability studies were conducted by subjecting bloodstains to a variety of environmental conditions for 1, 3, 6, 9, 12 and 15 months, followed by qPCR analysis.

Age Determination, Identification of Newborns, Validation

B120 mRNA Profiling: Identification of Solid Tissues of Forensic Interest by Multiplex Real-Time PCR

Jane S. Juusola, PhD, University of Central Florida, Department of Chemistry, Orlando, FL 32816-2366; Kerri Dugan, PhD, Counterterrorism and Forensic Science Research Unit, Laboratory Division, Quantico, VA 22135; and Jack Ballantyne, PhD, University of Central Florida, Department of Chemistry, National Center for Forensic Science, Orlando, FL 32816-2366*

After attending this presentation, attendees will be briefed on a novel mean of identifying tissues of forensic interest.

This presentation will impact the forensic community and/or humanity by demonstrating a mRNA based approach, such as the multiplex real-time PCR method described here, could allow the definitive identification of the tissue components present in a forensic casework sample and is one of many assay platforms that conceivably could supplant conventional histological methods currently employed in forensic casework analysis.

Fragments of solid tissue from internal organs such as brain or muscle are occasionally encountered at violent crime scenes especially those involving assaults with a firearm and may be associated with bullet fragments that have entered and exited an individual. The identification of the tissue source of this solid tissue may be an important investigative aid in itself. However, identification of the tissue is presently accomplished by conventional histological means, which is time consuming, labor-intensive, and requires the services of a highly trained histologist and/or pathologist.

Terminally differentiated cells, whether blood lymphocytes, ejaculated spermatozoa, muscle fibers, or adipocytes, have a unique pattern of gene expression, which is evinced by the presence and relative abundance of specific mRNA species. If the type and abundance of mRNAs can be determined in a stain or tissue sample recovered at the crime scene, it would be possible to definitively identify the tissue or body fluid in question. Advantages of an mRNA-based approach, compared to conventional biochemical or histological analysis, include greater specificity, simultaneous and semi-automated analysis through a common assay format, improved timeliness, decreased sample consumption and compatibility with DNA extraction methodologies.

It has been previously reported that it is possible to isolate total RNA of sufficient quality and quantity from biological stains to enable subsequent detection of particular mRNA species using the reverse transcription-polymerase chain reaction (RT-PCR) technique and that candidate sets of blood-, saliva-, semen-, vaginal secretions-, and menstrual blood-specific genes have been identified using a combination of literature and database searches. The development of multiplex mRNA-based assays for the identification of body fluids of forensic interest that are compatible with current DNA analysis procedures have been reported.

These same principles have been applied to the development of mRNA-based identification methods for tissues of forensic interest and have identified and tested candidate sets of skin-, muscle-, adipose-, and brain-specific genes in the present work.

A set of multiplex real-time PCR assays for the definitive identification of skin, muscle, adipose, and brain have been developed. Real-time PCR employs a 5' nuclease assay to detect specific amplimers and eliminates the need for post-PCR processing and gel electrophoresis. The real-time instrument is capable of multi-color detection, and so by using probes labeled with different reporter fluorophores, it is possible to develop multiplex assays for tissue identification. Real-time PCR also has the ability to quantitate target sequences, which is important in establishing the tissue-specificity of a gene product, particularly when the relative abundance of a number of different mRNAs can demonstrate a unique or restricted pattern of expression.

Real-time PCR triplexes that are composed of two tissue-specific genes and one housekeeping gene have been developed and optimized for the detection of skin, muscle, adipose, and brain RNA. The data analysis methodology is based upon determining the delta C_t (dC_t) values generated using the C_t of the housekeeping gene (HSK) and the C_t of each of the

tissue-specific genes (TG) (C_t HSK- C_t TG). Depending upon the tissue-specific gene being tested, a positive dC_t value would indicate the presence of a particular tissue, while a negative dC_t value would indicate the absence of that tissue.

mRNA Profiling, Multiplex Real-Time PCR, Tissue Identification

B121 A Report on the 2005 FBI GSR Symposium

Michael A. Trimpe, BS, Hamilton County Coroner's Laboratory, 3159 Eden Avenue, Cincinnati, OH 45219; and Diana M. Wright, PhD, Federal Bureau of Investigation, 2501 Investigation Parkway, Quantico, VA 22135*

The goal of this presentation is to enhance the audience's knowledge of GSR analysis by reporting on the developments at the FBI-sponsored GSR Symposium.

Some of the most experienced GSR analysts have come together to discuss important issues in the discipline. This presentation will impact the forensic community and/or humanity by demonstrating why it is imperative to disseminate that information to the whole community in order to develop standards for practices, procedures, and competency initiatives.

A gunshot residue (GSR) symposium sponsored by the FBI Laboratory, was held in Quantico, Virginia May 30th to June 3rd of 2005. The participants were from private and public laboratories, both international and domestic. This diverse group was primarily composed of very experienced analysts, but some had little experience. In spite of these diversities, the participants had a mutual desire to update procedures in GSR analysis and reach a consensus on many recent topical developments, as they all perform GSR analysis by Scanning Electron Microscopy Energy Dispersive X-ray Spectrometry (SEM/EDS).

In three full days of earnest discussions, the format for the symposium followed a pattern whereby a topic was posed as a question or statement. Professional and friendly discussions ensued on the topics. The discussions were enhanced, where necessary, by short reports from the authors of appropriate studies on the topics. Using an electronic personal response system the group then voted on the topic which often led to additional discussion and voting to determine if consensus could be reached on the issue.

Selected topics included: terms to describe particles (unique or characteristic); report writing; contamination issues; brake pads; fireworks; police cars; ASTM E-1588 guide; Proficiency testing; acceptance criteria; victims; suicides; time limits; Instant Shooter Kits, and clothing.

The goal of the symposium was to initiate a dialogue between experienced analysts regarding critical GSR issues. The resulting consensus could then be issued as guidelines for the entire forensic community engaged in gunshot residue analysis. The magnitude of topics proved to be too much for this work to be completed in one symposium. Therefore, a future symposium and/or SWGGSR are being planned.

This presentation will report on the developments of the discussions to date and the results of voting on these varied GSR topics.

FBI, GSR, Symposium

B122 The Effectiveness of Using ATR-FTIR Microspectroscopy and Individual Morphology to Determine the Manufacturers and Brands of 40 Different Unburned Smokeless Gunpowder Samples

Brenda L. Dowell, MFS, National University, Forensic Sciences Program, 11255 North Torrey Pines Road, La Jolla, CA 92037*

After attending this presentation, attendees will understand the value of the combined analyses of ATR-FTIR microspectroscopy and individual morphology in determining the manufacturer and brand of unburned smokeless gunpowder particles.

Unburned smokeless gunpowder particles can be traced back to their manufacturer based on their individual morphology and chemical composition. This presentation will impact the forensic community and/or humanity by providing a vital clue for investigators and possibly lead to the identification of the purchaser/bomber. Additionally, this evidence would be important in the prosecution of a case if the questioned gunpowder particles collected can be shown to be the same brand purchased by the bomber or found at his residence.

When used as an explosive device or weapon, smokeless powder may not be entirely consumed by the explosion, resulting in undamaged and intact particles. The combined use of attenuated total reflectance Fourier-transform infrared (ATR-FTIR) microspectroscopy and individual morphology has the potential to identify the manufacturer and brand of a sample of unburned smokeless powder, or at least narrow the search. This study evaluated the efficiency of these methods in identifying the source of an unknown powder.

First, 145 different brands of powders representing 13 manufactures were categorized according to their morphology and then analyzed by ATR-FTIR to create a reference database. Second, a total of 40 samples were randomly chosen, morphologically categorized and analyzed by ATR-FTIR. Third, a detailed comparison to identify the manufacturer and brand of each powder using the reference database and the unknown powder data was conducted.

All samples were classified using a previously developed system (1) that places particles into five general categories based on morphological characteristics: lamel, ball, tube, disc, and flattened ball. Subcategories of tube powders include short and long tubes, while subcategories of disc powders include thin and thick discs. Due to the large variation seen in the flattened ball category, two subcategories were created: angular flattened ball, and irregular flattened ball. When further expressions of the powders were necessary, additional descriptive factors were utilized including color, luster, bias, perforations, uniformity of particle size, surface textures, tails and scrap, or any other descriptive qualities and notable observations.

During the initial comparison, possible source powders were systematically eliminated based on morphological inconsistencies with the unknown, thus forming a small group of similar powders. The ATR-FTIR spectra were employed for additional discrimination.

After thorough examination of the morphology and IR spectra, the known powder most similar to the unknown sample was chosen as the source. Thirty-eight out of forty unknown samples were correctly identified to manufacturer and brand of powder. Of the incorrectly identified samples, one sample was misidentified in both the manufacturer and brand of powder. With the second sample, identification of the manufacturer was accomplished but the brand was incorrectly identified.

The ultimate goal of this study was to identify the brand of smokeless powder from a questioned powder. Providing an investigator the correct identity of a questioned powder is the goal, but if this is not possible providing the investigator a short list of two or three powders provides valuable information.

If unburned smokeless gunpowder particles can be traced back to their manufacturer and brand based on their individual morphology and chemical composition, this could be a vital clue for investigators and possibly lead to the identification of the purchaser/bomber. Additionally, this evidence would be important in the prosecution of a case if the questioned gunpowder particles collected can be shown to be the same brand purchased by the bomber or found at his residence.

Reference:
(1) Moorehead W. The Characterization of Reloading Smokeless Powders Toward Brand Identification. *Proceedings* American Academy of Forensic Sciences. Annual Meeting, New Orleans, LA: February 2005; Criminalistics-B93

Smokeless Powder, ATR-FTIR, Morphology

B123 The Characterization of Reloading Smokeless Powders Toward Brand Identification - Part 2

Wayne Moorehead, MS, Annie Tibbetts, BS, and Aletha Basconcillo, BS, Orange County Sheriff-Coroner, 320 North Flower Street, Santa Ana, CA 92703*

After attending this presentation, attendees will have an understanding of the value of morphology, micrometry, and gas chromatography with a mass spectrometer (GC/MS) detector in the brand identification of unburned smokeless powders.

This presentation will impact the forensic community and/or humanity by comparing a questioned unburned smokeless powder sample against the database of information can provide analysts with the ability to brand identify smokeless powder or provide a short list of brands. Additionally, the database may be available on CD or DVD at a later time for use by laboratories.

While the government closely monitors explosives, canister smokeless powders can be purchased over-the-counter by sport shooters and hunters for reloading ammunition or by bombers for constructing improvised explosive devices. Explosive fillers from pipe bombs submitted to crime laboratories frequently contain smokeless powder. Canister smokeless powders offer a readily available, relatively inexpensive explosive for use by the criminal element.

For this study, smokeless powders were subjected to different methods of analysis to build a library database for brand identification or to provide a selective list of possible powders. By using a combination of morphology, micrometry, and acquired gas chromatography/mass spectrometry (GC/MS) data, unique brand identification or a short list of possible smokeless powders from an unknown powder is possible.

Macroscopic and microscopic features of various brands were noted. Unless a unique identifier, such as a colored 'dot', was present the macroscale examination could not identify a single, unique brand. Microscopic morphology was used to categorize the smokeless powder kernels and several approaches were used in the brand identification. Using micro-morphology and then GC/MS data to attempt brand identification was one method. Micrometry was added to reduce the number of possible candidates before or after GC/MS analysis.

The samples were extracted with methanol:dichloromethane (30:70) solvent, minimally vortexed, and injected into a GC/MS. The number of peaks, retention time of the peaks, and the mass spectrum analysis of the content of each peak was made. After morphology and micrometry, GC/MS was useful in further distinguishing brands.

Smokeless Powder, Brand Identification, GC/MS

B124 Exposure to Gunshot Residue (GSR) in High-GSR Environments: Can GSR be Transferred to Non-Shooters in an Environment With a High Background of GSR?

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After attending this presentation, attendees will learn about current research into the prevalence of gunshot residue particles on the hands of subjects who have not fired a gun but have been exposed to high levels of gunshot residue in the workplace.

This presentation will impact the forensic community and/or humanity by providing information on the prevalence of gunshot residue on non-shooters will assist in the interpretation of gunshot residue findings to courts of law.

Gunshot residue (GSR), which is produced upon the discharge of a firearm, consists primarily of micron-sized particles that contain the elements lead (Pb), barium (Ba) and antimony (Sb). These particles can escape from a firearm via the muzzle, breech, and other surfaces that do not form a gas-tight seal around the cartridge case, and can then be deposited onto nearby surfaces. It is known that GSR particles can be easily transferred from one surface to another by contact. The purpose of this study was to determine whether or not GSR particles could be identified on the hands of non-shooters in environments with a high background of GSR particles.

During a tour of two firearms factories in which over 200,000 rounds of ammunition are test-fired annually, the author collected samples from the hands of a number of staff members, including those who do not come into contact with the completed firearms as part of their job. The back and web area of each person's hand were sampled using an aluminum stub covered with double-sided tape and these were analyzed for GSR using a scanning electron microscope coupled with an energy dispersive x-ray spectrometer (SEM/EDS).

Of the hands of the five staff members who were sampled in factory #1, a facility that produces handguns, two of the staff (a machinist and a receptionist) did not have GSR present. Of the remaining three staff, two GSR particles were identified on the hands of an accountant, 13 GSR particles were identified on the hands of a machinist (neither of whom handle firearms) and 420 GSR particles were present on the hands of the person responsible for inventory control and shipping of the firearms. The high number of GSR particles on the latter individual is not unexpected, as this person handles completed handguns following the test firings that are done for each firearm following its manufacture.

Of the hands of the nine staff members sampled in factory #2, a facility that produces machine guns, three of the staff (a receptionist, an engineer, and a product sheet designer) did not have GSR present on their hands. One GSR particle was identified on the hands of each of three machinists, one who has never handled a firearm and two who had not handled a firearm on the day of sampling; nine GSR particles were identified on the hands of the tour guide, who had picked up two firearms in the firing range earlier in the day, but had subsequently washed his hands; 121 GSR particles were identified on the hands of the weapons technician (assembler). The gloves worn by one of the staff members while test firing each firearm were also examined to determine the number of particles present on the shooter. More than one thousand GSR particles were present on the samples from these gloves.

The above results demonstrate that as expected, activities that involve test firing or handling recently fired firearms result in the transfer of a large number of GSR particles to a person's hands. However, it is possible for those who work in an area with a high background concentration of GSR particles, but whose workstation is separate from the test firing area, to

accumulate only a small number of GSR particles or no GSR particles on their hands. This indicates that the possibility of "chance" contact with GSR particles, even in an environment with high background levels of GSR, is low. These small particle numbers are similar to those commonly seen in casework; however, the background levels of GSR in an environment other than a firearms manufacturing facility is expected to be much lower, thereby making the likelihood of "chance" contact with GSR particles very small in an everyday environment.

Gunshot Residue, Background, Exposure

B125 Gunpowder Stipple Patterns of Commonly Encountered Small Firearms

Kay M. Sweeney, BS, KMS Forensics, Inc., PO Box 8580, Kirkland, WA 98034*

After attending this presentation, attendees will learn about a process for developing, recording and comparing arithmetical data relating to the potential for specific firearms and ammunition to create gunpowder stippling patterns.

This presentation will impact the forensic community and/or humanity by demonstrating the documentation of data relating to gunpowder stippling patterns in a structured arithmetical format allows for clearer scientific discussions in general and oral courtroom presentations in particular.

Gunpowder stippling patterns on human skin have long been recognized as a valuable indicator of the distance between a discharging firearm muzzle and the surface of skin first perforated by the resulting fired bullet. The first level of apparent gunpowder stippling pattern evaluation is generally performed during autopsy by forensic pathologists where-in conclusions are developed defining the stippling injury's source/cause. Unfortunately, in most cases where an apparent gunpowder stippling pattern is present on a deceased body, no samples of the injured tissue or even the embedded particulate are collected as evidence. Many times it is not possible to verify an original autopsy designation of the injury pattern as being caused by gunpowder impact without autopsy samples because of the limiting quality of photographic images taken for documentation purposes. In cases involving multiple gunshots on the scene it may be difficult to determine, without microscopic examination of embedded particulate, if the bullet entry wound in exposed skin is in fact the result of direct gunfire or if the skin is a secondary target and associated stippling is caused by debris from the bullet exiting the primary target material.

The next level of interpretation of gunpowder stippling patterns involves a process by which the distance between muzzle and skin is determined. Clearly, gunpowder particles exiting the muzzle of a firearm, along with the fired bullet, at the time of discharge will have velocities that vary dramatically from one another but many will have at least the same velocity as the fired bullet. Particle size will also vary depending on the amount of burn that the gunpowder particle has experienced before it exits the muzzle. The size of the particle, and therefore its mass, and its velocity at the time it contacts the surface of the skin directly relate to the seriousness of the injury produced. If the particle is too small and/or too slow, no injury will be produced. The temperature of the particle at the time of impact, especially with respect to whether or not it is still burning, will also affect the severity of injury visible in the skin.

The study currently underway is focusing on a system of documenting gunpowder stippling patterns produced by several different hand guns and several different brands and loads of hand gun ammunition. The firearms were fired into white, smooth surfaced, one half inch thick, ceiling tiles (suspended ceiling design) cut to rectangles approximately 8 ½ by 11 inches. Any gunpowder particle impact point that exhibited fractured surface characteristics, or greater damage such as surface perforation, were considered to have enough energy to produce a stipple mark in skin and were included in stipple concentration counts. A template of concentric circles drawn at one inch, two inches, three inches, and four inches from the center point was prepared on clear mylar sheet stock and this was used as an overlay on top of the test fire ceiling tile panels with the center point placed dead center on the bullet defect in the panels. The circles were scribed into quarters and counts for stipple marks were made in one quarter of the circle. The counts, for purposes of this presentation, are reported as the number of stipple marks per square inch, and are classified by definition as "First Order Quarter-Arc Density" for the particle damage count in the quarter of circle area from center point to the quarter arc at one inch out from the center, "Second Order Quarter-Arc Density" for the total particle damage count in the quarter of circle area from center point to the quarter arc at two inches from the center point, and so on.

Three different semi automatic pistols of the 9mm caliber class were tested and found to produce the following results:

Colt Mustang Pocketlite .380 Auto, (9x17mm) with 2 ¾ inch barrel: At a six inch muzzle to target distance, First Order Quarter-Arc Density = 76.4 stipple marks per square inch; Second Order Quarter-Arc Density = 63.05 stipple marks per square inch; and no marks were present beyond the two inch radius arc.

At a twelve inch muzzle to target distance, First Order Quarter-Arc Density = 19.1 stipple marks per square inch; Second Order Quarter-Arc Density = 12.1 stipple marks per square inch; Third Order Quarter-Arc Density = 10.6 stipple marks per square inch; and no marks were present beyond the three inch radius arc.

At an eighteen inch muzzle to target distance, First Order Quarter-Arc Density = 2.5 stipple marks per square inch; Second Order Quarter-Arc Density = 3.1 stipple marks per square inch; and no marks were present beyond the two inch radius arc.

Makarov 9mm, (9x18mm), with 3 5/8 inch barrel: At a six inch muzzle to target distance, First Order Quarter-Arc Density = 57.3 stipple marks per square inch; Second Order Quarter-Arc Density = 43.3 stipple marks per square inch; Third Order Quarter-Arc Density = 20.3 stipple marks per square inch; and no marks were present beyond the three inch radius arc.

At a twelve inch muzzle to target distance, First Order Quarter-Arc Density = 24.2 stipple marks per square inch; Second Order Quarter-Arc Density = 24.8 stipple marks per square inch; Third Order Quarter-Arc Density = 20.4 stipple marks per square inch; Fourth Order Quarter-Arc Density = 16.2 stipple marks per square inch; and no marks were present beyond the four inch radius arc.

At an eighteen inch muzzle to target distance, First Order Quarter-Arc Density = 5.0 stipple marks per square inch; Second Order Quarter-Arc Density = 5.1 stipple marks per square inch; Third Order Quarter-Arc Density = 3.8 stipple marks per square inch; Fourth Order Quarter-Arc Density = 3.2 stipple marks per square inch; and no marks were present beyond the four inch radius arc.

Beretta 9mm Luger, (9x19mm parabellum) model 92FS with 4 ¾ inch barrel:

At a six inch muzzle to target distance, First Order Quarter-Arc Density = 183 stipple marks per square inch; Second Order Quarter-Arc Density = 139 stipple marks per square inch; and no marks were present beyond the two inch radius arc.

At a twelve inch muzzle to target distance, First Order Quarter-Arc Density = 43.3 stipple marks per square inch; Second Order Quarter Arc Density = 44.6 stipple marks per square inch; Third Order Quarter-Arc Density = 32.7 stipple marks per square inch; and no marks were present beyond the three inch radius arc.

At an eighteen inch muzzle to target distance, First Order Quarter-Arc Density = 15.3 stipple marks per square inch; Second Order Quarter-Arc Density = 14.6 stipple marks per square inch; Third Order Quarter Arc Density = 12.7 stipple marks per square inch; and no marks were present beyond the three inch radius arc.

Gunpowder, Stippling, Pattern

B126 Examination of Fired Bullet of Non-Straited Markings of Abnormal Barrels

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The goal of this presentation is to identify crime bullets that in most cases can be established as to have been fired through abnormal and/or superman make firearms whose barrels have non-straited land and groove marks.

This presentation will impact the forensic community and/or humanity by identifying whether the fired bullet from the barrel of abnormal firearms is fired from such firearms, so it shall be beneficial for correct judgments.

Examination of crime bullets fired through rifled barrels of superman make and/or abnormal undersized firearms was conducted. The instrumental and physical examinations were carried out on the class and individual characteristics markings. The bullets were fired through the rifled barrel of abnormal and undersized make firearms. The examinations were carried out so that the characteristics marks available on the bullet fired through such barrels have been analyzed; with special reference in imitation make firearms and superman make firearms. Such type of crime bullets may be classified on physical and visual examination and for confirmation the microscopic comparison examination was carried out with test fired bullets.

Analysis of the crime bullets fired through the barrel of undersized firearm is comparatively easy and reliable. This is due to the bullet not traveling along the pre-determined path from the breech to muzzle end. The bullet accepted irregular rifling marks and surface irregularities; these were observed. The characteristics break, shape, size, and relative positions of rifling marks and shaving can be used to identify the fired bullets in respect to the firearm. The importance of the characteristics marks is clear, especially when the bullets are mutilated and characteristics marks, striations are not sufficient to permit identification. The marks are so pronounced and characteristic that positive identification in some cases is possible; even by visual examination and instrumental comparison. Jacketed bullets lodged inside a weapon usually cannot be identified in respect to the firearms because there is no absorption of lands and grooves, and continuous striations marks due to resistance of the movement of bullets. Only microscopic comparison is possible on certain data for identification. It is not possible to compare the lead bullets with jacketed bullets. If the crime bullet is made of lead, it cannot be identified by comparison with the jacketed test fire bullets and vice versa.

Abnormal, Barrel, Bullet

B127 The Analysis of Cosmetic Glitter

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After attending this presentation, attendees will understand how to analyze various types of glitter and how glitter can be separated from substrates such as cosmetics.

This presentation will impact the forensic community and/or humanity by enabling forensic examiners to analyze cosmetic glitter when encountered in crimes

Cosmetic glitter is added to a large number of cosmetics and other products. These include lipsticks, blush, face powder, mascara, eye shadow, body soaps and even writing pens. Glitter is made up of fine (0.25-1.0mm) pieces of polyvinyl chloride (PVC), polyester, or aluminum. It occurs in a number of geometric shapes, most notably square or hexagonal. Round and irregularly shaped pieces are also encountered. Many types of glitter are bilayered, usually with one plastic layer and a thin aluminum or plastic secondary layer. It comes in a wide variety of colors. A large number of manufacturers of glitter are found worldwide, most notably in China and Taiwan. Quality control of the size and shape is relatively poor.

In this project, forty glitter-containing cosmetic products were purchased at two stores. These included lipsticks, face creams, mascaras and eye shadows. Solvents systems were developed to separate the glitter from the substrates. Solvents included water, methanol, hexane and toluene. Different solvents were required for different products.

The glitter products were then subjected to visual inspection under a stereo microscope, visible microspectrophotometry and infrared (IR) microspectrophotometry. These techniques were evaluated to see to what extent glitter could be differentiated among different brands of the same product and among different products.

Glitter, Cosmetics, Microscopy

B128 A Validation Study for Electrical Tape End Matches

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After attending this presentation, attendees will understand the design and results of a study to evaluate the validity of conducting tape end match examinations.

Few published studies exist to support admissibility challenges such as *Daubert* and *Frye* for fracture matches (physical matches). This study is the second in a series that will impact the forensic community and/or humanity by evaluating the validity of conducting end match examinations on different types of tapes submitted to forensic laboratories.

Tape end match examinations have been conducted in crime laboratories for decades; however, few publications exist to support admissibility challenges such as *Frye* and *Daubert.* The Chemistry Unit of the FBI Laboratory has embarked on a series of studies to address the validity of conducting end matches on different types of tapes submitted as evidence to crime laboratories. In 2004, the first phase of the FBI Laboratory's validation study, which addressed conducting end matches on duct tape, was presented at the American Academy of Forensic Sciences meeting in Dallas, TX. Phase two, a study that addresses conducting end matches of vinyl electrical tape, will be the subject of this presentation.

Poly(vinyl chloride) electrical tapes are often submitted to crime laboratories in association with an improvised explosive device (IED). The objective of the analysis is to establish a possible evidentiary link between a suspect and a crime or crimes. A logical first step is to attempt end matches of physically consistent pieces of tape. This study was designed to determine the validity of conducting end matches on vinyl electrical tapes and to evaluate the error rate associated with such an examination.

The study involved ten different test designs where the source roll of tape, mode of separation from the source roll, and/or test set preparer varied. Seven different rolls of vinyl electrical tape were used to prepare the sets. All were commercially-available at common retail stores, black in color, and nominally ¾ inch wide. The rolls varied in price, product grade, and manufacturer. For the purpose of the study, the modes of separating the electrical tapes from the source rolls were tearing, nicking with a sharp implement and then tearing, or using a dispenser provided with the roll. Cut ends were not evaluated in this study. As an additional variable, two different people prepared the test sets.

A total of 30 test sets, three sets from each of the ten test designs, were prepared for administration to the three test participants. For each test set, ten (10) strips of tape were separated from the source roll as prescribed in

the test set design and placed sequentially on a plastic sheet. After documenting the original sequential order of the tape strips, three or four of the pieces were removed at random from each of the test sets. The test sets administered to the test participants potentially contained one to six tape end matches.

The test participants were instructed to evaluate whether end matches existed among the strips of tape in each set. The results of the initial distribution of the test sets were evaluated by the test administrator. In cases where an end match was unidentified or misidentified, the test set was reevaluated independently by the other test participants and each rendered his or her opinion. During this reevaluation phase, the results of the initial administration of the test set were not revealed to the analysts conducting the reevaluation.

The results of this study will be presented in detail. Discussion will include the number of correctly identified tape end matches and whether variables such as product grade and mode of separation from the roll have an apparent effect on the ability to conduct these examinations.

End Match, Validation Study, Electrical Tape

B129 Use of a Database for Significance Assessment and Sourcing of Duct Tapes

Andria L. Hobbs, MS, Maureen J Bradley, PhD, Jennifer Gauntt, MS, Dennis C. Ward, BS, and Marc A. LeBeau, MS, FBI Laboratory, Chemistry Unit, 2501 Investigation Parkway, Quantico, VA 22135*

After attending this presentation, attendees will learn about the compilation and use of a duct tape database, which allowed for the assessment of the significance of the results of duct tape comparisons and the evaluation of the database's utility for sourcing.

This presentation will impact the forensic community and/or humanity by informing the forensic community about the significance of the results of a duct tape comparison and to determine the utility of a database for sourcing purposes.

Duct tape examinations have been conducted in crime laboratories for decades; however, few publications exist to support the discrimination ability of such examinations. As a result, the Chemistry Unit of the FBI Laboratory embarked on this study to assess the significance of the results of a comprehensive duct tape comparison and to evaluate a database's utility for duct tape sourcing.

Duct tapes are often submitted to crime laboratories in association with abductions and murders. The objective of the analysis is to establish a possible evidentiary link between a suspect and a crime or crimes. A logical first step is to conduct visual and microscopic examinations on the submitted samples in order to evaluate and compare physical characteristics such as color, width, thickness, scrim count, and fabric weave.

If the samples are consistent following visual and microscopic examinations, chemical composition analysis is performed on each of the tapes' components. According to the FBI protocol, the first step is the analysis of the duct tape adhesives by Fourier transform infrared spectroscopy (FTIR) with a microscope attachment. For samples that remain consistent following FTIR examination, scanning electron microscopy / energy dispersive spectroscopy (SEM/EDS) is then performed on both the adhesives and backings. X-ray diffractometry (XRD) is also performed on the intact specimens and occasionally on the duct tape backing alone.

The study involved the analysis and comparison of over eighty duct tape samples acquired since 1993. Most of the tapes were purchased at common retail stores, are marketed as general-purpose or economy grade, and cover a variety of manufacturers. Therefore, the collection represents tapes that could be easily obtained through retail channels.

In order to evaluate the analytical scheme's overall ability to discriminate the samples, an individual sample's analytical results were evaluated in a stepwise fashion through the examination protocol until it was discriminated from all others. The number of samples found to be indistinguishable following all examinations then provided the overall discrimination ability of duct tape analysis.

Each of the physical and chemical examinations was performed on all of the samples in this collection in order to compile a database for sourcing of duct tapes in casework. All the physical information was subsequently stored in Spectral Library Identification and Classification Explorer (SLICE), a platform for archiving EDS and X-ray fluorescence spectra with data entry capabilities for relevant physical and chemical information. The relational search capabilities of the physical data and EDS spectra aided in the evaluation of evidentiary significance for this project. FTIR and XRD data were stored in a separate format, though the general information obtained from those examinations was still included in text format in SLICE.

In order to validate SLICE for use in casework, several of the database samples were chosen at random. An analyst was then given the samples and instructed to treat the samples as casework samples from a sourcing case to determine if she could determine the products' manufacturers.

The results of this study will be presented in detail. Discussion will include the ability of the analytical scheme to discriminate the samples. Furthermore, the results of the validation study will be presented, and a casework example will highlight use of the database for sourcing.

Database, Discriminating Power, Duct Tape

B130 Covariance Mapping as an Aid to Ignitable Liquids Classification and Rapid Database Searching

Michael E. Sigman, PhD, and Mary Williams, BS, National Center for Forensic Science, University of Central Florida, PO Box 162367, Orlando, FL 32816-2367*

After attending this presentation, attendees will learn a simple mathematical approach to treating GC-MS data for ignitable liquid samples that aids in the classification of the sample by ASTM guidelines and can be implemented as an automated database search routine.

This presentation will impact the forensic community and/or humanity by demonstrating presenting an improved methodology for ignitable liquids analysis and the introduction of a data analysis method that may be implemented for rapid searching of a single database or networked databases.

This presentation will focus on the use of covariance mapping as an aid in the classification of ignitable liquids by ASTM E 1618 guidelines and as a method to facilitate automated searching of ignitable liquid databases.

This presentation will impact the forensic community and/or humanity by presenting a simple mathematical approach that facilitates the examination of gas chromatography – mass spectromtery (GC-MS) data collected in fire debris analysis. The method is easily implemented for rapid database searching and can be readily incorporated into existing databases.

Under the conditions employed in electron ionization mass spectrometry, compounds of a given class (*i.e.* alkanes, aklylbenzenes, etc.) exhibit similar fragmentation patterns. Identification of the most prevalent ions in a sample and the relative amounts of the ions corresponding to different classes of compounds forms the basis for the preliminary steps in ASTM classification of an ignitable liquid. The ion-profile information can be extracted from the GC-MS data set manually with subsequent visual pattern recognition. Alternatively, the information may be conveniently obtained by calculating the covariance between the individual ion chromatograms. The computational method removes the time domain information from the dataset; however, the information is not lost and is retained in the original dataset. The resulting data matrix may be graphically presented as a solid surface which has distinguishing features that are useful in classifying the ignitable liquid. The diagonal elements of the calculated matrix are proportional to the integrated product of the corresponding extracted ion chromatogram, while the off-diagonal elements correspond to

the product of two different extracted ion chromatograms integrated over the chromatographic time coordinate. When the covariance matrix is intensity-normalized, to compensate for variable sample size, and presented as a 3-D surface, different classes of ignitable liquids can be recognized by visual inspection.

Two intensity-normalized surfaces may be directly compared by defining the sum of the absolute difference, calculated element-by-element, as a "distance" between the two the surfaces. The distance will tend toward a limiting value of zero for identical surfaces and toward a limiting value of two for surfaces that are totally non-overlapping, thereby providing a measure of surface similarity. Data will be presented to show that the distance is minimized for surfaces corresponding to ignitable liquids constituting the same ASTM classification. The distance calculation provides a convenient computational method of comparing an unknown sample with database entries.

Results will be given for calculations on a series of ignitable liquids representing various classes and sub-classifications under the ASTM E 1618 standard. The method clearly discriminates between petroleum distillates, isoparaffinic products, dearomatized distillates, oxygenated solvents, naphthenic paraffinic products, and gasoline at various stages of evaporation. Discrimination between sub-classifications (*i.e.* between medium and heavy petroleum distillates) is less distinct in some cases. In addition, the advantages and limitations of the computational method for inter-laboratory data comparisons will be demonstrated and discussed, along with the utility of the method in analyzing matrix-contaminated samples.

Ignitable Liquids, Fire Debris, GC-MS Analysis

B131 The Scientific Working Group for the Analysis of Seized Drugs

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The objective of this presentation is to update forensic drug analysts on the Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) and on the proposals recently adopted as SWGDRUG recommendations. These recommendations include:

- New "Botanical" verbiage added to the Methods of Analysis/Drug Identification Section
- Appendix A – Properties for the Validation Process
- Appendix B – An Example of the Validation of a GC/MS Method for Heroin Analysis

This presentation will impact the forensic community and/or humanity by demonstrating Published recommendations (www.swgdrug.org) have been available since 2000 to forensic scientists around the world. These recommendations have addressed Methods of Analysis, Education and Training, and Quality Assurance issues. All recommendations were developed with input from the international forensic drug analysts community.

All aforementioned recommendations have been discussed widely in the forensic science community. During this presentation, the significant factors from these recommendations will be explained. Time will be allocated for questions from attendees. Representatives from the SWGDRUG Core Committee will answer questions and address the concerns of attendees.

In past presentations to the American Academy of Forensic Sciences, a synopsis of the history of SWGDRUG and goals of the core committee have been presented. This year's presentation will focus on the specifics described above. However, the following information is presented here for those unfamiliar with the SWGDRUG process. SWGDRUG has been in existence since 1997. The mission of SWGDRUG is to recommend minimum standards for the forensic examination of seized drugs and to seek their international acceptance.

The objectives of SWGDRUG are the following:

- To recommend minimum standards for forensic drug analysts' knowledge skills and abilities
- To promote professional development of forensic drug analysts
- To provide a means of information exchange within the forensic drug analyst community
- To promote the highest ethical standards of practitioners in all areas of forensic drug analysis
- To recommend minimum standards for drug examinations and reporting
- To establish quality assurance recommendations
- To seek the international acceptance of SWGDRUG minimum standards

The SWGDRUG core committee is comprised of representatives from federal, state and local law enforcement agencies in the United States, Canada, Great Britain, Germany, Japan, Australia, the European Network of Forensic Science Institutes (ENFSI), the United Nations Drug Control Program (UNDCP), Africa, and South America, a forensic science educator, the American Society of Crime Laboratory Directors (ASCLD), ASTM, and the National Institute of Standards and Technology (NIST). All members of the core committee have worked together over the past six years to build a consensus on the development of recommendations which have impacted forensic drug analysis standards internationally.

Published recommendations (www.swgdrug.org) have been available since 2000 to forensic scientists around the world. These recommendations have addressed Methods of Analysis, Education and Training, and Quality Assurance issues. All recommendations were developed with input from the international forensic drug analysts community.

Criminalistics, SWGDRUG, Drug Analysis

B132 Rapid Illicit Drug Analysis Using the Infrared Microprobe

John A. Reffner, PhD, Smiths Detection, 14 Commerce Drive, Danbury, CT 06810*

After attending this presentation, attendees will learn that the combination of microscopy and infrared spectroscopy is a unique technology for rapid analysis of illicit drugs.

The forensic drug analyst is overwhelmed with samples, pressured by backlog and pressured for immediate results. By combining microscopy and infrared spectroscopy, the infrared microprobe is a unique tool, able to analyze illicit drug sample quickly and be in compliance with SWGDRUG and ASTM recommendations. Advances in instrumentation and software are combined to create a rapid, reliable and reviewable system. This technology will impact the forensic community and/or humanity by impacting the way illicit drug sample are analyzed.

Because of the magnitude of the illicit drug problem and the ever-increasing scrutiny of the legal system, the forensic drug analyst is under great pressure. A defendant's rights to a speedy trial, establishing probable cause for warrants and standardized analytical testing are important concerns of criminal justice. For the forensic drug analyst this translates into "do it fast", "do it right every time", "report results quickly" and "create a reviewable record". Infrared microprobe analysis fills these needs.

The forensic science community recognizes its obligation to provide the public with high quality results in a timely manner. Two peer groups, SWGDRUG and ASTM Committee E-30 have recommended minimum standard practices for illicit drug analysis [1-2]. Recently, ASTM published E 2329-04, *Standard Practice for Identification of Seized Drugs*. This standard is based on the recommendations of SWGDRUG and establishes minimum standards applicable to the identification of seized drugs. Because they provide unique molecular chemistry identifications, infrared

spectroscopy, mass spectroscopy, nuclear magnetic resonance (NMR), and Raman spectroscopy are designated as Category "A" techniques.

Based on its ability to discriminate different drugs, infrared analysis is a primary method of analysis. Since no two compounds are exactly the same, mid-infrared spectra are often referred to as molecular "fingerprints". Infrared (IR) spectra of documented samples are recorded and stored in "spectral libraries". An unknown spectrum is "searched" through the library and the "best match" is determined. The analyst compares the library data with the IR spectrum of the unknown and he or she makes a scientific decision. The analyst selects the best method for confirmation. Infrared analysis can differentiate cocaine hydrochloride (HCL) form cocaine base ("Crack"), or ephedrine from pseudoephederine and can identify unstable drugs like GHB (gamma hydroxybutyric acid). These determinations are not possible by other analytical techniques.

Many forensic drug laboratories use microcrystalline test to either prescreen or confirm the identification of illicit drugs. For example, a common microcrystalline test for cocaine is to place a drop of a gold chloride solution (5-g $AuCl_3$ per 100-ml H_20) on a few grains of powder. Unique crystals, shaped as feathery crosses, are formed in a few minutes. Using internal attenuated total reflection (ATR), the ATR spectrum of the gold chloride salt can be recorded to confirm the microcrystal test.

Street drugs are impure; they are often mixed with cutting agents or impurities. Using an infrared microprobe combines the imaging of the microscope with the analytical power of infrared analysis. Microscopic examination lets the analyst see discrete phases so that infrared spectra can be collected from each phase. Fig. 1 is a micrograph of a heroin street drug. Spectral analysis confirms that the light (birefringent) phase is mannitol and the dark phase is heroin.

When vibrational spectroscopy is combined with light microscopy the analysis of illicit drug samples is enhanced. The three "R's" for the drug analyst are: rapid, reliable and reviewable. Speed is essential for short turnaround-times and reducing case backlog. The analytical method controls the rate of analyses. Reliability is crucial. There is zero tolerance for false positive results (Type I errors). Results and procedures must be reviewable, providing a check on the expert's testimony and protecting the defendant's rights. Modern infrared microprobe analysis satisfies these requirements.

References:

The Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG). Microgram 2001; 34(6):136.

ASTM E-2329-04 Standard Practice for Identification of Seized Drugs, ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

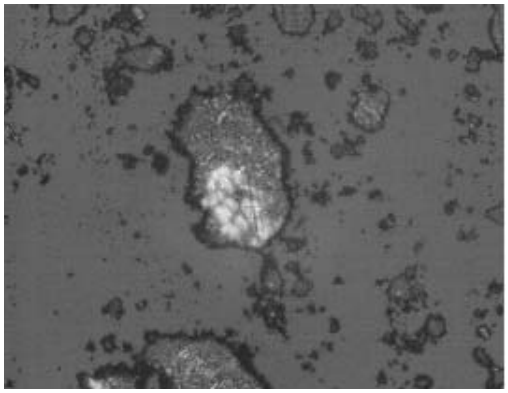

Fig. 1. A heroin "Street" drug sample viewed with polarized light to see different phases. The mannitol crystals are birefringent, appearing white, while the heroin is dark.

Infrared Microprobe, Drug Analysis, ASTM

B133 Geographic Information System (GIS) Functionality: A New Approach to Evaluating the Distribution of Seized Drug Evidence From Crime Laboratories in the United States

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After attending this presentation, attendees will have an enhanced understanding of the spatial distribution of controlled substances seizures and indicators of controlled drugs availability by using Geographic Information System (GIS) display functionality. The presentation will be based on laboratory analysis and drug identification data from the National Forensic Laboratory Information System (NFLIS). GIS techniques will also be applied to the October 2004 –September 2005 NFLIS data to map the levels of selected drug items seized and identified by county within specific states and at the state level. These map displays by state will reveal important drug problem variation within a state as well as drug problem variation across states.

The integration of GIS functionality for data exploration and display, when applied to a drug seizure database, such as NFLIS, has the potential to reveal important drug problem variation within a state, as well as drug problem variation across states. This presentation will impact the forensic community and/or humanity by demonstrating how the ability to map the levels of selected drug items seized and identified within specific states and their counties offers a valuable and unique resource for state and local forensic laboratories that analyze substances secured in law enforcement operations across the country, significantly enhancing their efforts to monitor and understand illegal drug abuse and trafficking.

This presentation will provide timely data from the National Forensic Laboratory Information System (NFLIS) program which is a database system that provides nation-wide drug seizure and laboratory identification information. To date, approximately 247 individual forensic laboratories that perform drug analyses participate in NFLIS. The program's goal is to include all 306 state and local municipal forensic laboratories as well as the approximately 20 federal laboratories that perform drug chemistry analyses in the U.S.

During the period October 2004 through September 2005, an estimated 1,200,000 drug items will be analyzed by state and local laboratories in the United States. The number and percentage of analyzed drug items for the four most frequently reported drugs will be presented at the national level. Regional distribution of these drugs by state will be examined via application of GIS techniques and other analyses. Highlighted findings will include the estimated prevalence of drugs seized and analyzed with special emphasis on cocaine and methamphetamine. GIS generated maps will be used to display levels of cocaine and methamphetamine identified based on the county of seizure for several states in the western census region as well as some states from the other regions. The distribution of drugs by major drug categories (*e.g.*, narcotic analgesics and benzodiazepines) will be presented conventionally and graphically as maps. Data on drugs identified in strategic geographic locations, areas bordering major interstate highways and selected major metropolitan areas will be summarized.

NFLIS state and local forensic laboratories analyze substances secured in law enforcement operations across the country and offer a valuable and unique resource for monitoring and understanding illegal drug abuse and trafficking, including the diversion of legally manufactured drugs into illegal markets. The integration of GIS functionality for data exploration and display further enhances the importance of the NFLIS data as an important information resource for drug policy and drug control agencies by providing timely information on drug trafficking and abuse spatial patterns across the United States.

GIS Functionality, Drug Seizures, Drug Database

B134 Image Recognition, Analysis, and Library Searching Applied to Photomicrographs

Suzanne C. Bell, PhD and Rebecca Hanes, BS, West Virginia University, Bennett Department of Chemistry, 217 Clark Hall, Morgantown, WV 26506-6045

The goal of this presentation is to describe applications of digital image processing to polarized light microscopy, specifically as applied to microcrystal testing. Attendees will obtain an overview of this application and how automated digital image processing techniques can be used to create databases and library search algorithms. These algorithms are conceptually similar to database searching used with instrumental techniques such mass spectrometry and infrared spectroscopy. Statistical analysis of digital image databases will also be addressed and will demonstrate how photomicrography can be integrated with instrumental data to increase specificity of identification and to associate probabilities and uncertainties to the results of digital image analysis.

This presentation will impact the forensic community and/or humanity by increasing the reliability and specificity of data obtained from microscopy and will facilitate data basing, statistical analysis, and development of Daubert admissibility principles to photomicroscopy across a broad range of applications.

Digital image processing is an established tool for the forensic analysis of fingerprints, firearm, and toolmark evidence. However, these algorithms have not been widely applied to other types of images such as photomicrographs. Existing instrumentation and software facilitates rapid collection of such images, leading to the creation of large databases. Such databases allow for data mining, statistical analysis, validation, pattern matching, and searching. Systematic data collection and analysis will be indispensable for moving microscopy from what is perceived to be a subjective analytical tool to an objective and quantitative one. This presentation will describe this evolution using microcrystal tests employed in drug analysis as an example.

Microcrystals of methamphetamine, amphetamine, and cocaine were obtained using ASTM Standard methods. Replicate images were collected under optimized and controlled conditions. Stages of crystal growth were documented, as were all observed variations of morphology. Images of common diluents and contaminants were also collected, along with images of mixtures as would be expected in actual evidence. Image processing and archiving using Image Pro® (Silver Springs, MD) followed. The extracted numerical descriptors were transferred to statistical analysis programs for comprehensive evaluation. These protocols will be presented in detail, as will the associated quality assurance and quality control procedures.

Extensive statistical and data mining procedures were used to identify fundamental morphological features of the different crystals from dry powder mixtures to mixtures of crystals and diluents. From this work emerged algorithms to search image databases, produce a list of potential "hits" and associated probabilities, and present the user with images for comparison. In effect, this database has become a searchable library similar to those used with mass spectrometry and infrared spectroscopy.

The power and potential of image processing and searchable libraries lies in combined applications. Consider the combination of color tests, crystal tests, and microspectrophotometry for the characterization of white powders: Since all analyses can or do rely on variations of a microscope as a detector, it is conceivable that these tests could be combined on a single slide. Proper design makes possible a device that miniaturizes the traditional presumptive-screening-confirmatory test routine used in solid dose drug analysis. A simple, passive flow microfluidic device exploiting these ideas is the subject of another presentation.

Microcrystal Tests, Polarizing Light Microscopy, Digital Image Processing

B135 A Micro-Fluidic Device Integrating Color and Crystal Tests and ATR

Rebecca D. Hanes, BS, and Suzanne C. Bell, PhD, West Virginia University, Bennett Department of Chemistry, 217 Clark Hall, Morgantown, WV 26506*

After attending this presentation, attendees will learn how color and crystal tests can be integrated with IR microscopy in a simple microfluidic device. An indispensable aspect of such application is a searchable database of both crystal morphologies and IR spectra.

With this new microfluidic design, forensic scientists will be capable of performing a series of simple, standard tests both in the field and in the laboratory in a short amount of time. These simple tests, coupled with infrared spectroscopy, will impact the forensic community and/or humanity by having the potential to automate many of the routine aspects of forensic drug analysis.

When first introduced into the forensic community in the late 1800s, color tests and then microcrystal tests became invaluable assets to chemists, and were often the only methods available to identify certain substances. As analytical chemistry progressed, advanced technology became more available, such as mass spectroscopy and infrared spectroscopy. These became standard tools in the identification process. The continued practice of color tests for screening purposes is rarely challenged today. However, the role of microcrystal tests in drug analysis is not as apparent. Recent advances in instrumentation, particularly in microspectrophotometry, coupled with a greater understanding of the chemistry, the structure and the morphology of the microcrystals used in forensic science has led to a renewed interest in forensic chemistry's oldest tool. These potential applications include coupling microspectrophotometry with a polarizing light microscope, and microfluidic devices specifically designed for solid drug analysis. The analytical procedure used for both the color and the microcrystal tests are described below and will be discussed in the presentation.

The first step in the analytical procedure was performing color tests on cocaine, methamphetamine, amphetamine and heroin using typical reagents, including Marquis and Mandelin. The color reagent was first added to a fiber to observe any change of color the reagent might produce. Then, a solution of the controlled substance in methanol was added to the fiber. Thirteen different types of fibers were tested to determine which type of fiber showed the most color change when both the reagent and the drug solution were added. Using microspectrophotometry and CIE-LAB coordinates, images and information about how both the reagent and the drug react with the fiber were collected. The information and images collected where then stored in a database for further analysis. This analysis is described in a related presentation.

Secondly, microcrystal tests were performed on cocaine, methamphetamine, amphetamine and heroin following the ASTM methods. These microcrystal tests were performed first with pure substances, then the addition of diluents and adulterants commonly found with each type of drug. These diluents and adulterants were added one at a time, approximately 1:1 ratio until a total of 5 additives were mixed with the controlled substance. Images of the crystals formed were then taken and stored in an image database for further analysis.

The final step was to add confirmatory tests. Infrared microscopy using attenuated total reflectance (ATR) and a diamond tip objective were employed for this purpose. As applied in this work, simple microfluidic device prototypes were designed on templates that fit on a typical microscope slide. These devices utilized various combinations of color, crystal and ATR-IR spectroscopy for the identifying and analyzing of various drugs and drug mixtures. This presentation will discuss these results in detail.

Micro-Fluidics, Infrared Spectroscopy, Crystal Tests

B136 Detection of Narcotics and Organic Explosives Using Volatile and Semi-Volatile Chemical Markers

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The goal of this presentation is to describe the analysis of volatile and semi-volatile chemical marker compounds for the detection and presumptive identification of narcotics and explosives by Solid Phase MicroExtraction Ion Mobility Spectrometry (SPME-IMS).

Locating narcotics in a search or seizure situation or detection of illicit explosives before detonation is problematic due to the intentional concealment of these substances and their unique chemical properties. To date, the most effective means of locating contraband material has been the detection canine teams. It is believed that the canine is using volatile and semi-volatile chemical marker compounds to locate contraband material. Some of these volatile and semi-volatile compounds have been identified in the headspace of narcotics and explosives through canine detection team research. Detection of these compounds by an instrument but in a manner similar to that of a canine detection team will impact the forensic community and/or humanity by allowing a well understood method supported scientifically into the courts assuring probable cause.

Solid Phase MicroExtraction (SPME) provides improvements over other sample extraction and pre-concentration methods due to commercial availability, selectivity, field portability, cost, ease of use, rapid and solvent free extractions. Ion mobility spectrometry (IMS) affords a sensitive, low cost, rapid, and portable method for presumptive analysis of organic materials, such as narcotics and explosives. These spectrometers have become widely used in the nation's ports of entry and in presumptive search and seizure situations. The installed base of ~10,000 IMS conducts over 10,000,000 analyses each year. These devices are currently employed as particle samplers and do not use a sample pre-concentration technique. SPME was recently coupled to IMS through an adjustable temperature flow controlled interface. This interface successfully converted the IMS particle sampler into a vapor sampler and allowed for sample extraction and pre-concentration. Vapor sampling is important because it offers improved sensitivity and may allow for stand-off detection. Conversion of the widely used IMS particle sampler into a vapor sampler though an accessory would update the current infrastructure without significantly increasing cost.

Locating narcotics in a search or seizure situation or detection of illicit explosives before detonation is problematic due to the intentional concealment of these substances and their unique chemical properties. To date, the most effective means of locating contraband material has been the detection canine teams. It is believed that the canine is using volatile and semi-volatile compounds to locate contraband material. Some of these volatile and semi-volatile compounds have been identified in the headspace of narcotics and explosives through canine detection team research. For example, the following compounds have been identified in the headspace of explosives: 2-ethyl-1-hexanol (2-E-1-hexanol), cyclohexanone, 2-nitrophenylamine (2-NPA), dinitrophenylamine (DPA), R-(+)-limonene, and 1,3-diethyl-1,3-diphenylurea (1,3-DE-1,3-DPU). Detection taggants are required components in United States manufactured or imported plastic explosives. Detection taggants exist in the headspace of explosives and can be used for trace chemical detection of explosives in addition to these compounds. Canines have many advantages but development of an instrumental technique would allow for use in hazardous situations, increase duty time, and facilitate remote detection.

IMS is normally operated in positive ion mode for drugs of abuse and negative ion mode for explosives. The operation parameters were optimized for detection of the volatile and semi-volatile chemical markers instead of the narcotic or explosive parent compounds. For example, detection of the common taggant 2,3-dimethyl-2,3-dinitrobutane (DMNB) requires alteration of the standard operating conditions. SPME-IMS has been successfully used for the detection of these compounds at concentration levels expected to produce an alert for concealed drugs or explosives in an enclosed space such as the cargo hold of an airplane. The application of this patented and novel approach to drugs and explosives detection is presented.

Narcotics, Explosives, SPME-IMS

B137 The Chemistry of Phosphorus-Containing Reducing Agents and the Significance of Phosphate, Phosphite, and Hypophosphite in Clandestine Laboratory Casework

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After attending this presentation, attendees will understand the significance of the anions of phosphate, phosphite, and hypophosphite in the various phosphorus – iodine methods of methamphetamine manufacture and how these anions can be identified using capillary electrophoresis.

Due to the similarities of the various phosphorus – iodine methods of manufacture, this presentation will impact the forensic community and/or humanity by providing a better understanding of the phosphorus chemistry involved in each method as well as assisting in the recognition of the manufacturing process through the use of inorganic anion analysis by capillary electrophoresis.

Since the early 1980s, the use of red phosphorus with iodine or hydriodic acid has been a common means of reducing ephedrine and/or pseudoephedrine to methamphetamine. Other phosphorus-containing reducing agents, such as hypophosphorous acid, phosphorous acid, phosphorus triiodide and white phosphorus, can be used as a substitute for red phosphorus to convert iodine to hydriodic acid. Although these other phosphorus-containing reducing agents are common in some regions of the world, they do not have the popularity that the red phosphorus method currently has in the United States.

Identification of phosphorus-containing reducing agents used in suspected methamphetamine laboratories is an integral part of the evaluation of samples collected from these sites. Samples may include unused starting materials, reaction mixtures, and waste byproducts. Visual inspection of samples prior to analysis provides only limited value in assessing possible materials present. Chemical analysis is required to identify materials present in collected samples. In the absence of readily identified starting materials, evaluation of reaction mixtures and or waste products is necessary to identify the manufacturing method and make production capacity estimates.

Six experiments were carried out using different phosphorus-containing reducing agents (1 – red phosphorus, 3 – hypophosphorous acid, 1 – phosphorous acid, and 1 – phosphorus triiodide) with iodine to convert ephedrine to methamphetamine. Samples were collected throughout each experiment to provide a means of monitoring the reaction progression and the chemical species generated during the reaction process.

This paper will discuss the use of anion analysis by capillary electrophoresis (CE) for the identification of iodine and phosphorus-containing anions (hypophosphite, phosphite, and phosphate) and compare those results to organic analysis data obtained using gas chromatography / mass

spectrometry (GC/MS). Phosphorus chemistry and reaction mechanisms will be reviewed for the purpose of determining the significance of finding various phosphorus anions in samples that have been collected. Equations have been developed, using phosphorus chemistry and reaction mechanisms for the various phosphorus-containing reducing agents in combination with iodine, that can be used to predict the ratios of phosphorus anions that should be present based on the type and quantity of starting material. Using these predictive measures, anionic species identified in samples from clandestine laboratories can be used to determine what starting materials were used and the relative ratios of those starting materials. Results from the examination of actual case samples will be presented.

Methamphetamine, Phosphorus, CE

B138 Identification of Principal Components in Khat Leaves (Catha edulis) Using Liquid Chromatography Atmospheric Pressure Electrospray Ionization Mass Spectrometry

Adrian S. Krawczeniuk, MS, and Shirley T. George, MS, Department of Justice, Drug Enforcement Administration, Northeast Laboratory, 99-10th Avenue, Suite 721, New York, NY 10011*

After attending this presentation, attendees will understand the methodology for the identification of the two principal components of khat: cathinone and cathine using LC/MS

This presentation will impact the forensic community and/or humanity by demonstrating a new LC/MS application that will assist the forensic drug chemist in identifying controlled compounds in khat leaves. Present methodologies make conclusive identification especially GC/MS difficult, requiring derivatization to confirm cathinone and cathine.

A liquid chromatography mass spectrometric (LC-MS) method using atmospheric pressure electrospray ionization (API-ES) was developed for the identification of the two principal alkaloids in seized khat, cathinone (2-amino-1-phenyl-1-propanone) and cathine ((+)-norpseudoephedrine).

The leaves and young shoots of *Catha edulis* Forsk are usually referred to as khat. Khat is an evergreen shrub or tree that grows wild primarily in eastern Africa and the southern Arabian Peninsula. The chewing of khat is endemic in certain parts of Africa and the Arabian Peninsula. Users chew the fresh plant material for its stimulant and euphoric effects, similar to the effects of amphetamine. Cathinone (Schedule 1) has been determined to be the principal alkaloid responsible for the pharmacological and stimulant effects, similar to amphetamine in potency. Cathine (Schedule IV) had been originally identified as the main naturally occurring alkaloid present in khat responsible for its stimulating effects, together with its diastereomer norephedrine. Cathine occurs mainly in older plants and is also formed by reduction of cathinone during drying and storage. In fresh or well preserved khat material, cathine exists as only a minor component in comparison to cathinone.

Present confirmatory techniques for the identification of cathinone and cathine have relied on gas chromatography-mass spectrometry (GC-MS) and gas chromatography-infrared detection (GC-IRD). However, GC-MS of cathinone and cathine gives weak spectral information and molecular ion confirmation is difficult, requiring the need for derivatization. GC-IRD offers more specificity in the identification of cathinone and cathine. The use of liquid chromatography-mass spectrometry (LC-MS) and in-source collision induced dissociation fragmentation using a single quadrupole mass spectrometer provides another analytical technique possessing good discriminating power for the identification of the principal khat alkaloids.

Sample preparation involved soaking the freeze dried khat leaves (approximately 10 g) in 0.1N H_2SO_4 followed by extraction with chloroform to remove neutral organic compounds. The acidic solution is basified with 5% sodium carbonate and the cathinone and cathine are extracted into methylene chloride. The methylene chloride extract layers are evaporated to dryness under a stream of air and reconstituted in methanol for LC-MS analysis. Separation was performed on a 15 cm x 3.0 mm Phenomenex Polar-RP column using 10mM ammonium formate pH 3.7 (93%): 7% acetonitrile as the mobile phase along with diode array detection at 250nm and 210nm. Baseline selectivity was achieved for norephedrine (4.4min), cathine (4.7min), cathinone (5.4min), ephedrine (5.9min) and amphetamine (7.6min). Electrospray parameters were optimized via flow injection analysis and in-source collision induced dissociation experiments were performed to optimize fragmentation of the compounds of interest. Ionization is effected via electrospray in positive mode resulting in a protonated pseudomolecular ion (M+H) for the compounds of interest. The method utilizes dynamic fragmentor voltage ramping (*m/z* 152 (80V), *m/z* 150 (90V), *m/z* 134(140V), *m/z* 132 (150V), *m/z* 117 (200V), *m/z* 91 (240V), *m/z* 50 (300V)), resulting in collision induced spectra, with cathinone exhibiting a prominent pseudomolecular ion of m/z 150 and cathine exhibiting a pseudomolecular ion of m/z 152. The method is robust and allows for the rapid screening of multiple exemplars of seized khat submissions for the identification of cathinone and cathine.

LC/MS, Cathinone, Cathine

B139 The Importance of Detailed Mechanistic Fragmentation Analysis for Interpretation of GC/MS-derived Spectra and its Application to Methamphetamine and Regioisomers

Sandra B. Sachs, PhD, and Francis Woo, MS, San Francisco Police Department Crime Laboratory, 850 Bryant Street, San Francisco, CA 94103*

The goal of this presentation is to challenge the controlled substances analyst to think about mass spectrometry (MS) fragmentation mechanisms of organic molecules in general and apply these rules to regioisomers of methamphetamine. The ultimate goal is to approach spectral interpretation in a mechanistic fashion allowing the analyst to assign most peaks in a spectrum to a chemically reasonable and specifically identified structure.

This presentation will impact the forensic community and/or humanity by allowing the analyst to 1) discount a spectral library suggestion as inaccurate, thus lowering the chance of a misidentification, 2) verify that the compound in question has been correctly identified leaving no major peaks in a MS-derived spectrum unexplained or 3) construct a reasonable chemical structure based on logical losses of an unknown that possesses an unusual spectrum; for example, when a non-routine compound is encountered.

An overview of the primary decomposition routes giving rise to many of the molecular fragments observed as *m/z* peaks in MS-derived spectra will be presented. Examples of these routes include: induction, α-cleavage, benzylic cleavage and rearrangements. Each of these routes will be defined and illustrated. In addition to these primary decompositions, another important analysis is to determine whether or not molecular fragments undergo secondary decompositions, which include internal rearrangements and further fragmentation. While admittedly more difficult to perform, the capability to propose chemically viable mechanisms for secondary decomposition analysis is an important skill which will be highlighted in the remainder of this work.

It is important to recognize that several sites of ionization are possible in a molecule depending on the type of functional groups present and how large the molecule is. The proportion of the entire analyte population with a given radical cation site from any of the several ionization sites available in the molecule is dependent upon the ionization potential of the site. This

means that several mechanistic pathways are occurring simultaneously within the analyte population necessitating a full account of all possible fragmentations in order to assign structures to each of the spectral peaks. It should be noted that while multiple ionizations within one molecule are possible, the energy required to accomplish this is prohibitive thus effectively rendering any resultant peaks arising from this process to extremely small relative abundances within the spectrum. The work presented here was performed on an electron impact (EI) quadrupole mass-spectrometer. Upon evaluation and comparison with ion-trap mass-spectrometer data, no significant differences were found.

A full fragmentation scheme for methamphetamine will be presented. This scheme will be used as an example for a deconstructive-style analysis of MS-derived spectra showing examples of each of the primary decomposition routes, namely, induction, α and benzylic cleavage and rearrangements described above. Generalizations from this specific example will provide insight into fragmentation mechanisms for molecules containing amine groups and phenyl rings as these functional groups are virtually omnipresent in routine controlled substance analyses. Also shown will be an empirically derived procedure to easily determine the geometry of dimethyl- or ethyl-substituted imine fragments (RRC=NRR where *m/z*=58) by simple spectral peak pattern recognition. Comparison of quadrupole data with ion trap and spectral library data shows that this imine secondary fragmentation analysis is indeed platform independent.

Skills from this analytical approach will be showcased by studying a previously unreported regioisomer of methamphetamine: N,α,4-trimethyl phenmethylamine, or TMPMA. The authors synthesized this novel ring-substituted methamphetamine regioisomer with the sole intent of testing *a priori* analysis of expected spectral peaks. It will be shown that the mechanistic chemistry detailed above provided a correct explanation for all of the peaks above 10% relative abundance of the base peak. Certainly this predictive skill is useful in some casework; however, the converse may be more useful: when an unexpected or unusual peak pattern arises in a spectrum, analyzing it to determine structure of the molecule. However infrequently the need arises to analyze an unusual compound in casework, reliance solely on the spectral library may not yield useful results, necessitating alternative methods such as those proposed here.

Methamphetamine, Fragmentation, Gas Chromatography/Mass Spectrometry (GC/MS)

B140 Simultaneous GC-NPD-MSD System for Forensic Analyses

Bruce D. Quimby, PhD, and Joseph L. Hedrick, PhD, Agilent Technologies, Inc., 2850 Centerville Road, Wilmington, DE 19808-1610*

After attending this presentation, attendees will understand new techniques to significantly improve their gas chromatographic analyses which use nitrogen specific and mass spectral detection. The techniques increase the speed of analysis by collecting the nitrogen signal; mass spectral (MS) scan data, and mass spectometry in the single ion monitoring mode (MS SIM) data simultaneously. Analysis speed is further increased by backflushing heavy matrix components from the column.

This presentation will impact the forensic community and/or humanity by providing a faster and more reliable GC analyses of, for example, drugs of abuse and toxicology samples.

In forensic gas chromatography (GC) analyses, there are often three important types of data to collect. Nitrogen selective detection with an nitrogen phosphorus detector (NPD) is used because it is sensitive and selective for drugs and makes a convenient screening tool. Mass spectrometry is used in the single ion monitoring (SIM) mode for trace detection of target analytes, and in scan mode for identity confirmation via spectral matching with libraries. In many cases, samples are run on separate GCs: one with the NPD and one with a mass selective detector (a mass spectometer) (MSD). The MS data may require two runs, one in scan mode and one in SIM. It would therefore be advantageous to collect all three types of data simultaneously in a single instrument run.

To accomplish the desired simultaneous collection of all three types of detection data, a gas chromatography interfaced simultaneously with a nitrogen phosphorus detector and mass spectral detection (GC-NPD-MSD) system was constructed with two post-column microfluidic devices in series. The first device is a Dean's switch, which is a fluidic component that directs the column effluent to either of two pathways. Effluent can be sent out a vent or to an effluent splitter. The effluent splitter divides the effluent equally between an NPD and MSD. The system uses deactivated fused silica tubing as restrictors and interconnects between devices. Metal ferrules are used to obtain leak free seals that do not loosen with thermal cycling of the oven. Electronic pneumatic control is used to supply both devices with constant pressure makeup gas.

In practice, the Deans switch is used to vent the solvent peak, excess derivatization reagent, column bleed during post analysis bakeout, and any other unwanted peaks. The rest of the time the column effluent is sent to the splitter and thus to the NPD and MSD. The venting capability reduces the frequency of MS source cleaning and extends the life of the NPD bead. A significant advantage is the ability use solvents which would normally damage the NPD bead, like $CHCl_2$, CCl_4, $CHCl_3$, etc. The MSD is operated in a mode where SIM data and scan data are collected in alternate cycles. The data from a sample analysis consists of three signals: the NPD response, SIM MS data, and scan data and are processed accordingly.

After acquisition of the data, if high boiling matrix components are present in the sample, the column can be backflushed. This removes the heavies much faster than simple bakeout. Backflushing is done by time programming the Deans switch pressure to a high value while programming the inlet pressure to a low one, reversing the flow through the column. The heavy material is the carried out the split vent. For example, backflushing at 300 C for two minutes can remove heavies that would take 20 min at 320C to elute.

The described system provides a means to obtain nitrogen, SIM and scan data with decreased analysis time.

Gas Chromatography, Nitrogen, Mass Spectrometry

B141 Establishment of a Forensic DNA Profiling Training and Laboratory Service Business at the Biotechnology Center, Shadow Lane Campus, University of Nevada Las Vegas

Walter E. Goldstein, PhD, and Tracy R. Welch, BS, Biotechnology Center, Shadow Lane Campus, University of Nevada Las Vegas, 1001 Shadow Lane, MS 7401, Building B, Las Vegas, NV 89106-4124*

After attending this presentation, attendees will have increased knowledge in regard to factors involved in establishing a Forensic DNA Profiling ("DNA Fingerprinting) Laboratory. They will also receive information based on methods and techniques in extraction, purification, quantification, amplification and analysis of DNA.

This presentation will impact the forensic community and/or humanity by establishing specialized short term niche training n Forensic DNA Profiling. The workshops are designed to satisfy specific individual needs of those in the forensic community. This training, as already demonstrated, is valuable in helping those in the forensic community, improve their skills, advance in the profession, or attain a professional position in the forensic community. Specialized laboratory services also are being established to augment services of others to help fulfill community and national needs. Sharing of these experiences will help others.

In a process that started early in this decade, a new Biotechnology Center has been established at the Shadow Lane Campus of the University of Nevada-Las Vegas. Within this Center, a modern Forensic DNA

Laboratory is in place that provides training services in "DNA Fingerprinting" and laboratory services in DNA Profiling.

This presentation will cover the planning, development, and implementation of this laboratory. Laboratory process flow, construction history, equipment selection and implementation of the program will be described. Methods to assure that technical and economic goals are satisfied will be presented. Experiences in developing strategic partnerships essential to meeting objectives will be shared. The acquisition of skills, knowledge gained, and corrections will be covered. Experiences in conducting successful workshops and information taught will be described.

Forensic DNA Profiling, DNA Fingerprinting, UNLV

B142 Is Forensic Anthropology Important in an Interdisciplinary Forensic Science Program?

Susan G. Wallace, PhD, and Liz Walker, Baylor University, PO Box 97370, One Bear Place, Waco, TX 76798*

After attending this presentation, attendees will have a better understanding of the diversity within forensic science programs.

This presentation will impact the forensic community and/or humanity by making them aware that interdisciplinary forensic science programs are growing in popularity. Each program is unique and allows for a student to choose a forensic science program that meets their area of interest.

Forensic science programs have in the past focused on one disciplinary area; chemistry has been the most prevalent at the undergraduate and graduate level. In the past five years the United States has seen a dramatic increase in undergraduate and graduate programs in forensic science. Interestingly, they are more interdisciplinary than their predecessors. The trend appears to be towards incorporating several different areas of forensic science within the forensic science program thus providing a very thorough view and knowledge of the different specialties. Baylor University finds that adding skeletal biology and forensic anthropology to be an enhancement to its program. The forensic anthropologist is able to identify fragments of bone. They determine not only if it is human or nonhuman but also ascertain stature, sex, ethnicity, and age. This discipline is also aware of the time it takes human remains to decompose in different climates and areas so they can determine how long a body has been in a particular location. They are trained to diagnose trauma and any abnormalities that might be present on the skeletal remains which aid in the identification of the deceased individual. Most of this work is done within the context of law enforcement and criminal activity thus making it an integral part of forensic science. With the majority of the Baylor students declaring premedical studies the addition of these classes has proved to also be very beneficial for medical school study.

Forensic Science Programs, Forensic Anthropology, Interdisciplinary Education

B143 Tales of a "Non-Forensic Scientist" in a Forensic Science Undergraduate Classroom

Donna M. Mohr, PhD, Cedar Crest College, 100 College Drive, Allentown, PA 18104*

After attending this presentation, attendees will have experienced a new teaching perspective from a "non-forensic scientist" in the field of forensic chemistry.

This presentation will impact the forensic community and/or humanity by providing insight on how to effectively teach forensic science courses having never experienced collecting or analyzing evidence from a crime scene. The content will be especially beneficial to fledgling professors and high school teachers.

In the real world, a forensic scientist may wear several hats, depending on the type of lab he or she works for. In general, forensic science involves methods of collecting and analyzing evidence, which allows the criminal justice system to apply the results to prove or disprove an alleged criminal's innocence. To accomplish this, forensic scientists need to have a firm understanding of the scientific principles behind the methods and analytical instrumentation used. They also need to be able to think critically and communicate effectively to a lay audience. Thus, forensic science is a somewhat complex field, which has fortunately grown in popularity over the past decade. Consequently, undergraduate and graduate level forensic science programs are sprouting up nationwide. Additionally, forensic science courses have become almost common- place at the high school level. Who is going to teach all of the future forensic scientists? Often, it is not former practicing forensic scientists, since most practicing forensic scientists do not have doctoral degrees, and are therefore not eligible for full-time tenure track faculty positions at most institutions. Consequently, in comes the "non-forensic scientist" into the forensic science classroom. The question becomes, can someone effectively teach forensic science courses at the college or high school level, having never collected evidence from a crime scene, analyzed evidence in a crime lab or testified as an expert witness in court? The answer is yes.

At the heart of forensic science lie the principles of the natural sciences. Both the natural and forensic sciences invoke the scientific method to pose a question, develop hypotheses, design experiments, gather data, and ultimately solve a scientific problem. While casework stories certainly make for an interesting lecture, they are not necessary to teach the principles of science. A great place to incorporate the scientific method and critical thinking exercises is in either a lab or research experience. This also introduces the other side of forensic science. The availability of cutting edge technologies that simply did not exist in the past, has certainly facilitated the advancement and capabilities of the forensic science field. Consequently, the following relationship can be derived.

research $\longleftrightarrow$ training/teaching $\longleftrightarrow$ practice

At the research level, there are forensic chemists/biologists developing analytical methods and techniques practiced by forensic scientists in crime labs. What about the middle person (the teacher)? Is she a researcher or is she a practicing forensic scientist? They are both scientists, and they are both keenly aware of issues involving the qualitative and quantitative analysis of crime scene evidence. It is important for forensic science students to realize that there are many opportunities to explore in the field. By teaching them how to solve scientific problems, their options are limitless.

Education, Forensic Science, New Teachers

B144 Future Forensic Scientists: Where Do They Come From?

Scott L. Rubins, MA, Syracuse University, New Rochelle High School, 265 Clove Road, New Rochelle, NY 10801*

After attending this presentation, attendees will come to understand the significance of early education in forensic science starting at the high school level. Professionalism, order, consistency, proper work habits and good analysis of evidence are the cornerstones of forensic science. In order to have students to adopt this philosophy they need to work in an environment that fosters this type of professional atmosphere. Many of these intro level courses are actually quite advanced, and colleges and high schools are working together to produce a forensic scientist at the highest level possible.

This presentation will impact the forensic community and/or humanity by imploring AAFS members into going and seeking both high school and college forensic science programs (as many already do) and lend their expertise and support. This is the only way these programs can truly be successful and help to produce the future forensic scientists.

Where will the future forensic scientists come from and should the profession care? The answer is simple. They will come from the nation's high schools, colleges and graduate schools. And yes, the profession should care. But why is this any different than in the past? Because in the last ten years the bar has been raised to an extremely high level, expectations are higher and technology is moving at exponential speeds. The media has consumed the public with the mysticism of forensic science and everybody wants to be on CSI. *This* is what is driving the revolution of future forensic scientists. However, this is where everything changes.

Forensic science courses have been established in high schools nation wide by the hundreds to provide an outlet for those students who are awed by the idea of forensics. The AAFS has helped in this venture through the Forensic Science Education Courses (FSEC) which have trained nearly 800+ teachers. Although many are survey courses, some are taught on an advanced or college level making it possible to cover many topics in detail. The result is that every year there are a handful of students who do extremely well and decide to make forensic science their life's work. These students chose to go to college to major in forensic science. Here lies the explanation as to why it important to care **where** the students come from. These students coming from these programs are driven, they have essentially started their training in high school and are extremely prepared when they get to the college level. They are not just exploring the possibility of this as a career, they are making it one. In response to this interest and demand from students, many colleges have added forensic science concentrations or majors to their academic programs. The bottom line is that when you start with a more driven and knowledgeable student, what you get out is a better prepared, smarter, more productive forensic scientist. With the public expecting "CSI-like results" the industry can keep up without programs like these.

Professionalism, order, consistency, proper work habits and good analysis of evidence are the cornerstones of forensic science. In order to have students to adopt this philosophy they need to work in an environment that fosters this type of professional atmosphere. In theses classes, the students do the real work of real forensic scientists making what they do in class authentic. They use the real tools and equipment of forensic scientists (not all, GCMS is too expensive) and take part in mock crime scenes where the aside from solving the case, the most important aspect is the documentation, collection, identification and analysis of evidence. They also study crime scene reconstruction through patterns such as blood spatter and gunshot residue. These courses are aligned with state education math, science and technology standards and teach the students how to; 1) think critically, 2) generate, process, and transfer information, 3) solve problems using an interdisciplinary approach, 4) use analysis and inquiry to solve problems, and 5) apply scientific concepts to address real life problems.

Educators and professionals in the forensics community bear a certain responsibility to make sure that these students get the best education and training possible. This can only be accomplished with support of AAFS members and forensic professionals willing to give their time to work with teachers on curriculum, give advice, speak to students and participate in the FSECs to train more teachers. Reach out to local high school and college programs and offer your help and support and become an invaluable and permanent part of their support team as well as their curriculum. This is where the future forensic scientists come from.

Forensic Science Education, High School/College, AAFS Support

B145 Taking Stock of the Forensic Sciences: Need for a System-Wide Perspective

Joseph L. Peterson, DCrim, Sam Houston State University, College of Criminal Justice, Box 2296, Huntsville, TX 77341-2296*

The goal of this presentation is to assist forensic practitioners to appreciate the scientific, organizational, budgetary, legal, and professional considerations that affect the quality and effectiveness of science provided to the criminal justice system.

This presentation will impact the forensic community and/or humanity by assisting attendees to approach their forensic practice with awareness of the many nonscientific factors in the criminal justice system that influence the quality and effectiveness of work.

Although advances in the forensic sciences in recent years have dramatically expanded their potential for assisting the criminal justice system in identifying humans and materials, reconstructing crimes, and associating or disassociating persons with their victims and scenes of crimes, serious challenges and pitfalls threaten this potential. While some of these problems are scientific in nature, many more issues reside outside the profession and in the domains of the police, the courts, the media, and the public. This paper is based on numerous research studies and inquiries the author has made over the past several years. Most forensic crime labs have been positioned within police agencies for decades that have not always provided adequate budgetary and scientific support. The courts are beginning to call for proof of the reliability of forensic methods, the press has exposed questionable and unprofessional practices, and the public is demanding the field meet a higher standard of service. Unless the forensic sciences begin to address these problems with enthusiasm and a measure of urgency, the field's tremendous potential will be frustrated. The three primary sections of this presentation will address 1) key conditions within forensic sciences profession, 2) the influence that law enforcement has on the field of forensic science, and 3) important legal issues the courts/judicial system must address.

Forensic Science Profession – The profession, itself, must actively support programs that upgrade the quality of science being practiced. Efforts are needed to improve the quality of forensic science education programs offered and technical training delivered both to entry level and experienced professionals. Budgetary and resource deficiencies severely limit the quality and timeliness of services offered and these limitations must be addressed. Professional standards (certification, accreditation, proficiency testing, robust methods) must be embraced and should be made mandatory. Research addressing the empirical foundation of the pattern evidence professions (handwriting, firearms and toolmarks, latent fingerprint identification, and others) must be pursued with vigor.

Law Enforcement – Many of the most serious problems affecting the forensic sciences have their origin with the fact that most laboratories are located within police organizations. Police agencies have failed to provide laboratories with adequate financial resources to handle casework, resulting in too few scientific personnel and large case backlogs. The recent study Census of Forensic Crime Laboratories 2002 found that more than 500,000 requests were backlogged. By their own report, laboratories need upwards of $500 million of new funds to add personnel, and expand and upgrade facilities to respond to this backlog. Equally serious, investigations launched by journalists and defense investigators reveal shoddy work practiced in some laboratories, unqualified personnel practicing their craft, and a laboratory atmosphere that does not promote the unbiased examination and interpretation of the evidence. Many criminal justice and legal panels are recommending the field give serious consideration to alternative organizational arrangements to insure forensic practitioners have independence and are free from organizational bias and related pressures.

Courts/Legal Standards - While DNA has become the new "gold standard" of forensic science practice, the U.S. Supreme Court, through the Daubert decision and its progeny, has raised the bar governing the admissi-

bility of scientific techniques. Courts are demanding methods are peer reviewed, forensic examiners follow the scientific method, and demonstrate the reliability of their techniques through documented error rates. Better-trained prosecutors, defense counsel and judges will challenge future forensic scientists to insure they meet proscribed standards. The fallibility of many types of evidence in death penalty cases has led the courts to review the reliability of all evidence – including scientific. Criminal justice professionals and lay users of forensic science are becoming more knowledgeable about the scientific strengths and limitations of particular forensic evidence. While this places more pressure on forensic examiners, it will also stimulate the field to make needed changes.

The impact of forensic science is becoming more and more dependent upon the actions of nonscientific, criminal justice professionals and lay users of laboratory results. The costs and benefits of the various alternatives mentioned will be discussed.

Standards, Resources, Justice System

B146 Women in (Forensic) Science

Max M. Houck, BS, MA, West Virginia University, Forensic Science Initiative, 886 Chestnut Ridge Road, Suite 309, Morgantown, WV 26506-6216*

After attending this presentation, attendees will gain a better understanding of the cultural aspects of why women are so prevalent in the profession of forensic science and how to attract and retain quality employees leading to a diverse workforce.

This presentation will impact the forensic community and/or humanity by providing an appreciation for the underlying reasons of the current workforce in forensic science.

Encouraging women to pursue science, engineering, and technology (SET) careers is an important part of creating a capable, diverse workforce. A portion of this encouragement entails experiencing viable female role models in the sciences and as portrayed in the popular media. As Julie King noted in her editorial (*Science* V308, 29 April 2005), while industry sees the advantages in a diverse workforce, academia has yet to inculcate these practices into its own diversity. However, one scientific discipline has attracted an inordinate number of females to its academic ranks: Forensic science.

Most forensic science programs are overtly female in population—the program at West Virginia University has been 62% to 67% female since its inception. The Introduction to Forensic Science course taught to last year was 86% female. This pattern is repeated in forensic science programs in the U.S. and abroad: The Higher Education Academy and SEMTA (the Sector Skills Council for the Science, Engineering and Manufacturing Technologies) published an overall rate of 67% for the U.K. (1) This predominance of females in forensic science is mirrored in operational forensic laboratories (the discipline's "industry"); for example, Minnesota's Bureau of Criminal Apprehension Forensic Science Laboratory is 72% female and 60% of South Carolina's Law Enforcement Division Forensic Science Laboratory are female.

Why is forensic science such as attractive SET career for women? Several factors may provide indications. Changes in the way the media portray women (and minorities) in science, especially forensic science, may have encouraged women. In the 1990's, women and minorities were under-represented as leads in television series with a scientific theme; however, the current slate of *CSI* dramas have generally improved this representation.

	1994-1997 (%'s) (2)		**2002-2005 (%'s)**
	U.S. Population	**Science in Prime Time**	***CSI***
White			
Male	41	75	41.2
Female	42.1	13.2	23.5
Black			
Male	6	8.3	11.8
Female	6.6	1.4	11.8
Hispanic	11	0	1.8
Asian	3	0.7	0

Is this one of the lesser known results of the so-called "*CSI* Effect"? Men and women scientists in equal numbers report seeking a career in science due to the influences of science fiction media in their childhood (3). Perhaps the way the science is employed in the media portrayals makes a difference. Women are more interested in medical research than men (3) and medicine has obvious social import as does forensic science. As one female students explained when asked about her personal motivation for forensic science, "I could use my [science education] more to help people. I saw I had more options than in medicine." Additionally, reality-based shows like *Forensic Files* portray the industry by interviewing real forensic scientists—most of whom are women. Other forms of reality-based media can be influential, such as books written by female scientists aimed at children and young adults (4).

By studying the motivation of why forensic science is dominated by women, other SET academic disciplines could benefit in the recruitment and retention of a diversity of quality students. The predominance of females in forensic science has implications that affect not only academia but ultimately will affect the demographics of the industry, employer culture, and employee satisfaction as well (5). Diversity is a key to success but only if managed appropriately. Although the academy and industry of forensic science may have caught on to attracting a diverse workforce, their next challenge is to learn to manage it (6, 7).

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Women, Personnel, Forensic Science

B147 Engaging College Freshman in Forensic Science Education

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After attending this presentation, forensic science educators will understand the importance of engaging students from the start of their college career through curriculum development.

This presentation will impact the forensic community and/or humanity by allowing forensic science educators to reevaluate their level of interaction with incoming freshman and to demonstrate the potential advantages of early intervention.

Educating the forensic scientists of the future is a real challenge. Students must possess a strong science background, superior communication skills (oral and written), and a good working knowledge and appreciation for forensic science. Over twenty years ago the Council on Forensic Science Education (COFSE) formed in order to address these issues. At the time there were no guidelines or recommendations for universities planning on offering Forensic Science Programs. As a result, a degree in Forensic Science did not mean the same thing from one university to the next. For example, one program might be based out of a traditional science department, while at another university a program might be based out of criminal justice department and contain virtually no science content.

The lack of consistency in the forensic science degree led employers to shy away from hiring forensic science graduates preferring to hire graduates with degrees in Chemistry or Biology. COFSE paved the way by pulling together professors from public and private universities offering both undergraduate and graduate programs in Forensic Science. They discussed issues of curriculum development and improving academics in forensic science education. More recently a Technical Working Group on Forensic Science Education and Training, (TWGED), formed to generate recommendations for program standards. TWGED was made up of forensic science educators (many of whom were already COFSE members), laboratory directors and attorneys. Wisely, TWGED also sought to involve "end users" into the discussion. The result was a June 2004 National Institute of Justice publication (NCJ 203099). The document, "Education and Training in Forensic Science: A Guide for Forensic Science Laboratories, Educational Institutions, and Students," was a great reference that started to tackle some of the more difficult issues. It defined what "the model candidate" was and provided some sample curricula for both undergraduate and graduate forensic science programs. Unfortunately, once the report was completed, so was TWGED's mandate.

To carry on the legacy of TWGED the American Academy of Forensic Sciences (AAFS) created an accreditation body known now as the Forensic Science Education Programs Accreditation Commission (FEPAC). This body adopted the TWGED recommendations with minor revisions to serve as the guidelines for accreditation. For new programs, the guidelines can act as a framework upon which they can begin to build. Existing programs must look to see what modifications need to be made to bring them into compliance with the standards.

While these changes have brought monumental improvement to forensic science education, they have done little to assuage the culling of the incoming crop of freshman hit by a first year encompassing Biology, Chemistry, and Calculus. For the most part forensic science educators take a pragmatic approach to high attrition rates. Some universities have even started taking advantage of them by adjusting the fall and spring laboratory sections of Biology and Chemistry to be combined and only be offered during the spring. The dramatic size reduction that occurs between the first and second semester allows a more manageable lab section size.

Since forensic science is such an applied science, some forensic science educators do not even interact with their students until they have completed all of the science prerequisite courses. It is the author's contention that this is a grievous error. This is not just based on academics. Because of the interrelationship with the law, students are now held to a higher ethical standard. For some, college is their first true experience of freedom. It is during this vulnerable time that it is important to remind them of the extent of background searches that most employers will use.

The author has found that the best way to do this is to create a special course required of all incoming forensic science freshman. The one credit course is entitled "survey of forensic science" and is only taught by the Program Director. This allows incoming freshman to form a relationship with the person that should be guiding them in the program during their first year instead of during their third year if they have even made it that far. The course highlights different areas of the NIJ publication (NCJ 203099), clarifies the order and structure of the program, and allows students to get a smattering of all of the different subdivisions of Forensic Science. This later point also serves to stimulate the student, demonstrating the practical application of the science they are about to learn.

Student Engagement, Forensic Science, Education

B148 Printed and Web-Based Forensic Science Education Resources

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After attending this presentation, attendees will understand the number and types of printed resources for forensic science education and the resources available on the web for forensic science education.

This presentation will impact the forensic community and/or humanity by assisting educators in forensic science in knowing the extent and types of resources for education in forensic science.

In recent years the number of institutions of higher education and secondary schools that offer forensic science courses or degrees has increased dramatically. This is partly due to the popularity of forensic science on television, books and the movies. The American Academy of Forensic Sciences lists more than 100 degree programs in forensic sciences and there are hundreds more colleges and universities that offer one or more courses. Hundreds of high schools and even middle schools now offer courses in forensic science.

Most educators like to use a textbook to provide the main educational material in a course. Until recently there have been very few suitable textbooks for introductory courses and almost none for advanced courses. Likewise there has been very little in the way of laboratory manuals for forensic science courses and many teachers develop their own materials for lab.

This paper will survey the printed and web based resources available for teachers and students in forensic science. They will be divided by the level of the course and the main subject matter.

Education, Books, Resources

B149 Assessing Academic Competency in Criminalistics

Lawrence A. Presley, MS, MA, Arcadia University, 450 S Easton Road, Glenside, PA 19038*

After attending this presentation, attendees will understand the use of a national examination for the assessment of academic competence in forensic science.

This presentation will impact the forensic community and/or humanity by demonstrating how a national examination in forensic science will have a large impact on forensic science education and employment by forensic laboratories.

The National Institute of Justice's 2004 special report on the *Education and Training in Forensic Science: A Guide for Forensic Science*

Laboratories, Educational Institutions, and Students provided a framework for undergraduate, graduate, and continuing education within the forensic science community. This report also provided the impetus for the creation of the Forensic Science Program Accreditation Commission (FEPAC), and hence the beginnings of a formal and national assessment of academic competency in the field of forensic science. The American Board of Criminalistics (ABC) has provided one component of a standardized national assessment of academic competency through the use of a General Knowledge Examination (GKE); however, this test is designed for practitioners in the field, and includes experience based questions presuming a working knowledge of the field of criminalistics. FEPAC and ABC are working toward a national examination similar in design and reporting to the Graduate Record Examinations which would be appropriately designed for undergraduate and graduate forensic science students. The national Forensic Science Aptitude Test (FSAT) would provide a standardized and national score of forensic science program graduates. These scores could be used by FEPAC and other forensic science educational institutions to assess on a national level and in standardized format the quality of forensic science programs. This would be consistent with the NIJ 2004 report and FEPAC accreditation standards and goals targeting program improvements and a high level of competency for forensic science graduates. A national Forensic Science Aptitude Test (FSAT) could also be used by crime laboratory directors to assess the overall forensic science knowledge of applicants, and subspecialty scores could be used as indicators of relative strengths or weaknesses in specific academic areas. A national examination would provide an important, reliable, and relevant tool for educators and crime laboratory directors for assessing academic competency in the field of criminalistics.

FSAT Forensic Science Assessment Test, Assessment, Competency

B150 Integrating Digital Forensics into a Forensic Science Academic Curriculum

Ronnie D. Jewell, MS, and Terry W. Fenger, PhD, Marshall University, Forensic Science Center, 1401 Forensic Science Drive, Huntington, WV 25701*

The goal of this presentation is to show the relationship between the educational curriculum and the field of digital forensics. It will include information about the technical and scientific working groups for digital evidence and digital forensics that are available to institutions seeking to create a digital forensics program curriculum.

This presentation will impact the forensic community and/or humanity by providing a better understanding of the scientific and technical working groups and realize how these groups impact the development of curriculum for academic forensic programs.

Marshall University's Forensic Science Masters Degree Program began in 1994 to meet the growing need for forensic scientists. Initially the emphasis was DNA based but in 1999, the program began expanding its offerings into the digital field by offering a course in digital imaging. The following year a course in cyber crimes was added and in 2003 two additional digital forensics courses were added. These courses became the basis of its area of emphasis in Computer Forensics. The first cohort of students in computer forensics graduated in 2005.

Over the past decade a number of changes have occurred within the program. The program expanded faculty, staff and curriculum; a new building was constructed; more courses were offered; and recently, the program underwent a voluntary audit by the Forensic Science Education Program Accreditation Commission (FEPAC).

Over the past five years a number of changes have occurred in the digital forensics field as well. Guidelines and standards were developed by technical and scientific working groups; laboratories began accreditation through ASCLD/LAB; practitioners are becoming certified through private organizations.

Academic institutions often lag behind when it comes to educating students in a rapidly evolving field such as digital forensics where technologies and techniques change so quickly. This presentation is designed to show the relationship between the educational curriculum and the field of digital forensics. It will include information about the technical and scientific working groups for digital evidence and digital forensics that are available to institutions seeking to create a digital forensics program curriculum.

Digital Forensics, Curriculum, Education

B151 Developing an Undergraduate Research Program in Forensic Science: The Cedar Crest College Experience

Lawrence A. Quarino, PhD, Cedar Crest College, Department of Chemical and Physical Sciences, Allentown, PA 18104*

After attending this presentation, attendees will understand the reasons for developing a student-based research program in an undergraduate forensic science program and the resources needed for implementation.

This presentation will impact the forensic community and/or humanity by fostering the belief that undergraduate forensic science research programs are a benefit to the profession because they help students develop skills necessary for success as future practitioners of the field.

Traditionally undergraduate academic forensic science programs have not placed a large emphasis on student research in their curriculum. This may be due to a lack of resources and faculty, inadequate time and space available in undergraduate schedules, a preference of faculty for graduate student research, and a belief among faculty that undergraduates have little interest in research. Additionally, many feel that since forensic science is an applied science, the goals of undergraduate forensic science education are not well served by independent student research. Despite these problems and beliefs, the undergraduate forensic science program at Cedar Crest College has made student research a central part of its academic program. Student-based research programs have been a cornerstone of other undergraduate science programs at Cedar Crest and have long achieved positive student outcomes.

The establishment of a coherent and structured undergraduate forensic science program can foster future success as a forensic science professional in a variety of ways. A meaningful research experience can serve as a preparation for graduate school where student research has a more traditional role. Research also tends to bring many of the concepts learned in the classroom together in a coherent fashion and gives these concepts more meaning to the student. Under proper faculty guidance, research can develop critical thinking ability, problem-solving skills, and an ability to evaluate data through statistical measures. Furthermore, student research fosters both independence and learning to work as part of a team. Research can create a vehicle by where students can contribute to the profession while still students by offering the possibility of presenting original research at professional meetings or publishing in peer reviewed journals. Finally, research creates an appreciation of forensic science literature and the intellectual curiosity and creativity necessary to address the scientific needs of the forensic science community.

The undergraduate forensic science student research experience at Cedar Crest encompasses four semesters during the student's junior and senior year and is required of all students in the program. The first semester is spent formulating a research proposal under the guidance of a faculty member. Many of the projects available to students are part of on-going research that requires several years to complete. In addition to reviewing the literature relevant to the project and providing an experimental design, students are required to submit a budget for the project. The second and third semesters are spent performing laboratory work. During these two semesters, students are required to attend weekly research meetings and to

give three presentations each semester to the forensic science research group, which includes both faculty and students. Research performed during the second semester (spring semester, junior year) and the third semester (fall semester, senior year) still allows adequate time for the submittal of an abstract to a professional meeting for presentation at the meeting while the student is still matriculated. The fourth and final semester is spent writing a manuscript (Journal of Forensic Sciences format required) and presenting the work in a seminar fashion to students and faculty. First, second, and final drafts of the manuscript are submitted according to schedule. The two-year student research experience does require resources and time. Faculty are allocated contact hours to deal with student research and funding for research projects is budgeted annually as part of the normal operating expenses for the program. In addition, outside funding is being solicited. Success does depend on the commitment of faculty, students, and administration.

Student outcomes of the research experience have been successful. Under the structured format and with guidance from faculty, students do achieve research goals, finish projects, and present their findings in the manner expected of a professional. During the four years the research requirement has been in place, students have given 8 presentations at professional forensic and other science conferences. In exit interviews conducted of graduating seniors in the past three academic years, 41% stated that the research requirement was the most rewarding facet of their undergraduate education. Of the program's graduates in the past three academic years, 41% are in or have been accepted into graduate programs in either forensic science, forensic science-related or other science programs and 35% are employed in forensic science or other science laboratories.

Undergraduate Education, Student-Based Research, Forensic Science

B152 Aspects of Curriculum and Pedagogy in Forensic Science Programs

H. Dale Nute, PhD, Florida State University, Panama City, 4750 Collegiate Drive, Panama City, FL 32405*

After attending this presentation, attendees will be able to discuss the concepts underlying forensic science curriculum and pedagogy and make more informed decisions regarding their selection.

This presentation will impact the forensic community and/or humanity by demonstrating how delineation of some of the concepts underlying the selection of curriculum and pedagogy will stimulate a more comprehensive discussion of what subjects should be taught in forensic science educational and training programs, at various levels, and how they should be taught.

Much as the field of forensic science encompasses virtually all the sciences, so does teaching forensic science encompass all of the problems inherent in teaching science, mathematics, and the philosophy of science. Forensic science courses have become one of the most popular types of courses from middle school to graduate school. Teachers like the interest in science that the courses generate, even among students not planning on a forensic science career. However, detractors fear the creation of pseudo-scientists, of non-thinking technicians, and of unrealistic expectations for future employment. Accreditation initiatives now focus the concerns both for teachers and practitioners. These concerns seem to revolve around pedagogy, curriculum, and instructor credentials. This presentation will deal with the first two topics as they, hopefully, constrain the instructor credentials to include both relevant education and varied experience.

Although an instructor's enthusiasm and a high profile topic go a long way towards enticing students to learn, they accomplish nothing without substance. The key questions thus become: "What is that substance?" and "How should it be taught?" The debate begins with the definition of forensic science. A superficial approach to "Application of science to the purposes of the law" leads to the idea that the forensic scientist is a passive tool of the attorney. A more professional approach, by contrast, is that the forensic scientist knows both science and the law and thus can, himself, intelligently apply science to a dispute under investigation. Learning to think like either an investigator or a scientist is a significant challenge. Learning to think like both is formidable indeed. Which learning goals are realistic and/or desirable, and what does it take to achieve them?

Subject matter in too many instances includes only forensic chemistry and DNA examinations, leaving both the use of the findings and the thought process of the more complex disciplines unexplored. This generates a technician mentality that is contrary to the needs of the profession in the opinion of many professionals. What then should the curriculum include?

Fundamentally, there are three critical requirements of physical evidence – relevance, reliability, and authenticity. This triumvirate requires knowledge of logic and the law for relevance, of statistics and science for reliability, and of legal procedures for authenticity. Unfortunately, of the three, legal procedures are simplest and thus receive the most focus by those college instructors who have little or no forensic science experience and thus can teach little else. A comprehensive forensic science program includes examples of all of the fundamental examination types – identification vs. explanation, and classification vs. individuation vs. association (individualization and causation). Also, any forensic science education program, even a truncated one, should be grounded on the scientific method – logic, protocols, and statistical analysis – and on probability, the principle that underlies all three.

How should this range of subject matter be taught? Facts are easy to teach and test. Applying those facts via examination protocols is much harder due to the testing equipment required and to the time necessary to learn a skill. Even more difficult is learning to select and apply the appropriate protocols for problem solving. It requires considerably more time and individual attention to teach a student to reason through a problem, empirically test a variety of hypotheses, and assign a probability to the results of each. The concept called "higher order learning" counters years of training students only to read and regurgitate and requires rethinking of teaching techniques by teachers and of learning techniques by students. But, it is absolutely mandatory for a professional discipline. As an example, how an error rate is determined via protocol development is a key concept required of the forensic science professional.

This session will present an overview of the pedagogical aspects of forensic science with justifications for teaching some of the more fundamental topics and examples of how they could be approached.

Delineation of some of the concepts underlying the selection of curriculum and pedagogy will stimulate a more comprehensive discussion of what subjects should be taught in forensic science educational and training programs, at various levels, and how they should be taught.

Forensic Science Education, Pedagogy, Curriculum

B153 Forensic DNA Research and Teaching at San Jose State University: Establishing Partnerships in Academia, Biotechnology, and Government

Steven B. Lee, PhD, Forensic Science, Justice Studies Department, San Jose State University, One Washington Square, MacQuarrie Hall 521, San Jose, CA 95192*

After attending this presentation, attendees will understand the types of forensic DNA Research and teaching strategies being utilized at San Jose State University. Also the attendees will learn creative ways to establish partnerships in Academia, Biotechnology, and Government to support their forensic DNA research and teaching programs.

This presentation will impact the forensic community and/or humanity by making forensic science educators aware of new programs being offered at SJSU. In addition, descriptions of teaching strategies in forensic DNA will provide educators and also criminalists conducting DNA casework new methods of presenting molecular biology concepts. Finally, forensic science administrators at both educational institutions and crime laboratories will become aware of funding sources for forensic DNA research and education.

Forensic science has gained widespread popularity among students of all ages and backgrounds. Both science and non-science majors are attracted to forensic science classes and programs at nearly every educational level. Programs in forensic science are rapidly being developed to accommodate the increase in interest. Among them are two new programs developed at San Jose State University.

In Fall 2003, San Jose State University announced the approval of two interdisciplinary BS degrees in forensic science: Justice Studies with Biological Forensic Science and Chemical Forensic Science emphases. Although the program is relatively new, there are already 3 faculty members at SJSU in Justice Studies and Biology that have working experience in forensic science: a forensic molecular biologist, a forensic entomologist and a forensic pathologist. Furthermore, the department has also just submitted a request for a new forensic chemistry tenure-track position.

The goals of the programs are to provide a foundation of core scientific knowledge coupled with effective analytical and problem-solving skills and an understanding of key criminal and legal issues. The programs aim to prepare students for entry-level positions in crime laboratories, graduate school or science careers.

The degrees consist of 24 credits of JS courses including forensic science and criminalistics, 36 of core science prep courses including biochemistry, statistics, general chemistry, organic chemistry, quantitative analysis, and physics, and 24 biology emphasis or 26 chemistry emphasis credits. Upper division electives are required for each major (minimum of 6 or 4 credits) along with 39 credits of general education and 2 PE credits. Total credits required for the BS in biology are 128 semester units, and for the BS in chemistry are 131 semester units.

Establishing a research and teaching program in forensic DNA requires significant resources and support. Academic grants, biotechnology donations and government collaborations have been leveraged to establish the undergraduate forensic programs at SJSU.

This report will provide an overview of the forensic science biology and chemistry programs. In addition, some of the current forensic DNA undergraduate research projects will be described. They include 1) Development of a Y Alu-based rapid screening kit using molecular beacons for sexual assault evidence, 2) Comparison of DNA archiving strategies and 3) Evaluation of DNA recovery from different plastic storage tubes.

A compilation of innovative approaches, activities and teaching techniques that engage the students through hands-on, inquiry-based learning and critical thinking activities that have been developed for both undergraduate and graduate courses will also be discussed. Finally, a brief description of the partnerships and funding strategies that have been leveraged to establish the program will be provided.

Although the program is fewer than two years old, enrollment has more than tripled since it was first announced. The first three graduates from the forensic biology program will complete their degrees December 2005. All of them are applying for entry level positions in city or state crime laboratories.

Forensic DNA, San Jose State University, Forensic Science Education

B154 Graduate Research: Collaborations With Private and Public Laboratories: Sponsored by the California Forensic Science Institute

Katherine A. Roberts, PhD, California State University, Los Angeles, 5151 State University Drive, School of Criminal Justice and Criminalistics, Los Angeles, CA 90032*

After attending this presentation, attendees will learn about the services and mission of the CFSI.

This presentation will impact the forensic community and/or humanity by demonstrating the implementation of research development collaborations with crime laboratories and private organizations in designing and testing research in the application of advanced technology to forensic services.

The California Forensic Science Institute (CFSI) is a partnership involving the Los Angeles County Sheriff's Department, Scientific Services Bureau; the Los Angeles Police Department, Scientific Investigations Division; and California State University, Los Angeles (CSULA) School of Criminal Justice and Criminalistics. The Institute is dedicated to the advancement of forensic science and criminalistics. Specifically, four central objectives have been identified: In-Service Training, Career Development, Public Education and Research Development.

The Institute will serve as the training, research, and development arm of the Los Angeles Regional Crime Laboratory. In addition to LAPD and LASD, the Laboratory will house the School of Criminal Justice and Criminalistics, CSULA. The construction of this facility, to be located on the campus of California State University, Los Angeles, is scheduled to be completed by February 2006.

The objective of this presentation is two-fold: to promote the services and mission of the CFSI *and* to discuss research development collaborations with crime laboratories and private organizations in designing and testing research in the application of advanced technology to forensic services.

Research Development, Graduate Education, Career Development

B155 Experience With and the Rationale for a Doctoral Program in Forensic Science

Peter R. De Forest, DCrim, John Jay College of Criminal Justice/ CUNY, Sciences, 445 West 59th Street, New York, NY 10019*

After attending this presentation, attendees will gain an understanding of the need for advanced degrees in forensic science/criminalistics.

This presentation will impact the forensic community and/or humanity by explaining the rationale for obtaining advanced degree in criminalistics.

The field of criminalistics has undergone rapid growth over the past few decades. The number of personnel employed in the field has increased nearly two orders of magnitude during this time. Maturation as a profession has been slower. Recent encouraging changes such as the impact of laboratory accreditation under the auspices of the Laboratory Accreditation Board (LAB) of the American Society of Crime Laboratory Directors (ASCLD) and the certification of scientists by the American Board of Criminalistics (ABC) are clear indicators of a maturing profession. Progress with methods of analysis and broader approaches to the analysis of evidence types has been fostered by the efforts of scientific working groups (SWGs) sponsored by the FBI and by Committee E-30 of the American Society for Testing and Materials (ASTM).

Slower to develop still has been general agreement concerning the appropriate academic preparation for scientists working as criminalists in

forensic science laboratories. Such general agreement is a hallmark of mature professions. Until very recently this agreement has been missing. Personnel in laboratories have been drawn from university programs in forensic science, chemistry, biology, molecular biology, and even medical technology. It is encouraging to note that in recent years educational programs in criminalistics have been playing an increasingly important role. Although, historically these programs have never been major contributors to the staffing needs of forensic science laboratories, the situation is beginning to change. Maturation of the field has led to recognition of the importance of such programs.

Pioneering visionaries in this field, such as Dr. Paul L. Kirk, saw the need for advanced degrees in the field as early as the middle of the 20th Century, but few were established. These visionaries recognized that many problems encountered in criminalistics casework were every bit as complex and challenging as those faced in the highest levels of scientific research. The first doctoral program in criminalistics in the United States was the one established by Dr. Kirk at the University of California at Berkeley in the early 1960s. This was a sub-program of the doctoral program in criminal justice offered by the School of Criminology at the university. This school was later disbanded in the wake of draconian reductions in the levels of state support for the university. The products of this program still continue to positively impact the field in a way that it disproportionate to their number.

The program that the author has headed for the past twenty some years is physically housed at the John Jay College of Criminal Justice but is part of the Ph.D. Program in Criminal Justice offered by the parent university, the City University of New York (CUNY). John Jay is one of the nine senior colleges, which along with several community colleges, make up the multi-unit City University of New York.

The Forensic Science Concentration in the Ph.D. Program in Criminal Justice is effectively a stand-alone science Ph.D. program. It is a very challenging program. Only a fraction of those who have entered the program have completed it. Those who have completed the program and have been awarded the Ph.D. degree have acquitted themselves well in the field. Some are program heads at other universities. Others are respected laboratory administrators and researchers in major laboratories. All are acknowledged leaders in the field of criminalistics.

At this time forensic science education is growing "leaps and bounds" on a worldwide basis. The demand for these programs has allowed some universities to set higher admission standards for entry into forensic science graduate programs than is the case for more traditional science graduate programs. The field can benefit greatly from this.

Forensic Science Education, Doctoral Degree, Criminalistics

B156 Firearms Artifacts From the Fetterman Battlefield

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After attending this presentation, attendees will learn about the application of criminalistic techniques to the examination of historical artifacts. Attendees will also learn about how to remove calcareous concretions from cartridge cases and bullets without damaging firing pin impressions or land and groove engraving.

This presentation will impact the forensic community and/or humanity by presenting to the forensic community the oldest firearms evidence ever successfully matched using a comparison microscope. It will show that even very old firearms evidence may be successfully examined.

In 1866 the U.S. Army established a series of forts in Dakota Territory. These forts were intended to provide a degree of protection from Indian attacks for civilians traveling on the Bozeman Trail to the gold fields in what is now southern Montana. The Sioux and their Cheyenne allies were enraged by this incursion into the primary hunting grounds ceded to the tribe under the Fort Laramie Treaty of 1851. The U.S. forces guarding the Bozeman Trail had their headquarters at Fort Phil Kearney in what is now northern Wyoming. Four companies of the Second Battalion of the 18th U.S. Infantry and C Company of the 2nd U.S. Cavalry garrisoned the post under the overall command of Col. Henry B. Carrington, 18th U.S. Infantry. The Indians routinely attacked wood cutting parties who were procuring wood for building and domestic use at the post. On December 21, 1866, a woodcutting party came under attack several miles west of the fort and Col. Carrington dispatched a relief force under the command of Capt. William J. Fetterman, A Company, Second Battalion, 18th U.S. Infantry. Capt. Fetterman's detachment consisted of two other officers, forty-nine infantrymen, twenty-seven cavalrymen, and two civilians. Instead of moving directly to the relief of the woodcutters, Capt. Fetterman and his men pursued parties of mounted Indians over a ridge north of the fort. Fetterman's force was ambushed as it moved along the Bozeman trail and Fetterman and all of his men were killed. This was the worst disaster suffered by the post-Civil War U.S. Army prior to the Battle of the Little Big Horn.

The site of the Fetterman Battle has several features that make it an almost ideal subject for battlefield archaeology. Documentary information about the course of the battle is limited; the battlefield has been isolated for most of the intervening time since the battle; and the two sides used different types of weapons. The Indians used mainly bows and arrows and smoothbore muskets, while the U.S. Army forces were armed with Spencer repeating carbines, Springfield rifled muskets and various types of pistols. Firearms-related artifacts were recovered from the battlefield in 2002 and 2004. These artifacts included the following items: (1) Expended cartridge cases fired in the Spencer repeating carbines carried by the cavalry; (2) fired bullets from Spencer repeating carbines; (3) fired bullets from .58 cal. Springfield rifled muskets carried by the infantry; (4) expended percussion caps for the rifled muskets; and (5) pistol bullets fired from various caliber pistols (presumably the side arms of the officers and troopers). It was hoped that examination of these artifacts would shed light on the course of the battle. In order to do this, expended cartridges and percussion caps fired from the same weapon would have to be matched using forensic firearms examination techniques. It was first found necessary to develop a cleaning method to remove calcareous deposits from bullets and cartridges. Once these deposits were removed the microscopic details of firing pin impressions and rifling marks could be examined. At the present time three groups of expended Spencer cartridges have been matched. This is the oldest firearms evidence to be successfully matched by their firing pin impressions. Expended percussion caps fired from the same weapon have also been identified.

Firearms, Archaeology, Microscopy

B157 Evaluation of the Collection of Mathematical Facts in Bloodstain Pattern Evidence

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After attending this presentation, attendees will gain an understanding of the flaws to mathematical reasoning with regard to the Reconstruction of the Origin in Bloodstain pattern evidence.

This presentation will impact the forensic community and/or humanity by making those involved with bloodstain patterns re-evaluate mathematical logic and firearms comparative continue studies which will help correct and validate the use of techniques in reconstructing the origin of blood dispersing events.

After attending this presentation, attendees will be aware of updated principles and logic which can lead to a better foundation for the methodology in Reconstruction of the Origin in Bloodstain pattern evidence. Prevailing rationale involves serious flaws which must be addressed before corrections can be developed.

This paper will impact the forensic community and/or humanity by identifying errors in logic and misapplications of mathematic theorems used in the procedure of reconstruction of the origin in bloodstain pattern evidence. A preliminary series of experiments involving firearms dispersed blood drops was conducted to investigate the effects of blood drop velocity with the format to be made available to attendees wishing to continue these studies.

Introductory phrases such as "we all know..." and "it has long been accepted..." are encountered with presentations regarding bloodstain pattern evidence. Some of these concepts are based on flawed logic, yet review of scientific principles is omitted due, perhaps, to a lack of respect toward the evidence. Some scientists, even those working in the field, still claim that bloodstain pattern evidence is *all* subjective.

Bloodstain pattern evidence originated from careers not requiring technical academic background. Dr. Paul Kirk saw the potential in a more scientific approach from his awareness of European studies, which he brought to the US. Instead of carrying on and expanding upon Dr. Kirk's work, those who followed deviated from his concepts to apply their own interpretations. His death may have prevented intervention in the development of some erroneous logic. Beginning with Dr. Kirk's casework and court testimonies, a preoccupation has existed with qualifying the evidence as a science discipline. This is now of less concern.

Mathematics and physics were the standards in acceptance during the 1940s through 1980s, when bloodstain pattern analysis was being taught and it gained popularity with investigators. An association between math, physics and bloodstain patterns became essential in order to justify expert testimony in cases where bloodstains were of evidentiary benefit to the adversary process. Because the value of the evidence was considered more important than questions regarding why applications worked, challenge to accuracy of logic was ignored.

The current requirement for review of bloodstain pattern evidence mathematical principles is analogous to a quote from a French pioneer chemist: "A science is built up with facts as a house is with stones, but a collection of facts is no more a science than a heap of stones is a house." (Jules Henri Poincare (1854-1912), quoted by Bernard Russell in preface to Science and Method, 1913).

The statements: a line bisecting parallel lines creates equal angles, a right triangle can be constructed between two parallel lines, and the measurements of a blood spatter stain can be related to the dimensions of the drop that left the stain, are all part of a collection of facts which may not have any connection to the scientific process defined in a method, yet the technique appears to work when applied to mock crime scenes. Suggestions are presented to explain why it works and the result of a preliminary study given which will increase understanding of more applicable logic.

One of the major factors in the appearance of a bloodstain—the speed of the blood drop at impact with a surface—has routinely been ignored. The success of using the technique with beating mock scenes was evaluated by comparing with a series of mock scenes constructed using single gunshots into human blood at the California Highway Patrol Academy Firearms range near Sacramento, California. The results were evaluated for measurement of blood spatters by two methods: completing the oval and bloodstain pattern training technique (BPT). Other points were evaluated in regard to reconstruction of the contact between the bullet and the blood source, where possible. The importance of correct construction of the area of convergence was noted as well as the benefits of using confirmatory information with the mathematical technique.

Conclusions show a need to continue the evaluation of methods, comparing mock scenes with real ones, and_re-evaluating the use of oval or ellipse cut off points for bloodstain measurements.

Bloodstain Patterns, Crime Scene Reconstruction, Identification Training

B158 What Drives Criminalistics Examinations?

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After attending this presentation, attendees will gain an awareness of the various points of view that come into play in choosing and examining items of evidence.

This presentation will impact the forensic community and/or humanity by providing a forum for discussion of the importance to criminalistics of mutual understanding between attorneys and scientists in the course of scientific investigations of crimes.

The juxtaposition of scientific and legal subject matter in the criminalistic workplace has no effect on the fact that criminalistics and all other forensic sciences must meet the same scientific standards as other disciplines if they are to serve their purpose – to provide reliable scientific analyses of evidence. Just as there is no change in the foundations of legal practice because it uses science, neither should there be changes in core scientific practices because the results happen to apply to criminal matters.

It is easy for all to accept this broad statement of forensic scientific integrity as it applies to the actual performance of analytical methods. However, science places other responsibilities on its practitioners than the proficient operation of equipment. In particular, scientists are constrained to generate physical ideas that comprehensively explain their observations and then to test rigorously the effectiveness of their explanatory ideas. Interestingly, in practice, these constraints can lead to the perception that the scientist is doing either too much or too little in examining evidence in casework.

In this paper, by giving several instructive case scenarios involving the selection of items to examine and methods to be used in the examinations, the effects of scientific thinking on the actual practice of criminalistics are explored.

Ethics, Criminalistics, Law

B159 A More Sensitive Sex Determination Assay

Carrie B. Jackson, BS, and David R. Foran, PhD, Michigan State University, School of Criminal Justice, 560 Baker, East Lansing, MI 48824*

After attending this presentation, attendees will learn of the utility of human DNA primers that target multicopy nuclear sites on the Y chromosome and autosomes for determining sex in samples of forensic relevance, particularly those for which standard genetic sexing techniques fail.

This presentation will impact the forensic community and/or humanity by addressing a means of determining the sex of forensic samples that contain degraded DNA and/or DNA that is present at extremely low quantities, which typically provide a challenge to crime laboratories. This presentation will demonstrate the utility of multicopy nuclear targets to determine the sex of forensic samples, thus assisting the criminal investigation process.

DNA analysis is a very useful tool in the criminal investigation process; however, analysis can be complicated by a lack of viable DNA. Aged skeletal material, blood, and tissues, or shed hairs, nails, and skin cells, often do not yield DNA amplification products when single copy nuclear loci, those typically tested by the crime laboratory, are examined. Sex determination of a forensic sample is generally made using the single copy gene amelogenin. If this marker cannot be amplified owing to low DNA quantity, it is still possible that amplification of high copy number loci may be successful. In theory, if loci are present as many copies on the chromosome and small amplicons are targeted, amplified products can be obtained with extremely low starting concentrations of DNA. These products can then be analyzed using standard agarose gel or capillary electrophoresis.

In the experiments described here primers for the Y chromosome locus DYZ1, which exists at 2000 to 4000 copies per cell, were designed and used to test control DNA at decreasing concentrations, as well as forensically useful samples (*e.g.*, bone and hair shafts). As a positive control, primers for the chromosome 17 alpha satellite DNA, which exists at approximately 1000 to 2000 copies per cell, were designed and tested. Results show that the multi-copy markers are two or more orders of magnitude sensitive than standard amelogenin amplification when control DNA is tested. Likewise, in many cases forensically relevant samples can be sexed using this method when amelogenin testing fails, while in contrast, amelogenin analysis was not successful when the high copy markers were negative. Overall, the ability to yield information using the high copy number markers on samples that could not otherwise be amplified will be a useful tool for the criminal investigative process.

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Sex Determination, DNA, Multicopy Loci

B160 The Utility of Y-STR Analysis in Casework

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The goal of this presentation is to present to the forensic community the Centre's guidelines for Y STR testing and highlight successful casework examples where Y STR analysis has proved to be a very valuable forensic tool.

This presentation will impact the forensic community and/or humanity by providing guidelines for when to employ Y-STR testing in casework; potential for standardizing use of Y-STR methodology in casework where sample is potentially limiting.

The CFS utilizes the PowerPlex® Y (Promega Corporation) multiplex system that allows for the characterization of 12 STR loci on the Y chromosome. Validation of the PowerPlex® Y DNA typing system for use in forensic casework at the CFS was previously included as part of a collaborative inter-laboratory study (Krenke et al., Forensic Science International 148 (2005) 1-14) that demonstrated this system to be highly robust, sensitive and precise. Experience shows that a full Y chromosome STR profile was generated when as little as 31 pg of DNA was amplified. With respect to mixtures of female and male DNA, a full male Y STR profile was generated with a 10,000-fold excess of female DNA in the sample. To date, a male-specific quantitation system has not been implemented, and as such, an estimate of the amount of male DNA present in a sample is determined, whenever possible, based on the ratio of female to male DNA observed in the autosomal STR results.

The Y-STR testing service that was implemented in casework at the CFS in April of 2005 is largely designed to assist with three main case types: homicides, sexual assaults and familial analysis (*i.e.* criminal paternity cases). The CFS guidelines that have been developed with respect to which sample types are amenable to Y-STR testing include the following:

- Case history and results (body fluid identification &/or autosomal STR results) that indicate the possibility of a male source that has not been fully elucidated by autosomal testing.
- Autosomal analysis that indicates a mixture of DNA is present where a major component can be readily determined, while the gender of the minor component or the number of individuals contributing to the minor component is in question.
- Paternity cases with a male child.
- Comparison samples that require testing for the purpose of addressing the possibility of a familial relationship to the perpetrator.

It is imperative that the interpretation of Y-STR profiles and the reporting of their significance reflect the case history at hand and the hypothesis being tested. Equally important is the need for the scientist to draw upon their training and experience. The evolution of the above guidelines is, in turn, a reflection of the laboratory's collective experience with the PowerPlex® Y system in conjunction with a hypothesis-based testing approach. To date, approximately three quarters of cases forwarded for Y-STR analysis at the CFS have been sexual assaults and testing has proven to be a valuable tool in circumstances where the amount of male DNA present in the sample is often negligible relative to the amount of female DNA. In the majority of sexual assault cases that were subjected to Y-STR testing at the Centre, the purpose was to assist in developing a Y-STR profile suitable for comparison to known samples, as previous attempts to generate a male DNA profile with autosomal STRs were unsuccessful. In some of these cases, a full male Y chromosome profile was obtained, thereby providing valuable evidence that could assist in identifying the perpetrator, where none had existed previously. Y-STR testing has also been utilized to specifically address an assumption made upon which the interpretation of autosomal STR results was based. In one example, a mixture of DNA from at least three individuals, including at least one male, was obtained from a semen stain in the crotch of a pair of underwear and a 9-locus STR DNA profile was determined based on the assumption of a single minor male contributor to the mixture. In this case, subsequent Y-STR analysis supported this assumption. Y-STR analysis has also proved useful in addressing the possibility that particular persons of interest may be biologically related to the perpetrator of a crime. In specific cases, the number of alleles shared between the crime scene DNA profile and a particular known individual was indicative of a familial relationship. Y-STR testing was undertaken in order to assist in determining whether a male relative of the known individual could be excluded as being the perpetrator.

Overall, to date, use of the PowerPlex® Y system in casework at the Centre has proven to be an invaluable tool and has assisted countless investigations. Future work will focus on implementing a method of quantitating male DNA, such that more informed decisions can be made with respect to proceeding with autosomal or Y-STR analysis.

Y-STRs, Hypothesis-Based Testing, Casework

B161 A Comparison of the Performance of Commercial Y-STR Kits for Operational Use With Challenging Samples: Extended Interval Post-Coital Samples, Mixtures and Environmental Insults

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The goal of this presentation is to inform the forensic community of the performance of commercial Y-STR kits using a variety of challenging samples.

This presentation will impact the forensic community and/or humanity by demonstrating aiding in facilitating the transfer of Y-STR technology to the crime laboratory, by way of a performance comparison between commercial products from three commercial vendors and two in-house Y-STR multiplexes.

Although it is routine for most forensic laboratories to obtain an autosomal STR profile of an individual from DNA recovered from a crime scene, a more limited number of laboratories have the capability of performing Y-STR analysis. In order to aid in facilitating the transfer of Y-STR technology to the crime laboratory, a performance comparison between commercial products from three commercial vendors (Promega, Realigned, and Applied Biosystems) and two in-house Y-STR multiplexes

(MPI and MPB) was conducted. The main focus of the study was to ascertain whether commercial Y-STR kits were able to obtain a male profile from challenging samples to the same extent that in-house Y-STR systems were capable thereof. Specifically the relative performance characteristics of the Y-STR systems with respect to their ability to determine the numbers of semen donors in admixed samples, the identification of the genetic profile of the male component in a male/female mixture, the identification of the genetic profile of the male component in extended interval post-coital samples and with environmentally challenged samples is reported.

Initially an in depth evaluation of each Y-STR system's sensitivity limits was carried out including going beyond the limits established by the manufacturer. The results indicated that one in house kit and one commercial kit were able to obtain reproducible male profiles at 30 picograms of single source male input DNA. An evaluation of the Y-STR systems' ability to obtain a genetic profile of the male component in a male/female mixture used two different approaches. The first included analyzing one nanogram of male DNA in the presence of an increasing quantity of female DNA whereas the second required the input of a total of 300 nanograms of mixed DNA (containing male DNA in different proportions) to the PCR reaction. The results for the first approach identified one commercial kit that was able to obtain a genetic male profile at a 1:4000 male/female ratio. The results for the second approach demonstrated that one in house kit was able to obtain reproducible male profiles at a 1:16,000 ratio whereas one commercial kit was able to obtain reproducible male profiles at 1:10,000.

Challenging samples representative of those found in casework were prepared for evaluation. Post-coital samples were obtained from the cervix of two females in monogamous relationships with a five day abstinence period before each sample was obtained. The samples obtained were collected individually at zero hours, twelve hours, one day, two days, three days and continued to a seven day collection. The samples were extracted using both a differential and non-differential extraction. Three male body fluids (blood, semen, and saliva) were exposed to different environmental conditions. The first condition was heat and humidity, second condition was heat, humidity, sunlight and rain, and the third condition was heat, humidity and rain. The samples ranged from one day exposure to 6 months exposure. This study was used to determine the longevity of a stain under environmental insults.

Detailed results of the performance characteristics of the Y-STR kits using these challenging samples will be presented in detail.

Y-STR's, Commercial Y-STR Systems, Extended Interval Post-Coital Swabs

B162 Characterization of a Novel Stutter Product in the Y-STR Marker DYS392 a nd a Rare Polymorphic Variant in the DYS456 Homologue Identified Using the AmpF*l*STR® Yfiler™ PCR Amplification Kit

Lori K. Hennessy, PhD, and Chien-Wei Chang, PhD, Applied Biosystems, 850 Lincoln Centre Drive, Foster City, CA 94404; Bruce Budowle, PhD, FBI Laboratory, 2501 Investigation Parkway, Quantico, VA 22135; and Lisa Calandro, MPH, and Julio Mulero, PhD, Applied Biosystems, 850 Lincoln Centre Drive, Foster City, CA 94404*

The goal of this presentation is to share the results obtained on the characterization of the novel stutter product in the Y-STR marker DYS392 and a rare SNP variant in the DYS456 homologue identified AmpFlSTR® Yfiler™ PCR Amplification Kit.

This presentation will impact the forensic community and/or humanity by providing additional information to guide forensic scientists in the interpretation of data when using the AmpFlSTR® Yfiler™ PCR Amplification Kit for Y chromosome STR analysis.

Y-chromosome short tandem repeat (STR) markers yield a high degree of confidence that only the male contributor is being analyzed in male-female mixtures. The AmpFlSTR® Yfiler™ PCR Amplification Kit is a commercial multiplex system designed for the simultaneous amplification of 17 Y-STR markers (DYS19, DYS385a/b, DYS389I/II, DYS390, DYS391, DYS392, DYS393, DYS437, DYS438, DYS439, DYS448, DYS456, DYS458, DYS635 (formerly known as Y GATA C4) and Y GATA H4). A by-product of the amplification of the trinucleotide repeat locus DYS392 is the formation of N-3 and N+3 stutter products. Sequence analysis of the novel N+3 stutter band demonstrates that its sequence is one TAT repeat longer than that of the corresponding main allele. Both N-3 and N+3 stutter percentages increased as (1) the main allele repeat number increased, as (2) the magnesium concentration was increased in the reaction or if (3) the initial amount of DNA template was decreased. Since both stutter products behave in a similar and reproducible fashion, it is proposed that the same rules that apply to the interpretation of N-3 stutter products could be applied to N+3 stutters.

During an extensive multi-population study with Y-STR loci amplified using the AmpF*l*STR® Yfiler™ PCR amplification kit, amplification of a 71-bp fragment was observed in 2.32% of the male samples analyzed (N=3141). By direct sequencing of this fragment, it was determined that the primer binding sequences were identical to that of the DYS456 locus. A T to G single nucleotide polymorphism (SNP) enabled amplification of the 71-bp fragment. The SNP is located within an X-Y homologous region at Xq21.31 and was observed with the highest frequency within the African American and Sub-Saharan African populations in this study. Presence of the SNP on the X chromosome did not interfere with the reliability of typing the DYS456 locus and the other Y STR loci typeable using the AmpFlSTR® Yfiler™ PCR amplification kit. Full profiles in a mixture of male: female at 1:4000 were obtained using the current configuration of the AmpF*l*STR® kit even in the presence of female DNA containing the G variant.

In this study, the novel stutter product at the DYS392 locus and a new, rare SNP variant in the DYS456 homologue have been characterized. These results provide additional information to guide forensic scientists in the interpretation of data when using the AmpF*l*STR® Yfilerä PCR Amplification Kit for Y chromosome STR analysis.

Y-STR, Genotyping, SNP

B163 The Eyes Have It: Helping Identify Human Remains Using the Strength of Match Between Prescription Eyewear and Medical Records

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After attending this presentation, attendees will be exposed to a new method of individuation based on the strength of match between spectacle (glass) prescriptions and medical records, and will be able to use a new web-based tool for these comparisons.

This presentation will impact the forensic community and/or humanity by providing investigators an additional tool that can increase the accuracy of identification of unknown individuals based on eyewear prescription data.

The identification of human remains is a primary focus of forensic specialists. In many instances, the results from medicolegal examination, odontology, anthropology, and nuclear or mitochondrial DNA analysis can identify unknown individuals. Alternate lines of non-biological evidence, such as identification cards, clothing, and shoe wear are often used as corroborating evidence. Using spectacle prescription data is not a new idea to law enforcement and forensic specialists, but opticians and doctors are usually constrained to a simple "match" or "no match" conclusion with the prescriptions listed in medical records. The web-based tool introduced in

this paper will let doctors, analysts, and investigators easily determine the strength of individuation by calculating the frequency at which the observed prescription occurs in various U.S. populations.

The available databases draw from both military and civilian sectors of the U.S. population and currently contain more than 1.2 million individual eye prescriptions. An additional dataset contains approximately 4000 individuals with self-reported biological data (sex, age, and ethnicity). While the bulk of the prescription data is linked with individuals of military service, civilians from the Department of Defense and dependants of military service members are also included. Additional information available in the largest database includes rank or grade, job type, and type of glasses. General population information is available for the smaller database, which contains approximately 65% males and 35% females. Reported ages cluster around the late-teens to mid twenties, though every age is represented from 4 to 95 years. Self-reported ethnicity is largely White, ~60%, with other major ethnicities present (Black ~15%, Hispanic ~15%, Asian 4%, Native American ~3%, Pacific Islander ~1%, mixed ~1%).

The web-based tool introduced here allows the user to search for matching prescription information within each database. The databases can be queried for any combination of the corrective states including sphere, cylinder, cylinder axis and bifocal powers for each eye. The sphere and cylinder corrective powers are typically measured in increments of .25 diopters, while the axis correction is on a 180 degree scale. These variables have a respective minimum of 80, 72, and 180 possible conditions, giving a total of 1,036,800 possible combinations per eye, or $1x10^{12}$ combinations for both eyes (exclusive of bifocal corrections). As with many other types of biological data, some corrections are more common than others; common single eye corrections (using sphere and cylinder corrections only) may occur in about 12 per 1000 individuals though common dual eye corrections drop to approximately 2 per 1000. If the axis correction is added to the query, the frequency can drop to 1 per 10,000 or greater.

As eyewear is typically directly related to the genetic make-up of an individual (trauma and surgery are the major exceptions), prescription data is highly individualized. Further, the frequency of a given prescription can be combined with frequency data for other independent biological information such as dental or mtDNA data, to provide extremely strong statistical estimates of the likelihood of individual identification. The presentation will demonstrate these applications through several cases, particularly those dealing with the identification of fallen U.S. service personnel, as conducted by the Joint POW/MIA Accounting Command in Hawaii.

Personal Identification, Spectacle Prescriptions, Refractive Errors

B164 The Use of Wick Evaporation With Wicking Bottles to Prepare Crystals for Micro FT/IR Spectroscopy

Howard A. Harris, PhD, JD, University of New Haven, 300 Boston Post Road, West Haven, CT 06516*

After attending this presentation, attendees will learn an improved method for preparing small crystals of purified materials suitable for Infrared Microspectroscopy.

This presentation will impact the forensic community and/or humanity by demonstrating a simple way to isolate or purify many different types of trace materials for unambiguous identification by infrared spectroscopy. It is particularly appropriate for moisture sensitive compounds. Examples will be given of drugs and explosives for which this method should be advantageous.

The use of a little know technique[1] for recovering small amounts of soluble material from a much larger volume of insoluble material called wick evaporation[2] has been reported That paper used the method to recover purified LSD and iso-LSD, in the form of tiny crystals, from preparative thin layer chromatography. These crystals were shown to provide excellent Infrared spectra using a micro FT/IR spectrometer. A modification of this technique which makes it simpler to use and much more versatile is reported here.

By carrying out the wick evaporation in a closed system, which is referred to as a wicking bottle, a much wider range of solvents and conveniently work with moisture or air sensitive materials can be used. The wicking is done as before in a shell vial. General procedure is to have from 500 to 1000 micrograms of target compound and to add about one milliliter of wicking solvent. The vial is placed in a small bottle (a four ounce glass bottle is convenient) containing five to ten grams of finely divided silica which has been activated by heating to about 150 degrees for a number of hours (usually about twenty-four) to drive off adsorbed solvent and activate the silica. Thus the wicking is done in a closed system and the crystals are produced on the portion of the wick sticking out of the vial, usually toward the end. The crystals are kept in a dry atmosphere until removed or the vial and wick can be removed and placed in a dessicator. The wicking bottle is regenerated to be used again by placing it in a 150 degree oven overnight or until it is needed again.

This technique allows one to use wicking solvents covering a wide range of volatility and polarity. Solvents such as non-polar hydrocarbons like hexane to more polar materials such ethyl acetate, tetrahydrofuran and even methyl or ethyl alcohol have been successfully used. The volatility range was severely limited when the wicking was done in the open atmosphere in a hood, because in humid weather evaporative cooling condensed ice crystals on the end of the wick and interfered with the desired crystallization.

One can wick organic bases that are not normally easily crystallized solids by converting them to their hydrochloride salt before wicking. Many of these salts wick well with THF, ethanol or methanol. Further very hydroscopic materials such as ammonium nitrate and sodium gammahydroxybuterate, which can absorb enough water from the atmosphere to dissolve themselves in humid weather, can be wicked to produce crystalline materials for infrared spectroscopy.

The simplicity of the method was increased by using twine for wicks. In the first paper the wicks were made by twisting a small piece of glass wool into a wick. Although this is not difficult, snipping off a piece of braided twine is quicker, easier and one has more uniform wicks. One can purchase nylon or polypropylene twine at most hardware stores and of course cotton is also available. Nylon was used for most of the wicks but the polypropylene seemed to work as well. Four examples will demonstrate the versatility of this method: Separation of cocaine base and cocaine hydrochloride, recovery of sodium gammahydroxybuterate from solution containing gammabuterolactone and salt, recovery of materials from preparative thin layer chromatography and recovery of ammonium nitrate from a simulated debris mixture.

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Sample Preparation, Infrared Spectroscopy, Purification

B165 Enantiomeric Purity Determination With HPLC-UV/Optical Rotary Detection

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After attending this presentation, attendees will 1)understand the theory and practice governing UV and optical rotary measurements made on drug substance pure enantiomers and enantiomeric mixtures; 2) review

the application of HPLC with UV and optical rotary detection to the measurement of enantiomeric form and/or purity in forensic casework involving several different drug substances; and 3) implement a low cost approach for the determination of enantiomeric form and/or purity in bulk drug substances or drug formulations.

This presentation will impact the forensic community and/or humanity by providing a general, reliable, and low cost approach for the determination of enantiomeric purity in bulk drug substances and drug formulations.

For chiral drug substances, the enantiomeric form (*d*, *l*) and purity may have important implications in forensic casework. Enantiomeric drug pairs frequently exhibit varying pharmacological and toxicological effects in the body, which may result in differing legal classifications and/or prescribed uses for the two enantiomers in the pair. For example, the *l*-isomer of methorphan (levomethorphan) is under DEA schedule, whereas the *d*-isomer (dextromethorphan) is an unscheduled pharmaceutical drug. For methamphetamine, both the *d*- and *l*-isomers are under DEA schedule, and both isomers also have legitimate pharmaceutical uses. The determination of enantiomeric form and purity may also provide information on the synthetic route or source for some illicit drugs.

In this work, the determination of enantiomeric form and purity for a variety of drug substances based on HPLC analysis with in series UV and optical rotary detectors is presented. The principle is simple, and is based on the linear relationships which exist for both the UV signal (signal proportional to the total concentration of *d*- and *l*-isomers) and optical rotary signal (signal proportional to the net excess of *d*- or *l*- isomer). Calibration curves based on the ratios of the optical rotary and UV signals for the pure and mixed enantiomers are shown to be linear, and reliable for the determination of enantiomeric purity in bulk drug substances and drug formulations. Examples from actual forensic casework including methorphan, selegiline, ephedrine, and pseudoephedrine are presented. Applications involving the determination of enantiomeric purity for amphetamine in a prescription drug formulated with a 3:1 enantiomeric ratio, and for methamphetamine will also be presented.

The major advantages to this approach are: 1) No chiral separation is necessary allowing the use of previously developed achiral HPLC assays. This also precludes the need to purchase multiple chiral columns for different drug substances. 2) The measurement of bulk drug purity or drug formulation potency can be made at the same time. 3) The cost of the optical rotary detector is relatively low (ca. $25 K). Disadvantages include the limited sensitivity of the chiral detector, making this approach unsuitable for the analysis of drug substances in bodily fluids in clinical and toxicological investigations, or for drug substances with very low specific rotations.

Enantiomeric Purity, Optical Rotary Detection, Drugs and Drug Formulations

B166 Analysis of Fingerprint Residue by Pyrolysis GC-MS

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The goal of this presentation is to discuss the analysis of fingerprint residue by pyrolysis gas chromatography/mass spectrometry (GC-MS). The contents of the discussion will stem from research which seeks to 1) identify and quantify the components in fingerprint residue, 2) analyze how these components decompose when exposed to high heat, and 3) determine if useful information may be obtained from the decomposed fingerprint.

This presentation will impact the forensic community and/or humanity by providing a method for analyzing latent fingerprints which have been decomposed by heat (as in arson cases and weapon cartridges). In addition, the ability to prepare a mixture of fingerprint components at their respective representative concentrations will prove to be beneficial to others performing fingerprint research and may aid in the potential production of a standard fingerprint residue.

For little over a century, fingerprint patterns have been classified with the Henry system and used to include or exclude persons from criminal investigations. Fingerprints can be seen, developed, and lifted from many different surfaces such as paper, drywall, glass, and metal. These patterns can even be lifted from the surfaces of firearms and cartridge cases. However, if a cartridge case has been fired after handling, the latent print may no longer be visible. In addition, most fingerprint evidence is gathered from surfaces at or near room temperature. A comprehensive literature search revealed no significant effort directed toward learning how fingerprints decompose at high temperatures and how this decomposition affects subsequent analysis. A comprehensive understanding of thermal degradation of fingerprint residues could lead to the development of reagents targeting such residues. These specialized developers could be used for evidence recovered from arson scenes and cartridge cases for example.

This study was performed in two phases. First, a list of fingerprint residue components was compiled as completely and quantitatively as possible in order to allow the bulk production of a representative fingerprint residue. Current studies show the main components of fingerprint residue (mostly eccrine sweat and sebaceous fluid) to be amino acids (such as valine, alanine, and tyrosine), cations (barium, sodium, and calcium), anions (such as phosphate and sulfate), biochemicals (such as pyruvate and uric acid), vitamins, and proteins. Therefore, techniques such as HPLC (high performance liquid chromatography), gas chromatography, and mass spectrometry were used to identify the primary components of fingerprint residue. From these laboratory studies, a synthetic fingerprint residue solution was generated.

Finally, this mixture was utilized in the second phase of the work via pyrolysis GC-MS. A Perkin-Elmer Clarus 500 gas chromatograph and mass spectrometer were coupled with a CDS Analytical Pyroprobe 5150 to perform this analysis. The goal was to simulate the high heat conditions that latent prints may be exposed to in situations such as when a cartridge is fired from a weapon, an arson crime is committed, or related combustion events occur. Results were used to construct a comprehensive list of pyrolytic products.

Pyrolysis, Synthetic Fingerprint Residue, Arson

B167 Cyanoacrylate Fuming of Latent Fingerprints - Chemical Studies and Their Forensic Implications

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After attending this presentation, attendees will understand how components of fingerprint residues interact with cyanoacrylate molecules to lead to fingerprint visualization.

While fuming of fingerprints with superglue is well known, this presentation will impact the forensic community and/or humanity by proposing and defining the processes by which polymer formation occurs preferentially on a fingerprint in contrast to the surfaces around it.

The use of alkyl cyanoacrylates (commonly called superglue) for the fuming/detection of latent fingerprints is one of most well-known methods of forensic analysis. While the approach has been well defined, and on non-absorbent surfaces it works well, questions remain on how the selective formation of polymer on a fingerprint actually occurs. Fingerprints are very complex chemical mixtures. A number of components (amino acids, fatty acids, hydrocarbons, proteins) have been cited as the key component in this method, while few studies definitively make this

identification. The behavior of several components of fingerprints, to determine if they alone will lead to a fuming response similar to an actual fingerprint, were investigated, with a focus on the behavior of hydrocarbons. Thin films of hydrocarbons will fume in a humid cyanoacrylate atmosphere, responding similarly to actual fingerprints. Some hydrocarbons respond more than others, with a dependence on not only the size of the alkane molecules, but extent of branching. The thickness of the 'film' is also an important variable. These observations suggest that a good model for fuming of fingerprints may be gas chromatography - in which an analyte partitions between a gaseous mobile phase and a liquid stationary phase. This model will be addressed. Also, studies of fuming simulated hydrocarbon fingerprints suggest that one may consider superglue fuming experiments as a time dependent study, where the rate at which prints appear could provide additional information on when they were created.

Fingerprint, Fuming, Detection

B168 Spectrochemical Analysis and Spectral Imaging of Latent Fingerprints and Trace Evidence Included Within the Prints

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The goal of this paper is to inform the attendees of the capabilities of spectral imaging of latent fingerprints. The presentation will describe how latent fingerprints can be non-invasively imaged to develop prints not originally observable by the human eye. Attendees will be shown ways to enhance latent fingerprints using mathematical operations on the data. Additionally, ways will be shown how to detect and identify evidential materials within latent fingerprint ridge lines. The research described in this presentation has not yet been validated for casework.

This presentation will impact the forensic community and/or humanity by demonstrating how spectral imaging should become a significant means to non-invasively image latent fingerprints, physical evidence within the prints, and other types of physical evidence. This method not only can produce an image showing the environment of the evidence, but can potentially be used to obtain the chemical composition of all the materials imaged. This method does not have the clarity of visible light microscopy when the objects are visible, but because a wide range of the electromagnetic spectrum can be used for imaging, particular wavelengths that are most sensitive to the material in question can be utilized to develop images and to potentially identify the material.

Fingerprints and trace evidence are critically integral to forensic investigations. Latent prints primarily contain residual material from an individual in contrast to fingerprints with ridge patterns imprinted in substances such as blood. They typically require invasive techniques using chemical reagents to develop the fingerprint patterns. Forensic trace evidence characterization traditionally involves the identification of the surrounding environment, determination of the material's identity, and the establishment of a possible source. Then, the material is circumstantially associated to the prints in the vicinity. Trace evidence gathering often requires invasive and destructive approaches to latent fingerprints. For example, swabbing or taping techniques to remove trace materials for analysis are likely to destroy latent prints. At present, print containing areas are avoided in the removal of trace evidence. Consequently, analysis of trace evidence within a print is not currently done.

In this paper, a non-invasive infrared spectroscopic imaging approach to detect and record latent prints will be demonstrated. Additionally, the simultaneous determination has been made of the presence and identity of contained trace evidence will be discussed. The spectroscopic separation of overlapped prints and nanogram detection of included fibres, drugs, and explosives will be demonstrated. Not requiring analyte transfer to an instrument, non-optimized sensitivity arises from the spatial localization afforded by imaging and is amenable to detecting a number of different chemical species simultaneously. For the first time, probable correlations can be conducted between the individual identifiers of fingerprints and trace evidence.

Spectral Imaging, Infrared Spectroscopy, Latent Fingerprints

B169 Recovery of Physical Evidence From Crime Scenes Contaminated With Chemical and Biological Warfare Agents

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After attending this presentation, attendees will be briefed on the standard operating protocols for the recovery of DNA, the chemical detection of latent fingerprints and the chemical enhancement of footwear impression evidence from crime scenes contaminated with either chemical or biological warfare agents. In addition they will understand the rationale for the choice of agents used and the techniques employed for evidence recovery within the context of this research; the methodology (sample preparation, mode of exposure, evidence recovery & exposure to decontamination agents); and, the effects of decontamination agents, Chemical Warfare agents and Biological Warfare agents on the physical evidence.

This presentation will impact the forensic community and/or humanity by demonstrating how the knowledge base for the forensic examination of physical evidence contaminated with chemical or biological warfare agents does not exist in the forensic identification or the forensic science community to any great extent. This research project is an attempt to fill some of that knowledge gap. The study is in its fifth year and nearing completion whereas many similar studies are just getting started. For any forensic identification specialist or forensic scientist who is responsible for examining this type of evidence, this will be a valuable presentation to attend.

If fingerprints were present on the plastic bags used to disperse Sarin during the Tokyo subway gas attack in 1995, would investigators know how to recover them? If DNA was present on the stamp or seal of the US Anthrax letters that were circulated in 2001, would investigators know how to safely recover it?

This presentation describes a five-year research program that examines the effects of chemical and biological warfare agents on the

ability to recover physical evidence such as DNA, fingerprint and footwear impressions. Results will be presented on the recovery of fingerprints, footwear and DNA after exposure to biological and chemical warfare agents and selected decontamination agents.

Learning Objectives: to provide rationale for the choice of agents used and the techniques employed for evidence recovery within the context of this research; to describe the methodology (sample preparation, exposure to agents, evidence recovery & exposure to decontamination agents) to explain effects of decontamination agents on evidence; to discuss the effects of CW agents on the recovery of fingerprints, footwear and DNA; to discuss the effects of BW agents on the recovery of fingerprints, footwear and DNA; and to recommend protocols for forensic examination of CW and BW crime scenes.

CBRN Forensics, Physical Evidence, Standard Operating Protocols

B170 Forensic Science Supporting Emergency Responders: A Working Model

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After attending this presentation, attendees will learn how a forensic science lab can support an emergency response team.

This presentation will impact the forensic community and/or humanity by demonstrating how a forensic lab can become involved in the efforts to improve homeland security.

Portable analytical instruments are available that can perform rapid on-site detection and identification of hazardous chemicals including chemical warfare agents (CWAs) and toxic industrial chemicals (TICs). The challenge in adapting these technologies to the needs of the emergency responder is to make them into tools that can provide lab quality results in the field while remaining both robust and user-friendly. There are challenges and concerns associated with placing sophisticated instrumentation in the hands of emergency responders who may have a limited scientific background. The operator must ultimately be able to provide dependable and representative data that are used to make immediate decisions in an emergency situation. It is critical that this data is transformed into reliable information due to the potential impact of a false positive or false negative result. Some portable instrumentation manufacturers, recognizing that their users may not have a scientific background, provide a reachback service that provides technical support and assistance in identifying compounds. Is there an alternative approach to taking emergency responders and teaching them to be chemists or taking chemists and teaching them to be emergency responders?

This presentation will describe a partnership between a Forensic Science Laboratory, the Centre of Forensic Sciences (CFS), and a first responder team, the Ontario Provincial Police - Provincial Emergency Response Team (PERT) that utilizes the expertise of both groups. PERT was formed as a result of consequences stemming from the terrorist events of September 11, 2001, with an objective to provide rapid mobilization capability to address acts of terrorism involving a Chemical, Biological, Radiological or Nuclear threat (CBRN).

The challenges, strategies and successes of providing training and support to an emergency response CBRN team consisting of police officers using portable GC-MS and FTIR instruments will be discussed. The CFS provides assistance in a number of areas including sampling, operation, data collection and interpretation, validation, quality assurance, field exercises and evaluation of new instruments and technologies. The benefits to PERT include enhanced credibility for their program by partnering with an ASCLD-LAB accredited forensic science laboratory, training and access to experts in many scientific fields. As a result of this program, the CFS is better prepared to act as a resource in response to a mass disaster through a closer relationship with the emergency response community, and has gained opportunities to work with and evaluate portable instruments. The forensic chemist adds to their skill set by becoming proficient in generating reliable data in the field under non-ideal conditions, skills that may one day be used routinely at crime scenes.

The emergency responder may encounter a wide range of chemical hazards at a scene that need to be identified. There is no one 'black box' instrument that can identify all chemicals; a number of complimentary techniques may be required. This presentation will address the suitability and performance of two portable instruments; the Hapsite® GC-MS (Inficon, East Syracuse, NY) and the HazmatID™ FTIR (Smiths Detection, Danbury, CT), for on-site analysis of TICs, CWAs, explosives, white powders and "clan lab" chemicals by emergency responders.

The use of analytical instrumentation in the emergency response field is largely self-regulated, unlike in traditional forensic, environmental and pharmaceutical labs. This will likely change over time as the operation of, and the results generated by these instruments are subjected to closer scrutiny. The CFS\PERT training and development model has been successful in implementing a quality program that is laboratory-based but flexible enough for the field.

Homeland Security, Emergency Responders, Portable Instruments

B171 Polarized Light Photography of Bloodstains on Dark Reflective Surfaces

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The objective of this presentation is to introduce an improved method for photographic documentation of bloodstain patterns on dark reflective surfaces.

This presentation will impact the forensic community and/or humanity by introducing a time and cost-efficient way of improving the detection and photographic documentation of bloodstain patterns found on dark reflective surfaces, ultimately aiding reconstructive efforts.

Polarized light photography provides a nondestructive technique of documenting bloodstains on dark reflective substrates. Accurately visualizing and photo-documenting bloodstain patterns on an article of clothing can provide crucial information for crime scene reconstruction efforts.

Traditionally, black and white photography used color filters to either lighten or darken a stain against the surrounding background to elucidate the forensic information contained on a difficult substrate. However, this technique provides little benefit with bloodstains on very dark or black surfaces. Observing and documenting bloodstains on dark reflective surfaces is problematic due to the glare reflected off of the surface as well as the lack of contrast between the stain and substrate.

Previous studies have shown the usefulness of chemical enhancement techniques on bloodstain patterns, including Luminol, amido black, and leucocrystal violet, with the drawback of potentially compromising DNA analysis and altering the stains. Performing background corrections on digital images and the combination of digital photographs taken at two or three wavelengths have also been shown to lead to enhanced visualization of blood on some strong colored substrates.

Photography represents a nondestructive method of documenting stains. Traditional photography has limited applicability to dark, reflective surfaces where the investigator is attempting to demonstrate the position of dark, reflective bloodstain patterns.

This study introduces an improved method of photographing these dark, bloodstained substrates without the use of specialized film needs or digital imaging operations and that has applicability to digital photography as well.

Criminal cases involving bloodstains on a dark nylon jacket and a black leather jacket prompted experimentation with different types of illuminators and filters. The combination of a plane polarized filter over the illuminator in conjunction with a polarizing filter fitted over the camera lens resulted in a significant improvement in the contrast of images obtained.

Further experimentation is being done with a variety of bloodstained, dark reflective fabric substrates in order to optimize the lighting angle, direction of vibration of the plane polarized light, and camera settings. The results of these experiments will be shared in this presentation.

Photography, Polarized Light, Bloodstain Patterns

B172 Discrimination of Automobile Side Windows by micro-XRF

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After attending this presentation, attendees will learn about the effects of recent improvements in the design X-ray fluorescence spectrometers on their use for the comparative analysis of glass fragments, including the factors which affect the ability to discriminate between samples of lass using X-ray fluorescence techniques. Specifically, this presentation will offer insight into the capabilities of a polycapillary, micro-XRF instrument for the source discrimination of similar glass fragment samples, the limits of accuracy and precision of the results obtained, and the rates at which comparison errors occur.

This presentation will impact the forensic community and/or humanity by demonstrating This research provides a basis for the analysis of glass samples utilizing X-ray fluorescence (XRF) techniques.

Differences in surface geometries and thicknesses of small glass fragments result in inaccuracies in the results of comparative XRF measurements, including loss of signal from elements with larger excitation depths. Furthermore, difficulties in spectral interpretation result from variations in detector sensitivity for different x-ray energies and interferences from other X-ray phenomena such as diffraction.

X-ray fluorescence measurements were made using an Eagle II (EDAX) spectrometer with a Rh tube. Samples selected for this study are tempered automobile glasses with similar refractive indices (n_D=1.5186 ± 0.0002). Semi-quantitative comparisons, based upon the ratios of the net intensities of the silicon (Si), potassium (K), manganese (Mn), and iron (Fe) emissions to the calcium (Ca) emission and the strontium (Sr) to zirconium (Zr) net intensity ratio, were used for this study.

Statistically-based tests can be used to test the hypothesis that the means of measurements from two samples are equal. For this study, three forms of the Student's t test were utilized. One form, which uses pooled standard deviations from the samples, is based on the assumption that the sample variances are equal. The second test, Welch's modification to the t test, assumes that the sample variances are unequal. Finally, in the third variant of the t test, the equality of variances for each variable was tested using the F-test and the appropriate form of the t test was applied to the data set. That is, those comparisons showing unequal variances were compared using Welch's modified t test, while those with equal variances used the pooled standard deviation t test.

A Type I error, or false exclusion, is made when the conclusion reached is that the two samples are distinct when in fact they are from the same source. A Type II error, or false inclusion, is a failure to distinguish between two samples that are from different sources.

The first portion of this study investigated the ability of replicate measurements on a single fragment to adequately account for the effects of changing surface geometries and the limits of thickness tolerances. The second portion of the study focused on the ability to discriminate between similar sources of glass, the ability to identify the correct source of a single fragment, and the rates of Type I and Type II errors associated with these comparisons.

Although the accuracy and precision of results obtained by μXRF analysis of glass fragments is limited to some extent by the size and shape of the fragments and by the x-ray source energy range of the instrument, this study has demonstrated that μXRF may be used to differentiate some glass sources that are indistinguishable by refractive index. A semi-quantitative approach involving multiple measurements of the ratios of x-ray peak intensities for selected elements in each fragment is optimal for using μXRF for glass source discrimination.

Micro-X-Ray Fluorescence, Trace Evidence, Glass

B173 Elemental Analysis of Glass by LA-ICP-MS, a Comparison of Various Laser Methods to Optimize Sensitivity, Precision and Accuracy

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After attending this presentation, attendees will learn how to characterize glass, collected at crime scenes, using laser ablation inductively coupled plasma mass spectrometry, ultimately for discrimination purposes and learn the fundamentals of laser ablation ICP-MS and why it is an emerging technique for elemental analysis of forensic materials.

This presentation will impact the forensic community and/or humanity by illustrating the utility of laser ablation inductively coupled mass spectrometry as an excellent method for characterizing glass fragments, collected at given crime scenes, and then using this characterization to match the fragment(s) back to the source. The net result of such determination and discrimination measures is to assist with linking a person or object to a crime scene or crime scenes.

Bombings, drive-by shootings, burglaries, assaults, and automobile hit and runs are just a few of the cases in which glass fragments, collected at a crime scene and/or transferred to a suspect or a secondary crime scene, can become a key factor in solving crimes[1]. Glass examiners often employ traditional techniques, such as fracture matching, as well as various optical and physical associations, such as color, thickness, and refractive index (RI) determination; oftentimes, these techniques do indeed provide efficient means to associate a person or object to a particular crime scene[1]. Nevertheless, characterizing glass fragments solely on the physical and optical properties does not provide as good discrimination as does the comparison of trace elemental profiles. Previous researchers, have discovered that the trace elemental analysis of glass fragments can compliment traditional comparison techniques providing for additional discrimination between glass samples originating from different sources. Techniques including x-ray fluorescence, neutron activation, scanning electron microscopy, and atomic absorption have all been utilized for elemental glass profiling; however, inductively coupled plasma mass spectrometry (ICP-MS) has emerged as the method of choice for trace elemental profile determinations[1]. In comparison to other elemental analysis methods, ICP-MS offers many advantages, including enhanced sensitivity, multi-element determinations, and high sample throughput[1]. Moreover, research has demonstrated that both dissolution (acid digestion) and laser ablation sampling methods offer competitive means en route to accurate and precise analytical results for the analysis of glass. Nevertheless, it has been shown that laser ablation offers many distinct advantages to its dissolution counterpart, including an elimination of health-related issues (use of con-

centrated acids is not required), also, laser ablation has much smaller sample-size requirements (~ picograms versus ~ milligrams for dissolution techniques), and, most importantly, no sample preparation is necessary for laser ablation because of its direct sampling approach (thereby equating to faster analyses)[2].

This research will focus on laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS), with emphasis on the comparison of two types of laser sampling devices, a femtosecond (fs) laser system and a nanosecond (ns) laser system, and its application to the analysis of glass. As compared to nanosecond laser ablation, femtosecond ablation is advantageous for such laser systems ablate smaller aerosol particle sizes, laser-plasma interactions are greatly reduced, less plasma shielding occurs, and minimal sample lattice heating results; to add to that, femtosecond laser ablation is essentially non-thermal, which equates to the possible elimination of matrix dependence and fractionation[2,3]. Along with the analysis of NIST certified glass standards, twenty-one different glass samples originating from vehicle windows were analyzed by LA-ICP-MS, using both nanosecond and femtosecond lasers, as well as the utilization of different types of inductively coupled plasma mass spectrometers, a quadrupole instrument and a magnetic sector instrument. Characterization of these glass samples using laser induced breakdown spectroscopy (LIBS) has been performed by this laboratory; therefore, comparisons between LIBS data obtained and the LA data obtained in the given experiments will be discussed, as well as general background information related to this technique.

In addition, a secondary laser ablation analytical approach will be presented; secondary, in the sense of collecting an ablated mass onto a substrate followed by the ablation of the substrate (containing the ablated mass). The theory behind this technique involves the rationale of pre-concentrating the material of interest, in this case, glass, onto the substrate, and then increasing the laser spot size for the secondary ablation, which will ultimately increase the number of particles entering the ICP-MS over the same time, and, thus, an increase in sensitivity can be obtained. It is important to point out that for trace elemental determinations, sensitivity is crucial; therefore, in summation, the research presented in this paper will focus on the different ways to optimize such sensitivity with respect to forensic glass examination while retaining the precision and accuracy already achieved and previously reported.

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Glass Analysis, Laser Ablation, ICP-MS

B174 Characterization of Automobile Float Glass With Laser Induced Breakdown Spectroscopy (LIBS) and Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS)

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The goal of this presentation is to present the results of a pilot study of Laser Induced Breakdown Spectroscopy (LIBS) and Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) for the discrimination of automobile glass.

This presentation will impact the forensic community and/or humanity by demonstrating how LIBS provides an alternative method to LA-ICP-MS that is more economical and allows more rapid data collection.

Forensic glass analysis provides direct comparison of questioned and known glass samples. For each of the 23 automobile float glass samples studied, shards from the same glass were analyzed using both LIBS and LA-ICP-MS. Refractive index measurements were also made on all 23 glass samples by the GRIM3 method. All LIBS measurements were made at the National Center for Forensic Science at UCF. All LA-ICP-MS and refractive index (RI) measurements were made at the South Carolina Law Enforcement Department (SLED) Columbia, SC. Pair wise comparisons were made of the data for all samples to determine discrimination factors for each technique.

The Ocean Optics LIBS2000+ system was used for data acquisition; it utilizes a Nd-YAG laser that emits at a fundamental wavelength of 1064 nm (Big Sky, model CFR200, 98 mJ/pulse, pulse width 7 ns). For the LIBS measurements, glass samples (float side) were analyzed by comparing 5 spectra each comprised of an average of 10 single-shot spectra (detector delay of 15 microseconds) in one spot. The LIBS sample chamber was purged with Argon gas for 45 seconds prior to initiation of the laser ablation, followed by a 30 second Argon purge after every 50 laser shots. This data was used to select 29 emission wavelengths that were shown to have reproducible intensities for repetitive scans. These emission lines were in turn used to calculate 13 ratios of intensities, a method that eliminates errors in data analysis that can be caused by laser shot-to-shot fluctuations. Of the 13 intensity ratios, 10 of these were selected based on their ability to discriminate between glass samples.

Previous research has shown that it is possible to discriminate automobile samples based on their isotopic abundance using LA-ICP-MS plus the refractive index. The Agilent 7500s ICP-MS instrument used in this research utilizes a New Wave Research/Merchantek LUV 213 nm laser system for data sampling. In this work, 16 isotopes were selected for glass sample discrimination purposes. In order to determine sample discrimination ability, ratios of these isotopes were used in order to minimize the effect of laser shot-to-shot fluctuations. Four (4) layers of glass are sequentially ablated by rastering across the surface of the glass. The first layer of the glass is ablated but not analyzed, while the next three layers of the glass are analyzed following ablation. For each layer that is ablated, 10 laser scans are taken and each scan is comprised of 12 isotopic mass spectrometric analyses. Discrimination of different glass samples was accomplished by comparison of data taken from the same layer of the respective glasses (*e.g.*, data from layer 1 from glass A is compared to data from layer 1 from glass B).

Twenty three (23) automobile glass samples (253 pair-wise comparisons) were used for this study. Discrimination of the automobile glasses was achieved with the inclusion of the refractive index (RI) for each sample. Discrimination capability was measured for both LIBS and LA-ICP-MS at a 99% confidence interval (CI). For the LA-ICP-MS, data was collected for each layer of glass individually and was subsequently averaged. Using LA-ICP-MS and RI, 98.00% of the samples could be discriminated at a 99% CI. The use of LIBS and RI allowed 96.00% of these same glass samples to be discriminated at a 99% CI.

LIBS, Automobile Glass, Elemental Analysis

C1 Analyzing Some Potential Security Problems Using a Regular Telephone Set

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The goal of this presentation is to identify potential security problems in using regular telephone sets and to share the authors' experiences with counter-measures for finding audio surveillance equipment by attaching wire-taps or coupling devices. It also benefits those inexperienced with eavesdropping equipment to help prevent a disclosure while talking about confidential information in a telephone conversation.

Improvements in telecommunications in the last century have enabled people to talk to each other efficiently over the phone without geographic or time barriers. The telephone set has become the most popular form of telecommunication because it is available to every office and family in the world. Consequently, eavesdropping is often used to monitor specific persons under surveillance. Normally, the placement of the eavesdropping device is done secretly. Advanced integrated circuit technology is integrated into these devices. Therefore, wiretaps are getting smaller and better than before. The newest device is tiny in size and light weight. This small size and weight is reflected in the increased number of wiretapping cases. Fortunately, most cases are resolved in time by the investigating authority. This paper will discuss personal experiences involving real counter measurement jobs rather than discussing the high technique of applications and implementations. By way of sharing experiences on some special cases, it will remind readers of possible job related consequences. However, it shall be kept in mind, eavesdrops do not necessarily use physical elements or high technology. Many of them modify the circuitry layout in the telephone set to achieve the purpose of listening. By picking up special properties from regularly installed elements, nobody is able to visually recognize the difference between normal and illegal telephone components. After all, signal transmission can be done by any possible method. This paper is going to describe some real cases of eavesdropping on a telephone set and show the results from a lab proving the feasibility of execution in the field. This presentation will be very helpful to people working in countermeasures who are analyzing a telephone bug. It will also be useful as a reference of procedures to do surveillance for finding equipment for eavesdropping on telephone communication.

Surveillance, Telephone, Countermeasure

C2 Tractor Trailer Lane Encroachment Estimation

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Attendees will learn a method of determining tractor trailer offtracking and lane encroachment in a small and variable radius curve of high super elevation when the crash combination is not available for site trials. This presentation will demonstrate an alternative method of solving similar problems to having to make detailed location surveys and procuring and learning expensive computer programs.

A tractor trailer descended Horsepen Mountain on Highway 52 in Mingo County, West Virginia, after dark on a rainy evening. This section of highway is composed of connected very small radius curves that cause standard tractor trailer combinations to offtrack so severely that the vehicles encroach into the oncoming lane by several feet. The trailer of such a combination struck an oncoming ambulance making an emergency run and pushed it against the rock cliff on the inside of the curve.

The dimensions of the crash tractor trailer were not initially available to the authors, so a simulation of its line of travel through the curve by driving a combination of similar dimensions through the crash site twice was developed; once with the rear moveable double axles as far to the rear as possible and again with them as far forward as possible. This yielded the maximum and minimum possible offtracking and encroachment for this vehicle.

The trial runs were made while traffic was stopped and during daylight hours in clear weather. The driver was instructed to steer as far to his right as possible to minimize encroachment and to comply with testimony of the crash trucker. It also gave the crash trucker the benefit of doubt in several ways; including that the driver during the trials could drive more slowly and see the outside guardrail better than the driver at the time of the crash. This allowed him to travel closer to the guardrail than the crash driver. The crash trucker testified a speed of about ten miles per hour at the time of impact and the trials were run at a fast walking speed.

During the trials, assistants spray painted the points of contact between the inside tires of the first and last axles of the combination and the surface of the highway. The resulting painted lines of travel were located by measurement. The amounts of maximum offtracking and encroachment closely agreed with and verified calculations using the dimensions of the trials combination and the radius of the curve at the point of impact.

The first run, with the rear axles rearmost, revealed that there was enough room remaining for the ambulance to have been missed given its location at impact claimed by the plaintiffs and the trucker having driven as far to the right as possible. The former was several feet inside the inside fog line and the latter had his right front tire on the shoulder between the outside edge of the pavement and the guardrail. This indicated that one or both vehicles were not as far to the right as possible.

During the second run the ambulance was placed at the location its driver claimed at impact. Its left rear corner was almost two feet inside the first run's closest point of travel of the trailer. During the second run the trailer missed the ambulance by several additional feet.

Following these trials, a true exemplar of the crash tractor trailer was made available for inspection. This combination was found to be slightly longer than the one used in the trial runs, meaning that its offtracking and encroachment would have exceeded that of the simulations. New calculations were performed refining the expected maximum offtracking and encroachment for the true exemplar combination.

Impact occurred before the combination had achieved maximum offtracking, so the actual amount of offtracking and encroachment at the point of impact was determined by adjusting the maximum calculated offtracking of the true exemplar by a facto determined by the amount of offtracking developed during the trial runs compared to the maximum offtracking with that combination. This yielded that the crash tractor trailer would have offtracked and encroached nearly another foot into the oncoming lane more than did the simulation combination. However, there remained almost a foot of clearance for the vehicles to safely pass had both been as far to their right as possible.

A major advantage of re-enacting the travel of the tractor-trailer is that it automatically took into account all the idiosyncrasies of the curve such as its varying radii and widths and high degrees of super elevation; factors not accounted for in the standard equations for offtracking and would otherwise require extensive surveying and calculation.

At trial defense admitted fault.

Offtracking, Encroachment, Tractor-Trailer

C3 Injury Patterns and Impact Sequence of a Multiple Rear-End Collision

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Attendees will be shown how errors were made while disregarding physical evidence in favor of witness statements that validate one conclusion in the analysis of a multiple rear-end collision. This presentation will impact the forensic community by enlightening the forensic engineer to become more thorough in investigations of vehicle collisions.

INTRODUCTION: Motor vehicle collisions are often studied when an occupant's injury is not commensurate with the collision severity. The collision reconstructionist is used to determine collision severity, the restraint system engineer evaluates the performance of the safety system, and the biomechanical expert seeks to define the type and cause of injury. However, an overlap in the roll of these disciplines can occur during the collision analysis.

CASE STUDY: During morning rush hour traffic, a four vehicle, multiple rear-end collision occurred on a congested highway. Prior to the collision sequence, all vehicles were traveling in the same traffic lane. All the witnesses agreed the collision was initiated after the front vehicle, identified as vehicle #4, slowed for traffic ahead. After vehicle #4 came to a stop, vehicle #3 stopped behind it without incident. Reacting to the change in conditions, vehicle #2 came to an abrupt stop behind vehicle #3. Unfortunately, vehicle #1 did not brake soon enough, and rear-ended vehicle #2. The force of this impact thrust vehicle #2 into the back of vehicle #3, and in turn, vehicle #3 impacted the back of vehicle #4.

Vehicle #4 and vehicle #3 sustained minimal damage, and the occupants did not suffer any significant injuries. Vehicle #2 sustained minor damage to the front, but major damage to the rear. Driver #2 sustained significant facial injuries including a LeFort fracture involving the left orbital bone, a dislocated left eye, a fractured nose, three fractured teeth, and a chin laceration. Vehicle #1 sustained major damage to the front. Remarkably, the four occupants of this vehicle, all wearing 3-point lap and shoulder belts, did not suffer any significant injuries.

This collision sequence is not unlike many studied before. Most of the responsibility falls on the driver of the rearmost vehicle due to failure to stop in time. Driver #2 was simply in the wrong place at the wrong time. The collision sequence in this case was not contested until the two occupants of vehicle #3 changed their story regarding the order of the impacts felt. The new version offered was that the vehicle was impacted twice in the rear by vehicle #2; first because vehicle #2 was unable to stop in time, and then a second time because vehicle #1 impacted the rear of vehicle #2. Given this alternate collision scenario, it appeared that driver #2 shared the responsibility of the collision with driver #1.

A biomechanical expert was retained by counsel for driver #1 to determine the more likely collision sequence. When this expert was hired, the vehicles were not available for inspection, but photographs of vehicles and property damage existed. The selection of the more likely collision sequence was made primarily by considering the cause of the injury to driver #2. Upon review of the medical records, this expert concluded the injuries suffered were those consistent with a frontal collision, and an analysis was undertaken to determine which interior surface caused the injury.

In his opinion, the facial injuries to driver #2 were severe enough to be associated with a fractured windshield, but since the windshield of vehicle #2 was not fractured, impact to the windshield was ruled out. Similarly, there was no evidence of steering column collapse or wheel rim deformation, so this expert ruled out a head strike to the steering assembly. What remained as a potential source of injury was the driver's airbag that had deployed in the collision sequence and whose fabric was covered with splattered blood. And, while inflation-induced injuries were rare in his opinion, this expert concluded the inflating airbag caused the facial injuries to the driver. Therefore, this expert concluded vehicle #2 first impacted the rear of vehicle #3, and then vehicle #1 subsequently impacted the rear of vehicle #2.

FURTHER ANALYSIS: This analysis is replete with inaccuracies. Many examples of significant physical evidence were disregarded. Only the witness statements which changed during the collision investigation support this conclusion. It is known that independent witnesses' statements often conflict, and this only confounds the analysis of some challenging collision reconstructions. However, the physical evidence can outweigh witness statements, and the thorough expert will be diligent in his search of witness marks.

Driver #2 was wearing his 3-point, lap and shoulder belt at the time of collision as evidenced by striations to the plastic coated latch plate, and the deployment of the buckle pretensioner. A significant amount of blood was deposited throughout the interior of vehicle #2. Blood stains appear on the seat upholstery, the center console, the head liner, the interior door panel, and the airbag fabric. However, the blood splattering on the airbag fabric does not reveal a pattern consistent with facial impact. This blood is evenly distributed over the entire circular panel, and the streaks of blood are not aligned symmetrically to indicate one wheel position at the time of deposit. Clearly the airbag was not the source of injury.

If all forward structures of the vehicle interior were dismissed as a source of injury to driver #2, how were the extensive facial fractures suffered? The most likely candidate was discovered during the inspection of the vehicle, before it was sold for salvage. When the right rear door was opened, a strong witness mark was observed to the rear surface of the right B-pillar, revealing tissue, hair, and blood, and associated upholstery tears. The location of this witness mark was adjacent to head restraint at the approximate height of the driver's head. If indeed this witness mark was the source of the severe facial injuries of driver #2, his head would not strike this surface in a frontal collision.

A blood stain on the inboard side of the driver's seat back had run a few inches on the upholstery before drying. However, this blood stain, which ran in response to gravity, did not have a vertical alignment with the seat back in the position as found at the inspection. The direction of the blood stain indicated the driver's seat back was further reclined when the blood had dried. This finding suggested a seat back failure.

Research indicated an FMVSS 301 movable barrier rear impact test was conducted on a vehicle similar to vehicle #2. A 4000 lb movable barrier impacted the test vehicle at 29 mph. The test vehicle attained a change in velocity of 16.4 mph, and sustained deformation very similar to the damage to the rear of vehicle #2. Review of the test video revealed some startling results.

The video shows that as the test vehicle is accelerated forward upon impact by the movable barrier, the test vehicle is thrust under the test dummy. The test dummy sinks into the driver's seat back. Then the seat back continues to recline such that the test dummy's upper torso rotates backward until the head is behind the left B-pillar. As the seat back continues to deform, the test dummy's torso rotates until its head drops below the top of the left rear door belt line and disappears from view. After reviewing the results of the crash test video, the suspicion that the face of driver #2 struck the B-pillar was validated.

The opinion that driver #2 struck the left B-pillar was strongly opposed by the expert for driver #1. This expert suggested the presence of blood and tissue in that area was the result of medical personnel extricating the driver. This expert also suggested this area of the B-pillar was not exposed when the rear door was closed. However, the witness mark observed on the B-pillar is not concealed when the rear door is closed.

CONCLUSION: Oftentimes there is an overlap between the disciplines of experts analyzing an accident vehicle. The presence of physical evidence in the vehicle interior can be consistent with the collision scenario and should be considered when formulating opinions of the collision dynamics. Errors may arise if physical evidence is disregarded when it contradicts witnesses' statements. Only after thorough investigation can a more complete analysis be achieved.

B-Pillar, LeFort, Multiple Vehicle

C4 Vehicle Stability

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After attending this presentation, attendees will gain the ability to compare and make use of two analyses for vehicle stability: 1) a one degree-of-freedom analysis; and 2) a five-degree-of-freedom analysis for studying the point at which a vehicle becomes unstable in a turn.

This presentation will impact the forensic community and/or humanity by providing methods to ensure fairness in the presentation of vehicle stability evidence for both criminal and civil actions.

Vehicle stability for a real, four-wheeled car is extremely complex. The basic model for that vehicle type is shown in FIG. 1, with examples of some of the applied forces.

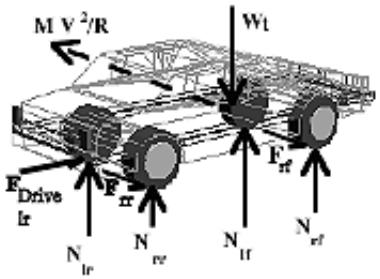

FIG. 1: Model for vehicle stability

Note that the tires are subject to normal forces, side friction forces, and driving or braking friction forces, which obey the inequality for the friction circle at each wheel. Five degrees-of-freedom describe this model: vertical and lateral deflections with yaw, pitch, and roll rotations, illustrated in FIG. 2.

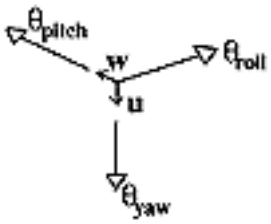

FIG. 2: Model degrees-of-freedom

The model contains two types of structures that store elastic energy: the suspension at each wheel and the lateral spring for each tire. The forces on the car in a turn cause it to pitch forward against the suspension, to roll laterally against the suspension, and to displace and yaw laterally against the lateral stiffness of the tires. All five degrees-of-freedom are required to analyze the stability of the four-wheeled vehicle. Apart from the complexities of the tire behavior when a steer angle is introduced, what makes this problem difficult is the fact that it is three times statically indeterminate: researchers can remove one wheel and theoretically the car will stand on three supports. One front and one rear wheel on ice and the car will again theoretically be supported in a turn by only two tires that deflect laterally. Because the problem is statically indeterminate, the analysis was carried out by using elasticity theory, specifically the theorem of minimum potential energy (PE) with a form of the finite element method. For roll, pitch and vertical deflection, the linear problem uncouples with a potential energy:

$$PE = 1/2[\ K_{front}(u+a\ q_{pitch}+TW\ q_{roll})^2+K_{front}(u+q\ q_{pitch}-TW\ q_{roll})^2$$
$$+K_{rear}(u-b\ q_{pitch}+TW\ q_{roll})^2+K_{rear}(u-b\ q_{pitch}-TW\ q_{roll})^2]$$
$$- Wt\ u - h\ q_{roll}\ (Wt\ V^2/gR_1)\cos q_{cg} - h\ q_{pitch}\ (Wt\ V^2/gR_1)\sin q_{cg}$$

Four examples were studied using this theory and basic experiments were run using a tire fixture with various inflation pressures on a standard asphalt surface. The conclusion of the paper is that this model for vehicle stability, which examines the condition at each wheel, shows the true critical point at which the vehicle becomes unstable. This is in contrast to the simplified one- degree-of-freedom equation result that: 1) ignores the friction circle effects at the wheels, 2) assumes that the vehicle is always in a neutral steer condition, and 3) places the center-of-gravity on the pavement such that the effects of suspension in roll are negligible.

Some specific results for the example problem comparing this analysis with a one-degree-of-freedom (ODF) result gives the following:

$$R = 862.\ \text{feet}$$

$$m = 0.68$$

$$V_{ODF} = \sqrt{\ m\ G\ R} = 138\ \text{ft/sec (94 mph)}$$

$$V_{Model} = 84\ \text{ft/sec (57 mph)}$$

At that speed, the four-wheel vehicle model shows the vehicle deflects its suspension 8.8 inches on average, it pitches forward 5^o , the roll angle, to the outside of the turn, is 3^o, the lateral tire displacement is 1.9 inches, and the vehicle rotates in yaw against the tire stiffness an angle of 0.5^o. The normal force on the right-rear tire is nor = 177 lbs, while the lateral force required for equilibrium is F_{arr} = 124 lbs. This is an under steer vehicle and would expected it to become unstable and yaw clockwise, breaking traction on the right-rear tire in a turn to the right. In contrast, the one-degree-of-freedom model requires that all four wheels be in the critical condition, which is not true for this nose-heavy under steer vehicle.

Stability, Yaw, Potential Energy

C5 Unique SDM Data Patterns

Holly A. Adams, BSME, Automotive Data Consultants, 14436 Four Chimney Drive, Centreville, VA 20120*

After attending this presentation, attendees will learn the different ways a vehicle data recorder can "see" a crash event.

This presentation will impact the forensic community and/or humanity by providing a better understanding of how vehicle computers record data, especially during a crash.

The goal of this presentation is to highlight some unique SDM data storage patterns that may not appear to make sense at first glance. Some of these patterns are alluded to in the SDM Data Limitations paragraphs that print out with the reports generated by the Vetronix CDR. Others are only fully understood after a reconstructionist has completed their accident scene analysis or a complete vehicle inspection is completed. In either case, these examples are meant to shed some light on the special way that a crash recording device can "see" an impact.

A couple of basic terms must be understood regarding SDMs. Pre-crash data in the world of SDMs is points of data taken at approximate time intervals and stored by different vehicle computers in data addresses that are constantly being overwritten until a potential deployment is sensed. At that time, those data points are transferred to the SDM on the vehicle's computer network. That potential deployment sensing time is called algorithm enable. It is the point during the beginning of an event at which the computer "wakes up" because a threshold above normal has been reached. This threshold varies from vehicle to vehicle. A non-deployment is an incident where the SDM "wakes up" but determines the event is not deployment-worthy.

One of the SDM Data Limitations is stated as "Some of the pre-crash data, from the deployment file, may be recorded after algorithm enable, if

the deployment event has a long crash pulse." In other words, if you have an impact with a long crash pulse, like a T-bone or an embankment, the SDM may record some of the post-impact data as pre-crash data. An example of this will be shown in the data from a 2002 Cadillac Escalade that T-boned a Nissan Altima.

Another interesting example of SDM data occurs when, on first glance, the data recorded by the SDM does not seem possible. In this case, the CDR download of a 2002 Buick Regal SDM showed a pre-crash speed of 106 mph with a constant 95% throttle, but an RPM value that dropped almost in half at the -2 second pre-crash value. All analysis of the SDM hexadecimal data indicated valid pre-crash data points. After the reconstructionist's review of the accident scene and police witness interviews, it was found that the Buick attempted to beat a red light. As the Buick sped through the intersection, it rear-ended a 2001 Ford Windstar and sent it airborne, killing the Windstar driver.

A third example involved a 2001 GMC Sierra that T-boned a 1997 Chevy Blazer. The Sierra's steering wheel was bent, and the CDR printout contained only a partial near deployment record, including some pre-crash data and the indicator lamp status, which generally indicates some form of a power loss. When the vehicle was inspected, the SDM was found with the larger of two connectors unseated. This discovery created several questions including, "Is this non-deployment record relevant?" and "Was the air bag malfunction indicator lamp (MIL) functioning properly?" Varying analysis found the answer to both of these questions to be "yes." The case settled.

The final case involves a 2001 Suburban. There was approximately 15.1 inches of crush and the steering wheel was deformed. The SDM recorded a near deployment only. A maximum delta V of 14.2 mph was recorded, but the delta V graph contained 0 and 0.44 mph data points. Careful examination of the data revealed that the delta V buffer was in the process of being overwritten. Therefore, only the end of the crash pulse was saved, and the beginning, which would give insight into deployment versus non-deployment claims, was lost through the overwriting of the delta V buffer.

Each of these cases highlights a different type data storage pattern that can, at first, appear confusing, but after careful analysis, is able to contribute to the overall understanding of the accident.

SDM, Crash Data, Data Recorders

C6 Determining Inter-Event Independence for a Heavy Truck Multiple Impact Collision

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By describing these efforts and methodology, the attendees will be exposed to the inductive use of EDR data to derive parameters useful in heavy truck accident analysis. These methods include the use of inter-event boundary conditions to evaluate the potential independence, or non-independence, of the multiple collision events in the subject accident.

This presentation will impact the forensic community and/or humanity by helping the attendee to learn how to apply heavy truck black box data, and derived reconstruction data points, to create practical analysis case modes, with common-sense meaning, that can have large legal and financial consequences. This will allow the attendees to extend their existing forensic skills, abilities and professionalism by applying them to an area scientific investigation where pre-2000 skills may be less complete.

SYNOPSIS: This analysis concerned a 1999 Kenworth W900 Tractor Trailer traveling on a highway, which impacted six slower moving or stopped units in five impact events before coming to rest. The issue constituting our principal assignment was a determination of the potential independence, or non-independence, of the five identifiable collision events in the subject accident. In other words, a major litigation issue was whether this accident constituted one amalgamated event or constituted five separate events.

This required an examination of the facts of the subject accident, the vehicle EDR data and reconstruction results. The result of the analysis was a set of sub-incident scenarios, which showed that, as long as the tractor trailer driver stayed on the road, there was no scientific way for the four separate impacts subsequent to impact #1 to be considered as independent or physically sole and separate. The analysis results were presented as four sets of sub-incident analysis charts.

The analysis results were derived from secondary and tertiary data parameters based on the primary EDR data, as well as from the Newtonian laws of physics and motion.

LEARNING OBJECTIVES: By describing these efforts and methodology, the attendee will be exposed to the inductive use of EDR data to derive parameters useful in heavy truck accident analysis. These methods include the use of inter-event boundary conditions to evaluate the potential independence, or non-independence, of the multiple collision events in the subject accident.

THEORY OF THE ANALYSIS: There were six steps required to accomplish this analysis. Elements of the analysis include:

1. Derived Parameters Based on the EDR Data

The first part of the analysis was to determine the subject tractor EDR acceleration record (the first derivative of the EDR velocity record) at and about the projected time of the collision sequence record to determine if there was a clear indication of vehicle impact. This can be determined by seeing if the indicated longitudinal deceleration (- SAE J1733 'X' axis acceleration) exceeded the known maximum braking ability of the subject tractor-trailer combination. Figure 1.1 shows the source EDR data for the -10sec to +14sec period. Figure 1.2, the derived data (acceleration), shows that, in this case, there was no indication of vehicle impact from the derived acceleration record. Figure 1.2 also shows that the hard brake record is triggered at approximately -0.30 G to -0.33 G (or above -9 mph) , which is defined as 0.0 sec in the EDR hard brake record.

Time	Vehicle Speed (mph)	Engine Speed (rpm)	Brake	Clutch	Engine Load (%)	Throttle (%)	Cruise	Diagnostic Code
-0:10	76.0	1628	No	No	57.50	100.00	No	No
-0:09	76.0	1631	No	No	53.50	100.00	No	No
-0:08	76.0	1626	No	No	62.00	100.00	No	No
-0:07	73.5	1585	Yes	No	89.00	100.00	No	No
-0:06	67.5	1332	No	No	0.00	0.00	No	No
-0:05	66.0	959	No	No	0.00	0.00	No	No
-0:04	51.0	598	No	No	19.00	0.00	No	No
-0:03	53.0	597	No	No	19.00	0.00	No	No
-0:02	56.5	598	No	No	20.00	0.00	No	No
-0:01	52.0	599	Yes	Yes	21.50	0.00	No	No
0:00	43.0	597	Yes	Yes	22.50	0.00	No	No
+0:01	36.0	599	Yes	Yes	21.00	0.00	No	No
+0:02	31.0	600	Yes	Yes	20.00	0.00	No	No
+0:03	28.0	599	Yes	Yes	20.50	0.00	No	No
+0:04	25.5	599	Yes	Yes	24.50	0.00	No	No
+0:05	22.5	599	Yes	Yes	28.00	0.00	No	No
+0:06	19.0	599	No	Yes	27.00	0.00	No	No
+0:07	17.0	599	No	Yes	27.50	0.00	No	No
+0:08	16.0	601	No	Yes	26.00	0.00	No	No
+0:09	11.5	599	No	Yes	27.00	0.00	No	No
+0:10	9.5	600	No	Yes	25.50	0.00	No	No
+0:11	6.0	600	No	Yes	25.50	0.00	No	No
+0:12	2.0	600	No	Yes	25.00	0.00	No	No
+0:13	0.0	600	No	Yes	24.00	0.00	No	No
+0:14	0.0	604	No	Yes	19.00	0.00	No	No

Figure 1.1

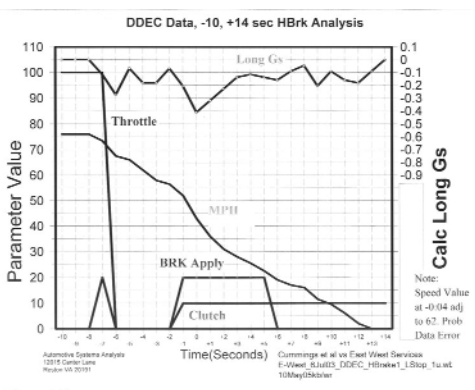

Figure 1.2

2. Positioning the Impact Sequence on a Distance Line and Time Line

The second part of the analysis was to identify the impact points in distance and time, starting with impact #1. This was done by reconstruction analysis[2] which positioned each asynchronous event against the synchronous EDR timeline (last stop record). The reconstruction analysis input is shown in Figure 2.1.

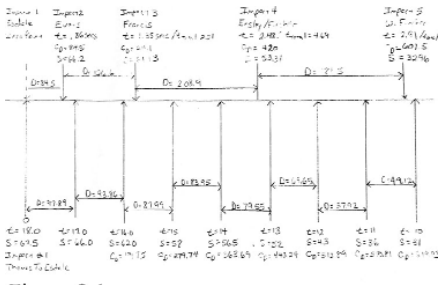

Figure 2.1

It is obvious, and a given, that impact #1 was an independent event. Thus, researchers' analysis concerned the independence, or non-independence, of the four succeeding impact events #2, #3, #4 and #5. This was accomplished by creating five analyses per impact event:

1. Maximum velocity loss from immediate prior incident to succeeding incident, at maximum braking (worst case analysis).

2. Velocity increase from immediate prior incident to succeeding incident, at maximum acceleration (worst case analysis). An example of analyses 1 & 2 (for event #3 - event #4) is shown in Figure 2.2.

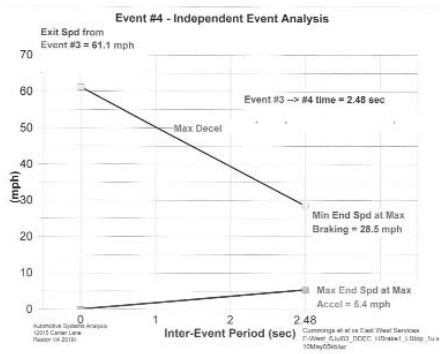

Figure 2.2

3. Distance to stop from prior incident at no braking (infinite, coast out). A reconstructed inter-event impact distance is superimposed on that distance to stop, and the calculated inter-event time is further superimposed over that data pair. From that data overlay, it can be shown that the accident could not be avoided at no braking input.

4. Distance to stop from prior incident at min statutory braking (FMCSR 393.52 Stop Table, 0.435 G). A reconstructed inter-event impact distance is superimposed on that distance to stop, and the calculated inter event time is further superimposed over that data pair. From that data overlay, it can be shown that the accident could not be avoided at minimum statutory braking.

5. Distance to stop from prior incident at max braking ability (Max Stop 0.60G). A reconstructed inter-event impact distance is superimposed on that distance to stop, and the calculated inter-event time is further superi posed over that data pair. From that data overlay, it can be shown that the accident could not be avoided at maximum capable braking.

Comparing overlay analyses for event #3 - event #4 and event #4 - event #5, one can see that there was approximately minimum FMCSR braking in the period between event #4 - event #5, whereas there was no braking in the period between event #3 - event #4.

3. Conclusion

This analysis was presented to the trial court, and the matter was resolved favorably.

References:

[1]Note that 1 G = 21.94 mph/sec. Thus, -9/21.94 mph/sec = -0.41G, more than enough to trigger a hard brake event, and well within the max braking capability of the truck (-0.60G).

[2]Reconstruction analysis, Julian R. Beaver, 9Apr04.

EDR Data Analysis, Crash Data Analysis, Braking Calculations

C7 Analysis of Pedestrian Impacts and the Debris Field

Robert D. Anderson, BSE, Biomechanics Analysis, PO Box 7669, Tempe, AZ 85281-0023*

Attendees will be briefed on an objective method to assist in the estimation of the area of impact in pedestrian impact investigations. This presentation will impact the forensic community and by demonstrating an objective, repeatable, and reliable mathematical tool for this application is appropriate.

Annually there are approximately 4,700 pedestrian fatalities, and another 70,000 pedestrian injuries in motor vehicle collisions.[1] In addition to vehicle speed and pedestrian visibility, typical reconstruction issues include determination of the point of impact. Using a case study as an example, it will be demonstrated how the method of least squares, an objective mathematical technique, can be used to estimate that area of impact from the debris field.

Overview of Event: In the early morning hours a 48-year-old male driver of a Jeep Wrangler left the roadway and passed through a barbed wire fence. The Jeep re-entered the roadway and traveled another mile or two before it became disabled on the shoulder of the divided highway.

According to ambulance personnel who passed the scene just before 2:00 a.m. the darkly clothed victim was attempting to flag down vehicles by standing on the shoulder ahead of his Jeep and waving what appeared to be a metal pipe in the air. Unfortunately, within about 10 minutes the pedestrian was struck and killed by a minivan.

Figure 1: Chrysler minivan

Figure 2: victim at point of rest

* Presenting Author

The minivan's driver told officers that he was traveling at 60 to 65 mph when the Jeep in the emergency lane without any lights on was observed. Both driver and front passenger described looking at the Jeep as the car passed, and when they looked back to the roadway a man in the lane was observed. The driver stated that there was no time to react before striking the pedestrian. Afterward the driver pulled to the side of the road and backed up towards the victim's point of rest.

Unfortunately, the investigating officers were unable to locate boot scuffs or other roadway evidence to confirm the victim's location on or off the roadway at the time of impact. However, a large debris field comprising of broken glass, antennae ball, biological material, boots, and cane and stopper were diagramed.

Pedestrian Orientation and Visibility: The victim's right leg fracture, posterior right pelvis dislocation, left and right boot placement and posterior boot heel abrasion are all indicative that the pedestrian was essentially facing the minivan, but somewhat presenting his right side.

The driver admitted that just before striking the pedestrian, his attention was turned toward the Jeep on the side of the roadway. Thus, pedestrian visibility would not appear to be an issue in this case.

Vehicle Speed: Typical of pedestrian collisions that occur at highway speeds, the pedestrian's trajectory was a roof vault. It should be emphasized that with fender and roof vaults, the vehicle is typically traveling faster than the pedestrian and therefore passes beneath or beside the victim during the collision sequence.

The body was airborne about 62 feet, and came to rest 78 feet past the first evidence of post-impact contact with the roadway. Using a 140 foot throw distance,, empirical data can be used to estimate pedestrian post-impact speed. Equations set forth by Barzeley[2], and Searle[3] yield estimates of 66 mph and 61 mph, respectively. This is relatively consistent with the driver's account of traveling 60 to 65 mph.

Pedestrian Point of Impact: Headlight glass, shoes and clothes are commonly used as indicators of the area of impact.[4, 5, 6, 7] While, it would certainly be tempting to subjectively place the point of impact at the cane's location, there is not an adequate explanation for the head light debris field or the location of the boots, nor would this be consistent with the eye-witness accounts, which all place the pedestrian forward of the Jeep.

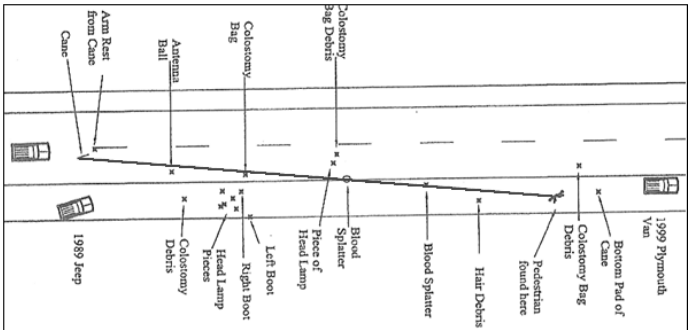

Figure 3, trajectory from cane to point of rest

The cane's point of rest can be explained as follows: direct contact with the mid portion of the cane while supported at the top would produce a high angular velocity of the cane. Release of the cane after it rotated past vertical provides a mechanism for the cane to be found upstream of the impact. In addition, the high angular velocity of the cane provides an explanation for the location of the cane's bottom stopper, which was found beyond the body.

Presumably, the representative line through the data field represents the best estimate of the pedestrian's trajectory, which can be used to indicate the area of impact. The "best fit" trajectory can be objectively obtained using the method of least squares, which treats each data point with equal significance. Unlike "eye-balling" this method is repeatable. Errors such as subjectively or inappropriately over-weighting some data points, like the cane's location, are eliminated.

In this case, the location of the jacket was excluded since it was likely carried to its point of rest by the minivan. The objects which had multiple points, such as the cane, an area of contact/splatter, and the pedestrian, were each replaced by a representative point. The diagram below depicts the resultant best fit line.

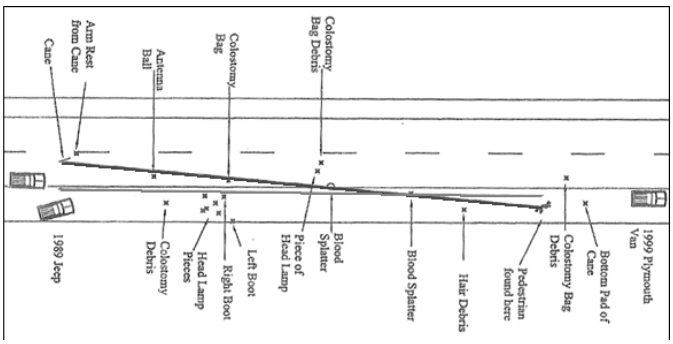

Figure 4, best fit trajectory

The above best fit pedestrian trajectory accounts for the fact that body impact with the pavement and point of rest, and both the victim's boots, the majority of the debris field from the minivan's right headlight were found within the emergency lane. Only the cane, colostomy bag and debris, one piece of headlight, and an antennae ball were found within the lane. Interestingly, the majority of the head light debris was found between left and right boots, as would be expected with the pedestrian facing the minivan's right head light.

Certainly, if it is assumed that the best fit represents the best estimate of the pedestrian's trajectory, then it must be concluded that the minivan most likely crossed the fog line and struck the pedestrian.

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Reconstruction, Pedestrian, Least-Squares

C8 Human Factors Evaluation of a Steam Shower

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After attending this presentation, attendees will gain an understanding of the process involved in conducting original research as part of a forensic human factors investigation as well as insight into how to evaluate the psychological or human factors that often interact with engineering issues.

This presentation will impact the forensic community and/or humanity by demonstrating an approach to evaluate issues that cannot be addressed using standard site inspection and laboratory techniques.

The authors present a case to demonstrate the use of original research to evaluate behavioral expectations of product users. Due to diabetes, Plaintiff has peripheral neuropathy (he has no feeling in his legs and feet). He took a steam shower in a hotel suite designated for people with disabilities. Prior to using the shower, Plaintiff noticed a vent on the wall that said "THERASTEAM" (name of company has been changed) in large letters covering the entire face of the plate. After using the steam shower, Plaintiff's leg turned red, became infected, and did not heal due to his diabetes. He ultimately had to have his leg amputated. How did this accident happen? What human factors engineering issues were causal factors? This presentation will explore the design of the steam shower, control devices, installation instructions, warnings, and behavioral expectations of the users.

The steam shower was controlled by two knobs labeled "time" and "temperature." Around the knobs, there were four hatch marks that were not labeled to indicate calibration. The temperature control, according to the Owner's Manual, was designed to be in increments of 107°, 116°, 124° and 130° F. The controls were installed in the suite kitchen, far removed from the steam shower. To use the shower, the user had to turn the timer knob, go past the kitchenette, through the restroom, and through a glass door to the steam shower.

In front of the bench seat is a steam outlet pipe (see Figure 1), approximately 12" above the floor and 18" from the seat. On the wall perpendicular to the seat (approximately 4 feet from the seat) was the thermostat vent (see Figure 2) located six feet high with "THERASTEAM" embossed across the front.

Plaintiff contended that the thermostat vent was the steam outlet. In actuality, the outlet pipe projected from the wall opposite the bench. The Owner's manual instructed, "Install steam head [outlet pipe] 18" above shower floor. The steam head should be located as far from the seating area as possible *for bather's comfort.*" No written warning described the safety hazard to the user if the steam head was installed near the seating area.

Plaintiff contended that the steam shower device was unsafely designed, improperly installed, and did not have effective warnings. Defense contended that Plaintiff was aware of his disability and should have taken better care to protect himself. They also contended that Plaintiff was inattentive since he failed to properly detect the source of the steam (steam could not be felt due to the Plaintiff's neuropathy).

A human factors evaluation of the system must take into account the both the device and users. An inspection of the shower while in operation indicated that the tile surface caused a reverberation which made it difficult to auditorily locate the steam source. Moreover, once a little steam entered the room, its source could not be visually identified.

In order to evaluate the user interface and perceptions, a study was conducted using photographs of the controls and shower components. Since Defense contended that Plaintiff was not reasonable in his failure to identify the steam outlet pipe, the authors tested 24 other people's perceptions. This study evaluated how people unfamiliar with the steam shower would interpret the components. Participants were first asked to estimate the time and temperature settings of controls as depicted in a photograph. While study participants were reasonably accurate with the time setting, no one was able to determine the temperature (responses ranged from 60° to 105°).

To evaluate the reasonableness of Plaintiff's belief that the thermostat sensor was the steam outlet, participants were asked to refer to photographs and identify the thermostat vent ("Please tell me what this object [pointing] is"), steam outlet pipe, and several items used as distracters (bench, shower hose, and handrail). Consistent with Plaintiff's perception, 88% of the study participants also misidentified the thermostat vent as the steam outlet while only 8% recognized it as a thermostat or sensor. Similarly, 8% of the participants correctly identified the steam outlet pipe.

The authors use this case study to illustrate the practical application of employing human factors research in evaluating reasonableness of conduct and product users' perceptions.

Figure 1. Steam shower seat area (outlet pipe indicated)

Figure 2. Thermostat vent

Human Factors, Perceptions, User Interface

C9 Identification of Airbag Design Features That Adversely Affect Injury Potential

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The goal of this presentation is to address how some airbag designs adversely affect occupant injury potential. Attendees will learn about production airbag system components, as well as airbag-associated injury patterns that have been attributed to those components.

This presentation will impact the forensic community and/or humanity by increasing knowledge of airbag design and by showing how visual inspection and experimental studies demonstrate the adverse interaction between some production airbags and the occupants they are designed to protect.

Laboratory testing and field studies of real-world crashes clearly support the effectiveness of airbags to mitigate injury. However, airbags are also known to produce injury. Crash statistics and case studies document the following airbag-associated injuries:

- head and facial injuries (diffuse axonal and brainstem injuries, basilar skull fractures, ocular and TMJ injuries, and thermal burns),
- neck injuries (atlanto-occipital joint extension injury),
- chest injuries (rib fractures, lung contusion, aortic tears, and cardiac injuries), and
- upper extremity fractures.

Out-of-position occupants are particularly susceptible to airbag-associated injuries due to their proximity to the deploying airbag.

The airbag restraint system is designed to limit the forces exerted on the human body and control occupant deceleration during a motor vehicle crash. The basic components of the airbag restraint system include:

- the crash sensor,
- the diagnostic package for determining operability status, and
- the airbag assembly.

The airbag assembly consists of:

- the inflator,
- the module, and
- the bag.

The purpose of the sensor is to detect the impact. The diagnostic package determines operability status and provides the triggering signals to activate the inflator. The purpose of the inflator is to inflate the airbag. The module is simply the storage container for the airbag and inflator components.

Extensive research of airbag-associated injuries has led to the identification of the following design parameters that affect injury risk:
number and type of sensors, sensor location, and single versus multi-deployment thresholds,

- number and type of inflators,
- module cover size, tear pattern, and material properties,
- deployment location and direction, and
- airbag fabric, volume/size, shape, vents, tethers, aspirations, and folding pattern.

These design features dictate airbag performance (e.g., deployment timing, leading edge deployment speed, maximum excursion, steering column force).

The airbag sensors can lead to injuries when premature or late deployment occurs. Injuries have also been attributed to single-stage inflators, which trigger fast aggressive deployment in both low and high severity impacts. Head and arm injuries have been attributed to forceful module cover contact and related to its tear pattern and stiffness. The airbag deployment location and direction primarily influences passenger-side injury potential. Burn injuries are attributed to the airbag vents. Ocular injuries and arm fractures have been attributed to the absence of tethers (i.e., straps that connect the front and back airbag surfaces, limit the airbag excursion and deployment speed, and control the inflated bag shape and size). Specific folding patterns have been found to contribute to occupant eye injury potential.

Forensic analysis of airbag-associated injuries sustained in real-world crashes requires knowledge of these design features, as well as the performance characteristics of the subject vehicle airbag. However, the availability of this information to the public is very limited. Since many manufacturers offer "new and improved" airbags to replace deployed airbags, undeployed airbags acquired from salvaged vehicles have been found to be appropriate, if not optimum, specimens for inspection and testing. Many airbag design features can be identified by disassembly and visual inspection of undeployed salvaged airbags. Other design features, as well as performance characteristics, must be determined from static deployment testing. Multi-stage inflator designs are identified using the vehicle service manual or visually upon removal (e.g., dual-stage inflators have two wire connectors attached to the airbag module, and single-stage inflators have one connector attached to the airbag module). In static deployment tests, driver-side airbags are mounted to a steering wheel fixture and passenger-side airbags are mounted in the vehicle. Dynamic deployment characteristics are determined from full-scale frontal crash testing. High-speed films allow qualitative and quantitative comparisons of airbag designs.

Airbags, Injuries, Design

C10 Motor Vehicle Pediatric Brain Injury

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After attending this presentation, attendees will be able to recognize good science in biomechanics of brain injury in a child.

This presentation will impact the forensic community by showing methods that are good science in the study of pediatric brain injury. The methods provide a fairness in the presentation of evidence in both civil and criminal cases, particularly in the area of auto collision injuries.

Pediatric brain injuries in auto collisions are varied and serious. The mechanisms of trauma to the head for a child in an auto collision can number literally in the hundreds. One common mechanism is illustrated by the dummy in FIG. 1*: Subdural hematoma* and *diffuse axonal injury* caused by impact from either the vehicle interior or an air bag strike.

FIG. 1: Impact of child's head by air bag

There are three common effects from this mechanism that causes injury: 1) the increase in pressure in the cerebral spinal fluid (CSF) under the point of impact on the skull, 2) cavitation in the CSF caused by the decrease in pressure on the opposite side of the skull cavity, and 3) cavitation in the brain tissue and CSF caused by the shearing action from a high angular acceleration of the head-neck system. These are illustrated schematically in FIG. 2.

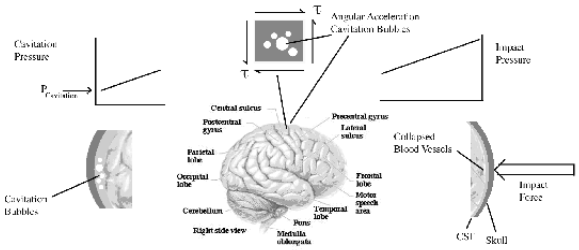

FIG. 2: Three effects from head impact acceleration

The increase in pressure in the CSF under the point of impact is illustrated on the right side of FIG. 2. The true mechanism for the formation of a subdural hematoma is subtle: The higher pressure in the CSF surrounding a blood vessel acts against only the blood pressure inside. Because the induced impact pressures can be an order of magnitude greater than the blood pressure, the blood vessel collapses and the bending action forms a lesion at the outer surface. This lesion can be large or quite small, the latter result yielding a very slow bleed of several days. Thus, the child can be injured and the event nearly forgotten when the child becomes comatose from pressure on the brain.

The cavitation in the CSF caused by a decrease of pressure on the opposite side of the skull cavity causes a contre coup injury to the brain. The schematic of this is on the left-side of FIG. 2. The true mechanism can be one of several forms, but *diffuse axonal injury* can occur. The basic equation for this is:

$$\mathbf{K\ d^2u/dx^2 = \rho\ a,}$$

where **K** is the *bulk modulus* of the CSF, **u** is the displacement of the fluid in the direction of the decreasing pressure gradient, **ρ** is the mass density of the CSF, and **a** is the acceleration of the head in impact. For a child, this equation yields accelerations on the order of 180 gs to cavitate the CSF on the opposite side of the skull cavity. This agrees with the literature for brain injury of children from infants to 3 years of age.

The third mechanism of brain injury in children that presented here is cavitation produced by an angular acceleration of the head-neck system, illustrated schematically at the top of FIG. 2. The mechanism for this injury is the shear stress generated by the acceleration of an element in the brain at the greatest throw distance from the point of rotation in the neck. The basic equation for this stress comes from a modification of the elasticity equation and results in:

$$\tau = \rho\ \alpha\ r^2/4,$$

where **ρ** is the mass density of the brain material, **α** is the angular acceleration in radians/sec^2, and **r** is the distance from the point of rotation of the head neck system to the element studied. Values of **α** that generate *diffuse axonal injury* in a child are generally in excess of 16,000 rads/sec^2, which this equation predicts within a few percent.

This paper gathers together the literature on pediatric brain injury and shows the basic mechanics for several of the mechanisms of injury in vehicle collisions. The application of these analyses can be very broad, from auto and other vehicle collision injuries to falls and child abuse.

Pediatric, Trauma, Brain

C11 Unrecognized Spinal Injury Risk to Restrained Occupants in Rear-End Vehicle Impacts

Carley C. Ward, PhD, Jennifer A. Ward, BS, and Hrire der Avanessian, PhD, Biodynamics Engineering, Inc., 860 Via de la Paz, Suite C3, Pacific Palisades, CA 90272*

This presentation will inform attendees of the misconceptions regarding injuries in moderate velocity (change in velocity less than 30mph) rear-end impacts. This is accomplished through analysis of actual injuries sustained, sled test results and restraint system effectiveness testing. Frontal impact protection for vehicle changes at velocities up to 30 mph is required by Federal Motor Safety Standard 208 and is enforced by the National Highway Traffic Safety Administration (NHTSA). However, no such protection is provided for rear impacts in this speed range.

This presentation will impact the forensic community and/or humanity by informing attendees of the misconceptions regarding spinal injuries in moderate velocity rear-end impacts.

Seatback yielding/failing in moderate velocity impacts (20 to 30 mph range) is not uncommon based on the New Car Assessment Program (NCAP) rear barrier impacts tests. Unfortunately, when seat backs fail rearward in real world crashes, paralyzing injuries to vehicle occupants can result. Although these catastrophic injuries occur to belted occupants, test data from restrained anthropomorphic dummies indicates a minimal-to-nonexistent risk. Test data, using the Federal Neck Injury Criteria (NIJ), would indicate that the probability of severe spinal injury is rare. Even though each test with seat back failure results in compressive neck loads higher than in similar tests without seat failure, the loads seldom reach the severe injury level.

An examination of ten paralyzed individuals was performed to explain the anomaly between the actual injuries and test data. The injured individuals ramped up their reclining seat backs and impacted the rear seat backs and/or the front of the rear package shelves. Either the lower cervical or upper thoracic spine was fractured as a result of compression or flexion-compression loading. The fracture location was dependent upon the orientation of the occupants' head and neck, as well as the angle of the rear seat when contact occurs. Similar to diving injuries, the velocity of the thorax is critical, since it is the momentum of the thorax that provides the force to fracture the spinal vertebrae. Velocities of the thorax toward the rear seat back in excess of 7.3 mph can produce vertebral fracture.

Slack introduced into the restraint system by the reclining seat backs was determined for four men and three women of different sizes and weights in two different vehicles. Male surrogates' height and weight ranged from 64.5 to 79 inches and to 168 to 254 pounds, respectively. The range for the female surrogates' height and weight was 64.25 to 66 inches and 161 to 237 pounds, respectively. Circumference of the thorax at three locations was recorded for each surrogate. Comparable anthropomorphic dummy data is also included. The occupants' dimensions, as well as their weight versus the slack introduced for the upright and reclined seat positions were plotted.

Girth circumference was found to be a critical measure. The results show that as much as 13.75 inches of slack can be introduced into the restraint system when an obese individual's seat back reclines. This amount of slack renders the restraint system ineffective when it is needed to control the momentum of the thorax. The heavier the individual, the less effective their restraint system becomes when their seat back fails. To illustrate the effect of belt slack on a reclined obese occupant, a rear impact was simulated using the MADYMO occupant simulation computer program. The slack introduced by a 50th percentile anthropomorphic dummy in a reclining seat was considerably less than that of the obese individuals. This difference in belt slack and the limited biofidelity of the dummy in rear impacts contributes to the relatively safe neck loading experienced by the dummy in sled tests. Results of this study show that dummy tests cannot be used to analyze the response of restrained overweight occupants in moderate rear-end impacts. Such dummy data would be misleading, indicating good protection actually, when the reverse is true.

Spinal Injury, Rear-End Impacts, Seat Back Failure

C12 Automobile Belt Fit Limitations Relative to the Pelvis – A Radiographic Study

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After attending this presentation, attendees will be shown the vulnerable position of a lap belt relative to the pelvis and abdomen. The limitations related to belt positioning are shown and the risk to female and overweight occupants demonstrated.

This presentation will impact the forensic community and/or humanity by showing the vulnerable position of a lap belt relative to the pelvis and abdomen. The limitations related to belt positioning are shown and the risk to female and overweight occupants demonstrated.

Although protection provided in frontal impacts has improved in the past ten years, abdominal injuries from the lap portion of the lap and torso restraint systems still occur. Also, the severe abdominal and spinal injuries sustained by occupants restrained by only a lap belt are well known. The recommendation has been to place the lap belt low on the pelvis. The pelvis being a strong bone could best support the belt forces. The Federal Motor Vehicle Safety Standard (FMVSS) for many years stated that the lap belt had to remain on the pelvis in a frontal crash. This study investigates whether the belt can even be positioned on the pelvis initially.

This radiographic study examines the position of an ideally positioned lap belt on a male and female. Radio-opaque pellets were attached to the seat belt webbing. The subject was seated on a flat seat with a vertical back and the belt positioned on the subject. The belt webbing was fed down through the slot between the seat back and seat bottom and the ends were anchored below the seat. Lateral x-rays were taken. The subject was then rotated 90 degrees and the lap belt was repositioned at the prior angle. In this position, frontal x-rays were taken. Because the x-ray source and film were close to the subject, the scanned image is distorted with the structures close to the x-ray source magnified. As a result complete spatial positions could not be determined from direct viewing of the scans. This phenomenon is described in Stewart C. Bushong's book, *Radiologic Science for Technologists*. To compensate for this problem, the scans were analyzed with the aid of computer graphics and photogrammetery.

In this study the male height and weight was 68.75 inches and 168 pounds and the female height and weight was 64 inches and 160 lbs. The male height and weight closely approximates the 50th percentile male and height of the female approximates that of the 50th percentile female (although, the female weight was 8 pounds heavier than that of the average female).

The results show that, even ideally positioned, the lap belt is at, or nearly at, the top of the pelvis. Belt positioning on the male pelvis was better than for the female because the male pelvis is taller. In general male pelvises are tall and narrow, while female pelvises are short and wide. The results show the precarious positioning of the belt on the female pelvis. Small changes in the belt orientation would raise the belt above the female pelvis. This places females at greater risk of abdominal injury. Other risk factors addressed in the study are the soft tissue on the top of the thighs, which tends to raise the location of the belt, and large obese abdomens, which separate the belt from the pelvis. For some overweight individuals, even initially, the belt cannot be safely positioned over the bony pelvis.

Lap Belt, Belt Positioning, Radiology

C13 Forensic Engineering Analysis of Passenger Vehicle A-Pillar Impact With Tractor-Trailer: Theoretical Approach and Full Scale Crash Tests

Laura L. Liptai, PhD, Biomedical Forensics, 1660 School Street, Suite 103, Moraga, CA 94556*

After attending this presentation, attendees will be shown differing objectives in theoretical and practical analysis.

This presentation will impact the forensic community and/or humanity by providing greater understanding of the analytical processes.

This analyzes a passenger vehicle impact with a Kenworth 3 axle pulling a 28 foot Freight Hauler trailer near Northern New Jersey, USA and the resulting possible closed head injury.

A Kenworth 3 axle pulling a 28 foot Freight Hauler trailer was traveling into a down hill curve at approximately 20-25 mph when the traffic in front was observed and the Kenworth had stopped. The passenger vehicle proceeded up the hill into the same curve. As the tractor- trailer braked hard, the driver felt the trailer and the towed forklift behind the trailer sliding out into the opposing lane. As the trailer slid into the opposing lane the passenger vehicle struck the trailer. The A-Pillar of the passenger vehicle was directly impacted by the flat bed of the trailer intruding into the passenger compartment.

The driver of the passenger vehicle initially reported striking her head without losing consciousness. The patient self extricated. On the scene, the emergency medical technicians computed the Glasgow Coma Scale as 15. Emergency department diagnostic studies were all negative including: plain film cervical spine and right shoulder as well as Head CT. The patient was discharged home in six hours with the following diagnoses: Blunt Head Injury, Cervical Strain Post MVA and Right Shoulder Injury. The driver of the passenger vehicle is claiming a brain injury in the incident.

The objective of the full scale crash test approach is to quantify the amount of acceleration sustained at the center of gravity of the brain and statistically determine the probability of a brain injury.

The A-Pillar was directly impacted by the flat bed of the trailer. This caused the A-Pillar tripod including the roof to fail. The amount of static intrusion may be estimated from photogrammetry. The elastic deformation can be calculated from the observed plastic deformation and by adding the dynamic elastic deformation to the static deformation the total dynamic intrusion can be evaluated.

The objective of the theoretical approach is to quantify the amount of dynamic intrusion sustained in the subject incident based upon the crash test datum and the static photogrammetric measurements.

A-Pillar, Head/Brain Injury, Tractor-Trailer

C14 Downed Power Lines & Electrocutions

Helmut G. Brosz, BASc, PEng, and Peter J.E. Brosz, BEng, PEng, Brosz and Associates, 64 Bullock Drive, Markham, ON L3P 3P2, Canada*

After attending this presentation, attendees will develop a better understanding of some causes of downed power lines which can lead to electrical injuries, electrocutions, property damage and business interruption.

This presentation will impact the forensic community and/or humanity by assist the legal and insurance community in regards to determining the cause and origin of downed power lines and probable responsibilities of any electrical injury and/or electrocution that results therefrom.

Forensic scientists and engineers will develop a better understanding of some causes of downed power lines which can lead to electrical injuries, electrocutions, property damage and business interruption.

A downed power line is an electrical conductor which is laying on the "ground" or on a "grounded" object. The power line could be at any voltage usually between 120 V AC and 735,000 VAC. The lower the operating voltage of the power line the less likely it can be detected by protective devices such as fuses, circuit breakers, reclosures and/or relays. A downed power line that causes fault current is usually not detected by ordinary overcurrent or ground fault protection. This type of fault is called a high impedance fault (HIF). These faults can occur when a conductor comes in contact with an object such as a tree, or falls on a surface of poor conductivity or a vehicle. Typically, a high impedance fault on a high voltage distribution system exhibits discontinuous arcing and flashing at various points of contact.

High-impedance faults generally do not create imminent damage to power systems due to the fact that the magnitude of the fault current generated is often too low to harm most electrical apparatus, however, undetected HIF's can cause fire, electric shock or electrocution. The significance of these hard to detect faults is that they represent a serious public safety hazard as well as a risk of arcing ignition for fires.

HIF detection devices are becoming available to utility companies but these detection devices require an extended time depending in part on the algorithm (sometimes up to a minute) to reliably differentiate an HIF from a normal load disturbance. Field-testing is one solution to detect these anomalies.

Case Studies of Downed Power Line Incidents and Electrocutions

1.	7200 V AC	Line on ground electrocutions
2.	480 V AC	Street light wire electrocution
3.	120 V AC	Street light wire electrocution
4.	220,000 V AC	Line in contact with tree
5.	13,200 V AC	Line on asphalt/electrocution
6.	27,000 V AC	Line /railway property damage

High Impedance Faults – Relay Protection Systems

1. Some current relay systems are equipped with the latest High Impedance Fault (HIF) Detection technology including detection algorithms that attempt to detect current voltages associated with high voltage downed conductors on soil, gravel, concrete, sand, and other surfaces by analyzing the frequency spectrum of the current waveform and voltage too.

2. The relays contain advanced microprocessor based digital protection, control, metering and monitoring systems and use waveform sampling. Data filtering of the current and voltage inputs together with appropriate 2nd order statistical based systems, wavelet based systems and neutral networks.

Causes of Downed Power Lines

Some causes of downed power lines are:

1. Vegetation/Tree Interference – Trees and branches can cause conductors to short circuit, separate, fall to the ground and remain energized. The fault current magnitudes are sometimes too small to operate some protective devices or the protective devices are oversized.

2. Galloping – Under certain wind, geographic and configuration conditions, overhead conductors can oscillate in the wind and ultimately lead to a downed power line.

3. Storms/Hurricanes – Wind borne large objects can blow down entire spans of lines. Poorly guyed pole lines can fall over. Winds in excess of 120 m.p.h. can damage lines and poles.

4. Hot Spots on Splices and Connections – Overheating splices and connectors can melt conductors and cause them to fall to the ground and remain energized.

5. Lightning Damage – Conductors by lightning are sometimes damaged to such a degree so as to cause them to break immediately or at a later date.

6. Overloaded Lines – Overloaded lines can sag into under-built circuits, short circuit and fall to the ground.

Downed Power Lines, Electrocutions, HIF Relays

C15 QA/QC and Data Defensibility for Environmental Forensics

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Attendees will gain knowledge of the necessity of evaluating data quality for answering environmental forensic questions that may or may not have been part of the original data sampling and analyses objectives. This presentation will impact the forensic community by providing a better understanding of how complex it is to consider data obtained for one purpose toward another.

It is critically important when assessing data for forensic purposes to assure that the data are suitable for answering the questions involved in the case. When environmental data is generated it is commonly done by laboratories whose procedures are designed to satisfy regulatory requirements for state, federal and/or tribal agencies. The EPA, state and other standard methods often state the frequency and criteria for the QA/QC samples to establish a likely concentration range for analytes above the practical quantitation limit. These data are often used subsequently for litigation purposes that need to answer questions that are different than those for which the analyses were designed.

The question of whether the methodology-generated QA/QC parameters are sufficient for answering the litigation question(s) is an issue that needs to be carefully investigated before the analyses are used for these new purposes. All too often the person originally requesting and using the data does not take the QA/QC into account except to the extent that it did or did not pass some standard criteria designed to assure that it is suitable for the original purposes the analysis was intended to address. When a subsequent user, say a geologist or environmental engineer is evaluating the data, the concentrations as if true at all levels and covering a wide range of possibilities are often used. This is not always the case.

Consider the different QA/QC samples.

Blanks: Typically the field QA/QC samples are examined. The field blanks and the trip blanks are generally evaluated and, if contamination is shown, the samples are then examined as the collection or shipping may have led to contamination. However, often overlooked are the various laboratory blanks, such as prep blanks, instrument blanks and calibration blanks. These are not always as closely examined, unless the data goes to court. If the calibration blank has an absolute value (note it is an absolute value so it can be above or below zero) that is greater than the reporting limit then the sample result for low level analyses is likely to be biased. The biases can be either high or low, but the result of the sample cannot be considered to be a "true" value but rather a limit. Considering the value as a limit may restrict the relevance of the data itself.

Laboratory duplicates and matrix spikes*:* It is difficult to draw conclusions regarding other samples based on the results of only one or two in every batch or group of twenty samples. If the QA/QC sample sent to the laboratory is a composite then it may be more scientifically logical to draw conclusions regarding all samples, but still it is difficult to argue that the individual samples behaved in the same way. Unfortunately, labs tend to treat QA/QC samples differently simply because labs are aware of their importance. This can show up in such differences as that the sample and duplicate are homogenized longer, or the matrix spike may be added after the sample is digested. Unless the lab fully documents the entire digestion and spiking process it is difficult to know and the spike is added prior to digestion, the matrix spike may be more carefully digested or treated. The logbooks that are used to record such data at times may lack information such as the amount of time the digestions was given or the individual bomb temperatures. Typically logbooks are used as a way to record sample ID and data such as the amount of mass used, however the logs are not a check list to ensure that all of the steps were completed. It is therefore important to review the written procedures that the lab actually used, rather than going to the generic source (the guidelines) to verify the adequacy of the procedure.

Certified reference materials (CRM): These samples (or laboratory blank spikes) often represent the absolute best that a lab can achieve. Considering that CRMs are either reagent water or freeze dried matrices and that laboratory blanks are always reagent water, this is not surprising. The lab may have criteria for CRMs and laboratory blanks that are similar to matrix spike recoveries (typically 75-125%) however those criteria are for real samples, which CRMs and reagent water are not. Reagent water blanks spikes should be able to achieve as good a result as a calibration standard. Typically, calibration standard results are held to 90-110% recovery. Considering that CRMs are not reagent blanks they may not have such good of recoveries, however they are very homogenous samples that are not really field samples, the recoveries should be considered the best achievable with the method. Like the spiked samples CRMs are often treated more carefully than field samples, including possibly being digested or extracted independently of the field samples being examined, making the actual recoveries of the CRMs less reliable than matrix spikes of the same material as indicators of how the analyses went.

Other Factors Affecting Analyte Quantitation:

Even within the regulatory guidelines, labs often use modified methods, providing the methods demonstrably deliver similar results for test samples used to audit laboratory performance. This means that the lab has modified the method, which may include the frequency and/or the criteria for the QA/QC results as well as any corrective actions to undertake and it is important to assess what effect these modifications will have under the requirements of the new questions, not just the generic specifications of the guidelines.

When laboratory samples cannot achieve a 90-110% recovery the sample results should be considered to be suspect in that the actual value

could be different than the reported value. Trends should be considered as well. Low recoveries can mean that the method itself has bias. However it can also be an indicator that the lab is using a solution that may be near or past expiration especially in the case of organics. High recoveries can be an indicator that the laboratory is biased or that the laboratory itself has contamination issues.

Laboratory contamination is always a concern. Laboratories have the analytes of interest in high concentrations to make standards and spiking solutions so contamination is always a possibility. Often the sampling containers are purchased from the laboratory as well. If the method by which the containers are cleaned as well as how "clean" the containers are is not documented then the samples must be considered suspect and any contamination could be argued to be due to the laboratory or sample containers. Thus once again the data is not as defensible.

Perhaps the most important matter is to examine any surrogates, internal standards or other standards to check performance. The question now being addressed may deal with different parameters than the original data objectives. It may be the checks, surrogates and/or internal standards are not relevant or suitable for the new question being examined. This will definitely pull into question the reliability of the data and must be considered before drawing interpretative conclusions from this data. The data may still be useful or not, depending upon the actual questions now being considered.

The above checks need to be completed before the data are evaluated for nonrandom variations that are attributable to batch or operator variations over the course of the study. These are often hidden variables because they are not documented in many data reports except in the run logs of the laboratory. Since samples are usually submitted in groups in a nonrandom fashion over the course of site investigations, any variations due to machine performance, extraction variations (including personnel), calculation standards and algorithms have to be accounted for before any more advanced examination of statistically significant data differences can be done. When this is not the case, the sorting of data for statistically significant trends may actually be sorting out nonrandom biases in the data sets.

Examples of all of these problems will be presented during the course of the talk leading to the inevitable conclusion that it will always be a complex issue to determine if sample data is reliable and reasonable. All the QA/QC samples as well as historical data and sample data need to be examined for trends, bias, or any peculiarities. Once the reliability of the data has been assessed, and only then, can the relevance of the data toward the questions being asked be carefully addressed. Data acquired for monitoring purposes may or may not answer questions regarding remediation, contamination extent or identify the potentially liable parties.

QA/QC, Evaluation, Significance

C16 Microscopical Analysis of Dusts From Disasters: Natural and Manmade

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After attending this presentation, attendees will have an understanding of how the microscopical analysis of dust particles can be used to determine the source of contamination caused by mass disasters: natural and man-made.

This presentation will impact the forensic community and/or humanity by showing the audience that the forensic investigation of trace evidence using various types of microscopes is being extended into the broader fields of engineering and environmental investigations. Decisions involving millions of dollars and potential health risk assessments are being made on the basis of forensic microscopical techniques.

Microscopical analyses are used to characterize the dust particles from natural disasters such as volcanic eruptions, forest fires, and wind storms as well as man-made catastrophic events such as building fires, building demolitions, and terrorist attacks such as the 2001 attack on the World Trade Center (WTC) buildings in New York City. Analysis of dust particles can be used to delineate the effective range of impact from mass disasters: natural and man-made. A number of different types of instruments including polarized light microscopy, scanning, and transmission electron microscopy, and FTIR (infrared) microscopy are used to characterize the dust. In some cases the microscopical characteristics of the dust particles can be used to determine a dust signature. Based on thousands of analysis of residential and office dusts, most normal building dusts can be described using a combination of approximately 20 different particle types. These particle types include: skin cells, pollen, fungal material, soil minerals, soot, flyash, synthetic fibers, glass fibers, plant fragments, hair, wool fibers, cotton fibers, paper fragments, ink/photocopy, paint, construction debris, insect parts, starch, aerosol particles, rubber, and rust/metal flakes. A microscopical study of the general composition of household dust involving 72 samples from 7 different geographic regions within the United States showed that the most common components in household dust were skin cells, soil minerals, plant fragments, hair, cotton fibers, and starch grains.

The dust that was disseminated during the man-made mass disaster of the destruction of the World Trade Center of September 11, 2005 has been extensively studied. It differs from the average household dust in that it contains high amounts of glass fibers, gypsum and cement. [Analyses have shown it to contain: glass fibers (primarily mineral wool) - 35 – 40 %, gypsum particles - 25 – 30 %, cement/calcium-containing particles - 10 – 15 %, cellulose (paper, cotton, wood fibers) - 5 – 10 %, combustion products (soot and char) - 1 – 10 %, crystalline silica ~ 6 %, asbestos (primarily chrysotile with some amosite and tremolitic) - < 1 – 2 %, other material classes (paint, metal, vermiculite, glass shards) <1 % per class]. The U.S. Environmental Protection Agency studied the question of a set of "signature markers" of WTC dust in their effort to identify residual WTC dust contamination in hundreds of residential and office units around Ground Zero. The Agency initially proposed using 3 markers: mineral slag wool, gypsum and elements of concrete. MVA Scientific Consultants was one of the laboratories that participated in the WTC Dust Screening Study of the proposed "Signature" analysis method. Based on the results of the study group, EPA concluded that gypsum and elements consistent with concrete did not meet the WTC signature selection criteria and proposed slag wool as a signature constituent of WTC dust. However, after studying EPA's "Final Report on the World Trade Center Dust Screening Study," an independent peer review group concluded, "the proposed method has not demonstrated the utility of slag wool as a successful signature constituent." Thus, at this time, no method of determining "WTC Signature Markers" has been accepted by the scientific community. It would appear that the $200 million plus demolition of a building in Manhattan based on a forensic dust examination allegedly showing contamination with WTC dust was not based on sound scientific judgment.

Microscopy, Particle Analysis, Dust

C17 TASER® Non-Lethal Weapons: Safety Data and Field Results

Rick Smith, BA, MBA, TASER International, 17800 North 85th Street, Scottsdale, AZ 85255*

After attending this presentation, attendees will have seen an overview of TASER® non-lethal weapons, including methods of operation and overview of results of safety studies and results of applications in the field.

This presentation will impact the forensic community and/or humanity by addressing the current debate over the safety of TASER devices, and in particular will provide the listener with the current state of the art in this technology, along with a description of the studies to date regarding its safety.

Introduction: One of the challenges facing the evaluation of non-lethal weapons is confusion regarding the meaning of "non-lethal" and "safe." For opponents of non-lethal weapons, "non-lethal" is taken to mean that the risk of a fatality must be zero, rather than the way in which the term is defined by the U.S. Department of Defense (DOD), namely "weapon systems that are explicitly designed and primarily employed so as to incapacitate personnel or materiel, while minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment. . ." DOD policy does *not* require or expect non-lethal weapons "to have a zero probability of producing fatalities or permanent injuries."

Similarly, and contrary to its use by opponents of the TASER, "safe" is not generally defined in absolute terms as meaning zero risk. For example, the Food and Drug Administration (FDA) has stated: "Although medical products are required to be safe, safety does not mean zero risk, since all medical products are associated with risk. A safe medical product is one that has reasonable risks, given the magnitude of the benefit expected and the alternatives available."

TASER® Technology: TASER brand non-lethal weapons are "conducted energy" weapons. They consist in major part of a hand-held device that when discharged uses compressed nitrogen to shoot two small probes, connected to the device by electric wires, a distance of up to 25 feet. There is a voltage difference between the two probes and when contact is made with a person, the hand-held device transmits powerful electrical pulses along the wires and into the person, through up to two inches of clothing. Analogous to radio jamming, the TASER stimulation overpowers the normal electrical signals conveyed by the body's nerve fibers, with the result that the person affected loses the capacity to perform coordinated action and falls to the ground. When the electrical pulses are terminated, the subject recovers within seconds. Primary risks associated with TASER use include fall-related injuries and injuries associated with strong muscle contractions, which are similar to strenuous athletic exertion.

Safety Studies: Numerous independent studies have established the general safety and effectiveness of the technology underlying TASER weapons. For example, a cardiac safety study published in January 2005 (Supplement, *Pacing and Clinical Electrophysiology Journal*) suggests a safety index ?20 for human adults weighting at least 99 lbs, a higher safety margin than many over-the-counter drugs including Tylenol®.

One TASER safety concern goes to whether the presence of drugs, e.g., cocaine, in the system of the targeted person increases the probability that an electrical stimulus will cause ventricular fibrillation (VF). Animal studies to date indicate the opposite, that cocaine presence actually *increases* the level of current necessary to induce VF, by over 50%. See Figure 1.

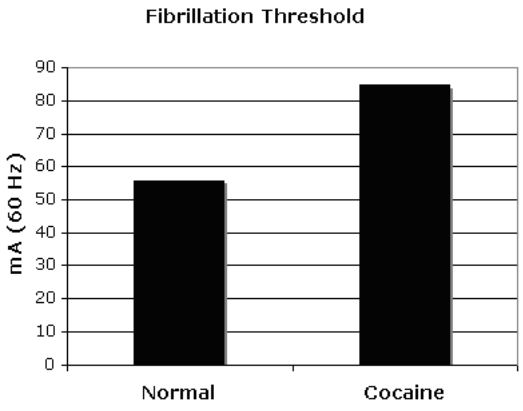

Figure 1.

In 1999 TASER International commissioned a university study of the cardiac safety of the TASER M26 in the presence of the drugs epinephrine, isoproternol, and ketamine. As part of that study, 17,000 electrical pulses were applied to five drug-dosed dogs over a period of two days without dangerous arrhythmias being induced in any of the animals, including one that had been given a toxic dose of ketamine, commonly used as an anesthetic agent in animals and known among illicit drug users as "Special K," with effects similar to those of PCP. Although these results to all known drugs cannot be extrapolated; nevertheless this study with three drugs that can create a dangerous cardiac risk for people already at risk, supports a conclusion that the probability that a cardiac event will result in any random human targeted by a TASER is very low.

Another recent study of TASER devices was conducted by the Human Effects Center of Excellence (HECOE) for the DOD: *Human Effectiveness and Risk Characterization (HERC) for Electromuscular Incapacitation (EMI) Devices*. It concluded that: "Overall, the results indicate that the use of the TASER M26 and X26 as intended will generally be effective in inducing the desired temporarily incapacitating effect without presenting a significant risk of unintended severe effects. Although likely to be uncommon, some severe unintended effects might occur." …"Analyses provided by law enforcement agencies indicate that increased use of the TASER M26 or the TASER X26 has decreased the overall injury rate of both police officers and suspects in conflict situations when compared to alternatives along the use-of-force continuum." "….[D]espite the dramatic nature of the neuromuscular response, application of this conducted energy weapon for temporary incapacitation does not appear to pose significant risk to the recipients."

Deaths In-Custody Involving TASER Use: According to a recent study published by the Madison (WI) Police Department, there have been approximately 90 incidents in which a TASER was used and the subject died at some point while in custody. This study found that the 90 incidents broke down as follows:

- 89 involved significant physical exertion (fleeing or fighting) on the part of the suspect.
- In 41 out of the 51 cases for which information was available, the suspect had ingested
- Controlled substances—usually cocaine, but also including PCP and methamphetamine prior to police contact (in 39 of the cases drug information was not available).
- In 54 out of the 59 cases for which information was available, there was a significant time delay between the application of the TASER and the suspect's death—sometimes up to a week (information was not available for 31 cases), a clear indication that the TASER did not contribute to these deaths (electricity is not stored in the body—if an electrical current is sufficient to cause ventricular fibrillation, it will do so immediately).
- Most involved violent struggles with police, in which other use-of-force tools/techniques (such as OC spray, baton strikes, beanbag rounds, and empty hand techniques) were utilized.

Included among the 90 cases were:

- 2 subjects who were shot (with firearms) by police after TASERs were deployed unsuccessfully.
- 2 subjects who died from head injuries (1 from a fall after TASER
- deployment, 1 prior to police arrival).
- 1 subject who slit his wrist prior to police contact and died as a result.
- 1 subject who filled his home with natural gas prior to police contact—when the TASER was deployed the house exploded, killing the subject and injuring two officers.

It was found that the breakdown of medical examiner or coroner cause-of-death findings in the 90 cases was as follows:

- In 46 cases the cause of death was recorded unknown, or the autopsy is unavailable. Most of these cases involved drug ingestion and/or a delay between TASER application and death.
- In 23 of the remaining 44 cases, the death was attributed to lethal drug consumption
  - In 8 of these cases the autopsy report specifically excluded the TASER as a contributing factor
  - In 3 of these cases the role of the TASER was deemed to be unknown

- In 9 of the remaining 21 cases, the death was attributed to medical causes, usually cardiac arrest due to physical exertion or pre-existing disease
  - In 5 of these 9 cases, the autopsy report specifically excluded the TASER as a contributing factor
  - In 2 of these 9 cases, the role of the TASER was deemed to be unknown
- In 6 of the remaining 12 cases, the death was attributed to trauma (gunshots, etc.) unrelated to the TASER
- In 6 cases, the TASER was deemed to have *contributed* to the subject's death; all 6 of these findings appear highly speculative and a review of them suggests that the TASER actually played no causative role in any of them.
- **Not one** of the autopsy reports ruled or suggested that the TASER was a primary cause of death.

It is useful to compare these 90 in-custody deaths with in-custody deaths *not* involving the use of TASERs. Most cases of sudden and unexpected death proximal to restraint involve young men in an "excited" state or one of "agitated delirium" resulting from psychiatric illness or intoxication from illicit drug use, individuals who were combative and suffered injuries as a result of a confrontation with law enforcement *before* being placed in the restraint position (Chan, Vilke, & Neuman, 1998). Given that approximately 5000 questionable in-custody deaths occurred in the U.S. and Canada in the five-year period (2000-2004) during which the referenced 90 deaths occurred, the latter represented only 1.8% of the total.

Field Use Data: Figure 2 shows the results of a Los Angeles Police Department study finding that TASER technology had the lowest injury rate to suspect and arresting officer of any force option available to the police, and that in fact both rates for the TASER were zero.

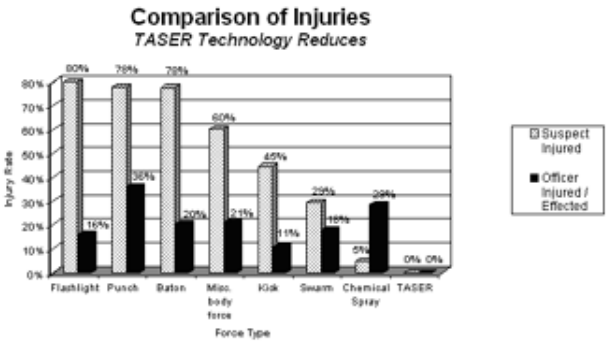

Figure 2.

Conclusion: The question of safety for non-lethal weapons is one that need be addressed relative to available alternatives. The question must be, "are these emerging technologies better than the alternatives in use have today?" The author strongly believes that TASER devices, while imperfect, are significant improvements over the traditional force options. Both laboratory studies and field results in the 7,000 law enforcement agencies deploying TASER technology today strongly indicate that TASER devices reduce the risk of injury to both police officers and subjects, resulting in safer communities, safer jobs for public safety officials, and fewer lives lost in police-involved confrontations.

TASER, Non-Lethal, Safety

C18 Theoretical Considerations Regarding the Cardiac Safety of Law Enforcement Electronic Control Devices

Mark W. Kroll, PhD, Cal Poly University, 493 Sinaloa Road, Simi Valley, CA 93065; James Sweeney, PhD, Arizona State University, Box 872303, Tempe, AZ 85287; and Charles D. Swerdlow, MD, Cedars Sinai Hospital, 8700 Beverly Boulevard, Los Angeles, CA 90048*

Attendees of this presentation will learn the biophysical basis for the safety of TASER-type weapons.

This presentation will impact the forensic community and/or humanity by providing a better understanding of the risk of ventricular fibrillation with in-custody-deaths in which a TASER type electrical weapon was used during the arrest process. This would be ideal for the session being chaired by Peter Alexander.

Introduction: The high-voltage, low duration pulses applied by the latest generations of electrical weapons are intended to stimulate α-motor neurons, which innervate skeletal muscle contraction, but not to stimulate cardiac muscle. Three types of factors contribute to the cardiac safety of these weapons: anatomic, the strength-duration relationship, and the relationship between cardiac thresholds for pacing and fatal ventricular fibrillation (VF).

Anatomic: The heart is located deep within the torso. In contrast, skeletal muscle and its stimulating α-motor neurons comprise much of the superficial layers. Even transcutaneous pulses delivered through large, antero-posterior electrodes for optimal cardiac stimulation send only 4% of their current through the heart. A much smaller fraction is delivered by small dart electrodes used for skeletal muscular incapacitation when delivered on the same side of the abdomen, thorax, or lower extremities.

The Strength-Duration Relationship: Nerve and cardiac electrical stimulation is accurately described by the strength-duration curve applied to average current. The threshold for stimulation is at a minimum ("rheobase") for pulses of infinite duration. The threshold for shorter pulses then rises up from the rheobase as the pulse is shortened. The duration at which the required stimulus strength doubles is called the chronaxie (d_c). Pulses with duration near the chronaxie are most efficient for stimulation.

The rheobase for α-motor neurons is approximately 1 A with a chronaxie of 100 μs. In contrast, the cardiac chronaxie is 3-5 ms for transcutaneous stimulation which is 30 - 50 times longer.

The most widely sold electrical weapon is the X26 (TASER International, Scottsdale, Arizona). It delivers a pulse with a complex "shaped" waveform of 50 - 100 μs in duration. The pulse repetition rate of 19 times per second causes loss of local muscle control. Note that the pulse duration approximates the chronaxie of α-motor neurons, making it an efficient stimulus for skeletal muscle but an inefficient stimulus for cardiac muscle.

The safety margin for cardiac stimulation can be estimated from the strength duration curve. The typical threshold for transcutaneous pacing is about 70 mA with 20 ms wide pulses, assuming the electrodes are applied for optimized cardiac stimulation. From this one can calculate the minimum charge required with extremely short pulses. Assuming a transcutaneous chronaxie of 4 ms:

$I = I_r(1+d_c/d)$

$Id = I_r d + I_r d_c = Q$

$70\ mA = I_r\ (1+4ms/20ms)$

$I_r = 58.3\ mA$

$Q_0 = 233\ \mu C = 4\ ms * 58.3\ mA$

The X26 delivers about 80 μC in about 70 μs. The required charge to pace for a 70 μs pulse is given by:

$Q = dI_d = I_r d + I_r d_c$

$= I_r d + Q_0$

$= 58.3\ mA * 70\ \mu s + 233\ \mu C$

$= 237\ \mu C$

Thus theoretically the X26 pulse is insufficient to pace the heart by a 3:1 safety margin, even if delivered through large electrodes optimally placed for cardiac stimulation.

Pacing threshold vs. fibrillation threshold: The ratio between the current required to pace the heart and that required to induce fatal VF depends on the duration of stimulation and pulse repetition rate. It ranges from 4 - 6 in published animal studies. Combining the theoretical 3:1 safety margin from the strength-duration analysis with a 5:1 estimate for the fibrillation-to-pacing threshold gives a theoretical estimate of a 15:1 safety margin, even if X26 pulses were delivered through electrodes optimized for cardiac stimulation. As noted above, anatomic considerations show that X26 electrodes are too small for optimal cardiac stimulation, and their location is usually suboptimal. Thus, one would expect a larger safety margin in actual use.

Experimental data: Peleska demonstrated a minimum transthoracic charge of 5 mC was required to induce VF in dogs. This divided by the 80 μC of the X26 gives an estimated safety margin of 62:1. Published experimental data using the X26 waveform indicate a safety margin of 30-40:1 for VF. Thus, the published experimental data supports this theoretical analysis.

Summary: The TASER X26 electrical weapon appears to have a sound theoretical basis for its large cardiac safety margin.

TASER, Cardiac, Fibrillation

C19 Stun Gun Fallacy: How the Lack of TASER Regulation Endangers Lives

Mark Schlosberg, JD, American Civil Liberties Union of Northern California, 1663 Mission Street, Suite 460, San Francisco, CA 94103*

This presentation will provide attendees with information about TASERs and police policies and training with TASERs.

This presentation will impact the forensic community by providing medical examiners with information to the number of deaths related to TASERs continues to grow.

Police use of TASER stun guns to subdue suspects in California and around the nation has increased dramatically in recent years. Billed by their manufacturer, TASER International, as a non-lethal alternative to deadly force, TASERs have been purchased and deployed by a growing number of law enforcement agencies. However, while the TASER is less deadly than a traditional firearm, it is hardly the non-lethal weapon its manufacturer promotes under the slogan "Saving Lives Every Day."[1]

Between 1999 and September 2004, 75 people in the United States and Canada died in incidents that involved the police use of TASERs. Since then, that number has more than doubled to at least 153, with 15 post-TASER fatalities in northern and central California, including one case where a 21-year-old man was jolted 17 times within three minutes before he died.[2]

Despite the high fatality rate involved with stun gun use, officials at TASER International have yet to concede that their product has led to a single identifiable death and, despite concerns raised by medical experts, the company continues to downplay safety concerns.

TASER's controversial marketing practices have not gone unnoticed. nThe Scottsdale, AZ based company's promotion practices and safety claims are being examined by both the Securities and Exchange Commission ("SEC") and the Arizona Attorney General.[3]

Several law enforcement agencies have also begun to question TASER's safety claims and the efficacy of the weaponry. In March 2005, two major Department of Homeland Security law enforcement divisions announced that the departments were not purchasing TASERs because of safety concerns. "There are enough question marks about the safety of this device. The safety of officers and the public is always a concern. It was determined that the device just didn't fit," said Barry Morrissey, spokesperson for Customs and Border Protection.[4]

Moreover, in April 2005, the International Association of Chiefs of Police ("IACP") issued a report recommending that local law enforcement reassess its TASER training and establish policies. The IACP particularly noted the lack of safety studies, concluding that "independent data does not yet exist concerning in-custody deaths, the safety of EMDT [Electro-Muscular Disruption Technology] when applied to drug or alcohol-compromised individuals, or other critical issues."[5]

In light of these concerns and the rising death toll associated with TASER use, the ACLU of Northern California ("ACLU-NC") conducted a thorough survey of 79 law enforcement agencies throughout northern and central California to determine how TASERs are being used. A close review of thousands of pages of policy and training materials used by departments reveals that, despite the growing number of deaths, increasing concern from medical and other experts about TASER safety, and extensive media coverage of problems associated with TASER use, the weapon remains largely unregulated.

Of the 79 departments surveyed, 56 have added TASERs to their weapons arsenals. Of those, 54 provided their TASER-use policies and/or training materials to the ACLU-NC, which concluded the following:

- Only four departments regulate the number of times an officer may use a TASER on an individual. The others place no restriction on the number of times a suspect can be shot. This is particularly troubling considering that several of the targets in California died after being jolted multiple times.
- Only four departments created any of their own training materials for their officers. The rest relied exclusively on materials produced by TASER International.
- The training materials produced by TASER International and relied on by local law enforcement grossly exaggerate the safety of TASERs, downplay their risks, and misrepresent medical studies on their effects. Most were published in 2003 and 2004 and are outdated considering the sobering facts that have come to light in the past year.

There are a couple of explanations for these results. Certainly, the failure of many in law enforcement to ask tough questions early on and take a skeptical approach to TASER International's representations provide a partial explanation for the lack of regulation. But TASER International is also largely responsible for the uninformed use of TASERs because its questionable marketing practices and exaggerated safety claims provide the basis for local police policy.

Given the increasing number of deaths associated with TASER use, the lack of independent studies on several critical safety issues, and the lack of policy governing the use of the weapon, the California Legislature and local law enforcement should act quickly to impose regulations on TASER use. The ACLU of Northern California therefore recommends several policy reforms including the following:

- ***Pass Legislation.*** The state legislature should pass a law that allows TASERs to be used solely as an alternative to deadly force. The British Government currently employs such restrictions.[1] TASERs are certainly a safer alternative to firearms, but until more independent safety studies are completed, law enforcement agencies should be restricted from using TASERs in non-life-threatening situations.
- ***Adopt Stricter Policies.*** Local government and local law enforcement should each independently adopt TASER policies. If local law enforcement will not restrict its TASER use to life-threatening situations, agencies should, at a bare minimum, adopt policies to minimize the risk of death such as prohibiting repeated shocks and protecting vulnerable populations such as the very young, the elderly and pregnant women.

- ***Revise Training Materials.*** Local law enforcement agencies should conduct comprehensive reviews of the TASER International training materials, revise them, and retrain all officers that have already completed the TASER International training.

While the TASER stun gun as the potential to save lives as an alternative to deadly force, it poses a serious health risk as long as it remains largely unregulated. State and local government should act quickly to impose regulations on the weapon so that TASERs do, indeed, save lives rather than end them unnecessarily.?

References:

[1]TASER International Web Site front page www.taser.com.

[2]Robert Anglen, "153 Cases of Death Following Stun-Gun Use," Arizona Republic, October 21, 2005, available online at www.azcentral.com.

[3]Robert Anglen and Dawn Gilbertson, "TASER Safety Claims Draw State Scrutiny," Arizona Republic, January 8, 2005; Greg Farrell, "SEC's TASER Inquiry Becomes Formal," USA Today, September 27, 2005.

[4]Kevin Johnson, "Federal Bureaus Reject Stun Guns," USA Today, March 18, 2005.

[5]International Association of Chiefs of Police, Electro-Muscular Disruption Technology: A Nine Step Strategy for Effective Deployment, April 4, 2005, p. 5.

[6]Association of Chief Police Officers ("ACPO"), Operation Use of TASER Policy, p. 4 ("TASER will only be deployed in circumstances where firearms officers are authorized to carry firearms. TASER will be readily available and will only be deployed alongside conventional firearms."); ACPO, Operational Use of TASER Operational Guidance, p. 3 (Authorized Firearms Officers ("AFOs") are, in accordance with the ACPR Manual of Guidance on Police Use of Firearms, issued with firearms – where the authorizing office has reason to suppose that they, in the course of their duty, may have to protect themselves or others from a person who is in possession of a firearm, or has immediate access to a firearm, or is otherwise so dangerous that the officer's use of a firearm may be necessary.")

TASERs, Police, Use of Force

C20 Lethality of TASERs– The Canadian Experience

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By attending this presentation, attendees will hear about the Canadian experience with deaths associated with the use of TASERs both in Ontario and other provinces and territories, and will understand the relative safety and non-lethality of this device when used to assist in taking control of aggressive individuals. The knowledge gained will assist death investigators in interpreting the correct cause and manner of death in these often-controversial cases, and may assist in advocating for a safe alternative to the use of firearms.

This presentation will impact the forensic community by demonstrating the impact of assisting death investigators to better understand the non-lethal consequences of TASER usage, and will encourage them to advocate for more widespread availability of this option to lethal firearms.

The TASER device has been the subject of a great deal of controversy because of its purported lethality, which this presentation will attempt to dispel. An overview of all known cases of TASER use in Canada where death has been temporally associated, along with a brief review of the TASER's mechanism of action and the history of availability of TASERs to Canadian police services will be presented. Canadian cases will be discussed, along with the conclusions for cause and manner of death, and the relative role played by the TASER in each case. Experimental studies that attempted to induce potentially fatal dysrhythmias will be summarized.

TASER usage by Canadian police services is a relatively recent phenomenon. For example, the Ministry of Community Safety and Correctional Services, the branch of provincial government responsible for policing services in Ontario, only in July 2002 approved use of TASERs for police tactical units and hostage rescue teams. In December 2003, approval was expanded to include Containment Teams and Front Line Supervisors. Despite this approval, many police services have been slow to embrace the technology and promote widespread usage.

Arguments against more widespread TASER usage have come largely from political activists and have included high costs of acquisition, alleged unproven safety profile, unknown long-term effects, and fear that the device will be misused by police. Any death involving some element of TASER usage by police has often been touted as yet another example of the device's lethality. In an attempt to better understand and clarify the dilemma, the Office of the Chief Coroner (OCC) for Ontario undertook a review of all known TASER-related deaths in Canada to attempt to establish whether there was a "cause and effect" relationship.

All cases included an individual presenting with aggressive behavior, many in a state of excited delirium precipitated by either drugs or a psychiatric condition. Following use of the TASER to subdue these individuals, all were restrained by police in one fashion or another, and sudden collapse occurred at least several minutes up to hours after the TASER shock. None became vital signs absent immediately, as one would expect if a potentially fatal dysrrhythmia had been induced by the TASER. All cases were determined to be a consequence of drug toxicity or complications of excited delirium, rather than due to TASER use. The manners of death were therefore concluded to be Accidental, rather than Homicide.

To test the potential lethality of TASERs, studies were undertaken in collaboration with the Department of Cardiology at the Hospital for Sick Children, Toronto to determine whether the electrical shock delivered by the TASER would pose a risk for initiating potentially fatal cardiac dysrhythmias. Because the high frequency current delivered by a TASER is similar to that used in therapeutic cardiac ablation procedures, it was hypothesized that the risk for inducing dysrhythmias should be similar. TASERing pig hearts did not produce any dysrhythmias, and hence these studies appeared to confirm that the risk for fatal dysrhythmias was non-existent.

Police have several use-of-force options open to them when dealing with agitated, aggressive individuals, including the use of firearms. "Less-lethal" options are frequently limited, and/or may have no effect on persons with excited delirium, leaving police to resort to the lethal option. In Ontario there have been seven fatal police shootings since January 2000. Some of these deaths might have been avoided had an effective, less-lethal option been available to the officers.

TASER deaths have been the subject of two inquests thus far in Canada, and several more are pending. In the one Ontario inquest conducted to date, the jury recommended authorization to carry TASERs for all front line police officers. This presentation seeks to add to the growing body of evidence regarding the effectiveness of TASERs as a less-lethal use-of-force option, and should assist forensic death investigators to advocate for more widespread use.

TASER, Lethality, Use-of-Force

C21 USA: Excessive and Lethal Force? Amnesty International's Concerns About Deaths and Ill-Treatment Involving Police Use of TASERs

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After attending this presentation, attendees will formulate a healthy suspicion about the potential role TASERs might play—not as the sole cause—but as a contributing factor in TASER related deaths.

This presentation will impact the forensic community by providing an unfiltered version of Amnesty International's position on the issue of TASER use. The community will see that the organization is neither anti-TASER nor anti-law enforcement, and that respected independent bodies have raised serious questions about the safety of TASERs—specifically, could TASERs be one of a number of factors that work in combination to lead to death.

"The work of law enforcement officials is a social service of great importance and there is, therefore, a need to maintain and, whenever necessary, to improve the working conditions and status of these officials."[1] Furthermore, "a threat to the life and safety of law enforcement officials must be seen as a threat to the stability of society as a whole."[2]

International human rights standards call on governments and law enforcement agencies to "develop a range of means as broad as possible and equip law enforcement officials with various types of weapons and ammunition"[3] and that "these should include the development of non-lethal incapacitating weapons."[4] It is self-evident that TASERs are less lethal or injurious than firearms, and Amnesty International acknowledges that there may be situations where TASERs can effectively be used as an alternative to firearms in order to save lives.

TASERs are widely promoted by U.S. police agencies as being a useful force tool, safer than many other weapons or techniques used to restrain dangerous, aggressive and focused individuals.[5] However, it appears that TASERs are commonly used to subdue individuals who do not pose a serious and immediate threat to the lives or safety of others, and Amnesty International's research shows that TASERs are being used in situations where police use of lethal force – or even batons – would never be justified. Instead of using them as an alternative to firearms in the United States,[6] most departments place them at a relatively low level on the "force scale."[7]

In many reported instances police actions using TASERs appear to have breached international standards on the use of force as well as the prohibition of torture and other cruel, inhuman, or degrading treatment or punishment. Amnesty International considers electro-shock weapons to be open to abuse because the weapon can inflict severe pain at the push of a button without leaving substantial marks, and can inflict repeated shocks. TASERs in "drive" stun gun mode are particularly open to abuse, as they are designed specifically for "pain compliance"[8] and tend to be used against individuals who are already in custody or under police control, often with multiple shocks.[9]

As discussed in the report, Amnesty International is concerned about the safety of stun weapons and the lack of rigorous, independent testing of their medical effects. When the organization's report was released in November 2004, Amnesty International had documented the deaths of 73 people who were reported to have died in the USA and Canada after being struck by M26 or X26 TASERs since June 2001. In the nine months since the report's release, that number has more than doubled. Amnesty International's is also concerned that the risks associated with TASERs increase as they become more widely deployed.[10]

While coroners have consistently attributed TASER-related deaths to factors including drug intoxication and pre-existing heart disease, medical opinion continues to suggest potential health risks from TASERs. Medical evidence shows that TASER shocks may exacerbate a risk of heart failure in cases where people are agitated, under the influence of drugs, or have underlying health problems. TASERs may have exacerbated breathing difficulties caused by factors such as violent exertion, drug intoxication, or use of other restraint devices, thereby triggering or contributing to cardiac arrest.[11]

As a result of these unresolved questions, Amnesty International believes that the TASER cannot be ruled out as a possible contributory factor in some deaths. In a growing number of cases, coroners have found TASER shocks to have directly played a role—along with other factors such as drug intoxication and heart disease—in contributing to some deaths. Recently, the medical examiner in Cook County, Illinois listed the TASER as the primary cause of death with other underlying factors.

Amnesty International is calling on U.S. state, federal, and local authorities to suspend all transfers and use of TASERs and other electro-shock weapons pending a rigorous, independent inquiry into their use and effects. Acknowledged medical, scientific, legal and law enforcement experts who are independent of commercial and political interests should carry out this inquiry. The inquiry should rigorously assess the effects of electro-shock weapons, taking into account human rights standards regulating the treatment of prisoners and use of force; it should include the systematic examination of all known cases of deaths and injuries involving the use of such weapons.

Where U.S. law enforcement agencies refuse to suspend deployment of TASERs, the organization is recommending that departments strictly limit their use to situations where the alternative would be use of deadly force, with strict guidelines, reporting and monitoring systems. Amnesty International further notes that measures such as stricter controls and training on the use of force and firearms are likely to be more effective in reducing unnecessary deaths or injuries.

References:
1. The United Nations Basic Principles on the Use of Force and Firearms by Law Enforcement Officials http://www.unhchr.ch/html/menu3/b/h_comp43.htm .
2. ibid.
3. ibid.
4. ibid.
5. "This non-lethal system is solely designed to stop the most hardened of targets: extremely violent, aggressive, goal-oriented and drug induced suspects." *TASER International website. O&A, 10/25/04.*
6. "TASERs are reliable devices that utilize innovative technology to stop violent suspects and provide effective alternatives to lethal force." *TASER International Website, "SAVING LIVES: MAKING LAW ENFORCEMENT SAFER;" 10/25/04*.
7. " … recent survey conducted of the more than 6,000 agencies deploying the TASER in North America showed that 86% of agencies had the TASER on a similar level with pepper spray (pepper level or before)." *TASER Non-Lethal Systems: Reducing Injuries and Saving Lives.*
8. "The drive stun mode affects the sensory nervous system ONLY making it a pain compliance weapon that will not cause EMD." *TASER International Instructor Certification Plan, Version 12.0, November 2004.*
9. "The students should anticipate using additional cycles to subdue suspects … almost half the deployments required additional discharges to obtain compliance. 1st cycle changes the behavior and the subsequent cycles allow for apprehension in most cases." *TASER International Instructor Certification Plan, Version 12.0, November 2004.*
10. "The numbers will continue to increase with the number of devices sold," Steve Tuttle, Director of Communications, TASER International, Atlanta Journal Constitution, May 29, 2004.
11. "Repeated, prolonged, and/or continuous exposure(s) to the TASER electrical discharge may impair breathing and respiration, particularly when the probes are placed across the chest or diaphragm." *TASER International Training, Bulletin 12.0 – 04, June 28, 2005, http://www.taser.com/documents/12-04_Restraint.pdf.*

Human Rights, Amnesty International, TASERs

C22 Analysis of Electrical Activation of Nerve and Muscle by TASERs

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The goal of this presentation is to increase understanding of the basic principles of skeletal muscle activation, as well as the evoking of strong sensations including pain, via TASER stun guns.

This presentation will serve the forensic community through theoretical analysis of the activation of nerve and muscle by TASERs. Rattay's "activating function" approach, along with knowledge of strength-duration time constants of excitability for skeletal muscle and nerve has been used to predict the electric field gradient levels needed for activation of each tissue type by TASER pulses.

The high-voltage, low-charge, brief pulse-width stimulus train applied by the latest generations of TASER stun guns is intended primarily to strongly activate skeletal muscle contraction (thus disabling the target individual through incapacitation of their ability to move and to stand), while secondarily also eliciting strong sensations of pain and/or exhaustion. The TASER X26, for example, delivers a somewhat complex "shaped" stimulation waveform that to a first approximation appears as a pseudo monophasic (half sinusoid) pulse of about 50 to 100 μsec duration about every 50 msec (delivering peak currents that can range over several Amps but with only about 50 μC of charge delivered).

In general, skeletal muscle activation by electrical stimulation is elicited by excitation of á-motor neurons which innervate such muscle fibers. This fact often comes as a surprise, in that skeletal muscle cells are themselves excitable. Skeletal muscle excitability, however, is less than that of motor neuron cells in that both rheobase and chronaxie values of skeletal muscle are higher than those of the myelinated nerve axons which innervate them. Therefore, immediately adjacent to TASER dart locations it is possible that skeletal muscle fibers may be "directly" stimulated but any significant distance away from the darts it is expected for skeletal muscle to be "indirectly" activated through its nervous innervation. Sensations of discomfort and pain in response to TASER stimuli are expected to result from a host of sensory nerve fiber types, to some extent dependent upon the specific locations of TASER dart attachment to the body (as well as the specific tissues located between and near the darts in what might be called the "capture" zone of the darts where excitable cells are activated).

From both efficacy (in terms of efficiently activating skeletal muscle between and near the darts) and safety (in terms of activating skeletal muscle with a wide safety margin in comparison to corresponding current levels that would be needed to excite or fibrillate the heart) viewpoints, analysis indicates that the TASER X26 stimulus pulse is a well designed stimulus. This is because:

- The timing of the X26 stimulus pulse is on the order of the strength-duration time constant τ (and chronaxie) for electrical excitation of the α motor neuron fibers which innervate and control the contraction of skeletal muscle, making it an effective stimulus in terms of pulse duration. It appears likely that reflex activation of additional skeletal muscle response may also occur through excitation of motor afferent myelinated nerves. Skeletal muscle not contained within the "target" zone of the TASER darts may also be activated if motor afferent or efferent nerves are stimulated which then innervate more distant musculature (as in the instance where nervous structures within or entering/leaving the spinal cord might be excited).
- The timing of the X26 pulse is also likely to result in widespread excitation of cutaneous myelinated nerves responsible in normal function for senses of touch, pressure, vibration, etc. Given the modest separation of the timing of the X26 pulse in comparison to the time constant values for excitation of the type III Aδ myelinated nerve fibers responsible for "sharp" pain (τ equal to about 650 μsec) as well as for activation of C fibers responsible for dull or aching pain (τ equal to about 500-600 μsec), one can conclude that activation of nerves responsible for perception of pain (at least in normal sensation) would certainly be higher if the X26 pulse were increased in duration. C fibers also have notably higher thresholds (in terms of predicted rheobase electric fields necessary to stimulate) than myelinated motor or sensory nerve fibers.

An important safety concern of the TASER technology is to insure that stimulation of the heart does not occur, which could cause life-threatening arrhythmias or cardiac arrest. The low-charge and in particular brief pulse-width nature of TASER stimuli applied through darts which have contacted the torso are inherently protective against such cardiac events (i.e. because current needs to penetrate deep within the torso to reach the heart itself, and because stimulus pulse-widths needed to activate the heart are longer in duration than those needed to stimulate skeletal muscle or nerve).

TASER, Muscle, Nerve

C23 Forensic Engineering Analysis of TASER™ Issues and Safety Warnings

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The learning objective is to recognize the roles AAFS can play in affecting difficult and sometimes controversial issues, in this case the TASER electric shock device. The desired outcome is a greater respect for the responsibilities of forensic practitioners in presenting objective and researched data, and the appreciation that AAFS can have a positive effect on safety issues.

At the February 2005 annual meeting of the American Academy of Forensic Sciences, a guest speaker presented paper C27 entitled "Lethality of TASER Weapons," in the Engineering Sciences Section's portion of the scientific session. The talk was basically a recap of the speaker's opinions delivered previously in a case involving a death in police custody following use of a TASER® brand weapon. The speaker made assertions about the lethality of the TASER, cited numbers of "TASER related in-custody deaths" ranging from 50 to 100 or more, numbers attributed to the news media, the American Civil Liberties Union and Amnesty International. He also referenced standards that in his opinion were applicable with regard to cardiac arrhythmia, electric shock, and electrocutions.

The presentation drew a large audience, far above the usual ESS norm. Clearly this topic engaged members from many sections of AAFS, including Criminalistics, Pathology-Biology, Jurisprudence, and Engineering among others. At its conclusion, there were several questions from the audience, but time was cut short, leaving several people without answers to serious assertions made, to the effect that the speaker had misstated and misrepresented the facts.

It occurred to the writer that this was somewhat unusual in ESS presentations, in that a fair opportunity to challenge the speaker was not afforded.

As a result of the attention the TASER paper received, this writer became intrigued by the notoriety of the product and the confusion that attended the presentation. As a result, this writer undertook an independent investigation of electric shock devices (ESDs), and in particular, the dominant product of this genre, the TASER. This included a trip to the TASER facility, and voluntarily experiencing the TASER first hand. The findings of this investigation were presented at a meeting of the National Academy of Forensic Sciences, in Chicago, July 10, 2005, in a paper entitled "Forensic Engineering Analysis of TASER Product Liability Issues" which included an analysis of ESDs and the environments in which ESDs were used, and addressed the question of how safety standards and concepts apply to these products.

In this analysis the ESD product may be seen differently from the consumer and law enforcement perspectives, respectively. This is related to the genesis of safety culture in MIL-STD 882, the basis of System Safety Engineering. MIL-STD 882 has had a profound influence on both the Consumer Product Safety Commission (CPSC), and consumer-product liability analysis. This framework was used to drive the present writer's analysis of the TASER and its environment of use.

Among the topics addressed was the widespread but statistically inappropriate reporting by the news media as well as the ACLU and AI, given the reality of the record. It was pointed out that the issue of In Custody

Deaths (ICDs) has been muddled into the TASER picture, and that many factors that must be considered to discriminate reality in the existing very confounded data set. The modeling of the overall law enforcement system and the many interactions that go into determining its effectiveness was a part of this presentation. In the present talk, key elements of this earlier presentation will be referenced for discussion and completeness.

After the presentation at the National Academy of Forensic Engineering meeting, this writer was approached by a representative of TASER International, and retained to repeat the presentation to its staff. This interaction has resulted in an unexpected and professionally gratifying result. TASER International has now undertaken a complete review and updating of all of its safety literature and products, and is now differentiating between the consumer and law enforcement markets. The important aspect of this development is that the manufacturer has pro-actively adopted significant aspects of this investigation to restructure and effectively present the necessary safety information. This information and warnings are now available to the consumer, law enforcement, volunteer, and training functions in a uniform, coherent manner, conforming to accepted standards.

In summary:

a) The safety culture at TASER International was changed
b) Safety, Technical, Training, and Marketing topics were separated to eliminate incorrect impressions, and to emphasize Safety
c) A warning pictograph was developed for ESDs
d) All packaging was changed to implement prominent warnings
e) All sales literature was revamped to emphasize warnings
f) Warnings were incorporated onto the product
g) All website information was changed to present safety first, then all other information
h) All purchasers must agree to the safety conditions of sale
i) All training literature was changed to emphasize safety
j) The company adopted a structured comprehensive approach to safety

based on the definitions of safety from safety engineering sources, including MIL-STD 882, CPSC, product liability practice, and DOD and FDA interpretations.

In this AAFS presentation details of the effort will be presented, including the organizational, technical, and legal issues that had to be addressed in this process. The process has also closed the circle, by creating a panel of TASER presentations at the Seattle AAFS 2006 meeting, offering an opportunity for all sides of the issue to be addressed.

TASER, ECD, Warnings

C25 Forensic Implications of Identity Management Systems

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Through this presentation, attendees will learn what kind of evidence can be extracted from digital information management systems, such as mobile phones and their networks, and newer developments such as the biometric chip in the passport.

This presentation will impact the forensic community by showing the impact of identity management systems, such as biometric systems, for use as digital evidence.

Identification management systems are more widely used and are, in practice, useful for extracting forensic evidence based on the digital information. Examples of identification management systems, as defined within the European Network of Excellence, FIDIS, are based on artifacts, such as magnetic stripe cards, smart cards, biometric devices, mobile devices, RFID-tags, digital signatures, and many other tokens that are used. The systems for storing partial identities in databases or on cards are expanding rapidly (the biometric passport is an important example), and for forensic evidence it is important to know the forensic reliability of these systems, such as:

- reliability of the underlying technology
- how well is an individual bound to an ID artifact
- transparency and disclosure by manufacturer or government
- data protection issues, and admissibility of the evidence in court

For reliable evidence in court it is important to know if:

- the central system could be misled, for example with compromise of communication channels
- a wrong person could be identified or not identified
- ease of data alteration and cloning

For mobile phones a wide use is available on extracting the data from the phones, and using location data as such. Forensic laboratories have developed tools to facilitate the examination of such phones. For mobile phones it is also known that particular SIM-cards could be misused by cloning them, and providers will improve the technology such that this kind of tampering is more difficult.

Another example of an artifact are biometric properties of a person. These biometric properties are acquired with a sensor. In this research, the authors have evaluated several technologies, based on expectation of future cases with biometric devices that could be misused. Different types of fingerprint readers have been acquired, with a wide range of sensor technologies behind them, from optical scanners to ultrasonic. It is widely known that fingerprints can be spoofed with simple techniques using glue and a printer. Once someone's fingerprint has been copied, most of these systems can be tampered with. Often the manufacturers will claim that there is detection if a certain finger is alive. During experiments with the biometric devices tested, these kinds of protection are easy to tamper with. In the scanners tested the authors have not detected any indication of live ness detection.

Other biometric properties such as hand scanners, iris scanners, and vein scanners where also relatively easy to fake. The problem is that once there is a widespread use of these biometric properties, that the techniques to fake them will also evolve, and that the databases which store them could be compromised.

A good example of the practical implications of biometrics is the biometric passport. In the biometric passport, also fingerprint and face are stored in a contactless chip. The data is encrypted, and is not easy to change, however once the keys are available to the passports, it is possible to steal the biometric data without permission of the owner. Here also are a number of issues of the fall-back system if the system does not work anymore, and what the possibilities are of spoofing the system. With face recognition it is widely known that look-a-like fraud is easy to use.

For forensic examination it is important to be aware of the fact that the systems could be compromised. In case of doubt, other evidence should be combined with the digital traces (time line analysis and for example mobile phones with their location data), before drawing conclusions.

Biometrics, Identity Management, Taxonomy

C25 Forensics for Floppy Disks and Recordable Compact Discs

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Can it be determined whether a floppy disk or a recordable compact disc (CD) is recorded in a particular drive or not? Do the physical systems in these drives leave traceable "fingerprints" on the disk? How is the information extracted to determine which drive recorded a particular disk? How can these methods be applied to a recordable CD (CD-R)? The goal of this presentation is to address these questions. The authors will show that traceable information does exist on the disk and that image and signal processing methods can be used to extract these fingerprints from floppy disk and CD-R.

This presentation will impact the forensics community by introducing the authors' investigation of the problem of determining which drive recorded a given floppy disk or CD-R disc. Image and signal processing methods will be described for floppy disks and CD-R discs. Experimental results will be presented to show that identical floppy drives can be discriminated and different brand CD-R drives can be discriminated.

Content: A 3.5-inch, 1.2MB floppy disk has 80 tracks in which information bits are recorded, and it has 79 gaps between the tracks. Track widths reflect width of the magnetic head of the drive creating this disk, and gap widths reflect movement of the magnetic head. Therefore, track and gap widths of a disk can be considered as the "fingerprint" that a drive leaves. In this research, the authors took images of disk surface under a microscope, and used image processing methods to extract track and gap widths from the pictures. The 159 estimated widths (80 tracks, 79 gaps) can be considered as a feature vector in the 159-dimensional space characterizing that drive.

A 5-inch, 700MB CD-R has also been studied. When an optical head writes bit "1" onto the CD-R, it burns a "pit" on the medium. When it writes a "0", it leaves the medium untouched, which is called "land". Pit and land represent the information bits. Different CD-R drives may have subtle difference in their laser powers and optical efficiencies, and lead to pits with different lengths, which is called "bloom." The amount of bloom reflects the laser power, therefore can be considered as a fingerprint of CD-R drives. When the CD-R disc is being read, the readback signal (i.e., the output of the optical pick-up) can be used to estimate the amount of the bloom. In this research, the analog readback signal is captured by an oscilloscope, from which the information bits are extracted. From the information bits and the analog readback signal, a signal-dependent auto-regressive (AR) model is trained. Coefficients of the AR model can be used as these features reflect the amount of the bloom. The authors' experiments used 26 coefficients, so a CD-R drive is characterized by a point in 26-dimensional space.

Results: In the experiments, 10 floppy disks from drive A, and 9 from drive B were formatted. The two drives are of the same brand (TEAC), and the same model (model # FD235-HF-A429). One "test disk" was selected, and used the remaining 18 disks to train a classifier using Support Vector Machine (SVM) or Fisher discriminant function, and tested the classifier using the "test disk". Nineteen trials were performed, each time with a different one of the 19 disks as the "test disk." All 19 "test disks" were correctly classified. The same experiments were performed on the CD-R drives, 18 discs written from drive C, and 10 from drive D. Drives C and D are of different brands (C: RICOH, D: Dell). All the 28 CD-R discs were correctly classified. However, discriminating same brand, same model CD-R drives turned out to be difficult.

Conclusions: Drives do leave traceable "fingerprints" in the disks recorded. The authors have developed image processing method to extract features from floppy disks, and signal processing method to extract features from CD-R discs. In experiments, two identical floppy disk drives were successfully discriminated, and two CD-R drives of different brand were successfully discriminated.

This research is supported in part by The Technical Support Working Group (TSWG). TSWG originated the idea for this Link Analysis of Computer and Media research project and provided support for it.

Floppy, CD-R, Classification

C26 Current Developments in 3D+2D Facial Recognition

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Participants will be briefed on the possibilities of 3D facial models for facial comparison. This presentation will impact the forensic community by demonstrating the limitations and opportunities of the use of 3D face models for image based identification will be shown.

The majority of automatic face recognition research has been focused on the use of two-dimensional intensity images. However, the current state of the art in face recognition is not sufficient for forensic applications. Although some of the techniques reach reasonably high levels of recognition under controlled circumstances with frontal face images, of course surveillance images hardly ever capture a suspect frontal face, with good lighting conditions, and a neutral facial expression. Therefore, current research in facial recognition focuses more on 3D methods including pose correction, lighting modeling and facial expression modeling.

In order to find the landmarks that are best suited for automated facial comparison, an analysis of 3D data from the facial area of 3D whole body scans is analyzed. Eight facial landmarks were manually annotated, and recorded in the scanning process. Absolute distances between these landmarks in the 3D models are measured.

To find a measure of the discriminating value of the distance measurements, the authors calculated the probability that the measurements of two subjects are not significantly different. If the measurements of a subject are close to the mean (i.e. a 'common' face), there is a probability that the same measurements are found in 1 of 2 subjects of the present data. If the measurements of a subject are in the tail of this distribution (i.e. a rare face), the probability that the same measurements are found on another subject is 1 in 12 subjects. Also experiments in which 3D models were used to estimate camera parameters using a least-squares estimation algorithm based on photogrammetric principles gave disappointing results: the remaining distance between corresponding points can be larger in the case where the scan model and the photo originate from the same person than in the case where the scan model and the photo are from different persons. The main reason for these disappointing results can be found in the level of measurement error due to landmark positioning, which is in the 2-4 mm range (own measurements and ICAO image resolution standards), compared to the standard deviation in the population, which is in the 5-10 mm range (own measurements and literature data). These relatively large measurement errors can be caused by landmark detection errors, low image resolution, but also facial expression and physical condition changes.

From these data it is clear that landmark distances, either 2D or 3D, will not suffice for forensic identification purposes. However, of course still other shape and texture features are available for facial comparison. In forensic comparison of a facial images, preferably reference images are used in which the head is positioned corresponding to the disputed facial image. 3D imaging techniques, together with 3D modeling software, offer the possibility of flexible and reproducible positioning of the head of a person corresponding to the face and camera position of the 2D facial images. This creates the opportunity to more accurately compare relatively unique features, like moles and scars, with respect to there shape and positioning on the face.

3D Models, Facial Recognition, Identification

C27 The FearID Ear Print Identification System

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Attendees will learn about the use of ear prints in criminal investigation and identification. This presentation will show the value of the use of ear prints in criminal investigation and identification.

In recent years, forensic individualization based on earmarks has been under fire. To solidify the scientific basis for ear print / earmark identification, the EU financed Forensic Ear Identification (FearID) project was started in nine institutes over Italy, the U.K. and the Netherlands. The FearID research project aims to obtain estimators for the strength of evidence of ear prints found on crime scenes. For this purpose, a sample of ear prints from 1,229 donors over three countries has been collected.

On the basis of two manual annotations, of which one is knowledge-based, methods for automated classification were developed and used for training of a system that classifies pairs of prints as 'matching' or 'non-matching'. The manual annotations were twofold: on the one hand, of operators denoting the contour of the ear prints to facilitate segmentation of the image, on the other, of anthropological specialists anatomically denoting specific locations in ear prints. From the annotated contour a connected structure is determined that is represents the imprint, and which is referred to as *superstructure*. On the basis of this superstructure, further analysis is performed using various image processing techniques. The anthropological annotation is analyzed through a method called Vector Template Matching (VTM). Here, following its annotation, each print has a template constructed, consisting of labeled points representing ear print landmarks and *minutiae,* distinguished into different classes. Prints are compared by assessment of the similarity between their templates.

A matching system was developed using samples of about 2/3 of the ear print donors as a training set, with data-fusion at the feature level. The analysis of the outcomes is based on the statistical method of (binary) *logistic regression* (BLR). Based on the training data, the BLR method extracts a linear combination of the used features, optimally separating pairs of matching from pairs of non-matching prints.

Testing of the developed matching system was performed using the remaining 1/3 of the sampled ear prints. Comparing lab quality prints this leads to a matching system with an equal error rate of 4%. Starting from a database containing two prints per ear, hit list behavior is such that in 90% of all query searches the best hit is in the top 0.1% of the list. The results become less favorable (equal error rate of 9%) for print/mark comparisons.

The system may be improved further by on the one hand using more image processing techniques and pattern recognition methods, on the other by making annotation data less operator dependent. The current study has focused on the performance of a semi-automated ear print / mark classification system. With respect to ear print / mark identification in court this may not be the most relevant issue, since performance of experts is crucial there. On the basis of the sample, performance of experts may be tested by presenting hit lists following query searches and scoring the results.

Ear Prints, Identification, Classification

C28 Validation of Image Processing Methods for Fingerprints

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Attendees will learn about which risks exist in different image processing methods. This presentation will demonste which kind of image enhancement methods can be used and what the limitations of the techniques are.

Forensic image processing has been used in forensic science for several decades. It started with publications concerning image processing on fingerprints, documents and video. Most forensic fields use some kind of image processing nowadays.

In Netherlands Forensic Institute laboratory several image processing methods are used for processing fingerprints :

- contrast stretching
- convolution filtering
- separation of colors
- dilation and erosion
- FFT techniques for filtering regular patterns

These methods are also used in combination and in local areas of the image. A question that arises when using these methods is if the methods have been validated (in order that no information is added that does not exist). Furthermore there is interest in new techniques that can be used for fingerprint enhancement with image processing (e.g. wavelet filtering).

The most common image processing methods as contrast enhancements are common knowledge, and do not have much risk of altering an image in such a way that the image alters in another image.

It is important to have new image processing methods validated and know what the risks are of these methods. For video image processing it is known that in some cases image processing, especially with methods such as super resolution, will result in the wrong conclusion. Another issue is that the software that will be used should be tested if it really does the image processing function that is requested.

More complicated methods such as FFT can degrade the image in such a way that the data can be altered. In 1993 this was mentioned in literature by E. Berg and in 1994 by S. Bramble.

In a *Frye* hearing in 1991 and a *Daubert* hearing in 1998 concerning image processing of fingerprints the methods were accepted in court without much discussion.

The authors will show several examples of image processing where this can be done in a proper way, without risk. The highest risk is when two fingerprints are overlapping and using FFT to filter one out.

For quality assurance, a test similar to the WSQ-validation test of the NIST has been carried out in the Netherlands. Images of fingerprints with different types and degrees of image processing are used and compared with the rolled prints. In a time frame of several weeks between the different sets, the latent print examiners are requested to find the minutiae that can be used for the comparison. The convincing points in the visible images should be pointed out. The points which were questionable are also pointed by the latent print examiner. Several latent print examiners were asked to do this test to have a more statistical sound evaluation of this test. The results of the comparison between processed images and the rolled prints are discussed. It appears that with extreme image processing some of the points are not correct. This situation can be avoided by always giving the processed and the image before image processing to the latent print examiner.

Fingerprints, Validation, Image Processing

C29 Examination of Unknown Video Formats and Broken Video Streams

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Methods for examination of unknown video files and the possibilities to examine the files in depth will be presented. The presenter will demonstrate a method of examination will result in more evidence in the court of information that was not visible before.

With the expanded use of different CCTV-systems and many new formats and CODECs for video streams and video files on the internet, examination of these files and streams is a non-trivial task.

CCTV-manufacturers often use proprietary formats in their systems, in such a way that the video files can only be viewed with their software. In practice, manufacturers will help by providing the software, or in some cases the software is already in the laboratory from an earlier case. If the software for viewing the images is not available, the file should be examined otherwise. The possibilities for this are very much manufacturer dependent. One method is with trial and error by using a database of available players. The risk with this method is that not the best quality is displayed on the screen, and that not all information (such as timelines) is available from the file. The other method entails examination of the file with software tools such as a hex viewer. In some systems, known headers, such as those from JPEG-images, can be retrieved and the information can be viewed. Often this kind of reverse engineering is too time consuming and will not work in practical cases. In theory however, one may find timelines and other information from these streams.

With files that are examined from computers that are confiscated or even intercepted data streams, no information may be available on players that can be used. One can test the file with the known players, such as Microsoft Media Player and other available players. It is often necessary to examine the file to find information on the file format and the CODEC that has been used. If the file is from a known type such as AVI or MPEG, the structure of the file is known, and the file can be viewed. Examination of the file itself can also reveal more information of the origin of it, which is important in examination of movies containing child pornography and snuff movies.

It becomes more difficult if the streams or files are damaged. The files should be repaired to view them. In case of an AVI-stream the header might not be available anymore. In this case a header should be composed to view the video stream.

At the Netherlands Forensic Institute researchers started the development of a software tool to examine video files. This tool should recognize the format of video files and the CODEC that has been used, and will also repair broken or incomplete video streams from AVI and MPEG-2. This should result in a standard method of investigation of such video material. For forensic work, tools will be developed for the open source community, if possible. The reason is that anyone interested can verify the software for quality assurance and validation purposes and that others can also develop new functionality.

Formats and CODECs, Digital Evidence, Video

C30 Investigation on Height Estimation of Persons in Surveillance Video

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The objective of this paper is to investigate measurement errors when determining the height of an individual in a video image. The author will present the conclusions of a study on height estimation of persons in video footage.

At the Netherlands Forensic Institute, a technique is in use to estimate the height of a questioned person in a surveillance video. This technique is based on the original footage, using 3D computer models and reference images from foils taken at the crime scene. If the person is fully displayed and the original recording equipment is still unchanged, the height of the questioned person appearing in the video image can be determined.

The height of the foils in the video images is measured using a 3D object, in most cases a thin cylinder. The object was placed in the 3D computer model by an operator estimating the position of the feet and the top of the head. The real height of the foils is measured at the scene using a ruler. The mean difference between the real and the measured height in the video image is used as a correction for the measurements of the questioned person. The standard deviation of these differences is used to determine the margin of error for the measurement of the questioned person.

With this technique the main sources of errors are:

- Difference in gait and pose of the foils and the questioned person.
- Interpretation of the operator: where are the feet and the head of the person?

To get a better knowledge of these errors and their effects an experiment has been performed. The experiment includes measurements on 24 people recorded by surveillance cameras of the institute. On recording days, individuals' height was also measured by the investigators. Factors that were being varied were the following:

- Operators: Four operators measured the height of the persons in the video images
- Cameras: Three different camera views were used
- Different points in time during the day: people were measured on footage at entry of the institute in the morning and at departure from the institute in the afternoon.

The same measurements were repeated by the same operators a few months later using a slightly different technique. In this technique the top pixel of the head of the person in the video image was defined as the top of the head.

The results and conclusions of this experiment will be presented.

Height Measurement, Surveillance Video, 3D Computer Models

C31 Testing Computer Forensic Tools at NIST

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After attending this presentation, attendees will have an awareness of the issues in validation of forensic software used in the examination of digital data and the role of the National Institute of Standards and Technology (NIST) Computer Forensics Tool Testing (CFTT) project. This presentation provide the information necessary for toolmakers to improve tools, for users to make informed choices about acquiring and using computer forensic tools, and for interested parties to understand the tools capabilities.

Regardless as to whether it is a criminal investigation, the discovery process of civil litigation or the response to an unauthorized computer system intrusion, whenever digital evidence must be examined, the investigator needs to know that the forensic software tools used in the process produce reliable, accurate, and objective results. The goal of the CFTT project at the NIST is to establish a methodology for testing computer forensic software. A methodology using the *conformance testing* model consisting of tool requirements specifications, test procedures, test criteria, test sets, and test hardware has been developed.

The test process begins with the selection by a steering committee of a specific forensic tool function for development of requirements that must be met. After specification, the requirements are published to the internet for public comment. In this way the entire computer forensic community participates in the process. After the requirements are in final form, a test plan is produced, also for public comment. At this point the steering committee selects a list of tools to test. The test plan is applied to the selected tools and test reports are published.

There are significant challenges for testing forensics tools. First, there are no standards or specifications for the expected behavior of forensic tools. Second, very arcane and often undocumented knowledge is required to understand the critical testing issues. Third, the behavior of the tools when executed in the presence of hardware errors is often relevant.

Currently specifications have been developed for acquiring digital data for examination, protecting original digital data during acquisition and recovery of deleted digital data. Test reports have been produced for the

most widely used tools for acquiring digital data and for protecting original digital data during acquisition. CFTT test reports have been cited in some high profile court cases, *e.g.*, Zacarias Moussaoui.

In general, the software tools used to examine digital evidence produce reliable consistent results. However, the tested tools often exhibit operational quirks that an examiner should be aware of. For example, acquiring all the digital data on a hard drive can be an issue. Depending on how the acquisition software asks a hard drive to report its size, different answers can be obtained. In addition, a hard drive may be configured to only report part of the actual drive. In other words, it is quite easy to establish hidden areas on a hard drive that can be missed in an examination if the tools used for the acquisition do not check for the hidden areas.

Testing reveals that there are sometimes significant tradeoffs in the selection of a tool. For example, software and devices for protecting original digital data usually follow one of two possible designs. Access to a digital storage device, e.g., hard drive, is provided by a set of commands through an interface. There is usually a set of possible read commands (to get data from the device), a set of write commands (to put data on the device), a set of control or configuration commands and a number of unassigned command codes. One design is to allow only the read commands and block all other commands; the other design is to block all write commands and allow any other command. This becomes an issue when an access protocol is revised and new commands are assigned to the unused command codes.

Several lessons learned during the testing of widely used tools are discussed. For example, the behavior of an acquisition tool used on an unreliable (i.e., has bad sectors) disk is of interest. However, an unreliable disk is just that, unreliable. For testing, a *reliable bad disk* is needed. This was accomplished by using software to simulate a disk with bad sectors on a normally functioning hard disk.

Digital Evidence, Software, Validation

C32 NIST Standard Reference Materials® (SRMs) for Forensic Measurements and Data Analysis

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This paper discusses the application of certified NIST Standard Reference Materials (SRMs) and the statistical analysis and interpretation of data related to laboratory calibrations and measurements used on the identification and/or comparison of specimens to be linked to forensic evidence. NIST SRMs provide the benchmarks to assess the levels of precision and accuracy in the measurement of a range of physical and chemical property and performance characteristics.

NIST supports accurate and compatible measurements by providing over 1300 Certified SRMs with well-characterized composition and/or properties. These SRMs are used to perform instrument calibrations in situ as part of overall quality assurance programs, to verify the accuracy of specific measurements and to support the development and standardization of new measurement methods. NIST SRMs are currently available for use in areas such as industrial materials production and analysis, environmental analysis, food and agriculture, radioactivity, health measurements, and basic measurements in science and metrology. Each SRM is supplied with a Certificate of Analysis. Along with standards organizations methods and procedures, such as those promulgated by ASTM and ANSI, NIST has published many articles and practice guides that describe the development, analysis and use of SRMs. NIST SRMs provide the benchmarks of precision, accuracy, and traceability, which validate measurements and data.

The measurement of physical, optical and chemical properties of samples is often employed to identify the type of material and/or application. Measurements of material properties can be used to track and identify the original producer, the date or period of manufacture and the intended use or application for the material or product. For example, property or chemical measurements and/or the evaluation of samples or product characteristics, in addition to visual markings if present, can establish a link in the chain from producer, fabricator, distributor, vendor, end-use or application, down to a specific geographical area or sample origin.

In the measurement of properties, chemical composition, or characteristics of samples, accuracy and uncertainty terms and traceability statements are of paramount importance in forensic investigations for the validation of data. These concepts must be used correctly to avoid possible confusion and inadmissibility of evidence. SRMs and the associated Certificate of Analysis state the intended purpose and application of a particular SRM, its certified property value(s) with associated uncertainty(ies), and present technical information deemed necessary for its proper use. The uncertainty attached to a certified value is especially important as it represents a quantity which characterizes the range of values within which the true value is asserted to lie within a stated level of confidence. A NIST SRM certificate bears the logo of the U.S. Department of Commerce, the name of NIST as certifying body, and the name and title of the NIST officer authorized to accept responsibility for its contents. In addition to the certified values, the SRM certificate may contain references and/or other pertinent information and data. SRMs certified values with their associated uncertainties, in applicable situations insure the integrity and the validation of forensic measurements and data. NIST certified values are obtained by one or more of the following measurement modes: 1) A definitive (or primary) method using specialized instrumentation capable of high accuracy and precision and whose errors have been thoroughly investigated and corrected; or, 2) Two or more independent methods at NIST using commercial instrumentation that is calibration based and with differing sources of systematic errors; or, 3) Interlaboratory data from selected laboratories using multiple methods and SRMs as controls. However, the sources of error with the latter mode will generally result in uncertainties greater than those for the other two modes.

There are a number of measurement methodologies related to the determination of materials properties and /or chemical composition. For instance chemical composition methods cover basic “wet chemistry” procedures and other very sophisticated techniques, which utilize atomic and radiation physics principles, and nuclear interactions that require complex and expensive apparatus. Fortunately, a number of SRMs having components comparable with those of the materials to be evaluated have been established. These SRMs and associated methods or standard procedures are available for equipment calibrations.

This paper will discuss and illustrate the use of a number of a range of SRMs of interest to the forensic community. The discussion will encompass measurement practices, methods, standards, and precision and accuracy considerations to be taken into account for the measurement methodologies employed. This paper will also provide insights on the future needs for SRMs for forensic measurements and characterization.

Standards, Calibrations, Measurements

C33 Arson or Accidental Flashback? Sorting Fact From Fiction

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The goal of this presentation is to provide some insight into the objective evaluation of expert witness opinions by providing a guide to forensic engineers on major issues of credibility, expert opinion, and accuracy of work conducted.

There is an increasing reliance on experts in the assessment, reporting, and resolution of insurance loss episodes, and of claims and counterclaims arising from such loss episodes. Regardless of how the resolution of such a

matter is attained by various parties, be it settlement, mediation, arbitration, or trial in a court of law, the expert's opinion will frequently be a key factor in determining the outcome.

The fact that different experts may express differing opinions on the same matter, will present a dilemma to those who would rely on expert opinion to guide the resolution of a matter under dispute to a true and just decision. Added to this delicate balance is the fact that some experts may – either by accident or by design – present an opinion which is intended to serve the interest of their client before serving the interest of truth and justice. When such an opinion is packaged in the shroud of scientific and engineering jargon, it may appear to be quite convincing even though it is not completely accurate.

A forensic expert will periodically be faced with the challenge of identifying, explaining, and unmasking the flaws of an opposing opinion, an opinion that, in reality, is a partisan statement.

This presentation will review the salient details of a case history that was resolved at trial. The matter before the court dealt with a fire loss that resulted in an insurer denying a claim on the basis that the insured had committed arson. The insured claimed that the fire was caused accidentally, and denied that arson was committed and sued the insurer for breach of contract.

Furthermore, as is often the case in such matters, the insured had been previously charged with the criminal offence of arson, but was acquitted at trial because the benefit of reasonable doubt is given. At the criminal trial, no expert or expert opinion was introduced to the court on behalf of the accused.

In preparation for the subsequent civil trial, counsel for the insured now retained the services of an expert. The plaintiff's expert put forward the notion of accidental flashback as an explanation for the cause of the subject fire, thereby negating the allegation of arson by the insured.

In a civil trial, while the plaintiff must prove their case, the final decision will be made on the balance of probabilities, as compared with a criminal trial, where there is a presumption of innocence, and hence the accused must be given the benefit of doubt. If a scientific opinion can be introduced by the plaintiff's expert in a civil trial that will materially alter the balance of probabilities, this may be sufficient for the plaintiff's case to succeed at trial. This is a delicate process which could work, if it effectively strengthens the plaintiff's case by simply weakening the defendant's case. Note that in so doing, no overwhelming factual evidence need be introduced by the plaintiff's expert. That is, the plaintiff's case was not strengthened by the introduction of important evidence, but rather by simply diluting the strength of the defendant's case.

As will be demonstrated in this presentation, the careful and objective forensic engineering assessment of every detail associated with the plaintiff expert opinion and hypothesis concerning flashback resulted in identifying a subtle but important flaw. Once exposed, and removed from the hypothesis, the flaw rendered the hypothesis of flashback as being not merely improbable, but clearly impossible.

Finally, it was absolutely necessary that the identified flaw be checked and cross-checked to assure its validity. This presentation will explain how, through the use of parallel forensic experts, the flaw was checked, tested and confirmed absolutely. When the flawed hypothesis was exposed in a clear, concise, and objective manner at trial, the plaintiff's case was totally destroyed and his claim was dismissed.

Arson, Expert, Flashback

C34 Construction Defects Resulting in Threats to Human Health and Unanticipated Expenses - Case Studies From the Ground Up

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The goal of this presentation is describe to the forensic community the cause and effect relationship between water intrusion and observable construction defects, as well as the relationship between construction defects and mold or other indoor air quality complaints. By increasing the understanding of engineers, design professionals, and homeowners, multi-million dollar law suits and expensive repairs can be avoided.

This presentation has four objectives: (1) to identify various conditions leading to construction defects; (2) to describe the difficulties inherent in identifying construction defects; (3) to describe how homeowner modifications or design changes may result in damage to structures and/or unsafe living conditions; and (4) to present case studies to identify primary and secondary construction defects. This presentation contains case studies that provide environmental information to show the cause and effect relationship between construction defects and other issues that may threaten human health and result in expensive repairs.

Construction defects caused by water intrusion and substandard construction practices are frequently among the primary allegations made in lawsuits. Construction defects may create opportunities for other issues that are more expensive and problematic than the construction defect itself. The primary effect of elevated vapor emissions is typically flooring failures. However, water damaged walls and mold may be a more costly effect of this type of water intrusion. In one case, elevated vapor emission test results of 12 lbs/1,000 sqft/24 hours exceeded the generally accepted flooring industry standard of 3 to 5 lbs/1,000 sqft/24 hours and resulted in delaminated flooring. Although, there was little visual evidence to support a mold claim, the owner felt it necessary to perform an indoor air quality survey and mold survey to assess this issue associated with moisture intrusion. The remediation to the flooring was relatively inexpensive, but the long-term cost and human health impacts from potential mold or indoor air quality complaints may not be determined for many years to come.

Unusual building materials may also lead to indoor air quality issues that threaten human health if are not handled properly. In a separate case, a homeowner complained of an ammonia odor in the home which went unidentified for several months. Extensive sampling and various scientific approaches were required to identify this less common construction defect associated with a chemically-modified insulation. This particular insulation produced an ammonia off-gas of more than 10 parts per million (ppm) which was more than the action level derived from the ATSDR Toxicological Profile for Ammonia. The no-observed-adverse-effect level identified in this profile for long term exposures was 9.2 ppm for ammonia in the air and the Minimal Risk level developed from the same data was 0.1 ppm in air. After the source of the ammonia was identified, the exterior paneling of the home was removed and new insulation was installed. Without a comprehensive understanding of the building process and chemical nature of building materials, this indoor air quality issue may have gone unresolved.

Modifications to landscape or drainage are some of the most common factors leading to soils-related damage in homes. By altering the pre-construction moisture content of soil and creating new drainage channels, homeowners may inadvertently cause soils to expand or collapse resulting in cracked walls, floors, and foundations. Elevated interior moisture levels and visible moisture intrusion may result from soils-related damage and are sometimes easier to identify than the primary construction defect hidden beneath the surface. For this reason, the secondary defect may be addressed without identifying the primary source of the problem. By adequately investigating construction defects (e.g. warped flooring or mold) the source of the construction defect may be recognized. Elevated moisture readings and visible mold observed in homes are generally the best clues regarding these source construction defects.

This presentation will provide a better understanding of both geotechnical and environmental issues that face design professionals with the aide of several case studies. The cause and effect relationships between primary and secondary construction defects will also be discussed in an effort to help design professionals prevent or mitigate potentially hazardous situations.

Construction Defect(s), Mold, Soil(s)

C35 Defective Jack Causes Fatal Collapse of Overpass Falsework

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The goal of this presentation is to illustrate methods of determining the load on construction jacks and some of the inherent risks in using jacks in construction and will describe some of the defects found in hydraulic jacks often used in construction which are probable causes of failure.

This presentation will impact the forensic community and/or humanity by exposing internal construction of some hydraulic jacks which renders them dangerously susceptible to failure under seemingly ordinary usage.

Falsework was being installed for a concrete box girder overpass in Fresno, California. The falsework bents had been erected and the steel beam stringers had been placed on the bents when it was found that the elevation of one of the bents needed to be adjusted. A single nominal 12 ton hydraulic jack was used between the steel bent sill beam and the timber pads which served as the footing for the bent. One worker operated the jack while two others were placing and removing shims at the corbels (The short cross beam which distributed the load from the bent sill beam to the pads) when the bent toppled toward the jack operator. An adjacent bent also fell and the steel stringers fell. The jack operator was fatally injured, and the two other workers suffered minor injuries.

There were questions as to what caused the collapse and where did it originate. There were allegations that the tip-over was caused by the lateral component of the cable guys being increased by the jacking, that the jack had no steel plate under it to keep the bearing pressure on pads within the strength of the wood perpendicular to the grain, that the jack failed because it was overloaded, and that the jack was an automotive jack not suited for use in construction. There was also a question as to whether there was one more stringer beam on each span than the falsework plans called for. Furthermore, there were differing statements as to where the jack had been placed.

Study of the many scene photographs and the falsework plans revealed that the construction followed the plans except for the extra stringer which weighed 4000 pounds and except for a slope of the pads of approximately four degrees. The weight on the bent that would have been borne by the jack was then calculated for each of the stated positions of the jack with and without the extra stringer but allowing for the slope of the surface under the jack. These calculations showed that the load on the jack was well under the required test load on a five degree slope according to the ASME-ANSI standards for the jack.

Then the bearing pressure under the jack was computed allowing for the eccentricity of its base with respect to the ram and allowing for its minimum and maximum extensions. The pressure so computed was about 1400 psi, almost twice the proportional limit of the Douglas fir pads. If in fact this pressure was applied, the surface of the pad would have shown significant depressions or gouges at the jack location. Excellent photographs of the upper surface of the pads revealed no such deformations. Therefore it was concluded that the jack was most probably supported on a steel plate that was lost in the debris of the collapse and the clean up.

The effect of the maximum stroke of the jack on the tension forces in the guy cables was calculated and was found to be a small fraction of the force required to overcome the simple friction of the stringers on the cap beam of the bent. Therefore, the guy cables could not have been a factor in the collapse. The conclusion thus far was that the jack failure at loads it should have endured was the primary cause of the collapse.

Extensive photogrammetric examination of the failed structure provided verification of important artifact locations and dimensions. The documentation by site investigators was used to recreate the scene environment, and aid in the reconstruction of the collapse events.

A further analysis of PALD (Portable Automotive Lift Devices) test methods illustrated the limitation of the standard. At full extension, or within 25mm of full extension, the tested exemplar jacks offered little resistance to lateral instability. The moment coupling between the ram and the cylinder bore was insufficient to transmit moment forces to the jack base. A modified test protocol was designed to allow continuous deflection beyond the five degrees specified in the PALD standard. Comparisons were made between the two test methods.

The findings will be presented, including failure modes that were evident in the failed hydraulic jack. Going beyond the events of this particular case, this method arguably demonstrates a more realistic lab test that reflects the actual vertical and lateral loads applied under foreseeable conditions of use. Also, the paper address the continuing deterioration of applicable safety factors as the production of these units has been shifted to China and other countries.

Hydraulic Jacks, Bridge Collapse, Falsework

C36 Variability in the Measurements of the Slip Resistance of a Wetted Surface When Using a Single Variable Incidence Tribometer and Eight Different Neolite® Test Feet

James E. Flynn, BS, PE, J2 Engineering, Inc., 7636 North Ingram Avenue, Suite 108, Fresno, CA 93711*

After attending this presentation, attendees will learn the values obtained when using a Variable Incidence Tribometer to measure the slip resistance of a wetted surface can be influenced by the specific Neolite® test foot used with the tribometer.

This presentation will impact the forensic community and/or humanity by demonstrating the results of this study which contradict those of other investigators who have indicated that the use of different Neolite test feet will not have an effect on measurements of slip resistance. That contradictions are apparent should alert the forensic community to the necessity of monitoring the test performance of individual Neolite test feet.

The Variable Incidence Tribometer is one of two tribometers which are currently approved by ASTM International for the measurement of the slip resistance of both wet and dry walking surfaces. Although protocols for the use of the Variable Incidence Tribometer are set forth in ASTM International Standard F 1679-00, a precision statement has yet to be included in the Standard. A precision study for the Variable Incidence Tribometer was completed in 1998; however, each of the six independent participants of the study completed testing while using the same Neolite® test foot. This study was conducted to determine whether or not the use of several different Neolite® test feet and a single Variable Incidence Tribometer would result in variability in the measurements of the slip resistance of the metered test surface.

Three glazed ceramic tiles were selected as the test surfaces. Upon receipt, the tiles were first cleaned with acetone and paper towels. After drying, the tiles were again cleaned, this time with a mixture of one liter of distilled water and 5 ml. of Ivory® dish soap. The tiles were subsequently rinsed with distilled water and allowed to air dry. Prior to testing, the Variable Incidence Tribometer was place on the cleaned tiles and its position on the tile was marked with a Sharpie® pen.

Eight different Neolite test feet were selected and were prepared by sanding with 180 grit 3M wetordry sandpaper. The test feet were attached to the Variable Incidence Tribometer per the instructions set forth in the F 1679 Standard and the operator's manual. Prior to the initiation of testing the tested surface was wetted with a continuous film of distilled water. The test foot was also aprayed with distilled water prior to each test run.

The slip resistance of each of the three test surfaces was measured with each of the eight Neolite® test feet. Four tests of each tile were taken using each of the eight test feet for a total of 32 tests per tile. In an effort to eliminate the effects of potentially non homogeneous tile surfaces, all

tests were conducted on the same spot on each of the tiles and the tests were all taken in the same direction.

An analysis of the test results revealed that significant differences in the measurements of slip resistance were obtained through the use of the eight different test feet. Testing of a single wetted tile produced slip resistance readings ranging between 0.18 and 0.42. A reading of 0.18 indicates a very slippery condition while 0.42 can be considered slip resistant.

The observed variations in the measurement of the slip resistance of wetted surfaces indicates the need to monitor the test performance of individual Neolite® test feet.

Variable Incidence Tribometer, Neolite®, Slip Resistance

C37 Analysis of Electrical Power Input That May Affect Critical Instrumentation in a Forensic DNA Profiling Training and Service Laboratory Service Business at the Biotechnology Center, Shadow Lane Campus, University of Nevada, Las Vegas

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After participating in this presentation, attendees will have a greater appreciation of the importance of controlling the quality of electrical power supplied to sensitive and expensive instrumentation and the potential negative effects of power disturbances on forensic DNA results.

Disturbances in the quality of electrical power supplied to sensitive DNA instrumentation used in quantitation, amplification, separation, and analysis of short tandem repeat DNA fragments can have serious consequences on the forensic laboratory equipment and reportable results (that may or may not be obvious). This presentation clearly shows the importance of this subject and review critical aspects involved in electrical engineering and biological sciences applied to forensic science. This study should influence users to acquire and install such power protection.

In a process that started early in this decade, a new Biotechnology Center has been established at the Shadow Lane Campus of the University of Nevada Las Vegas. Within this Center, a modern Forensic DNA Laboratory is in place that is providing training services in "Forensic DNA Profiling" and laboratory training services in other genomic/proteomic analyses.

Instrumentation installed in this laboratory for DNA quantitation, amplification, and analysis is critically dependent upon the quality of electrical power supplied to the specific instrument. This presentation discusses the quality of incoming electric utility power, intra-laboratory power disturbances, dynamic measurements taken of the incoming alternating current (AC) power and economic loss impact case study effects (potential and actual) on sensitive and critical instrumentation typically used in "Forensic DNA Profiling" and other clinical and research applications. The AC power to this sensitive instrumentation is controlled by Franek Technologies Instrument Power Protection. The instrumentation examined includes, as example, the Applied Biosystems Prism 7000 Real Time PCR used in DNA quantitation and the Applied Biosystems 3100 Avant used in separation and analysis of Short Tandem Repeat DNA fragments.

Power Protection for Sensitive Instrumentation, Forensic DNA Profiling, UNLV

D1 Exercises to Improve Your Proficiency as a Forensic Expert Witness

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Attendees will learn four complimentary training exercises, developed at the Centre of Forensic Sciences, to improve courtroom testimony skills. The implementation of these exercises will develop individual courtroom presentation skills and abilities.

This presentation provide information regarding training exercises that can assist a forensic expert witness improve his/her competency within the witness box with respect to delivery and education of the court concerning complex scientific concepts.

The forensic expert witness must assist a court or inquiry to understand complex scientific evidence. Information incompletely or inaccurately conveyed, or not understood by the participants, is of little or no use, and may have a negative impact on the administration of justice. Answers and statements that contain insufficient information are unacceptable and those that lack clarity simply obfuscate the witness' testimony.

To develop the skills needed by a proficient forensic expert witness, the Centre offers a number of training exercises to its scientists, including:

1. Practice Court
2. Questions of Fear
3. Turnabout Court
4. Ringing the Bell

Practice Court: The Practice Court is a role-playing assignment. The scientist is given the opportunity to provide testimony using one the scientists own case files. Managers and senior scientists play the roles of Crown/Defence/Judge. It is important that these roles are filled from other sections or disciplines as often as possible, rather than that of the case scientist, as individuals in the same discipline are as familiar with the jargon and acronyms as the scientist and may not recognize the need to explain them in court.

This element compels the scientist to define or eliminate jargon and acronyms from speech – behaviors that are very important in communicating complex scientific information to a lay audience within a courtroom. With the elimination of jargon, etc., the language becomes more comprehensible to the lay audience (i.e., jury) and the officers of the court.

After the exercise, the scientist participates in a feedback session that focuses on language, demeanour, presentation, projection, clarity, knowledge, and comprehension.

Questions of Fear: The Questions of Fear exercise is often combined with a Practice Court as it targets both the reviewer's and the scientist's concerns with respect to the witness' use of terminology and clarity of information, e.g., it is important to be able to say Laser Ablation Inductively Coupled Plasma Mass Spectroscopy (LA-ICP-MS) when needed without tripping over it verbally, which appears unprofessional. The scientist must to be confident on the witness stand and comfortable with the terms and concepts of his/her area of expertise in order to communicate information well and provide effective education to the court.

The scientist is charged with writing out ten questions that 1) caused him/her problems within the Practice Court exercise, or 2) he/she was glad were not asked as he/she would have had to struggle to answer.

Each question is written on a separate piece of paper and placed into a bowl. The scientist pulls out one question per day and with instruction to answer it a single time, immediately, without any preparation – whilst looking into a mirror – and to complete the answer regardless of any verbal stumbles or inaccuracies. The exercise is repeated until the questions, phrasings and concepts are answered correctly, concisely and clearly. This exercise can quickly build up the individual's delivery skills and confidence in answering difficult questions.

Turnabout Court: Turnabout Court is an exercise in which a moderator asks senior scientific staff to answer a series of questions that submitted by junior scientific staff while all staff attends.

Two senior scientists answer each question and the answers are compared and discussed by the group. The discussions provide the junior staff with an understanding that although the core information behind an answer must be the same (accurate), explanations and delivery styles can differ as long as they are clear, correct, and concise. Personal differences are acceptable if the result is successful, i.e., the court is assisted in understanding the scientific issues.

Ringing the Bell: Ringing the Bell is an exercise specifically focussed on the use of a clear, straightforward language by the expert witness. The scientist answers questions pertaining to his/her area of expertise, asked by a senior scientist, in front of non-technical staff, e.g., secretaries or administrative support staff. These staff members ring a bell whenever the scientist uses a word that the listener does not understand or that is not explained within the answer. This forces the scientist to evaluate what is said and how it is said from the listener's perspective – a skill that is often difficult for junior staff to develop. They quickly learn how their regular phrases, words, and concepts need to be chosen carefully to impart the technical and scientific information that the court needs to understand the expert testimony.

Training, Court, Exercises

D2 Recent Research on Expert Witnesses May Help Reduce Error Rates in the Forensic Sciences

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Attendees will learn ways to minimize errors in the analysis of forensic casework, in report writing and in testimony. This presentation assist will attendees in thinking about how institutions can influence the examiners experimental work, conclusions, and report writing. Furthermore, they will learn about ways to minimize error by forensic examiners.

Reducing error rates is an important goal of research in the forensic sciences. There is an emerging field of study which deals with expert witnesses. It provides a set of tools to help practitioners in the forensic sciences reduce error rates in evaluating case work. Contributions to this field come from many disciplines, including economics, philosophy, sociology, and psychology. The authors review this literature and discuss its importance for forensic science.

Several important themes emerge from the literature on expert witnesses. Expert witnesses are human beings and subject, therefore, to social, psychological, and economic influences. These may be considered "extraneous influences." It is a legitimate and important scientific question to ask what extraneous influences exist and how they operate. Different researchers have proposed different and sometimes contradictory answers. The authors emphasize the notion that the institutional environment influences the significance and direction of extraneous influences. The authors argue that the influence of institutions should be of interest to forensic scientists and to managers and directors of crime labs. Researchers in forensic science should examine studies of expert witnesses to find ways of reducing error rates in forensic science evidence analysis, experimental observations, conclusions, report writing, and in testimony.

An understanding of the sources of error can help researchers understand the nature of the positive contribution that might be made by the scientific study of expert witnesses. Forensic scientists follow validated and accepted procedures in performing their analyses. However, these procedures will not generally prevent all errors. Some errors are explained by considering the procedure in the light of the underlying phenomenon being examined. These are "task-based errors." The error derives from the nature of the task that the procedure creates. For example, a procedure requiring fingerprint examiners to match only two Galton points (and nothing else) will have a higher human identification error rate than a procedure requiring the matching of five Galton points. The lower resolution procedure produces errors because it gives the analyst the task of matching only two Galton points. Other errors are explained by considering the procedure in light of the characteristics of the examiners themselves. These are "agent-based errors." For example, requiring traditional hair analysts to view one hair at a time would create a higher error rate than if the analyst used a comparison microscope. This difference is not attributable to any characteristics of hair, but to the limited ability of human examiners to retain in short-term memory a precise image of an examined hair. Agent-based errors may be further divided into two groups. If the error emerges even when the procedure is followed, as in the hair example, it is an "error against nature." If the error emerges only when the procedure is not followed, it is an "error against standard." PCR-DNA analysis can produce errors against standard because of the difficulty of adhering to its demanding protocols. By virtue of definition, all task-based errors are necessarily errors against nature.

The emerging field of study of expert witnesses provides tools for concentrating on agent-based errors, including both errors against nature and errors against standard.

Expert Witness, Quality Control, Minimizing Error

D3 Identification of Solvability Factors in Cold Case Homicide Investigation

Richard H. Walton, EdD, 800 Prospect Street, #1-E, La Jolla, CA 92037*

Attendees will gain a further understanding of the concept of "cold case" homicides; the background of the problem and identification of the means and methods for re-activation of these cases, and how changes in relationships and technology have allowed an increasing number of these cases to now be solved.

This presentation will demonstrate the solution of cold case homicide results only from the tri-fold team effort of investigators, prosecutors, and forensic laboratory personnel. The role and relationship of each is critical to these solutions. Changes in technology, including means and methods to process heretofore untested evidence, previously examined evidence, and the expansion of data banks such as CODIS and AFIS systems offer enormous possibilities to solve unsolved cases. Awareness and understanding of the inter-relationship required for successful cold case investigation and prosecution is necessary to successfully resolve these cases.

The objective of this presentation is to inform the forensic science audience of the results of a study designed to identify those solvability factors acknowledged by experienced homicide investigators as significantly contributing to the solution of previously investigated, yet unsolved, "cold case" homicides.

The number of unsolved murders in the United States is unknown. In the past decade, decreasing crime rates and increased forensic technology have combined to allow some law enforcement agencies the opportunity to re-investigate older, previously investigated but unsolved homicides. These cases have been dubbed by the media and public as "cold case" homicides. Groups of investigators dedicated to this facet of homicide investigation have been revealed in the literature as "cold case squads."

This qualitative study sought to identify and examine critical solvability factors in "cold case" homicides which have been successfully solved. An interview methodology combined with supplementary document review of 20 solved "cold case" homicides and analysis of 100 additional cold case homicides previously selected by the agency for re-investigation formulated the basis for the findings of this study. Six experienced cold case homicide investigators in the Unsolved Unit of a large urban sheriff's department participated in this study. This data was further synthesized with data resulting from examination of the systematic review utilized by the agency to assess in excess of 2,000 unsolved homicides for future re-investigation.

After attending this presentation, attendees will understand the concept of "cold case" and the background of this problem in society. Attendees will learn the various methods by which law enforcement agencies have identified their particular "cold case" problem, and the means and methods by which a cold case file may be located, reviewed, and an investigative plan formulated. Cold case homicide investigation is founded in the previous written record. On some occasions, this record does not, or never did, exist. Restoration of the case file and identification of methods that may be used in cold case investigation will inform the attendees of those factors which have been found by experienced investigators to contribute significantly to the solution of cold case homicides. In addition, attendees will be presented with means and methods to identify and recover relevant physical and biological evidence, despite the passing of decades.

The results of this study identified significant factors that contribute to the solution of cold case homicides. These factors may be construed as 1) changes in relationships and 2) advances in technology. The author will present an in-depth analysis of these factors. Changes in relationships will be explored to illustrate the psychological, human component of the reinvestigation of cold case homicides. Advances in technology and the expansion of data banks as exemplified by CODIS and AFIS databases will be discussed in depth to illustrate the expanding role of forensic science in the identification of suspects in cold case homicides. Further understanding of the role of technology and human relationships in cold case homicide investigation resulted from this study.

A paucity of research exists in the field of homicide study, and even more so in the arena of cold case homicide investigation. This research study may be the first of its kind to address this issue in the construct of an academically based study offering pragmatic results that identify applicable tools and techniques which enable law enforcement investigators and their forensic partners in the laboratory to identify, investigate, and solve unsolved, "cold case" homicides.

Cold Case, Homicide, Investigation

D4 Back-Transfer of Footwear and Tire Tread Design on Victim Clothing

Ernest D. Hamm, BA, 8628 Andaloma Street, Jacksonville, FL 32211-5013*

Attendees will learn of the possible presence of the pattern design of tire and footwear tread patterns on inside surfaces of clothing as a result of violent contact actions. The existence of this evidence may not be readily observed by the investigator and this presentation stresses a need for additional examinations to be considered in some cases.

This presentation will describe the process by which the recovery of potentially valuable investigative information through the identification of footwear, tires, and other objects involved in criminal acts such as hit-and-run accidents and aggravated assaults. This associative evidence can assist in determining the relationship of the objects with individuals.

Contact pressure on the outside surfaces of wearing apparel made by an object having a three dimensional pattern that can result in the back transfer of the object's pattern design if there is suitable transferring material present on the underlying surface such as be bare skin or other layers of clothing. While the pattern transfer on the outside surface may be visible as a negative representation of the object's pattern design, the back transfer on the inside surface can be seen as a positive depiction of the design features. However, a visible contact mark may not be seen on the outside surface if there is no transferring medium on the object, but the pressure can still be sufficient to result in an inside back transfer of design features. The presence of a transferring substance on underlying surfaces can result in a pattern transfer on multiple layers of clothing. Negative and positive tire tracks may not necessarily represent corresponding contact points because of differing areas having the transferring material. In the case of tire and footwear tracks, the back transfer can provide sufficient detail of class characteristics to aid in brand identification or association with a known footwear or tire.

While this type of evidence has been associated with footwear and tires, the same type of pattern transfer could be encountered in other types of assaults in which the image or outline of a weapon could be discerned. It has also been found that some transferring substances can require subsequent enhancing techniques.

The author will show a case involving a negative tire track on a trouser leg visible because of tire tread contamination and the corresponding positive tire track from material on the victim's skin as a result of being ran over with a vehicle. There will also be illustrations of experimental trials to demonstrate the likelihood of positive and negative track representations from a single contact action on multiple layers of clothing resulting from the presence of transferring substances.

Tire Tracks, Footwear Tracks, Associative Evidence

D5 Case Study: The Uncertainty of Establishing a Postmortem (PMI) Interval Based on Entomological Evidence Incorporating the Influence of Elevation on Ambient Temperature Reconstruction

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The presentation will discuss a particular case study that accounts for the influence of elevation on temperature when estimating a postmortem (PMI) interval based on entomological evidence. The authors intend to demonstrate how this environmental effect can influence a PMI estimate if not considered in the evaluation of temperature data. The attendee will learn how to incorporate elevational effects on ambient temperatures and subsequent PMI estimates based on degree day calculations with this modification to ambient temperatures.

This presentation will demonstrate that within general ecological and meteorological literature, elevation or altitudinal effects on temperature are well documented. However, little or no discussion among forensic entomologists has addressed this environmental influence on the calculation of a PMI. This particular case illustrates how failure to incorporate elevation modifications to ambient temperature can significantly underestimate a postmortem interval using insect evidence. The authors hope that forensic entomologists will recognize how elevation not only influences the established ecotone of a death scene but also impacts temperature reconstruction that is vital to reducing uncertainty on PMI estimations from insect evidence. Further, the authors hope that this case report will foster increased interactions between forensic entomologists and meteorologists.

Forensic entomologists define postmortem interval (PMI) as the period between oviposition (*i.e.*, egg laying) and the discovery of a corpse followed by preservation of recovered insect larvae. This approach rests on the fundamental relationship between insect development and the number of degree-days or thermal units accumulated over time. The comparison of average ambient temperatures with a base developmental temperature is recognized as a powerful method for estimating PMI. Several factors can influence specific insect development including individual species characteristics, weather and climate, presence or absence of maggot mass, drugs and toxins, as well as geographic domain.

A tendency exists for entomologists to act as their own meteorologist without taking into account various environmental influences which may increase the uncertainty associated with a specific PMI estimate. For example, adjustments to the temperature record are often required to account for local differences in elevation, vegetation, sun exposure, ground cover and soil type, wind, and recent weather including precipitation amount and intensity; even the rate of temperature increase or decrease may be considered important. In addition, micro-meteorological studies suggest small-scale climate forcing may produce pronounced temperature variations that are seldom captured by an observational network. These environmental influences often complicate the reconstruction of the most appropriate ambient temperature regime associated with an actual death scene.

The authors will present a case study in which the body of a young adult male was discovered near a ridgeline in steeply sloping terrain in southeastern Pennsylvania. The body was located in a heavily wooded location at an approximate elevation of 270 meters above mean sea level (MSL). The closest National Weather Service maintained weather observation station was located 14 km from the death scene at an elevation of 121 meters MSL on the property of a regional airport. Approximately 12 arthropod taxa were collected from the remains with 33 % of the identified flies of forensic importance. Post-feeding *Calliphora vicina* maggots were collected and represented the oldest identifiable insect taxon used to estimate the PMI. The final PMI was modified to include the primary influence of elevation on temperature, and secondarily, the exposure of the death scene to direct sun, angle of incidence, and slope.

Elevation, Postmortem Interval, Temperature

D6 The Investigation of Abuse in Nursing Homes

Betty L. James, RN, BSN, MA, 6822 West St. Joseph Highway, Lansing, MI 48917*

The goal of this presentation is to inform forensic scientists about abuse of residents in nursing homes by facility staff and how one state is trying to solve the problem. The presentation will impact the forensic science community and the public by examining the failure of present statues and laws, which need to be enacted to protect the vulnerable nursing home residents from an abusive staff.

Who is protecting your loved one who resides in a nursing home? Who guards her against having her precious diamond engagement and wedding rings stolen from her finger as she sleeps? What is being done to protect her from being sexually assaulted, if she lies unconscious? Who prevents the diversion of medications meant to alleviate her pain and suffering by a thief who cares only about his own addiction? What is done to protect her from physical, psychological, or sexual abuse? Part of the solution to the above problems is to enact federal and state legislation and then enforce that legislation.

In 1990 the federal government developed a Resident's Bill of Rights. This included 37 rights to which the individual is entitled, while a resident in the nursing home. The Federal government included specific directions to the states requiring all nursing homes participating in Medicare/Medicaid to educate the resident, families and public about The Resident's Bill Of Rights. Additionally the facilities were required to provide each resident entering a nursing home a copy of the Resident's Bill of Rights and explain it in language that easily understood.

Federal Medicare/Medicaid laws, Michigan Public Health Code and Michigan Nursing Home Regulations regulate the State of Michigan nursing homes. All states have similar legislative acts.

The Federal Medicare/Medicaid regulations require an annual survey be conducted on all certified nursing homes. A team of surveyors including registered nurses, dietitians, sanitarians, and social workers spend four to five days in each facility completing seven tasks that the federal government outlined for the annual survey. In the State of Michigan, for example, federally certified surveyors from the Michigan Department of Community Health complete the surveys and investigation of complaints.

The Michigan Legislature was concerned about the number of validated complaints and convictions that the Attorney General's office processed against nursing home's staff. The legislature, in conjunction with the representatives from the public and nursing home provider groups, studied the conditions in the nursing homes to determine why there were so many complaints filed against the facilities concerning resident care. Following the study, the legislature enacted Public Act 303, in 2002.

Michigan's Public Act 303 of Public Acts of 2002 (revised 12/15/03) was enacted to protect a vulnerable population. A person is defined as vulnerable when he or she is age 18 or over who, because of age developmental disability, mental illness, or physical disability requires supervision or personal care or lacks the personal social skills to live independently on his/her own.

This statute became effective on May 10, 2002 and required nursing homes, county medical care facilities, and homes for the aged to have a criminal background check on all employees hired after the above date. The new law allowed for three types of criminal background checks that are acceptable depending on the situation. These checks are (1) applicants who have already had a recent Michigan State Police (MSP) check. (2) Applicants who have resided in Michigan for over three years, and (3) those applicants who have not resided in the state for three years.

In early 2005 the Office of the Attorney General conducted a study of the effectiveness or ineffectiveness of the statute. The total population of 40,490 certified nursing assistants was identified statewide. The total nurse aide population in the study area were 5,533, 14% of the states nurse aide population. The areas studied contained 50 nursing homes, approximately 12% of the states 472 nursing homes.

A complete criminal history was obtained for all nurse aides within the geographic area. The checks included convictions, outstanding warrants, confirmed protection orders, and the mental health incompetence/commitment orders. The study included the criminal history data only of nurse aide employees, if compete information was available.

The study revealed that certified nurse aides had a total of 1,218 outstanding warrants that if convicted of the offenses could preclude them from working in a nursing home. Excerpts of the study will be presented during the presentation, which will indicate that the present system of checking the backgrounds of certified nursing assistance is not acceptable.

Nursing Home, Abuse, Elder

D7 Intuition, Interaction, and the Team Approach to Death Scene Investigation

Mary Beth Hauptle, DDS, Fulton County Medical Examiner's Office, 430 Pryor Street, SW, Atlanta, GA 30312*

Attendees will learn the advantage of "thinking out loud" and trusting their instincts on the scene of death, in a team approach to resolving issues regarding the manner of death. This presentation will impact the forensic community by fostering the team approach to quality death scene investigation. Through review of a series of documented death scene investigations, the author will offer insight into the interplay of deductive thinking with intuition in making assessments regarding the circumstances of a death without witness. By offering lessons learned through experience, this presentation will teach the value of sharing information on the scene by naturally "thinking out loud." Typical questions investigators need to ask themselves about the imagined scenario of death will be posed.

The imagination will be given full rein in deciphering the activities of the decedent at the time of death, coupling known environmental facts with surmised behavior associated with poor judgment when ingesting alcohol. Scenes of death resulting from incumbent failure to execute safety precaution on the decedent's part will be presented.

The attendee will walk through an assessment of two distinctly separate yet similar death scenes and examine the thinking that went into drawing conclusions regarding the proposed manner of death. In comparing and critiquing the photographic documentation of the two cases, the author will demonstrate lessons learned in establishing a good vantage point of the photographs in "telling the story" and the impediment of artificial barriers to "seeing the forest for the trees." Challenges to elucidating the suggested unfolding of the circumstances of death to the medical examiner back in the office will be discussed.

The scene of an unwitnessed death involving decomposed remains will pique the curiosity of the attendee in mentally recreating the decedent's final actions by asking, "How and why did he wind up in that position?" When last known alive time was vague at best on an unwitnessed death scene investigation with mummified remains, an example of the rapid firing of the unconscious mind will answer the question, "What's wrong with this picture?"

Scene, Investigation, Death

D8 Case Controls: Law Enforcement's Best Kept Secret - Tools Used for Validating Information From Cold Cases

Alan Price, MA, Southern Institute of Forensic Science, Regional Field Service Office, PO Box 336433, Greeley, CO 80633*

After attending this presentation, attendees will be able to establish and maintain case controls under specific guidelines for solving major cold cases. This presentation will demonstrate how the principles of using case controls has been used by law enforcement, in an ad hoc method for many years, yet has gone formally undefined in the literature. This concept is passed from one detective to another without any formal guidelines being drafted and presented to standardize this important principle. This presentation provides both an explanation of describing case controls as well as outlining guidelines for the long-term management of case controls.

This presentation formally introduces the term "case controls"—sometimes referred to as "case keys" or "hold-back information"—into law enforcement and forensic literature, and provides guidelines for establishing and maintaining case controls as a means of validating information in cold cases. When a case has been inactive for months or years, it is imperative for investigators to be certain that a suspect or witness is admitting to the actual facts of a case. This is accomplished by the establishment of case controls early during the initial crime scene evaluation and review by investigators. Case controls should be discreet actions or behavior performed by the perpetrator (i.e., not newsworthy), yet these actions be obvious enough to be observed by a witness. The actions must be non-evidentiary in nature so that defense counsel cannot claim that law enforcement withheld pertinent information in the case. Although not readily available to on-scene investigators, evidence discovered through more technical forensic laboratory techniques can contribute to establishing case controls. For case controls to remain legally effective they must be kept from the media and other non-involved law enforcement personnel outside of the case investigation. The disclosure of case controls by an individual will immediately implicate the disclosing person of having first-hand knowledge of the crime and/or crime scene.

Law enforcement entities around the country use case control methodology in an *ad hoc* fashion, and although they have been used for years to validate information in homicides and other major crimes, the literature neither mentions the term, nor does it provide a specific definition of the principle. Case controls may be in place for years until either a suspect or a knowledgeable witness presents them. A means of evaluating and validating new case information is essential, particularly in long-term investigations where investigators may have been rotated to another assignment, retire, or leave their careers.

The suspect's signature:

The outdated study of the investigative process by the Rand Corporation is one of the most comprehensive studies of its type, yet it failed to address the use of case controls in solving major crimes. Current investigative text books also fail to mention the utility of case controls. It is imperative to demonstrate that case controls are not the *modus operandi* (MO) of the crime, and a sharp distinction should be made between the MO and the signature of a suspect. A perpetrator's signature left at a crime scene can be used as a very significant case control. John Douglas et al., define a suspect's signature as being, "a repetitive ritualistic behavior by the serial offender, usually displayed at every crime scene and having nothing to do with the perpetration of the crime." Obviously, if the actions of the perpetrator are specific to his crime these actions can become a means of verifying a suspect's admissions or a witness' observations. This presentation encourages the retention of any discreet actions or behavior performed by a perpetrator, including signatures, as major case control.

Case Control Management:

The management of case controls is crucial to assure their use as a validation tool in solving a cold case. The following steps in managing these case controls are suggested:

1. The controls must be recorded in writing.
2. Controls should be placed in a sealed envelope and attached to the investigator's working copy of the case.
3. Access to the controls must be solely limited to the detectives that are responsible for investigating the case.

Case controls are never disclosed to the media. Divulging them eliminates their utility. The establishment of multiple case controls in each major case is recommended.

Elements used as case controls may include:

1. Specific actions of the perpetrator(s) that can be documented subsequent to the commission of the crime.
2. Instrumentalities used to commit the crime.
3. Specific elements in the immediate environment where the crime may have occurred.
4. Identified "souvenirs", "trophies," or "things of value" that may have been taken by the suspect.

It is suggested that investigators and crime scene technicians consult with their prosecutor's office to establish how the prosecuting authority wants the case controls to be maintained in criminal investigations. Since case controls are imperative in solving cold cases and validating information from suspects and witnesses, it is hoped that investigating agencies will draft and implement guidelines for their contribution in solving crimes.

Case Controls, Suspect's Signature, Modus Operandi

D9 Operation Iraqi Freedom's Social, Psychological, & Clinical Impact on Returning Soldiers

Kathleen A. Carson, MS, MBS, PO Box 20402, Billings, MT 59104*

After attending this presentation, attendees will have a better understanding of the personal impact and psychological impact of American soldiers serving in combat, the social impact of soldiers working with the extremely persecuted (Shiite children), the physical impact on soldier clinical forensic health issues incurred after two Persian Gulf Wars, and the forecasted future developments in Iraq's future.

We are all in one way or another parents, relatives, and fellow co-workers of soldiers currently or recently serving in the desert. This presentation will impact the forensic community and/or humanity by getting the word out to people who can make a difference for those who can no longer speak, Fallen Comrades.

Returning American soldiers become forensic suspect cases when they uncontrollably kill their spouse or act out rage and anger on others. Crime is filled with numerous accounts of prior soldiers killing from sadistic rapists to serial killers. Other soldiers will become clinical forensic cases like in the case of the Persian Gulf Illness.

The author presents this information as a soldier's case study in an effort to foster understanding and dedication to the men and women who have served and who shall serve honorably in the United States Armed Forces. Information gathered for this presentation was based on 8.5 months in Iraq as a Combat Service Support Acting Company Commander and Supply Platoon Leader in 2004 during Operation Iraqi Freedom II in southern Iraq and from serving as a Security Operations Assistant in King Khalid Military City, Saudi Arabia for three months during the first Persian Gulf War in 1991. It is recommended that those with forensic knowledge in areas of Criminalistics, Pathology, Psychology, Psychiatry, and Sociology assist in their appropriate field of research to help veterans readjust to society socially, psychologically, physically, mentally, and clinically in an effort to prevent unnecessary violent crime.

War, Soldiers, Impact

D10 An International Survey of Forensic Sciences in the Investigation of Human Rights Violation Cases of Torture

Debi Spencer, MFS, Clark County Coroner's Office, 1704 Pinto Lane, Las Vegas, NV 89106*

This poster will present a survey of international human rights violations cases of torture and the involvement of the forensic sciences. The presentation will emphasize the fact that torture exists today in over 120 countries including democratic countries and to promote a more proactive role of all the forensic sciences in cases of torture on an international scale.

Introduction: Defining torture is imperative in understanding the significance of forensic sciences involvement. Torture was defined by the United Nations in 1984 and this was the definition implemented for this study. Beyond understanding the definition of torture, it is pivotal to forensic investigations and the applicable forensic sciences to recognize the history of torture, the methods, and instruments of torture, the possible physical injuries sustained, in addition to the goals of torture, the target groups, and the potential perpetrators.

Method: Professionals who have direct involvement with victims of torture were surveyed to identify the nature and scope of the forensic science involvement in the investigation of past torture incidents. The participants were given a normative questionnaire requesting them to report on one individual incident. They were asked basic background questions about the victims and themselves including education attainment in the forensic sciences, the physical injuries the victims sustained, and several questions about the involvement of the forensic sciences. They were provided a list of the disciplines of forensic sciences including forensic investigation, forensic medicine/pathology, nursing, anthropology, radiology, odontology, psychology, toxicology, entomology, criminalistics, DNA analysis, firearm/tool mark analysis, trace evidence analysis, and document analysis. They were asked to indicated the involvement of these disciplines either to identify the victim, to obtain medical evidence, to determine time or cause of death, to gather evidence for a possible prosecution or for any other pertinent reason. They were also asked about physical evidence, documentation of that evidence as well as feedback on the judicial process of the case and professional opinion on the International Criminal Court and the importance of forensic science involvement in torture cases.

Results: There were 31 participants and 32 torture cases reported. The participants came from 15 different countries and from a variety of professions: 42% were from the psychology/ counselling field, 26% were from the medical field, 16% were human rights workers, 6% were lawyers and social workers, human rights investigators, and human rights educators were each 3%. They reported on torture victims from Afghanistan, Bolivia, Burundi, Cameroon, Chechnya, Chile, Ecuador, El Salvador, Georgia, Guinea, Guatemala, India, Iraq, Kenya, Nigeria, Pakistan, Rwanda, Sudan, Somalia, Uganda, Zimbabwe, and the United States between the years of 1973-2004.

In 66% of the torture cases, it was indicated that none of the disciplines of the forensic sciences were involved. In 11 of the 32, the following forensic sciences were indicated to be involved: forensic medicine/pathology, forensic nursing, forensic psychology, forensic radiology, forensic photography, DNA analysis, document analysis, and firearm/tool mark analysis. Forensic medicine/pathology was the most common forensic science being involved in nine of the eleven cases. It was also found that the forensic science involvement increased as the political power of the victim's target group increased.

Only 11 participants had formal education in one or more of the forensic sciences; therefore, a lack of knowledge in the forensic sciences has been concluded from these findings. It was also found that educational attainment of the forensic sciences was actually higher in participants that were not from one of the main English speaking countries.

Of the 32 cases, ten indicated no judicial process, six indicated charges were laid, of which two went to a criminal trial, one was in front of the Human Rights Commission and expected to go to trial, five were pending a possible immigration trial, and nine cases were involved in immigration hearings in the United Kingdom, Canada or the United States. This study found that there was a slightly greater involvement of the nature and scope of forensic sciences in future criminal trials compared to immigration hearings for asylum mostly in the area of physical evidence.

Conclusions & Recommendations: Forensic science expertise is inadequately applied in the international investigations of human rights violations cases of torture. Therefore, this will require an increase in forensically trained professionals in all countries working with victims of torture to detect, collect, and preserve forensic evidence. Greater recognition and appreciation of the problem and the ability of forensic science to address this problem is needed. An expansion of programs like The Physicians for Human Rights- International Forensics Program and an international involvement in the International Criminal Court would be steps in the right direction.

Torture, Human Rights, International Criminal Court

D11 Cardiac Rupture Following Blunt Chest Trauma: The Case of a High Semi-Truck

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This author will demonstrate the mechanisms of cardiac rupture following a particular road traffic accident. This presentation will explain that cardiac rupture is the most common injury following road traffic accidents. This injury has a high mortality rate. Blunt cardiac ruptures most commonly follow road traffic accidents and have a high mortality rate.

This is the case of a truck driver who lost his life following a fatal accident involving his semi truck and a low viaduct. The driver failed to wear his seat belt and was travelling about 70km/h.

Cardiac Rupture, Road Traffic Accident, Autopsy

D12 Food/Foreign Body Asphyxia or "Café Coronary": An Often-Ignored Cause of Death

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After attending this presentation, attendees will be able to identify risk factors influencing food asphyxia especially in elderly individuals; and be able to suggest preventive as well as effective accident control strategies that can be used to minimize the risk of food asphyxiation among the elderly.

This presentation will impact the forensic community and/or humanity by providing knowledge that foods are a high-risk factor and should be distributed in private systems. Awareness could be a first step in reducing the incidence of food body asphyxia. It is the role of forensic community to inform the public.

Introduction: Foreign body asphyxia is known to forensic pathologists, but many accidents are fatal because the event often goes unidentified. The authors analyzed six autopsy cases carried out recently at the

forensic institute in Angers, France. The results were compared with available literature. The goal of this study was to identify risk factors.

Method 1st, 2nd and 3rd cases: Women aged 53, 41, and 42 with excessive body mass and living alone, are each found dead at home in the kitchen presenting signs of major asphyxia. The autopsy revealed suffocation from a 25g piece of non-chewed meat for one, a 7x2 cm lump of cheese for another and a ten cm piece of bun for the third. Two of the women had dental prostheses. Toxicological analyses show the presence of alcohol and therapeutic doses of tranquilizers in two cases. 4th case: A 47-year-old man living alone and found dead in the kitchen slumped on the table. Suffocation was due to a 47g piece of non-chewed meat. The general dental status was poor and many teeth were missing. The patient had been treated with several anxiolytic tranquilizers. 5th and 6th cases: Men ages 57 and 60, living with a friend, found dead, one in the kitchen and the other in the bedroom, after complaining of discomfort according to a third. The autopsy concluded suffocation due to a piece of meat in both cases. The dental status was poor. Analysis revealed high blood-alcohol levels and the presence of anxiolytics. 7th case: A 62-year-old man experienced discomfort while eating in a restaurant. The autopsy revealed suffocation by a piece of meat. Toxicological analyses revealed a blood-alcohol level of over one gram.

Discussion: The subjects are of average age, while relevant literature describes these accidents at either extreme of life ages. Either the dental status was poor, or the subjects wore dental prostheses. This concept is confirmed by the literature: mastication, a *sine qua non* condition for correct deglutition, is a condition that requires good teeth. Alcohol is a recognized predisposing factor, as this study confirms. Similarly, the ingestion of barbiturates, either hypnotic or anti-epileptic, is often revealed (in six out of seven cases in this study). Authors also described the role of anti-dopaminergic or anti-cholinergic drugs. Finally, psychiatric pathologies are also considered risk factors. Four people underwent psychiatric treatment. This final element is perhaps linked to these people taking an increased-risk treatment. The foodstuffs found are often substances that are difficult to chew (meat, bread, cheese), that require more significant mastication efforts and good teeth. The accident often occurred at mealtime or afterwards. The study revealed only one case occurred before witnesses. In all other cases, the body was found in the kitchen.

Conclusion: In most cases, asphyxia is the cause, especially with more fragile subjects, who are suffering from psychiatric pathologies, chronic alcoholism and/or undergoing anxiolytic treatment. Emergency teams must bear this diagnosis in mind and attempt a Heimlich maneuver. Above all else, prevention must occur via improved oral and dental care for patients exposed to these pathologies, so as to reduce risks.

Food Asphyxiation, Autopsy Study, Cafe Coronary

D13 Sudden Cardiac Death In Young Adults

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Attendees will learn about the incidence of Sudden Cardiac Death in young adults, the contribution of social factors and behaviors to health status, modification of these factors and behaviors, how to raise community awareness of sudden cardiac death, and inform them of available basic non-invasive cardiac diagnostic screening tests.

This presentation will impact the forensic community and/or humanity by identifying Sudden Cardiac Death as a major public health problem; along with other community agencies identify populations at risk.

Introduction: Sudden Cardiac Death (SCD) is annually the leading cause of natural death in the United States. It is unexpected and often the result of untreated rapid ventricular tachycardia or ventricular fibrillation. Sudden cardiac death syndrome may be due to a wide variety of different conditions, including but not limited to acute myocardial infarction, coronary artery disease, cardiomyopathies, myocarditis, valvular heart disease, conduction abnormalities and drug toxicity (prescription and recreational). Therefore, the Harris County Medical Examiner's Office has identified SCD as a public health problem of great significance. Identifying populations at risk for sudden cardiac death and implementing interventions that will decrease morbidity and mortality.

Purpose: The study was completed to identify those populations at risk for sudden cardiac death and to implement interventions with other agencies within the community.

Methods: A retrospective record review was conducted at the Medical Examiner's Office, identifying deaths reported from 2002 to 2004. Specifically natural deaths were reviewed in which cardiac death was listed as the primary cause of death after autopsy (external exams included). All ages were queried with special attention to those individuals under the age of 50. Social factors, such as obesity, tobacco use, and chronic ethanolism and their significance in this population were also reviewed.

Results: Persons who died of sudden cardiac death in 2002 comprised of 1,453 or approximately 52% of those individuals autopsied at the Medical Examiner's Office. Of those cases, 20% were under the age of 50, 72% were male and 51% were Caucasian. A notable 43% of the individuals were smokers. Obesity was listed on the death certificate as a contributing factor in 5% of the cases and chronic ethanolism contributed in 3%. Atherosclerotic Cardiovascular Disease and Hypertensive Cardiovascular Disease were diagnosed in 54% of those individuals under the age of 20 years. From 2002 to 2004, cardiovascular disease was shown to be the cause of death in 16 children between the ages of 12 and 18 with the majority collapsing while participating in athletic events.

Implications: The important contribution of social factors and behaviors to health status has been documented in the medical and public health literature. Modifications of these behaviors may greatly reduce the risk of SCD. The Medical Examiner's Office and other public health agencies have a vital role in raising community awareness of SCD. A key goal of public health education concerning SCD should be to inform the community of the benefits offered by basic non-invasive cardiac diagnostic screening tests, such as requiring electrocardiograms for young athletes in order to detect potentially fatal arrhythmias prior to participating in sports programs.

Sudden Cardiac Death, Social Factors and Behaviors, Young Adults

D14 Use of Portable Instruments for Locating and Sampling Suspected Arson Debris in the Field

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Attendees will learn about a method for location of possible accelerants at a fire scene and collection of volatile compounds from debris in the field, eliminating the need to store large amounts of debris. This presentation will impact the forensic community by demonstrating a novel use of technologies that may be more efficient than current methods.

Arson is a serious crime resulting in hundreds of deaths and billions of dollars in property damage per year. Many fires are started by the use of an accelerant but the cause of an arson fire can be difficult to find. Electronic noses were evaluated in this study for their ability to detect the presence of accelerants in specific areas of a scene. After the location of possible accelerants has been detected by these devices, they may be collected using a dynamic headspace sampler to concentrate volatile compounds into an absorbent filled tube. The instruments were studied for their abilities to detect various types of compounds. Diesel fuel, cigarette lighter fluid, charcoal lighter fluid, and gasoline were examined neat or spiked onto a matrix material and burned. The substances chosen cover the volatility range of common ignitable liquid residues in order to express any inefficiency in the collection range of the instruments.

These electronic noses are small battery operated instruments that give a reading of the amount of VOC's present in air. In this way, they can be used to scan a scene for areas of interest. Accelerant detecting canines can be used for the same purpose. These instruments, while possibly not as accurate as canines, can be inexpensive and do not require a highly skilled operator. Several types of instruments are available, but this study utilizes the TLV Sniffer® (Bacharach, Inc., Pittsburgh, PA). The TLV Sniffer® is not complex in design. A small pump pulls samples of air into the instrument. The change in temperature of a resistance element is measured and expressed on the meter in parts per million of hexane. Another commercially available detector, the tpi®Pocket Combustible Gas Leak Detector (Test Products International) has also been tested. This detector gives an audible alarm and four lights indicating the level of alert.

Different matrices were examined with and without accelerant using the TLV Sniffer®. Carpet and padding, wood, Styrofoam, plastic, newspaper, wood and laboratory tissues were studied burned alone or with accelerant. Carpet and padding, wood, newspaper, and cotton without accelerant showed similar levels burned alone as samples burned with accelerant. Therefore, high readings do not necessarily indicate the presence of accelerant. The type and amount of matrix must be considered in the analysis of debris. All of the matrix materials were mixed together to form a representative matrix of common household materials for further testing. The tpi®Pocket Combustible Gas Leak Detector has also been shown to alert to small amounts of accelerant but did alert in a few instances to burned debris alone. Interfering substances can cause difficulties with these types of instruments. However, when used as a preliminary indicator of where to sample, they have shown to be useful.

The Canine Accelerant Detection Association proficiency test for canines was replicated using the TLV Sniffer®. The detector was found to successfully discriminate between samples containing only matrix and those containing accelerants. However, it was not able to alert to the location of a small amount of accelerant spiked onto pine board.

For field collection of volatile compounds from debris the Portable Arson Sampler (Portable Arson Samplers, Tooele, UT) was used. The device uses dynamic headspace concentration to remove possible ignitable liquid residues from debris and store them in an adsorbent filled tube. A pump draws air from a heated debris chamber and the volatile compounds in the debris are absorbed to the polymer beads in a pre-packed glass tube. Use of this instrument in the field potentially eliminates the need to transport large volumes of debris to the laboratory. Compounds are removed from the adsorbent by solvent desorbtion and can then be analyzed using gas chromatography/mass spectrometry. The data analysis methods used are intended to help confirm or exclude the presence of an accelerant in a suspected arson sample despite possible interferences from background, pyrolysis, and combustion products. The spectra are examined for the characteristic patterns of known accelerants. By this method, the Portable Arson Sampler has shown its ability to concentrate small amounts of accelerants from debris. The lowest volatility compounds were not efficiently collected under normal operating conditions, but enough of the characteristic pattern of the accelerant is recovered to allow identification.

Electronic Nose, Dynamic Headspace, Arson

D15 Intimate Partner Homicide in Lane County, Oregon: Its Relationship to Male Suicidal Ideation & Behavior

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After attending this presentation, medical examiners, death investigators, and public health officials will pay closer attention in their case work for the potential of male suicidal subjects to also have simultaneous homicidal ideation, particularly in relationship to violence toward intimate partners.

This presentation will impact the forensic community by increasing the consideration of the significance of risk toward homicide of male suicidal subjects. Implications for strategies of prevention, detection, and intervention in suicidal ideation in males will be discussed.

The rare incidence of intimate partner homicide is often amplified by intense public reaction coupled with scrutiny of public agencies by media reporting of such cases. Most scrutiny is retrospective upon how such an incident could have been prevented by intervention. The medical examiner has the opportunity of putting these deaths in perspective from their etiology in the entire context of public health and mental health issues in a community.

A recent such case in Lane County, Oregon involved an estranged husband who shot his wife at her residence as she returned from a court date at which he failed to appear. Responding police negotiated with him for several hours before he shot himself upon their entry to the residence. This case is resonant with a current case in the United States Supreme Court regarding the culpability of the law enforcement agency in failing to enforce an existing restraining order in a domestic dispute that resulted in a homicide-suicide of a father and his three minor children.

A survey of 75 homicide cases in Lane County over seven years demonstrated that women comprise 35% of homicide victims, and that about half of these women were killed by their intimate partners. Of these cases six also resulted in the suicide of their male assailants. The resulting question is posed: What percent of the far larger group of suicides occurred in the context of homicidal ideation toward an intimate partner?

This study reveals a significant number of suicides that occurred during or subsequent to violence directed at an intimate partner, short of homicide. One conclusion is that there is a great pool of males that frequently contemplate suicide as a mode of thinking and consequently engage in several modes of self-destructive behavior including domestic violence, suicide, and occasionally homicide. These cases usually occur without significant public awareness. This survey would suggest a relationship between the etiology of male suicidal ideation and the precipitation of domestic violence. Deeper study of this correlation may lead to strategies of intervention at the point of public contact between the perpetrator/victim and the medical-legal system.

Suicide, Domestic Violence, Intimate Partner Homicide

D16 The Variable Role of Kenyon Worldwide Emergency Services in the Mass Disaster Context

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Attendees will learn the variable role of the large scale mass disaster response organization, and highlight the role of interdisciplinary cooperation in this process. This presentation will impact the forensic community by making the forensic community aware of the variability that characterizes mass disasters, and the flexibility, in logistics, personnel, and protocol required to successfully adapt to this variation.

The efficient investigation of mass casualty incidents is dependant on the effective consultation of experts from a variety of disciplines that may include family assistance, crisis intervention, logistics, forensic investigation, forensic pathology, forensic anthropology, morgue technicians, and others. Every disaster is different and the coordinated adjustment of personnel in response to this variation can both expedite and increase the accuracy of the recovery, identification, and repatriation processes. This poster will use two recent disasters, the 2001 attacks on the World Trade Center in New York City, and the recent Indian Ocean Tsunami in Phuket, Thailand to illustrate the broad circumstantial variation that characterizes mass casualty situations; including discussions of variation in the scale of the events, logistical concerns, jurisdictional issues, and the issue of the taphonomic variation that distinguish the two events much of which is related to the distinction between man made and natural disasters.

Kenyon Worldwide Disaster Management is an international corporation whose mandate is to provide services in the wake of mass fatality incidents that include search and recovery of remains and personal effects, establishment and operation of mobile morgues, preparation, and preservation of remains both for repatriation and subsequent analysis, receipt and processing of personal effects, liaison and cooperation with law enforcement and emergency response agencies, and memorialization. Kenyon maintains a directory of experts of various specialties who can be deployed on short notice to fulfill roles in support of local agencies. The combination of those deployed is dependent on the circumstances of event and the needs of the client. In both New York and Thailand, Kenyon provided support in the form of logistics and personnel. This support was manifested in very different ways, however, as a result of the complex interaction of local resources and the specific circumstances of each disaster. For example, the city of New York maintained a contingency plan according to which the Office of the Chief Medical Examiner responded to the events of September 11th, 2001, and contracted Kenyon for additional support in the fulfillment of very specific goals in the investigation. The major role of Kenyon was as a provider of 1) expert personnel, including mortuary experts, and physical anthropologists, and 2) technology in the form of a technique by which the remains from the Trade Center were preserved for curing in a manner that is both economically feasible and effective for the preservation of potential DNA evidence. In addition, at the request of the Thai government, under the direction of the Australian government, Kenyon provided technical and administrative support in the Thai Tsunami Victim Identification Center. This information management center became the nerve center for all antemortem and postmortem record collection and reconciliation of records to determine positive identification of victims.

Specifically, this poster will include a written discussion of Kenyon's responses to these two incidents, and details regarding the complex cooperation between Kenyon and other agencies. The poster will begin by detailing the very specific differences between these two situations, including the fact that one was the result of deliberate human intent, and the other an act of nature. The taphonomic results of that distinction will also be discussed. Another distinction is the difference in the geographic scale of the two events and the associated jurisdictional implications. It will also include a graphical presentation (in the form of a tree diagram) of the structure that each deployment adopted as far as personnel, equipment, liaison activities, technical support etc.

This poster will benefit members of law enforcement, and management of emergency response agencies who are interested in developing contingency plans in the event of mass disasters. This benefit will come in the form of both sample data from which these plans can be developed as well as a demonstration of the extent to which the circumstances of a mass disaster can dictate the best response to it. It is also of a broader interest to the forensic scientist, particularly those interested in involvement in mass disaster investigation and response.

Mass Disaster, Disaster Response, Forensic Scientist

D17 Death and Diplomacy: Multinational Forensic Responses to Mass Fatality Incidents

Andrew J. Tyrrell, PhD, Derek C. Benedix, PhD, Kenneth N. Dunn, DDS, Paul D. Emanovsky, MS, Mark R. Gleisner, DDS, and Elias J. Kontanis, PhD, JPAC-Central Identification Laboratory, 310 Worchester Avenue, Hickam AFB, HI 96853*

Attendees will learn of the South Asian Tsunami disaster, a tragic event that brought to light some serious deficiencies in the realm of multinational forensic responses to mass fatality events. Some of these deficiencies as seen from the perspective of forensic scientists working at the mortuaries and information/data management centers in Thailand will be discussed. The reader will be made aware of some o the major process and coordination related issues still facing multinational forensic response teams.

This presentation will impact the forensic community and/or humanity by discussing major process and coordination related issues still facing multinational forensic response teams. It is anticipated that this poster will generate discussion among forensic professionals to help better prepare for the next mass fatality incident that involves decedents from different cultures and nations.

While the mission of the Joint POW/MIA Accounting Command (JPAC) is to search for, recover, and identify missing U.S. service personnel from past wars, JPAC is also tasked to undertake humanitarian missions. On 27 December 2004, JPAC was ordered to assist in the forensic response to the effects of the South Asian Tsunami. This poster presents some of the fundamental difficulties to overcome when large numbers of international Disaster Victim Identification (DVI) response teams work together. It illustrates these problems with reference to a case study where a body was lost at least three times, and an overview of the protocols utilized/enacted by the international community and local Thai authorities.

The current standard for the international DVI community (and that ultimately used post-Tsunami in Thailand) is the INTERPOL Protocol. Since, in its current incarnation, DVI is largely a police process; the INTERPOL Protocol reflects this bias. The protocols maintain an implicit assumption that scientific methods are the standards by which identifications are made. However, there is an explicit lack of scientific methodology that explains how to resolve the complex problems that arise when attempting to identify unknowns from large scale, open ended populations.

As of 5 April 2005 over 174,000 individuals were presumed dead as a result of the 26 December 2004 South Asian Tsunami (CDC 2005). The confirmed dead in Thailand (CDC 2005) numbered 5,395. Approximately 50% of the dead in Thailand were non-Thai (CDC 2005). The Thai local authorities responded by collecting bodies and using local

identification protocols and chain of custody procedures. They began storing bodies at temporary mortuaries and using a combination of the limited number of available refrigeration facilities, dry ice, and mass burials to try and decelerate the decomposition process. Initially four temporary morgues were established at converted temples (Wats). The Thai Royal Police has jurisdiction over the identification process in Thailand, but other Thai ministries are involved.

The Thai Government generously encouraged other nations to send forensic assistance. Approximately 30 countries sent DVI teams, or their equivalent, to Thailand, totaling over 600 personnel. A large multinational group (the Thai Tsunami Victim Identification Committee – TTVI) was eventually formed to oversee the identification process because of an urgent need to standardize operations, and thus the INTERPOL DVI protocols were implemented.

An estimated 700 bodies were "identified" and released prior to the establishment of the international DVI process. Since then, 4,082 post-mortem and 2,164 ante-mortem data files have been created. From these data files, 1,112 bodies have been identified, including 1,046 identified on the basis of one type of data (962 dental, 71 fingerprints, ten physical, and only three DNA). Sixty-six others have been identified by combinations of data types.

More than 95% of identifications have been of persons aged >17 years. It is uncertain why there has been a failure to identify children successfully in Thailand, as children have been readily identifiable from previous mass fatalities (Sledzik and Kontanis 2005; Warren *et al.* 1999) and nearly 50% of the deceased were from first world nations where there is presumably wide availability of dental and other antemortem records.

This poster concludes by stressing the overwhelming need for an international coordination body with responsibility for DVI. This body's first priority must be a critical review of the INTERPOL DVI system. Identification and repatriation is essential for the post-traumatic resolution of communities. Humanitarian assistance does not stop with the living.

South Asian Tsunami, Mass Fatality Incidents, Disaster Victim Identification

D18 The Swiss Approach of Assistance to Suicide

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Attendees will learn the legal and ethical aspects linked to assistance to suicide in Switzerland and compare them with those in other countries. This presentation will describe how, while it is quite unusual in most of European countries and in the USA, the practice of assisted to suicide is quite common in Switzerland.

Similar to euthanasia, assisted suicide is a subject that induces much discussion in many countries. While the law is very liberal in some countries such as Belgium and the Netherlands, this practice is very controversial in other countries such as France where it remains a forbidden subject.

In the United States of America, the laws concerning assisted suicide are very different from one state to another. For example, in Oregon assisted suicide is allowed if performed by a medical doctor. In other states, this act is condemnable. In Canada it is also punishable according to their Criminal Code, section 41. In Switzerland euthanasia is condemnable by law. However, the penal code doesn't condemn assisted suicide, whether it is by a medical doctor or another person, as long as is it not conducted by a selfish motive. The application of these practices has simplified in recent years and two societies for the right to die with dignity based on this principle born (Exit and Dignitas).

In the French and German speaking parts of Switzerland the association Exit assists individuals living in Switzerland with serious progressive and incurable disease, in ending their life. The association Dignitas, in the German speaking part of Switzerland, assists terminally ill individuals coming from foreign countries. Therefore, Dignitas every year assists several individuals from Germany where assisted suicide is not available at the present time.

Suicide Assistance, Euthanasia, Switzerland

D19 Crime Scene Reconstruction in Hospitals Using Wireless Technology

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The goal of this presentation is to illustrate two hypothetical crime scene preservations and reconstructions which were enabled by a hospital's network of telemetry, global positioning systems, radio frequency identification tags and other technological applications. The resultant capabilities of such networks include the tracking and recording of personnel activities, monitoring of equipment location and performance, and the assurance of a secure, precise data trail for events within the clinical environment.

This presentation will demonstrate technology applications have great potential for enhancing and augmenting basic hospital security systems and tracking capabilities, thus serving as a deterrent to criminal activities within the care environment. The highly efficient network of various technologies creates an impressive information and communication trail; even the most ingenious will have difficulty in circumventing or defeating its multiple, interactive and redundant capabilities without leaving behind incriminating evidence in one or more of the permanent memory banks inherent in the system.

The use of wireless devices in hospitals has been stimulated by the need to improve caregiver efficiency, streamline workflow processes, prevent clinical errors, enhance patient safety, and ensure automated documentation of critical events and processes. It was soon appreciated that such systems could provide additional benefits for the facility, including loss prevention of equipment, medications, and supplies and the ability to reconstruct decision-making processes and actions of personnel for retrospective quality review. Furthermore, the budgetary constraints and nurse shortages compelled healthcare administrators to search for communication upgrades in their facilities that could be installed without major retrofitting or reconstruction and permit uninterrupted service delivery. The dynamics and complexities of today's hospitals mandate a flexible, mobile, and easily upgradeable platform for its communication and information systems.

Telemetry and WiFi, wireless local area networks (WLANS), Bluetooth® technology, global positioning systems, and radiofrequency identification combine to create an incredible network for retrieving, analyzing, transmitting, and storing information about patient care activities and processes. The security processes inherent to wireless systems within healthcare possess the capabilities to track caregivers and equipment through the use of a passive RFID tag and possess multi-level safeguards to prevent medical errors, ensure patient safety and precise recording of care-related events. "Plug and play" integration models orchestrate people, processes and technology, bringing together disparate equipment with the care arena. Sophisticated wireless networks can effectively serve as a platform for preserving and reconstructing crime scenes within healthcare settings.

The elements of a hospital's wireless system will be outlined and the capabilities and interactions of components will be explained using clinical simulations. Two case presentations of hospital crime scene reconstructions will be used to illustrate the efficacy of data recovery from the hospital's wireless platform which concretely links the suspect to the criminal behavior. Bar-coding, process flow in a radiofrequency identification system using passive tags, global positioning devices, equipment-imbedded software, and telemetric applications will be described as they relate to evidence preservation and crime scene reconstruction.

Wireless technology applications have great potential for enhancing and augmenting basic hospital security systems, thus serving as a deterrent to criminal activities within the care environment. The highly efficient network of various technologies creates an impressive information and communication trail; even the most ingenious will have difficulty in circumventing or defeating its multiple, interactive and redundant capabilities without leaving behind incriminating evidence in one or more of the permanent memory banks inherent in the system.

Crime Scene, Reconstruction, Wireless Technology

D20 Broken Windows: Evaluating the Reliability of a Crime Scene Reconstruction Technique

Joseph A. Keierleber, MFA, MTC Forensics, 54 Pleasant Avenue, Peaks Island, ME 04108*

Attendees can expect to learn about the reliability of the glass fracture examination technique used to determine from which side a window was broken. The attendee will also learn the history of this technique, and hear proposals for continuing research into the technique's reliability.

This presentation will impact the forensic community by contributing the first reliability data measured under blind, controlled conditions for a forensic technique that has been in use for more than 70 years.

Austrian criminalist Hans Gross published in the 1890's the first description of how a broken pane of glass may be analyzed to determine which side was struck by a penetrating bullet (Kendall 1934). In 1930, Ukrainian researcher S.N. Matwejeff expanded on the work of Gross and investigated glass fractures to determine from which side a window was broken by means of a fist, stick, or other object (Matwejeff 1931). According to Matwejeff, a pane of glass broken by a striking object often shows two types of fracture lines: 1) radial cracks, which originate at the point of impact and radiate outward in a starburst pattern, and 2) concentric cracks, which run from one radial crack to another, in a roughly circular pattern. The edge surfaces of these fractures often show distinctive curved lines, or arcs, running from one side of the glass pane to the other. At one end, each arc appears to intersect the face of the glass pane at an approximate right angle, while the other end of each arc will appear to intersect its respective face at a very oblique angle. The examiner determines if the fracture is radial or concentric, and then notes which face of the glass is intersected at a right angle by the arcs. Matwejeff's technique states that for radial fractures, the right angle is always on the reverse of the side of the pane that was struck. This has come to be known as the "3-R Rule" (Radial cracks have Right angles on the Reverse side of the force). Conversely, if the fracture being examined is a concentric fracture, then the right angle intersection will be on the same side as the face of the glass that was struck. Thus, if the examiner is able to determine which way the piece of glass was facing (such as by piecing together all the broken pieces to reconstruct the window, or by looking for dirt or paint on one side of the glass fragment, and comparing this to the glass remaining in the window) before the window was broken, the examiner can conclude whether the window was broken from the outside or from the inside.

Matwejeff's published results reveal little about the conditions under which his test windows were broken. Furthermore, the Matwejeff study does not state whether the windows were examined under a blind condition, that is, whether the examiner had information beforehand about which side was struck. The absence of a blind condition raises concerns about examiner bias. A search of the literature revealed no published studies addressing the reliability of this technique. A FBI Bulletin of 1936 refers to experiments done by the Bureau in which over two hundred panes of glass were examined, and reportedly in each instance Matwejeff's findings were confirmed (FBI 1936). However, this very brief description by the FBI reveals nothing about the conditions under which the research was done.

The present study sought to address two shortcomings of the existing research: lack of controlled conditions during experimental window breaks, and lack of a blind condition in evaluating the reliability of the technique. Ten identical wood-framed windows were constructed. Each was labeled with a number, and one side of each frame was marked A, and the other side was marked B. Each window was then randomly assigned to be broken by striking either side A or side B. Each window was mounted on an upright stand and broken using a measured amount of force, by means of a pendulum. All glass fragments from each window were collected and stored in labeled packaging, and each window frame was packaged without disturbing any fragments that remained within the frame.

Twenty-two volunteers were given a brief tutorial on the technique, and then they examined each broken window and its associated fragments in a blind condition. The volunteers were asked to determine from which side each window had been struck, and to record their responses on a form. Each volunteer also completed a questionnaire regarding his or her confidence in the accuracy of his or her examinations, and whether the volunteer had any prior experience with the technique (a volunteer reported previous training in the technique). The volunteers' average performance was 8.1 correct evaluations (s=2.18, median=9.0), a result that is significantly higher than what would be expected due to mere chance ($p<0.001$). Of the 22 volunteers, nine evaluated all ten windows correctly. The probability of a volunteer getting all ten evaluations correct by chance alone equals 0.001. Of the 220 evaluations performed by the volunteers, 178 (80.9%) produced a correct response. There was a moderate correlation (r=0.69) between volunteers' reported confidence in the accuracy of their evaluations and their performance.

These results suggest that the Matwejeff technique enabled the volunteers, on average, to determine the direction of force at a rate significantly better than chance. However, this is a preliminary study. Further research is warranted, and should include a control group of volunteers with no familiarity with the Matwejeff technique, in order to rule out the possibility that study volunteers gain information about the direction of impact from sources other than the fracture pattern.

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Glass Fracture, Error Rate, *Daubert*

D21 An Analysis of the Effect of Time and Distance Relationships on Case Solvability in Murder Investigations of Abducted Children

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This presentation will provide results from a study which will help police investigators more timely and efficiently identify strategies and implement tactics which will lead to the capture of child abduction killers and the solution of child abduction murder cases.

This presentation will impact the forensic community by improving the efficiency and effectiveness of the investigation processes of those murders. Time and distance have been examined as part of solvability research for murders in general; however, this study will examine the effect of time and distance relationships as solvability factors in murder investigations of abducted children.

Child abduction murders are incredibly difficult to solve and deeply impact society and law enforcement officials involved in the investigation. A considerable amount of scholarly material on murder exists; far less is available on the murder of abducted children. No researcher has addressed the influence of time and distance on case solvability in murder investigations of abducted children. The solvability factors which affect the clearance rates of these types of investigations have been largely disregarded by social scientists. Because the murder of an abducted child impacts society in such an overwhelming manner, the absence of literature in this area is disturbing.

The relationship of time and distance to solvability was explored by examining child abduction murders occurring from 1968 to 2002. Information from each case relating to time spans and intervals of distance between murder incident component pairs was analyzed to determine if the time and distance relationships are critical solvability factors in murder investigations of abducted children.

This study determined that while time and distance relationships contribute in some ways to case solvability for murders of abducted children, the effect of time and distance relationships on solvability is unique to child abduction murders. Results showed that when any information on the dates and locations of the four murder incident components was known, the probability of child abduction murder case solution increased. There is a strong positive correlation between knowing the dates of occurrences for the murder incident component locations and the ability to identify a perpetrator.

This research also showed that in child abduction murder cases, shorter time proximity between murder incident locations has no significant impact on case solvability. Previous solvability research has shown that the more investigators know about the distances between the pairs of the murder incident components, the more case solvability will increase; this study of murder investigations of abducted children showed similar findings. Relatively close time and distance proximity between murder incident component pairs did not contribute significantly to case solvability. In addition, when the time and distances proximity decreased among pairs of murder incident components, the relatively distant proximity in time and distance did not contribute to case solvability.

This study is a valuable investigative tool for use in murder investigations of abducted children. Given the effect that intense media coverage of murder investigations involving abducted children and the intense pressure from victim's advocacy groups it is surprising that no empirical research has been undertaken before now to determine the effect of time and distance on case solvability in the murder of abducted children. This research adds to the understanding of investigation of murders of abducted children and provides several critical findings on case solvability in these types of cases. Because time and distance do not play the same role in case solvability in child abduction murder investigations as in general murder investigations, there may be other factors which can impact case solvability in murder of abducted children.

Child Abduction Murder, Solvability, Time and Distance

D22 What Criminal Investigators Believe are the Causes of False Confessions

Steven V. Gilbert, MFS, PhD, State University of New York at Canton, 34 Cornell Drive, Canton, NY 13617*

After attending this presentation, attendees will gain an appreciation of what criminal investigators believe are the causes of false confessions.

This presentation will impact the forensic community and/or humanity by demonstrating how false confessions have placed many innocent suspects in prison for lengthy incarcerations or executions. It is hoped that criminal investigators will take a more stringent view of what causes false confessions.

False confessions have become a mysterious phenomenon in recent years. Many innocent suspects have been exposed to the criminal interrogation only to provide their questioners with confessions to crimes they did not commit. Following these confessions, innocent defendants have been convicted and legally sanctioned for these reported crimes.

False confessions have been categorized as voluntary, coerced-compliant, and coerced-internalized. The voluntary false confession, the only one that is not influenced by law enforcement, is made by suspects who seek notoriety, suffer from mental illness, or attempt to protect the culpable party. The coerced-compliant false confession is a stressed-induced confession. Pressures exerted by interrogators may cause innocent suspects to succumb to accusations, and in an attempt to flee the intensity of the interrogation, confess to whatever the interrogator wishes. Their belief that a lack of evidence will prevent their convictions is often misled. The coerced-internalized false confession is received from suspects who experience mental breakdowns. Often consisting of confabulation, these confessions consist of fictional portrayals of what "could have" happened during the crime.

The forerunners of confession evidence are the criminal investigators who interrogate their suspects. In most interrogation courses, whether provided by police academies or commercial vendors, the criminal investigators are trained in various techniques and tactics that will assist them in inducing suspects to confess. Most criminal investigators are aware of the voluntary false confession, since high-profile investigations tend to draw these confessors to the public eye. However, the understanding and causation of the coerced-compliant and coerced-internalized false confessions is lacking.

A study was conducted of criminal investigators in St. Lawrence County, New York. The intention of the study was to determine what criminal investigators believed were the causes of false and truthful confessions. Interestingly enough, most respondents were able to define the various categories of false confessions. However, when questioned concerning their causation, the respondents were quite diverse in their beliefs. It was noted however, that the ones believed primarily responsible for the false confessions were the suspects and not the investigators themselves. Other aspects of false confession causation addressed suspect suggestibility, the coercive environment, and confession reliability in court.

The majority of criminal investigators believed that the typical interrogation room was not coercive to the extent that it would contribute to the false confession. In terms of suspect suggestibility, it was believed that young, novice suspects were more prone to make false confessions. Alcohol was not believed to be a contributory factor for false confessions, but drug usage and substance withdrawal were. According to the

respondents, all confessions, once admitted into court as evidence, could be deemed as reliable. This was placed solely upon the court's review of the confession's competency, and not the interrogation process. In this regard, false confessions have been admitted into court thereby causing sanctions against innocent defendants.

Voluntary, Coerced-Compliant, Coerced-Internalized

D23 Elder Injury at the End of Life

Patricia M. Speck, MSN, 1740 Overton Park, Memphis, TN 38112; and Diana Faugno, BSN, CPN, 1351 Heritage Court, Escondido, CA 92027*

Attendees will learn basic information about hospice care and non-intentional injuries and the healing patterns that occur with routine care in the frail elderly as demonstrated through a case study.

This presentation will impact the forensic community and/or humanity by providing better diagnostic skills of health care providers; assisting in the recognition that not all injury is intentional and that there are influences that can be revealed in the home setting; and providing care givers with stresses that will need local support services, such as Hospice programs.

The population of elderly is growing and will peak with the baby boomers in 2025. A significant number of these elders will remain in their homes with elder child caregivers. Some will have intentional injury and the research points to the issues with the caregiver. This case study however focuses on the frail senior elderly who are enrolled in hospice, expected to expire within six months, and are cared for by elder children. The hospice criteria for enrollment will be discussed as well as chronicled unintentional injury and the mechanism of injury. In this case study, the health care and ancillary care providers will be exposed to the unintentional injury potential in the frail elder, wound identification, information gathering assessment in a non-threatening, open environment, intervention that addresses the caregiver's needs, and safety support services necessary to maintain the comfort of the patient at the end of life.

Elder Abuse, Unintentional Injury, Intentional Injury

D24 Thailand Disaster-Tsunami 2004 (An International Response)

Frank A. Ciaccio, MPA, Kenyon International Emergency Services, Inc., 15180 Grand Point Drive, Houston, TX 77090*

The goal of this presentation is to review the events surrounding the tsunami of 2004 in Thailand with respect to how information was collected and processed in the International Information Management Center in order to determine positive identification.

This presentation will impact the forensic community and/or humanity by assisting the forensic science community in understanding the forensic and identification challenges faced in a natural disaster on an international scale. Although the methodology of how identifications are made has not changed, the advancement in technology has streamlined the process and the scope of developing, managing, and operating an Information Management Center is as critical as managing and operating a temporary morgue.

On the morning of 26 December 2004, a series of large waves between 50-100 feet tall struck southern Asia following an earthquake in the middle of the Indian Ocean. One of the hardest hit areas was the southern peninsula of Thailand. The island of Phuket which caters to a large number of visitors from Australia and Europe saw the largest number of fatalities among foreign tourists. Over 5000 foreign tourists were killed as a result of the tsunami which brought together one of the largest international responses for victim recovery and identifications in recent times.

Forty-two countries lost citizens as a result of this tragedy. Therefore, the scope of recovering and identifying human remains was greater than any forensic professional could imagine. The response by international Disaster Victim Identification (DVI) teams, private companies, and foreign countries was more than anyone could expect. The incredibly high human cost was far beyond the expectation and expertise of the Thai authorities, who had never experienced a disaster of such magnitude and had not prepared a systematic management plan.

With any disaster, there are always challenges in the recovery, identification, and return of human remains back to families. Some of these encountered were the result of the remote location of the disaster, the lack of resources in the area, weather conditions, and cultural differences due to the involvement of so many different nationalities. However, the ultimate challenge was the ability to coordinate and process antemortem and postmortem records in order to determine positive identification.

Victim identification is critical in any mass fatality incident. During the tsunami disaster, a global Information Management Center (IMC) was created that became the nerve center and repository for both antemortem and postmortem records. Within the IMC, methods were developed to handle the large number of records and information that was being filtered into the system on a daily basis. During its peak operations, there were different DVI teams from 17 countries working in the IMC. In addition, personnel trained in reconciliation were called upon to provide their expertise using various identification software programs.

With recent advancements in computer, fingerprint, and DNA technology, investigators have the tools and techniques necessary to determine positive identification on more victims of mass fatality incidents. Though the days of comparing radiographs by hand still exist, modern technology has brought this process to another level. The scope of developing, managing and operating an Information Management Center is as critical as managing and operating the morgue in a mass disaster.

Mass Disaster, Mass Fatality Incident, Identification

D25 FEMORS – The State of Florida's Mass Fatality Response Team

Larry R. Bedore, MS, Medical Examiner District 8, 606 SW 3rd Avenue, Gainesville, FL 32601; Bruce A. Goldberger, PhD, and Kelly M. Lonesk, MBA, University of Florida College of Medicine, Maples Center for Forensic Medicine, 4800 SW 35th Drive, Gainesville, FL 32608*

Attendees will learn how Florida developed a mass fatality response team to aid State Medical Examiners. This presentation will impact the forensic community by providing a working model to states interested in developing mass fatality response team.

Following the disasters of September 11, 2001, Florida's Department of Health Emergency Operations Division initiated steps to create a mass fatality response team as a state asset to serve local needs, especially for non-federally declared disasters and to augment federal response resources. In concert with the University of Florida's William R. Maples Center for Forensic Medicine, the Department of Health secured grant funding from the Centers for Disease Control and Prevention's 1999 Bioterrorism Preparedness Grant for program development of the Florida Emergency Mortuary Operations Response System (FEMORS).

FEMORS mission is to assist and support the local District Medical Examiner's Office, Florida Department of Law Enforcement and other responding agencies, in the event of a mass fatality incident as directed by the Florida Department of Health.

FEMORS was inaugurated in July 2002 and initially tasked with establishing a web-site (www.FEMORS.org), recruiting forensic professional volunteers, and designing an initial training program which was conducted in March 2003. The scope of the program is designed to:

- Develop protocols and train teams of volunteer forensic professionals to assist Florida Medical Examiners during disasters.
- Develop a Mass Fatality Plan Annex to the State of Florida Comprehensive Emergency Management Plan, and
- Maintain a portable morgue for response to mass fatality disasters.

Protocols, annual training sessions including National Incident Management System, and the Mass Fatality Plan Annex were completed by the summer of 2005. Specialized training sessions for Odontology and Family Assistance Center operations have also been conducted. Procurement of portable morgue equipment (provided by a grant from the Office of Domestic Preparedness) began in the fall of 2005 to complete the program design.

Team members activated for disaster response become Department of Health temporary employees for compensation including coverage for worker's compensation and liability. FEMORS was placed on stand-by for the four hurricanes of 2004 and was deployed during Hurricanes Charley and Ivan to provide assistance. In 2005, FEMORS was placed on stand-by for Hurricane Dennis.

Funding Source: FEMORS is a sponsored activity of the University of Florida in collaboration with the William R, Maples Center for Forensic Medicine. FEMORS is supported by the Florida Department of Health with funding made available through the CDC Bioterrorism Grant Number U90/CCU417006.

Mass Fatality Response, Disaster, Medical Examiner

D26 Restructuring Data Collection Strategies and Investigation Priorities in the Resolution of Mass Fatality Incidents

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After attending this presentation the participant will have gained an awareness of the need for restructuring the organization of investigations into mass fatality incidents. By use of supporting data and guided questioning the authors demonstrate that the decedent identification process in particular is being led by poorly tailored postmortem data collection standards. Participants will gain an understanding of the relevance of antemortem data standards. The authors will demonstrate that a balance needs to be redressed whereby antemortem data quality and availability become the guiding principles for determining the types of postmortem data collected and the standards of collection implemented.

This presentation demonstrate the overwhelming need for those forensic scientists involved in dealing with the aftermath of mass fatality incidents to start focusing on the "other half of the identification equation," i.e., antemortem data. The authors propose some structuring principles and guidelines that may be used to assist in more fully integrating antemortem data sets and to more successfully tailor postmortem data collection strategies to the antemortem data sets available for a given decedent population. This will lead to higher identification success rates, and, in the long run, a more timely repatriation of decedents.

The mass fatality incident (MFI) decedent identification process is driven by the collection and comparison of antemortem (AM) data and postmortem (PM) data to arrive at a positive identification. Current investigative efforts emphasize PM data collection methods and morgue operation procedures while paying relatively little attention to the relevance of AM data and congruence between the data sets. MFI investigations are currently driven by the PM data collection process.

The authors propose a new approach whereby PM data collection is driven by the availability and integrity of AM data. This approach requires that effective AM data collection procedures are tailored appropriately for the relevant populations and the underlying availability of data sources. Thus AM data appropriate to the incident must be made available prior to the onset of morgue operations, or simultaneous AM/PM data collection protocols must be rigorously constructed and implemented. To allow sufficient lead time the first priority of all mass fatality investigations is to stabilize the remains of decedents in order to minimize the loss of PM data. This stabilization period can be used to accommodate the development of effective and integrated AM and PM data collection and chain of custody procedures. Only once these are in place can PM data collection begin. The stabilization period is also a highly appropriate time to allow the resolution of national jurisdictional and international diplomatic issues.

To establish effective data collection protocols requires a fuller understanding of the variables that affect the identification process. Investigators must develop/address questions regarding four critical parameters:

1) Decedent population demographics
2) Incident dynamics
3) Capacity of available identification/investigation resources
4) Quality control of data collection

This information can then be used to construct hypotheses regarding the availability and applicability of AM information that will essentially guide the postmortem data collection process. Collection of PM data in advance of a full understanding of these four critical areas leads to wasted work and inappropriate (poor quality) underlying data that compromises the identification process. By delaying morgue operations until appropriately tailored data collection procedures are established the identification process effectively becomes a program of hypotheses testing utilizing high quality preliminary data. The authors will present data that identifies the primary variables affecting the MFI decedent identification process and how understanding these variables will expedite data collection and data synthesis.

The authors will also present case studies including the responses to a variety of aviation disasters, the 2004 South Asia Tsunami, and post-conflict human rights investigations in the Balkans. These will illustrate how the identification process and identification success rates following a large scale MFI are affected by AM and PM data collection strategies. These case studies focus on irreconcilable AM and PM data collection strategies as well as the collection of congruent AM and PM data that is inappropriate given the four parameters identified above. The authors will conclude by proposing a series of questions designed to prompt investigators to recognize and classify the most appropriate AM and PM data for the decedent population they are intending to identify. It is hoped that these will facilitate the identification process. Restructuring investigative priorities and data collection strategies provides the best opportunities to maximize returns from the identification process to include the greatest degree of resolution for post-incident communities.

Mass Fatality Incident, Antemortem Data, Decedent Identification

D27 Gunshot Injuries to Automobile Occupants: The Milwaukee Experience

John D. Carver, JD, MD, and Jeffrey M. Jentzen, MD, Milwaukee County Medical Examiner, 933 West Highland Avenue, Milwaukee, WI 53233*

After attending this presentation, attendees will be able to recognize characteristic patterns of gunshot injury, atypical entrance wounds, and confounding associated injuries often suffered by victims of gunshot wounds who were occupying automobiles. This presentation will alert the forensic community to these injuries, improve their interpretation and improve reconstruction of homicide scenarios involving automobile occupants, who often have left or been dumped from a vehicle, or been removed from a vehicle during resuscitation efforts.

This presentation will impact the forensic community by increasing the awareness and improving the interpretation of the wound patterns and confounding associated injuries suffered by gunshot victims who were occupants of automobiles.

A comparison of Milwaukee County homicides involving gunshot wounds to automobile occupants during 1994 and 2004 is made to determine whether there is an increasing incidence of these deaths. Of 156 deaths classified as homicides in 1994, 14% (n=22) involved gunshot wounds to automobile occupants. This percentage increased in 2004, when 18.6% of 97 deaths classified as homicide (n=18) involved automobile occupants. Selected cases from both years are presented to demonstrate characteristic patterns of injury in this setting.

Gunshot entrance wounds usually have a punched-out circular-to-oval appearance, with a surrounding area of abrasion caused when the bullet pierces the skin. Exit wounds are typically larger and more irregular than entrance wounds because the bullet loses rotational stability ("tumbles") as it passes through dense tissue, and deforms as it hits structures such as bone. Entrance wounds can have an atypical appearance when a bullet loses stability before entering the body. This may be due to ricocheting, weapon/ammunition mismatch, poor weapon construction, or the presence of intermediate targets.

Automobile occupant victims frequently display atypical gunshot entrance wounds because intervening glass or frame material deflects and deforms the bullet before it enters the victim's body. Atypical reentry wounds are the result of the bullet first passing through an upper extremity before reentry into the body. The perforation may have an irregular shape, with surrounding area of irregular abrasion. Tears surrounding the perforation may result in misinterpretation as an exit wound or, conceivably, as a contact entrance wound. Broken glass or other material from intermediate targets can also cause surrounding punctate abrasions and lacerations (so-called "pseudo-stippling") that may be confused with actual powder stippling of an intermediate range wound. Passage of semi-jacketed bullets through intermediate targets can also result in separation of the jacket from a bullet, resulting in large, irregular entrance wounds or even separate entrance wounds.

In the case of multiple gunshot wounds, the individual bullet paths tend to demonstrate the same spatial trajectories through the body (i.e., multiple entrance wounds to the same side of the body with the same front/back and up/down angles). If the victim is still able to move after the initial wounds, further entry wounds are sometimes found to the back, thighs, or buttocks. These would be the presenting targets to the shooter as the victim tries to escape further injury (by climbing over a seat or attempting to exit the opposite door). If initial x-rays of the body reveal a bullet not accounted for by the other entrance wounds and their corresponding bullet paths, careful examination of the buttocks and perianal area will sometimes reveal an additional well-hidden entrance wound.

Gunshot, Automobile Occupants, Homicide

D28 The Concept of the Forensic Landscape: Recognition of Patterns of Evidence in Mass Death Scenarios

Ian D. Hanson, MSc, Centre of Forensic Sciences, Technology and Law, Bournemouth University, UK/ Inforce Foundation, Christchurch House, Talbot Campus, Fern Barrow, Poole, Dorset BH12 5BB, United Kingdom*

Attendees will learn the concept of forensic landscape—the recovery and recognition of evidence across an environment in space and time. This presentation will impact the forensic community by increasing recognition that surviving evidence of crime and the linking of apparently discrete forensic scenes are possible in many circumstances using multidisciplinary analysis.

It may be perceived that sites such as plane crashes or mass graves are distinct entities containing the dead from mass disaster or human rights violations. This is not the case. These sites are usually the most obvious, intact, complex and culturally potent manifestations of a wider evidence of large scale death events.

These "main" sites are but one part of the surviving evidence of criminal events that cover a given area in space and time. Related sites and evidence other than that found in these epicenters of investigative focus are numerous and widespread. They are not always systematically looked for. The Forensic Landscape can be described collectively as all sites, evidence, and patterns of forensic relevance within the environment.

The Forensic Landscape is the surviving topography, alterations, deposits, artifacts, and materials left in the natural and cultural landscape within a given time frame, concerning and related to specific criminal events. The forensic landscape may be the area of a specific site, or a continuous landscape, represented by a continuous spread of evidence across the terrain, or a series of spatially separate sites linked by the same process of criminal activity.

This paper will consider what concepts from archaeology and crime scene investigation can be employed to maximize the recognition and recovery of important evidence from such landscapes, and how loss of evidence can be minimized, using multidisciplinary approaches.

Forensic Archaeology, Crime Scene Investigation, Mass Death

D29 Digital Evidence Survey: Current Trends and Needs

Marcus K. Rogers, PhD, Purdue University, 401 North Grant Street, West Lafayette, IN 47907; and Kay Scarborough, PhD, Eastern Kentucky University, 425 Stratton Building, Richmond, KY 40475*

After attending this presentation, attendees will be briefed on the current state of Law Enforcement practices related to digital evidence and the gaps that currently exist in this maturing field.

This presentation will impact the forensic community and/or humanity by providing scientifically derived statistics on the amount and types of digital evidence being processed by state and local law enforcement, and identify the needs that must be addressed.

The current presentation summarizes the findings from the 2005 Digital Evidence Survey conducted by Eastern Kentucky University, the University of Central Florida, and Purdue University. The study surveyed state and local law enforcement regarding digital evidence. The presentation will discuss trends related to the types and amount of digital evidence being collected and processed, and protocols and methodologies used during the phases of digital evidence handling and examination. The presentation will also highlight areas that were identified as requiring assistance, and provide meaningful statistics on the current state of digital evidence relative to state and local law enforcement.

Digital Evidence, Digital Forensics, Law Enforcement

D30 An Equivocal Death Investigation Case – Multiple Stabbings: The Victim Self-Inflicted 83 Stab Wound Injuries

Vernon J. Geberth, MS, MPS, PO Box 197, Garnerville, NY 10923*

The author will present an interesting equivocal death investigation, which involved multiple stabbing wounds, some of which penetrated the heart. The author will also to reiterate the significance of the medicolegal findings in the police investigation and why it is essential that police and medical examiners work as a team.

This presentation will impact the forensic community showing the importance of the evaluation of victim logy in determining the factors in an Equivocal Death Investigation as well as the importance of comparing autopsy findings with police investigation and the reconstruction of the crime scene. The impact of the presentation occurs when the audience understands that the medical evaluation of the multiple stabbing wounds explained how this victim was able to stab himself 83 times despite the penetrating stab wounds into the heart. The audience should appreciate the importance and significance of the medical examiner, the police, and prosecution working as a team to reveal the truth and see that justice is done for the deceased.

Equivocal death investigations are those inquiries that are open to interpretation. There may be two or more meanings and the case may present as homicide, suicide, or accidental death. The facts may be purposefully vague or misleading as in the case of the "Staged Crime Scene."

In this case, a 61-year-old man was found stabbed to death in his residence by another male who lived in an adjoining apartment. The victim had been stabbed multiple times in the chest. The knife was found near the deceased's left hand and a sheath for the knife was found near to the body. Lying on the floor next to the victim's body was a half empty bottle of Drano® drain cleaner liquid. A door with a dead-bolt lock, which had not been secured, separated the premises. The victim's body was lying in a water feature, which consisted of a tiled sunken basin with rock formation on the side. The water feature was devoid of water and had been plumbed shut at the end of her nose.

The police investigation indicated that the victim had been despondent. Detectives took a number of statements from people who knew the deceased. Most of the blood was confined to the basin and there were neither footprints in blood nor blood found anywhere else in the residence. There were numerous wounds to the abdomen area and some internal organs were protruding from the wounds. When the body was removed from the basin examination revealed slashing injuries to both wrists.

The medical examiner ruled the death a suicide. There were 83 stab wounds to the torso, multiple incised wounds to both wrists and ingestion of Liquid Drano®. The cause of death was exsanguination due to multiple stab wounds of the torso. The wounds were largely concentrated on the left side. Four wounds penetrated the heart. One penetrated the full thickness of the right ventricle. In addition to the stabbing wounds into the torso there were also multiple incised wounds to wrist.

The police investigation coupled with the medical examiner's findings determined this case to be a suicide involving multiple self-inflicted stab wounds, some of which penetrated the heart and the ingestion of Liquid Drano®, which caused hyperemia and hemorrhage.

The left ventricle of the heart supplies the pressure that you record in Blood Pressure measurement (120/80). The right ventricle of the heart is the collection

Equivocal Death Investigation, Suicide, Victimology

D31 Shooting Reconstruction: The Value of Evidence & Analysis in a Double Homicide

Alexander Jason, BA, ANITE Group, PO Box 375, Pinole, CA 94564*

Attendees will learn about analytical methods used in the reconstruction of complex shooting incidents and in presenting information in trial. This presentation will demonstrate effective methods for producing a shooting incident reconstruction which can be utilized by others in the forensic community.

HYPOTHESIS: Complex and apparently unconnected physical evidence can be effectively utilized to support or refute conflicting versions of a shooting incident.

A double homicide occurred; two victims were shot to death. Two others present at the scene provided conflicting versions of the incident: In this case, there were 12 shots fired; the victims had multiple gunshot wounds with their bodies found in two different locations. Multiple bullet impacts, blood spatter on walls and objects, as well as many additional potential evidence items further complicated the crime scene. The primary issue: Was this a deliberate homicide or multiple acts of self-defense? The physical evidence, while substantial in quantity, was initially regarded to be of insignificant value in answering the key question.

This paper demonstrates the methodology involved in a multidisciplinary approach to the reconstruction and analysis of a shooting incident in which blood spatter, bullet impact damage, cartridge case locations, and victim wound path evidence from the autopsy, and other elements are all integrated into an analysis which can be used to determine significant facts. These facts can then be utilized to determine what could and could not have occurred and specifically, which version – if any — of the incident is consistent with the physical evidence. Although a shooting incident reconstruction always includes the forensic crime laboratory analysis of the physical evidence, an effective reconstruction requires an understanding of the capabilities and dynamic characteristics of firearms, projectiles, ejected cartridge cases, gunshot residue and the dynamics involved in the production and projection of blood spatter from gunshot wounds. A chemical test of physical evidence items provided confirmation of damage caused by bullets which contributed to the overall reconstruction and is an important tool in shooting reconstruction. This case is an excellent example of how all these items can be integrated into an analysis and reconstruction.

An additional important component in the overall reconstruction is the use of 3D computer animation modeling and the graphic enhancement of crime scene photographs. While both were used during the trial in the form of demonstrative exhibits, they were also used in the actual analysis and reconstruction. The detailed and scaled 3D computer model of the house in which the shootings occurred allowed the crime scene to be rotated and viewed at many perspectives which was very helpful in determining both possible bullet trajectories and the trajectories of ejected cartridge cases. This paper will discuss the crime, the methods of the analysis, the reconstruction, and the trial outcome.

Shooting Reconstruction, 3D Computer animation, Crime Scene Analysis

D32 The Green River Murders

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Attendees will learn the motive, victim selection, methods of operation, body disposal techniques, and forensic evidence from the murders of the most prolific serial killer in American History, to date, Gary L. Ridgway. The presentation will consist of crime scene photos and video clips of Ridgway interviews.

This presentation will demonstrate the motive, victim selection, methods of operation, body disposal techniques, and forensic evidence from the murders of the most prolific serial killer in American History, to date, Gary L. Ridgway.

The 48 murders eventually connected to Gary L. Ridgway were part of the largest unsolved serial murder case in the United States. Ridgway was identified as a suspect in the Green River murders in 1984, but was not charged until a DNA test in 2001 linked Ridgway to four of the victims. Subsequently, forensic paint analysis was used to connect two of the victim's to Ridgway. Ridgway eventually pled guilty to 48 murders.

The presentation will focus on the modus operandi, victim selection and body disposal techniques Ridgway used in the first murders of the Green River Murder series. Video clips of Ridgway discussing the murders and a review of forensic evidence in the case will also be presented.

An overview of the Microtrace laboratory findings of tiny spheres of spray paint on the clothing of two of the Green River murder victims will be given. The spray paint formed small spheres which became embedded in the weave of fabric when dried while airborne. The particles, invisible to the naked eye, were easily transferable from killer to victim.

The paint samples were connected to Ridgway because they were identical to a highly specialized DuPont Imron paint used at the Kenworth truck plant which employed Gary L. Ridgway. In March 2003, Microtrace laboratory connected the spheres from the jeans which formed the ligature around victim Wendy Coffield's neck to the spheres found at the Kenworth truck plant. Microtrace was also able to identify the paint spheres on the clothing found with Debra Este's body. Again, the spheres were determined to be identical to the highly specialized paint used only at Kenworth truck plants and which happened to be in use at the factory in which Ridgway worked. Fortunately, because Ridgway was a carrier of the particles, five of the victims were connected to Ridgway through forensic paint analysis. Ridgway pled guilty to 48 counts of aggravated first-degree murder; including six that police had not initially connected to the case.

Green River Murders, Gary L. Ridgway, Serial Killer

D33 Forensic Science Continuing Education in the Classroom

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The goal of this presentation is to discuss the content and experience of providing longstanding continuing education to the adult public in forensic science and serve as a starting point concerning forensic science education in adult classrooms in their jurisdictions.

There is current widespread educational interest in forensic science as evidenced by numerous listings that contain "forensic" in their titles of academic offerings found by an Internet search. Continuing adult education courses offered by the School of Continuing Studies at the University of Toronto (www.learn.utoronto.ca) remain unique in the field of forensic science education.

Traditional university degree programs in forensic science provide a formal basis for the full-time student to seek experience and employment in forensic science. Continuing education is also available in specialized courses for the forensic practitioner at professional society meetings or other locations with a specific topic within the field. Education is also available through some criminology or criminal justice programs where an instructor with an interest in forensic science imparts information to the student geared toward employment within the criminal justice system. A few "on-line" courses are also available to the public. Continuing education classroom-based courses in forensic science at the School in Toronto are available to the public. Students of these courses may be involved in the aforementioned educational areas, or alternatively, be spawned to become involved in them or other areas such as law or law-enforcement. The courses are also attended by lawyers and law enforcement officers to enhance their knowledge of forensic science.

The School in Toronto has annually provided courses in forensic science to adults in the public domain since 1981. The core course, entitled "Forensic Scientists at Work," consists of nine two-hour evening classroom presentations and concludes with a final evening tour of a forensic laboratory with a multidisciplinary panel discussion with students. The course begins with an introductory presentation about forensic science and the judiciary, followed by forensic aspects of scene/exhibit identification, biology, chemistry, document examinations, coroner investigations and inquests, pathology, toxicology, and major case investigations. The last area incorporates several aspects of forensic science that were utilized by police in an actual investigation that was fully processed by the courts. Nine instructors, each a specialist by academic training and professional experience in their respective areas of forensic expertise, are engaged in the course, and include four active forensic scientists with government and/or consultant practices, two qualified medical practitioners, and three law enforcement officers. The Course Coordinator instructs the first class and another in their area of forensic expertise. The Coordinator also provides additional presentations on supplementary and/or timely topics, as well as engages questions in the classroom with the other instructors and students.

In 1998, the School in Toronto began to provide additional courses on an annual basis entitled "Special Topics in Forensic Science." It currently offers a series of three additional courses with two-hour evening presentations that provide other topics over a three-year cycle. Scientists have presented on forensic aspects of anthropology, entomology, geology, climatology, firearms and toolmarks, blood splatter interpretation, hair and fibers, fires, explosives, digital evidence (computers), gaming machines, engineering, quality assurance, drug analyses and clandestine preparation sites, alcohol in forensic casework, drug facilitated sexual assault, poisoning, and workplace drug testing. Medical/health practitioners have presented on forensic aspects of psychiatry, psychology, dentistry and odontology, sleep and fatigue in human performance, memory, and nursing. Law-enforcement officers and other specialized investigators have presented upon forensic aspects of criminal profiling, sexual assault, fraud, arson, motor vehicle collision reconstruction, video animation, and independent public investigations of police officers. Other presentations have included forensic social work and legal aspects of expert witness testimony, the latter involving a prosecutor and defense attorney.

Forensic practitioners engaged in teaching the public can hone their presentation and critical thinking skills by being involved in an academic interactive group format with students which may further their effectiveness in testifying to a jury at a trial. Students learn from instructors and other students in a classroom setting, and are provided by the instructors/Coordinator with supplementary resources for further information on topics of interest.

The strengths of the format at the School in Toronto include presentations from many actual forensic practitioners in their field of expertise, an interactive classroom format of delivery, an in-class Course Coordinator for technical/administrative support and additional presentations as required, and a tour of a forensic laboratory followed by a multidisciplinary panel discussion

Public, Continuing, Education

D34 Northeast Regional DNA Academy Performance Metrics

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After attending this presentation, attendees will be able to design a curriculum to include performance metrics that address the quality and productivity of forensic science DNA analyses. This presentation will demonstrate the key to quality in forensic science is education. Continuous courseware from academic institutions with competency assessments is needed for new scientist training and continuing education for experienced scientists.

This presentation will describe the curriculum and performance metrics of the NERFI DNA academy. Conceived as a regional center of excellence, the NERFI addresses a critical and ongoing need to produce highly trained, case-ready technical personnel for careers in professional forensic laboratories. NERFI will foster collaborations between local, state, and federal criminal justice agencies and other academic institutions to develop forensic programs in education, research, and outreach. The DNA Academy program was designed to provide a solution to address the nationwide shortage of forensic scientists. The explosive growth of DNA technology in the field of forensic science has created critical casework backlogs in all public and private forensic laboratories. Traditionally, the overwhelming majority of forensic laboratories have been forced to use one – on – one mentor training for new and existing employees. Laboratory efficiency is decreased by Mentor training and competition for casework instruments by 50%. The goal of the DNA Academy is to shorten the conventional one - on - one mentor training programs from one year to six months with a dedicated state of the art forensic training facility, university approved curriculum, staffed with SUNY Albany faculty and nationally renowned visiting scientists. Students successfully completing the DNA Academy will earn 12 credit hours of graduate course work. More importantly, the newly trained scientists will also meet all mandated state or international accreditation standards for forensic laboratories.

The curriculum from the Graduate program in Forensic Molecular Biology has provided the courseware framework for the DNA Academy. The University at Albany was one of the first in the Northeast to deliver a 40 credit Graduate Program in Forensic Molecular Biology. Overall, this program has been very successful. Thirty-five students are now enrolled in the program. The program is now in its fourth year and graduates have proceeded to placement in many private laboratories, public laboratories, and Ph.D. programs.

The DNA Academy curriculum consists of four modules that deliver 12 graduate credits hours of academic course work. Module 1 is a one credit hour, 8-week long distance learning component that provides the latest theories of forensic DNA technologies. A digital library of all pertinent reference materials and interactive video conferencing will be used for the distance-learning module. Module two and three consist of eight weeks of laboratory instruction held at the University at Albany. The "Mirror Laboratory" concept will employ the latest technologies currently in use in all forensic laboratories. The students will analyze evidentiary samples that are identical to the items received at crime scenes and submitted to forensic laboratories. For example, bloodstains on all types of substrates will be recognized, collected, amplified, and analyzed by identical instruments and techniques used in forensic laboratories. Moot court will then be used to measure the competency of all students as per national accreditation guidelines. The program is concluded with Module 4, a one credit hour, 4-week distance-learning component that instructs students in advanced techniques and report writing. Individual segments of the program will also be used to provide professional development programs that are mandated by legislative accreditation criteria. The graduates of the program will be competent to analyze a variety of evidentiary items routinely submitted for DNA analyses when they return to their home laboratories.

The authors will present performance metrics (number of extractions, quantifications, amplifications, and profiles generated) from a variety of samples analyzed by the students at the NERFI DNA Academy. Follow up surveys of the students will evaluate and compare mentor training to NERFI DNA Academy programs.

Forensic Education, Performance Metrics, DNA

D35 The Challenge of Teaching Bugs, Botany and Blood (DNA) in One Course

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Attendees will learn one approach to teaching quite dissimilar forensic topics to undergraduates in one course. It is presented to create dialogue with others teaching similar courses and hopefully create constructive criticisms on this course and other similar courses to increase the courses effectiveness. This presentation will provide one example on how to teach diverse biological topics in one course. It is presented to create dialogue with others teaching similar courses and hopefully create constructive criticisms on this and other similar courses.

This presentation outlines one of the four forensic courses taught in the Ferris State University (FSU) forensic undergraduate programs. The forensic biology degree builds on a major's foundation of biology and chemistry, with unique core courses in forensic biology, forensic chemistry, forensic human pathology, forensic DNA analysis and criminal justice courses in evidence and law. The degree is designed for the student who is interested in analyzing biological evidence as it relates to legal and other investigations, or collecting and processing evidence at a crime scene or in a laboratory.

Two of the courses taught in the forensic biology curriculum are also available for students in the Criminal Justice Forensic Minor Program and other curriculums such as psychology majors and allied health majors etc. The forensic biology course in this curriculum is the application of biological knowledge and laboratory and field techniques to criminal and civil investigations. Students in this course receive extensive training in the collection and analysis of biological evidence in both lab and field settings. Students learn how to evaluate mock crime scenes that include decomposition of animal remains in the field. They also learn how to document, collect, and analyze the insects, plants and other biological evidence to determine the time of death. Students learn to identify skeletal remains, and evaluate postmortem trauma by scavengers.

The problem in teaching this course is obvious. Students of mixed biological and chemistry backgrounds require the course be taught to give a delicate balance between background information and substance. Enough background to help the under prepared in biology and chemistry and enough substance to prepare the forensic biology majors and non majors alike to understand the meaning and importance of the biological evidence at the mock crime scenes.

The course has evolved over the seven years it has been taught to currently include three distinct areas of concentration, forensic botany, forensic entomology, and introduction to forensic DNA analysis. The course is lab oriented with lectures supporting the labs with background information. The laboratory periods for the botany and entomology are spent outside collecting the information at mock crime scenes and inside evaluating the information, writing reports, and predicting time of death. Five crime scene investigator teams collect the evidence with specific

tasks at the mock crime scene. The students are grouped by dissimilar backgrounds by the instructor and the groups are shuffled for each lab period. This allows all students to be involved in all types of data collection. The groups enter their data on the computer and that data is available on the course web page. Students are required to turn in the mock crime reports every week. The DNA labs are conducted inside and are hands on labs.

This presentation is one example on how to teach such diverse topics in one course. It is presented to create dialogue with others teaching similar courses and hopefully create constructive criticisms on this and other similar courses. This course also does not claim to teach students enough information for them to become expert witness in any of the topics but to open their eyes to the possibility of the value of this data to an investigation.

Teaching, Botany, Entomology

D36 Implementing an Accreditation Program in Forensic Science Education

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Attendees will be exposed to forensic science education in Egypt and have information about the state of education that has an important role in solving medicolegal problems using scientific processes**.**

The department of Forensic Medicine and Toxicology of the Faculty of Medicine, University of Alexandria was established in 1942 to promote education for and research in the field of forensic sciences. Since 1980, efforts have been made to improve the quality of education and training for both undergraduate and postgraduate students. Today, modifications are being applied to meet specific curricular requirements because most forensic scientists work in areas such as drug analysis, trace analysis, firearms, tool marks, and forensic biology.

Acknowledging the importance of an accreditation system for academic programs, the department started to implement new measures in forensic science education and student assessment to meet the requirements imposed by the American Academy of Forensic Sciences for accreditation. This will require evaluation and monitoring the overall efforts to fulfill the department mission, goals and objectives. It will also entail evaluation of students' performance, gathering information from graduates, collection of job placement statistics and employers' survey. The department will use the results of these evaluation activities to modify the curriculum and to improve the quality of education to meet the accreditation requirements.

Accreditation, Curricular Requirements, Education

D37 Consensual Flogging is not Physical Abuse

Diana K. Faugno, BSN, 1351 Heritage Court, Escondido, CA 92027*

After attending this presentation, attendees will understand that not all lesions on patients that present to your practice are indicative of physical abuse. History is important in order to determine if the injuries are due to physical abuse, accidents, or ritualistic erotic practice.

This presentation will impact the forensic community by expanding the knowledge base that not all bruises are the result of physical abuse. The practitioner needs to obtain the history of the lesions and educate the patient regarding unsafe practice in both flogging and strangulation.

The attendee will be able to review photographs of consensual flogging on the buttocks of a young girl. Her birthday present was a whipping by a group of young adults who used cat of nine tails to whip her over her clothes. She also disclosed that she practices consensual strangulation with her partner. She describes that her partner will let go when she is passing out. She imitates both of these practices before she has sex.

The history is crucial to determine the facts, especially what parts of the event were consensual. In some cases, attorneys must decide if the case has enough evidence to support a crime. It is difficult when the flogging and strangulation practice starts out consensually but has elements of force and ends in death. The key point is also patient education that consensual flogging and strangulation does not fit the credo of safe behavior. The intervention you provide may help the patient avoid morbidity or mortality.

Consent, Physical Abuse, Ritualistic Erotic Practice

D38 Extra-Genital Injuries in Sexual Assault

Amy Carney, MS, MFS, Palomar Pomerado Hospital District, 16226 B Avenida Venusto, San Diego, CA 92128*

After attending this presentation, attendees will recognize injuries which occur during sexual assault in other than genital areas of the body and understand the prevalence of these injuries in the absence of genital findings. Documentation on the State of California Form OCJP 923 will be illustrated, and photo documentation of injuries will be presented.

This presentation will emphasize the need for evaluation and documentation of all injuries during the forensic examination in sexual assault in addition to genital findings, and enhance the quality of forensic evaluation and medical care of the sexual assault victim.

Sexual assault is any form of nonconsensual sexual activity, ranging from fondling to penetration, and occurs across all ethnic classifications as well as age span, gender, and social class. Extra-genital injuries (EGI) are those which occur during sexual assault on other than genital areas. These include hematomas, abrasions, lacerations, erythema, and swelling. Mechanisms of injury include strangulation, stabbing, human bites, and blunt force trauma. During the course of a sexual assault injuries may occur on multiple sites and in multiple forms.

A review was done of 88 victims of sexual assault who were examined by the Palomar Pomerado Sexual Assault Team (SART) in 2001. The data was obtained from the County of San Diego SART Protocol. This study describes the rates, patterns, and characteristics of injuries across the represented ethnic groups. The injuries were documented by type, location, and mechanism of injury when available. Each case was reviewed for indication of sexual assault and all associated injuries, and then evaluated by distribution and number of injuries. The hypothesis for this study was "In data collected from an ethnically diverse urban and suburban population incidence of extra-genital injury will be found to be evenly distributed across the represented ethnic groups, regardless of presence of genital injuries." Injuries were primarily identified in two groups: 1) Classified, as defined by type and location, such as "perianal skin abrasion"; and 2) unclassified, such as "swelling." In 53 of the cases the victims knew their attacker, 13 were in a relationship with the assailant, 18 were strangers, and four were "unknown or other." The total number of EGI across all groups was 239. Incidence of EGI was found to be evenly distributed in three of the four examined groups. The findings of the study indicate that EGI were present in all 88 cases and in each group, even though only 75 cases had findings consistent with sexual assault.

Sexual Assault, Injuries, Extra-Genital

D39 SANE Program Evaluation Questionnaire (SPEQ©) Pilot in Three Cities

Patricia M. Speck, MSN, 1740 Overton Park, Memphis, TN 38112*

Attendees will learn about the development process of the SPEQ© and its applicability to new and developing SANE programs nationwide. This presentation will demonstrate multi-faceted research, which includes: 1) the fact that, since their inception, SANE programs lack continuity in their evaluative processes; 2) the use of the SPEQ© will highlight successes and opportunities to improve SANE programs in a number of content areas; and 3) SANE program evaluation is based in scientific method to meet the needs of the users of SANE programs, such as prosecutors, law enforcement, and forensic nurses.

The recent development of Sexual Assault Nurse Examiner programs nationally has provided an opportunity for justice for victims of sexual crimes and the accused. Their development has been identified as an emerging practice to help meet the goals to reduce violence against women and supported by an evolutionary understanding that is rooted in public health's understanding that violence is a health issue (Koop, 1985). These organizations include the World Health Organization (1984), the Department of Justice (DOJ) Office on Victims of Crime (1985), and the DOJ Office on Violence against Women (1994).

These international and national efforts to reduce sexual violence have had success with falling sexual crime rates, but there is no research to identify *what* in these programs is working to help in the falling rates of victimization. Since all programs that affect the public's health have been identified by the CDC to be either government-based, not-for-profit, or commercial enterprises, it is logical to use the *Framework for Program Evaluation in Public Health* (CDC, 1999) recommendations as a model to study SANE programs. This model includes engaging stakeholders, describing the program needs and resources, activities and expected effects, and providing an objective evaluative design.

The collection of scientific data, interpretation of the data and collaborative feedback with dissemination of the results is the hallmark of effective program evaluation (CDC, 1999). The SANE model of care does not have a unique tool with which to evaluate the program's formative development and activities or substantive outcomes. In 1999, the OVC funded a study about the development of SANE programs and their operations. The author (Ledray, 1999) lamented that there were "no hard data" to support the SANE model.

This researcher has developed and validated a tool for the evaluation of SANE programs. This presentation will present the pilot study of the three programs.

SANE Program Evaluation, SPEQ©, Program Evaluation

D40 Validation of Commercially Available Field Test Kits for Drugs of Abuse

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This presentation will provide attendees with information regarding validation of commercially available field test kits for drugs of abuse which will allow them to make purchases that suit their purposes.

The National Forensic Science Technology Center (NFSTC), has developed a comprehensive training program and quality assurance system that provides law enforcement with the resources necessary to perform preliminary identification of controlled substances utilizing field test kits. In order to provide information concerning test kit performance, this program has been expanded to include a validation study of the test kits most frequently employed by law enforcement. The test kits included in the validation study are those manufactured by ODV, NIK, and NARK II. In particular, the kits designed for presumptive identification of marijuana, cocaine salt, cocaine base, methamphetamine, and heroin were assessed. Sensitivity, specificity, and reproducibility were the criteria evaluated. Neat drug standards, neat cutting agents, samples of known percentages of drug standards mixed with common cutting agents, and street samples were tested. Each sample was run in duplicate with color assignment after a one minute time interval. Colors were represented by a numeric designation of hue, value, and chroma from the Munsell Color Chart System.

The results of this validation study provide law enforcement agencies with data to enable them to select test kits best suited to their needs. Information is provided with respect to the measured criteria as well as corollary observations regarding test kit quality control, handling safety, and color. Results and conclusions of this study will be presented here and included in the Best Practices Guide provided by NFSTC to all interested parties.

Validation, Drugs of Abuse, Field Test Kits

D41 Cocaine Related Deaths in Tarrant County

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Participants will learn about the distribution of cocaine related deaths as related to the age, gender, race, and socioeconomic status according to the zip codes in various parts of Tarrant County.

The Tarrant County Medical Examiner's Office serves a population of over two million Americans and over 8,000 inquests in 2004. A large number of deaths are associated with drug abuse and among them cocaine is most frequently used.

In pre-Columbian times the coca leaf, which is the source of cocaine, was officially reserved for Inca Royalty. The natives used coca for mystical, social, religious, nutritional, and medicinal purposes. In the following years, cocaine was effectively used as a pain killer, as well as a surface anesthetic. In later years, for the pharmaceutical firm Parke-Davis, cocaine was a fast selling product for hay fever and catarrh remedy. In 1886, Coca-Cola was sold as a temperance drink and was very popular and invigorating. Until 1903, a typical serving contained approximately 60 milligrams of cocaine. Today the Coca-Cola Company uses only the coca leaves for flavoring since the drug has been removed.

Cocaine is a powerfully addictive drug. During 2002, there were an estimated 1,059,000 new cocaine users in the United States. The average age of those who first used cocaine during 2002 was 20.3 years. According to the 2003 National Survey on Drug Use and Health, approximately 34.9 million Americans age 12 and older had tried cocaine at least once in their lifetimes. This represents 14.7 percent of the population ages 12 and older. About 5.9 million (2.5%) have used cocaine in the past year and 2.3 million (1%) had used cocaine in the past month.

Among the students surveyed in 2004, 3.4 percent of eighth graders, 5.4 percent of tenth graders, and 8.1 percent of twelfth graders reported using cocaine at least once during their lifetimes. Regardless of the ease by which one can obtain cocaine, 19.4 percent of eighth graders, 31.2 percent of tenth graders, and 41.7 percent of twelfth graders reported in 2004 that cocaine was fairly easy to obtain.

The purpose of this study is to establish the role of cocaine use in Tarrant County. The Tarrant County Medical Examiner's cases between the years 2000 and 2004 are tabulated to the following manners of death: natural, accidental, suicide, and homicide. Between the years 2000 and 2004, out of all cases reported to have mixed drug abuse, 376 cases were found to have cocaine.

Yearly Distributions of Cocaine

2000	**Male**	**Female**	**Black**	**Hispanic**	**White**	**Other**
	22	11	13	2	18	0
	0-19	**20-39**	**40-69**	**70+**		
	0	22	11	0		
2001	**Male**	**Female**	**Black**	**Hispanic**	**White**	**Other**
	32	10	11	4	27	0
	0-19	**20-39**	**40-69**	**70+**		
	2	20	20	0		
2002	**Male**	**Female**	**Black**	**Hispanic**	**White**	**Other**
	32	6	8	5	24	1
	0-19	**20-39**	**40-69**	**70+**		
	2	19	17	0		
2003	**Male**	**Female**	**Black**	**Hispanic**	**White**	**Other**
	65	16	25	10	45	1
	0-19	**20-39**	**40-69**	**70+**		
	6	34	41	0		
2004	**Male**	**Female**	**Black**	**Hispanic**	**White**	**Other**
	127	55	22	29	130	1
	0-19	**20-39**	**40-69**	**70+**		
	25	61	83	13		
2000-	Male	Female	Black	Hispanic	White	Other
2004	**278**	**98**	**79**	**50**	**244**	**3**
Totals	0-19	20-39	40-69	70+		
	35	**156**	**172**	**13**		

Cocaine, Socio-Economic Status, Zip Code

D42 Program Design for the DNA-STR Genotypes Searching System on Criminal Scene Application

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Attendees will learn how to manipulate valuable casework data with databases and design other evidence to collect. This information will be compiled from routine cases by using the DNA-STR genotypes Searching System. The authors offer the DNA-STR Searching Genotypes System which provides high efficiency, friendly operational procedures, absolute security, and convenience. The authors hope to integrate the resources of forensic science in Taiwan and keep feasible connection with worldwide related databases via Internet.

In the past several decades, short tandem repeat (STR) markers have become a tactful strategy for forensic DNA typing including individual information in forensic caseworks and paternity tests. However, the DNA databases are built of STR loci based on CODIS 13 and Y chromosome STR loci in forensic laboratories. These databases are eagerly shared with other forensic labs in Taiwan, aiming to establish local forensic data network for rapid identification of suspects, victims of catastrophe, and nameless human remains. In order to easily and feasibly manipulate these valuable databases, the authors developed a new automatic computer program, which is capable of integrating the current STR loci databases with pending data, meanwhile, searching and storing what is desired. The rapid, fuzzy and automatic computer program, so called the DNA-STR genotypes Searching System, is originally based on the platform of the Borland company software written for analyzing the present commercially available multiplex STR kits (from Applied Biosystems and Promega company). The commercial product of Borland company, Delphi Professional software, is a complete rapid application development (RAD) environment for the visual design, compilation, and debugging of programs written in the Delphi and C languages. Programs can be targeted for Win32 and Microsoft .NET. The Professional edition also provides RAD database development with basic local database connectivity.

Albeit the self-developed DNA Search System is designed on the basis of Delphi Professional software, there are various novelties coming from it. On the one hand the designed program can be applied to search local databases at each client site of local personal computer with authority control at the server end and on the other hand it can be connected and shared with other international DNA databases via web net. There are five icons available to key in individual data and various searching demands for comparison with either single case or multiple cases (group) to the whole database. The efficiency of the program has been tested by operating ten unidentified data to seven thousands individuals STR loci database and it was estimated in less than three minutes to finish. The authors are also planning to amplify the functions of the program by combing the ability of automatically calculating the index of the Power of Discrimination/Exclusion, Probability of the match, and the other statistic applications with this searching system for forensic cases and paternity tests. The excellent characteristics of the program are high efficiency, friendly operational procedures, absolute security, and convenience.

Short Tandem Repeat (STR), DNA Database, Computer Program

D43 CPI Distribution and Cut-Off Value for Duo Paternity Building

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Attendees will learn that CPI can be very low for real duo paternity cases and CPI could be very high for random pairs (duo). The presentation will demonstrate that a suitable CPI range should be developed for determining paternity.

The STR loci comprising CODIS has an average power of paternity exclusion larger than 0.9999 based upon mother, child and father combinations (a trio case). This figure is true for many populations. In cases requiring the identification of human remains if only one living relative (either of the parents or of offspring) is available, this represents a duo case for parentage building. In duo cases when allele sharing is found in all the 13 loci, the probability of parentage could be determined. However, it is hard to avoid a false parentage evaluation if the pair happened to share an allele at all 13 loci. In Taiwan, the National Unidentified Bodies CODIS 13 STR Database has approximately 1250 bodies and 350 families for comparison originally. Using STR typing and blood-relative comparing instances a body first-degree matched to more than one individual was rarely found, however the CPI (Cumulated Paternity Index) was extremely low. It is necessary to evaluate the false parentage rate and set a cut-off value of CPI and vise versa to analyze the distribution of CPIs from real paternity cases, hope to help evaluate the paternity and lead to identification.

According to the published frequencies of STR alleles, the cumulated power of exclusion (PE) for duo for Chinese in Taiwan is 98.13%. The data showed that about 1.87 % random individuals could not be excluded from being a first-degree blood relative to the population. For proving this, CODIS 13 population data of 1,000 Chinese in Taiwan was collected and paired resulting in 499,500 pairs. Microsoft Excel Macros controlled by a Visual Basic program written by authors was used to handle the allele sharing comparison and CPI calculation. There were 462 (0.0925%) pairs found with all 13 allele sharing loci. False parentage relation was noted when the CPI for pairs ranged from 2.56 to 6,835,432.78, and the median CPI was 484.69 meaning that if the CPI of 484.69 were used as the cut-off, 50% of the false pairs would not be recognized as first-blood-relative, and if the CPI cut-off increased to 1,000, 62.9% false pairs could be eliminated, however the false exclusion rate for real duos was 5.7%(cut-off = 484.69) and then increased to 10.8%(cut-off = 1,000) respectively. The dilemma could be resolved by profiling more STR systems when duos were found with low CPI or adding anthropology and other information to make the confirmation. This is especially the case for mass and open comparing operation of STR database for the unidentified bodies.

Forensic Science, STR, Paternity

D44 Fluvial Transport of Bones: Our State of Knowledge and Future Research Directions

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The author will offer a review of the forensic, anthropological, and paleontological research related to bone transport and deposition in river systems. A synopsis of the consistent results between the studies reviewed will be presented as well as a discussion of the conflicting data and ideas. Directions for future research will be outlined.

This presentation will provide a concise statement of what is known about bone transport and deposition, which should aid investigators in making informed decisions about where to look for the rest of a partial skeleton in a fluvial context, and make more informed reconstructions of the postmortem history of the remains under investigation. In some jurisdictions finding human skeletal remains in fluvial systems is relatively common. However, in a search it is often hard to find more than a few parts of a skeleton, and often reconstruction of the skeleton's history is complicated. This review will not enable investigators to identify exactly where to find bones or to identify exactly what their histories have been, however it will give them more information to work with that may increase their productivity and success rates with such cases.

Understanding the postmortem history of the bones found in forensics, anthropology, or paleontology requires knowledge and understanding of the processes that act on a body and its parts after death. Many modern and fossil remains are found in rivers or in association with river sediments, often having been transported by the river in order to be deposited where they are found. In order to piece together the postmortem history of remains found in fluvial contexts it is essential to understand how bones are transported in and deposited by river systems.

Previous work on the subject has focused on three methods of inquiry: 1) settling column experiments, 2) flume experiments, and 3) observation of bones in rivers. Settling column experiments generate data that can be used to calculate a theoretical behavior of bones in river systems; however, this theory has not yet been tested rigorously. Flume experiments have been used to directly observe bone transport and deposition while subject to water flow. Results of these experiments contradict some of the predicted behavior calculated from settling column studies. Flume data is powerful, however, in order to run flume experiments many flow and sediment conditions are held constant; a situation rarely found in nature. As a result, the conclusions made from flume data on bones have an unknown applicability to natural systems. Few studies have been performed placing bones in rivers and observing their behavior. Those experiments have shown that a bone's shape, size, and initial orientation alter its transport properties within a river. Similarly the interaction between the river bed and the bone being transported significantly alters a bone's transport and deposition potential.

From the above studies it is known that a bone's shape, size, density, and orientation in a flow all alter its transport potential. A bone's shape, size, and orientation can be loosely combined into one variable; the hydraulic shape. The hydraulic shape and density of bones seem to be the controlling factors in the transport of bone material. As flow velocities and water depths change the hydraulic shape, density, and the velocity profile of a river interact to produce deposition or transport of bones. General rules for the interaction between hydraulic shape, flow depth, and flow velocity will be advanced and discussed.

Future research should include a test of the existing bone transport theory generated from settling column experiments. Many bones should be characterized in a settling column, their transport behavior predicted, and this prediction should be tested by placing bones in a river system and observing how they are transported and deposited. Actualistic data obtained from bones in rivers should be compared to flume data to ascertain how applicable flume data is to the real world. Bone weathering and abrasion during transport should also be studied since modifications to bone surfaces could yield useful information about transport distance, and potentially the postmortem interval.

Fluvial, Transport, Bones

D45 The Many Facets of the Forensic Nurse in Mass Disaster Response

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Attendees will learn how forensic nurses offer a diverse background to integrate knowledge and clinical skills in all aspects of care when faced with natural or man made disasters. This presentation demonstrate the diverse applications that forensic nurses offer to multidisciplinary agencies when faced with a mass casualty event

Effective response to disasters is a necessary action of disaster teams in effort to secure and support the nation. Understanding scene safety and security is essential prior to rendering care to the injured. Forensic nurses, as members of disaster teams, are prepared to respond to situations from natural disasters to man-made disasters. Stabilization of injured persons is foremost in the acute phase and when standards of care and nursing practice directly apply to rendering treatment to injured victims.

There are countless types of disasters. Examples include: fires, building collapses, weather emergencies such as ice storms, hurricanes, or drought, pestilence such as West Nile Virus, and mass transportation incidents. Combinations of natural and man-made disasters occur and clinical forensic nurses are prepared to take on their role in an efficient and effective manner.

Administering first aid and emergency treatment is foremost and key at any mass casualty scene. Clinical forensic nurses are valuable assets in the stabilization and evacuation time period because they provide rapid immediate assessment of the injured and advanced life support care. They routinely deliver acute emergency care in trauma, contributing to the triage process and treatment of disaster victims. Some instances may require them to accompany the victim to a medical treatment facility to continue established care and life saving support.

Gathering critical information such as the victim's medical history, an account of what has occurred, and telephone numbers of family members may assist in facilitating care and treatment to each individual. The nurse's ability to accurately assess and meticulously document

observations of sustained wounds and to interpret mechanisms of injury acquired by victims proves advantageous in the pathological examination of injuries and in forensic investigations that may lead to civil or criminal litigation. Emergency response to and recognition of the forensic implications of these events is critical and overwhelming. The forensic nurse is a natural liaison to any community challenged with multidisciplinary efforts.

Because forensic nurse's cross-train with multiple agencies in preparation for mass disasters, the role of the forensic nurse is clearly understood as is their mutual understanding of the professional disciplines within the disaster response team. Forensic nurses may have opportunities to work with search and rescue teams, law enforcement agencies, and American Red Cross volunteers. Knowing what community services exist, directing people to the proper resources may assist in family reunification, and finding systems of support.

Provision of mortuary care, facilitated by the medical examiner's office, is another aspect of nursing care that forensic nurses are resourceful in facilitating communication between families and mortuary services. Identification of human remains as well as addressing concerns for care and disposition of bodies are duties of forensic nurse's that serve as death investigators.

Forensic nursing care continues into the aftermath of a disaster as delayed presentations of physical and/or psychological symptoms may develop among survivors. Nurses must consider that not only primary disaster victims but also caregivers and first responders to traumatic events may suffer from long term physical or mental health symptoms. Forensic nurses provide follow up care and referrals for such victims.

Lastly, a focus on prevention of future disastrous events must be considered to promote health and safety during all incidents. A review of outcomes following events and evaluation of what was learned is imperative in future planning and prevention. Forensic nurses understand the health care response to trauma and violence and contribute to expertise in health care. Training and education offered through the Department of Homeland Security, as well as governmental and community agency resources, is suggested.

Forensic Nurse, Mass Casualty Event, Disasters

D46 Strangulation in Sexual Assault

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After attending this presentation, attendees will be able to identify the different mechanisms of strangulation and have an understanding of the issue of power and control in sexual assault as well as the need for complete history documentation in the absence of physical findings. This presentation will impact the forensic community by raising the awareness of the need for meticulous examination and documentation of the sexual assault victim who has been strangled.

Strangulation as a mechanism of assault is often poorly understood by both investigators and victims in a trauma situation. The victim may be unable to completely describe what form the assault took, and investigators are often reluctant to pursue a mechanism in the absence of physical findings. The terms "strangulation" and "choking" have been used interchangeably in the literature which leads to confusion when attempting to differentiate the symptoms the victim is describing and the manner of assault.

Strangulation is frequently used as a means of control in sexual assault. The neck is a very vulnerable area in an attack, as the diameter is fairly small and the airway is fairly unprotected. The only weapon usually necessary is one the attacker has with him: hands. Although a ligature or other tool can also be used, the hand and forearm are the most commonly found to be used in strangulation. Symptoms described by victims after an attack include breathing and swallowing changes, voice changes such as hoarseness, a perceived feeling of swelling in the outer neck or internal structures, restlessness or combativeness, and incontinence of urine or stool. If physical injuries are present they may include bruising of the neck, scratches or abrasions, redness in the eyes from subconjunctival hemorrhage or discrete petechiae, and ligature marks if one was used. However, many victims have no visible injuries and some are too minor to photograph. Physiologic theories on how injuries produce symptoms include venous obstruction leading to cerebral stagnation and hypoxia; vagal collapse caused by carotid pressure as well as arterial spasm due to carotid pressure. The location on the neck in which the attacker applies force, how much force, and for how much time, as well as the surface area to which it is applied are all variables involved in producing symptoms. The amount of time that has passed between incident and injury documentation, be it very quickly or moderately long, can make the difference on finding "visible" injuries.

The authors will present two case studies of strangulation in sexual assault showing minimal visible injury to the neck with resultant symptoms. The need to ask the victim about injury to the neck will be emphasized as many forensic examiners fail to ask, examine, or document and most victims do not volunteer this information unless questioned.

Strangulation, Sexual Assault, Injury

D47 A Classification System and Identification Key for .177 Caliber Pellets

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After attending this presentation, the participant will understand: 1) the variety of .117 caliber air gun pellets styles available; 2) the procedure for classifying .117 caliber air gun pellets based on class characteristics; and 3) the advantages and disadvantages of identifying .117 caliber pellets based on class characteristics.

This presentation will demonstrate the development of a classification system that can be incorporated into the forensic laboratory to aid in the investigation and identification of pellet brands.

The purpose of this presentation is to present the results of a .117 caliber pellet classification system for identifying different brands of pellets based on their class characteristics.

In some cases, a pellet recovered from the crime scene may assist investigators by identifying the product brand. Even though all product brands cannot be identified, various brands of pellets can be eliminated based on the pellet's class characteristics.

An examination of 68 pellets from fifteen companies was conducted to determine if the brand of an unidentified pellet could be identified based on the pellet's class characteristics. The pellet producers were from China, Czech Republic, England, Korea, Spain, and the United States.

The five class characteristics used in the pellet classification system were the pellet's head shape, skirt type, length, weight and other markings or observations. The last characteristic was used to distinguish pellets with similar head style, skirt type, length and weight measurements.

The first division in the pellet classification was pellet head shape. These included: domed or round, wadcutter, pointed, and hollow point. Of the 68 pellets examined, 24 (35%) were domed or round; 21 (31%) were wadcutter; 17 (25%) were pointed; and six (9%) were hollow points.

The second division in the pellet classification was based on the skirt type. Pellet skirts were either plain or ribbed. Of the pointed pellets, 14 (82%) were plain and three (18%) ribbed. The domed pellets

were 16 (66%) plain and eight (33%) ribbed; the wadcutters were 20 (95%) plain and one (5%) ribbed. None of the hollow pointed pellets was ribbed.

The third division was based on the pellet's length. Ten pellets from each of the 68 types were measured with dial calipers to determine the average length of each pellet type. Pellets were grouped according to similar lengths but placed in separated categories when the length dimension exceeded .010 inches. The length for all pellets ranged from .199 to .392 inches.

The fourth category used to separate the pellets was weight. Ten pellets from each of the 68 types were weighed with a digital scale to determine the average weight for each pellet type. The weight for all pellets ranged from 7.0 to 18.2 grains.

The last category used to separate the pellets was other observations. These observations included whether the pellet had a visible seam on the side of the pellet. Pellets may be a non-diabolo style. They may have rings around the head or be manufactured out of plastic or metals other than lead. Also, they may have a coating.

Symbols used in the classification system for pellet head type were "P" for pointed, "D" for domed, "W" for wadcutter, and "H" for hollow point. Symbols for pellet skirt type were "P" for plain and "R" for ribbed. The length of the pellet was recorded in thousandths of an inch and the weight was recorded in grains. Markings and observations were noted in parenthesis. The class characteristics were separated by dashes in the classification system. For example P - P - .298 - 11.5 - (3-ring head) indicates a pointed pellet with a plain skirt that is .298 inches in length, weighs 11.5 grains and has three rings on its head. An identification key was made using the symbols so that when a recovered pellet is classified it may be checked against the 68 known types. This is not an absolute pellet identification system; however, it provides possible product identification of some pellets for the investigator. The system can also eliminate numerous pellet brands.

After classification, the domed pellets were subdivided into four groups. Group I contained seven pellet types; group II, five pellet types; group III, four pellet types; and group IV, eight pellet types. The wadcutter pellets were subdivided into five groups. Group I had seven pellet types; group II, ten pellet types; group III, two pellet types; group IV, one pellet type; and group V, one pellet type. The pointed pellets were subdivided into four groups. Group I contained four pellet types; group II, seven pellet types; group III, three pellet types; and group IV, three pellet types. The hollow point pellets were subdivided into four groups. Group I contained three pellet types; group II, one pellet type; group III, one pellet type; and group IV, one pellet type.

In conclusion, after subdividing the pellets, the largest category was the wadcutter type. This subdivision contained ten (17%) of the pellets. Even though individual pellets could not be identified in this wadcutter group 58 (83%) of the other pellet types could be eliminated. The smallest category was the hollow point pellets. This subdivision contained seven (10%) of the pellets. Of the 68 pellets examined 12 (18%) had unique class characteristics that permitted individual identification based on visual comparison with known pellets. Of the pellets with unique class characteristics, three were domed, three wadcutter, five pointed and one was a hollow pointed pellet. The pellet classification system and identification key would assist investigators in the identification of some pellet brands and the elimination others.

Air gun, Pellet, Class Characteristics

D48 Child Abduction Murders: A Description of the Victims, Offenders, and Factors Affecting Investigations

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Attendees will learn the results of a study that will provide police investigators with descriptive information which will lead to the capture of child abduction killers and enhance the solution of child abduction murder cases. This presentation will impact the forensic community by improving the efficiency and effectiveness of the investigation processes of child murders. Very little information exists in social science literature about the victims, offenders, victim-offender relationships and other factors affecting murder investigations of abducted children.

Child abduction murders are incredibly difficult to solve and deeply impact society and law enforcement officials involved in the investigation. A considerable amount of scholarly material on murder exists; far less is available on the murder of abducted children. This study provides an overview of descriptive information about the victims, offenders and other factors affecting the investigations of child abduction murders. The characteristics of the victims as well as the characteristics, motives and actions of offenders were examined. A description of the victim-offender relationship, the offender's motivation, and victim selection process is also included. Variables relating to the victim's cause of death and offender's post-offense behavior will be presented. Finally, a descriptive analysis of the variables affecting case investigations, physical evidence, and a comparison of single-victim and series cases in this sample are also included**.** Because the murder of an abducted child impacts society in such an overwhelming manner, the absence of literature in this area is disturbing.

The child abduction murder dataset (CAM) included 833 child abduction murders. Only cases in which the victim was 17-years-old or younger were used for this analysis ($N = 735$). Offenders in this sample ($n = 589$) were not identified in all child abduction murder investigations included in the CAM dataset.

The typical child abduction murder victim in this sample was a white (74.5%) female (74.0%), approximately 11-years-old ($M = 11.52$). Victims in this sample were predominantly from a middle-class (35.2%) or "blue-collar" (35.8%) family, living in an urban (29.3%) or suburban (35.2%) neighborhood, in a single-family residence (71.1%). The victim's relationship with their family was good (49.8%) and the family situation was not generally considered high risk (83.5%).

The typical offender from this sample of child abduction murder cases was a white male, approximately 27-years-old. The data indicated some interesting and meaningful characteristics of child abduction murderers which may enable law enforcement professionals to quickly identify and guard against potential offenders.

It is critical to understand the victim-offender relationship in order to properly protect children. The data indicated interesting differences in the victim-offender relationship by age and gender. The data also indicated that children are at a higher risk of victimization from those that they know than strangers.

In addition to information, on victims and offenders and their relationship, variables relating to the actual investigation process were explored which may prove valuable to detectives. A descriptive analysis of the variables affecting abducted child murder investigations including those related to witnesses, canvasses, and searches, investigative steps in the first 48 hours and physical evidence is provided.

Child Abduction Murder, Victim-Offender Relationships, Factors Affecting Investigation

D49 Forensic Radiography: Response to the London Suicide Bombings on 7th July 2005

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After attending this presentation, attendees will understand the role of radiography in the investigation of mass fatality incidents, the range of imaging technologies available and their application to the identification of the deceased and the forensic investigation of terrorist incidents. This presentation will present a case study of the application of radiography in the investigation of mass disasters. It is recommended that all mass fatality plans provide for rapid mobilization of radiological services using fluoroscopy and digital imaging.

Methods: On 7 July 2005, 56 people were killed and over 700 injured when suicide bombers staged four simultaneous attacks upon the London Transport system.

Positive identification of human remains is one of the most important tasks in mass disaster investigations and the London Mass Fatality Plan was immediately put into operation. A fully equipped emergency mortuary was established on a Military site in the City of London and was operational within 48 hours after the attacks. In accordance with the plan, the Association of Forensic Radiographers initiated its national response, mobilizing 27 forensic radiographers from throughout the United Kingdom who worked 12 hours per day in teams of 4-8 equipped with two digital fluoroscopes, direct digital and computed radiography systems and dental radiography equipment.

Radiological examinations followed the same established principles of the management of trauma, with primary, secondary, and tertiary surveys being undertaken at different stages of the investigation, making use of the most appropriate modern technologies available.

Over a sixteen day period, 56 bodies and 1162 body parts were examined. Primary surveys of whole bodies in unopened body-bags were undertaken using fluoroscopy by teams of two radiographers and a pathologist. The aim of the primary survey was to establish the nature of the contents of the bag, identify any hazardous material that may present a danger to mortuary workers, note any distinguishing features that may aid in establishing the identity of the victim, record the presence of jewelry and personal effects, note obvious injuries and, as the event was known to be a result of terrorist action, to search for any clues such as weapons or bomb fragments that might lead to a better understanding of the attack. Hard copy image was provided by means of a thermal film printer.

In the case of body parts, the primary survey was undertaken using direct digital and computed radiography. This technology offers a wide dynamic range, affording the pathologist, anthropologist, and crime investigator the facility to review the images under a variety of display settings to determine bone detail, soft tissue detail, and the presence of both metallic and non-metallic objects from the same examination.

Secondary surveys were undertaken following removal of clothing and external examination by the pathologist. The purpose of the survey was to document anatomical features that may be used for identification by undertaking radiographic examinations using standard projections for comparison purposes. In this particular incident, the secondary surveys were mainly limited to intra-oral dental radiography in conjunction with the odontological examination.

Tertiary examinations of both bodies and body parts were undertaken at the request of the pathologist in a number of cases.

Results: Fluoroscopy facilitated rapid location of jewelry and personal effects and allowed for documentation of injuries sustained by the victims. A number of foreign bodies were noted at primary survey and those that proved difficult to locate at postmortem examination were rapidly retrieved under fluoroscopic control.

Intra-oral dental x-rays undertaken on-site as part of the odontological examination enabled rapid and non-invasive acquisition of postmortem data for comparison with available ante-mortem records.

All 56 bodies were identified within six days from the start of the investigation. Identification by dental records was the primary identification method in 74% of these cases.

All 1162 body parts were examined using digital radiography. The rapidity of examination and the wide dynamic range offered by digital imaging enabled bone fragments and teeth to be recovered for further examination and DNA testing. In many cases, the high resolution of the initial radiographs eliminated the need for further skeletal or dental radiography. Alteration of viewing parameters enabled visualization of both skeletal and soft tissue structures from the same image and enabled location and retrieval of both metallic and non-metallic foreign bodies and minimized the need to undertake more invasive physical examination of the soft tissues.

Conclusion: Use of modern radiographic imaging technologies contributed greatly to the speed of the pathology examination and identification process. Fluoroscopy and digital radiography enabled items of forensic evidence to be located and recovered very rapidly whilst minimizing the need for invasive procedures to be undertaken.

Radiology, Mass Disasters, Terrorism

D50 A Decade of Student Deaths at Purdue University - Are There Similarities?

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Participants of this presentation will be briefed on the ten year statistical overview and information gained in this research of deaths among Purdue University college student that an be utilized in analyzing the cause and manner of deaths with the focus on adjusting or implementing preventative measures related to these deaths.

This presentation will impact the forensic community and/or humanity by providing the forensic community with information gained through this research which can be analyzed for potential implementation or improvement of services to college students in the area of suicide and homicide prevention. Being able to recognize and focus on the high risk students may also decrease suicide rate.

The ten year statistical overview and information gained in this research of deaths among Purdue University college students can be utilized in analyzing the cause and manner of deaths. The focus should be on adjusting or implementing preventative measures related to deaths among college students and improving or enhancing the college experience among co-eds. Review of the 121 death records, and law enforcement case reports revealed that a total number of 25 students committed suicide; three students were victims of homicide; 19 students died of natural causes; and 54 students died as a result of being involved in an automobile accident. The remaining 17 deaths were ruled either accidental or undetermined. In addition, the number of undergraduate student deaths was 91 and the graduate student deaths were 19, leaving 16 unknown of their collegiate status.

Homicide, Suicide, College Student

D51 Suicidal Hanging Resulting in Complete Decapitation: A Case Report

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Attendees will learn the criteria to differentiate suicidal or criminal decapitation that must be known by the forensic pathology community; and learn the contribution factors of a complete post hanging decapitation must be known by the forensic pathology community. This presentation will impact the forensic community by increasing the ability of forensic pathologists to correctly classify decapitations in hangings**.**

Death scene findings: A decapitated body was found in the morning by a jogger in a park beside a road bridge. The decapitated corpse lay against one pillar of a road bridge; a considerable amount of blood had splattered on the wall facing the neck stump. The wall was amply splattered with blood to a height of about one meter, indicating a vital arterial bleeding. The head was found five meters away from the trunk. A nylon rope was found tied to the base of a street lamp located on the bridge. The bridge was 7.20 meters from the road level. The lower end of the rope was 3.60 meters in length with a noose about ten mm in diameter. There was no evidence of a fight or any influence by another person at the discovery site. A handwritten letter of intend was found inside one trouser pocket of the deceased. The victim was identified from fingerprints; he was a 65-year-old man with no medical past history.

Postmortem findings: At the autopsy time the head and the torso were perfectly complementary with each other, without apparent loss of substance. The severance line passed through the low ventral to the high dorsal part of the upper cervical region and was a sharply clean edge. A band like abrasion pattern with rough-toothed margins around the skin of the neck was noted. The severance plane passed between the third and the fourth cervical vertebrae, with an intervertebral disc completely torn apart. The airway was severed at the trachea level, between the hyoid bone and the thyroid cartilage. The intima of the carotid arteries showed several horizontal tears and the adventitious showed some bruises. The entire severance plane showed marked extravasation blood in the tissue of the wound surfaces. Blood aspiration was noted. Furthermore, a longitudinal rupture of the thoracic aorta, fractured ribs and a burst fracture of body of the twelfth dorsal vertebrae were noted. The toxicological analyses, including alcohol analyses, all yielded negative results. Skull and cervical spine x-rays showed air within the meningeal spaces and ventricles. No skull fracture was diagnosed. The severance plane of the cervical spine was between the third and the fourth cervical vertebrae. A dry bone study was realised and confirmed the cervical bone severance plane and found a fracture of the spinous process of the third cervical vertebra.

Discussion: Although hanging ranks among the internationally frequent suicide methods, decapitation is an unusual complication. It is not only rare but also has a medico-legal importance in relation to the causal mechanisms, differential diagnosis with a post-homicide decapitation and identification. Cases reports already exist in the forensic literature. Suicidal hanging is generally associated with soft-tissues injuries but osseous lesions of the cervical spine are unusual. Concerning complete post hanging decapitation, the section of soft tissues always occurs at the uppermost part of the neck and the cervical spine and breaks generally between the first and the second cervical vertebrae, sometimes between the second and the third cervical vertebrae. However, the authors observed the cervical spine broke between the third and the fourth cervical vertebrae with a fracture of the spinous process of the third vertebra. The authors discuss and compare this finding with the severance line previously described in the literature. Others findings as cranial and caudal wound edges, blood aspiration, vital reactions are compared to the literature cases. The following conditions as results of post hanging suicidal decapitation are summarized.

The complete mechanism of decapitation and autopsy findings are discussed, reviewed and compared to this case.

The fractures of the ribs and the thoracic vertebra were attributed to the shock against the wall.

A large iconography is presented to illustrate the findings on the death scene, at the autopsy time, on the radiographies and the dry bones.

Decapitation, Suicide, X-Rays

D52 Managing Intellectual Capital

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Attendees will be made aware of techniques to measure, increase, and retain intellectual capital to increase quality within their laboratories. This presentation will impact the forensic community by advancing unique performance metrics that can be used by forensic science to measure laboratory efficiency; offering strategies for communicating successfully with funding agencies; and demonstrating a case example of increasing the intellectual capital of a large metropolitan forensic science lab, using a forensic advisory group.

Introduction: Intellectual capital is a strategic resource in organizations. This article discusses strategies for increasing the intellectual capacity of the forensic science laboratory. It begins with a definition of intellectual capital using a resource-based model of organizations. Next, it discusses laboratory structure and the measurement of laboratory efficiency. Human resource metrics and the importance of communicating with funding agencies are considered. The article concludes with a discussion of an overall strategy for increasing intellectual capital in forensic laboratories and offers a case example using a forensic advisory group.

Human Resources as Intellectual Capital: Demonstrating that investments in human resources lead to improved laboratory performance is critical to laboratory directors (Koussiafes 2004). Resource-based models propose matching the overall strategy of the organization with its human resource practices (Barney 2001). Originating from economics, the resource-based view considers human resources as assets as opposed to variable costs. The resource-based view is the philosophy behind initiatives to consider human resources as *intellectual capital.* In this model, human resource practices support the intellectual capital of the forensic laboratory by making the most of the job-related behaviors of the talent pool. Certain conditions must be present to maximize organizational performance. Intellectual capital must be *valuable, rare, inimitable, and nonsubstitutable* (Wright et al. 1994). These criteria are discussed next as they apply to forensic laboratories

Intellectual Capital, Management, Quality

D53 Promega Maxwell16™: A Simple and Integrated Solution for Small and Medium-Sized Laboratories

Michael P. Bjerke, MS, Curtis Knox, and Daniel Kephart, PhD, Promega Corporation, 2800 Woods Hollow Road, Madison, WI 53711*

Attendees will learn that additional opportunities exist for forensic laboratory for automated purification of STR-quality genomic DNA. This presentation will demonstrate a personalized instrument for the purification of genomic DNA.

Purification of genomic DNA for short tandem repeat (STR) analysis can be a tedious and time consuming process for any laboratory. Often there is a need to isolate DNA from a variety of sample sources such as whole blood, tissues, cells, and solid supports. As the number of forensic samples necessary for processing continues to climb, it's becoming more important for laboratories to automate this process. A number of automated liquid handling instruments have helped alleviate this bottleneck and streamline the purification process; however the dedicated equipment used in automated DNA isolation systems is typically expensive, highly specialized, and inflexible.

Promega has developed the Maxwell16™ System to provide maximum performance and flexibility in a simple, integrated reagent/instrument format. The Maxwell16™ instrument has been designed as a simple and robust purification platform with minimal training or maintenance and little setup time. The instrument occupies minimal laboratory bench space. The Maxwell16™ reagent cartridges come pre-filled with a variety of Promega reagent kits specified for optimal purification performance specific to sample type. The DNA IQ™ System reagent kit has been demonstrated for optimized isolation of genomic DNA from a wide variety of sample sources.

The Maxwell™ 16 system is designed to purify samples using Promega's DNA IQ™ Resin. The DNA IQ™ Resin is designed to optimize efficient purification product capture, washing, and elution. The Maxwell™ 16 instrument is a magnetic particle handling instrument that efficiently pre-processes liquid and solid samples, transports the magnetic DNA IQ™ Resin through purification reagents contained within the pre-filled cartridges, and mixes efficiently during processing. The efficient magnetic particle processing by the Maxwell™ 16 instrument avoids common automated purification headaches such as clogged tips, or partial reagent transfers that result in sub-optimal purification processing by other common automated purification instrument platforms. The system can process up to 16 samples in a single run. Purified concentrated products are high quality and ready for use in a variety of downstream applications, including STR analysis.

The authors will demonstrate the performance of Maxwell16™ System for the isolation of gDNA from a wide variety of tissue samples, blood, buccal swabs, and other forensic samples with yield, quality, cross-contamination, and STR profiles.

Genomic DNA, Short Tandem Repeat, Integrated

D54 Detecting Deceit: Exposing the Malingerer

Peter Lourgos, MD, JD, Nishad Nadkarni, MD, and Erick A. Neu, PsyD, Circuit Court of Cook County, 2650 South California Avenue, 10th Floor, Chicago, IL 60608*

This presentation will provide attendees with a brief historical overview into the art and science of lie detection, with an introduction to the most recent advances in brain imaging technology. The forensic examiner will be able to identify common characteristics seen in malingerers, and once the potential malingerer is identified, the evaluator will be familiar with psychological instruments and other tools commonly used to help clarify the diagnosis. The presenters will also share practical clinical insights based on their experience working as forensic court-appointed examiners in one of the largest criminal court systems in the country (Cook County, Illinois).

Malingering – the intentional production of false or grossly exaggerated physical/ psychological symptoms motivated by external incentives – often presents itself within the course of forensic evaluations, bringing into question the integrity of the data gathered. Whether in the context of avoiding incarceration (criminal arena) or garnering potentially large monetary awards (civil arena), the probability of malingering increases with the value of the perceived gain, especially in the psychological realm. A forensic examiner is often left with the difficult task of separating truth from fabrication. Additionally, when there are no laboratory tests available to corroborate an examinee's self-report, this task becomes an exceedingly challenging one. Traditional tests of lie detection have been predicated on the theory that an individual who intentionally misleads experiences increased anxiety which can then be measured physiologically (*e.g.*, skin temperature, sweating, heart rate, etc). Unfortunately, the accuracy of such tests comes into question when the act of lying produces little, if any, anxiety. Technological advances in brain imaging including fMRI (functional MRI) are beginning to show future promise as more reliable methods of lie detection. Until then, there currently exist instruments available to the forensic examiner which can be useful in assessing an examinee's self-report in the following areas: memory impairment, cognitive impairment, and psychological symptoms. These tests, along with clinical observations, become crucial components in the evaluation of a suspected malingerer.

Malingering, Detection, Evaluation

E1 The Reliability of a Controlled Substance Field Test Kit as a Basis for Probable Cause

Heather L. Harris, MFS, National Medical Services, 3701 Welsh Road, Willow Grove, PA 19090*

The goal of this presentation is to show practicing attorneys and expert witnesses the limitations of a controlled substance field test kit as a method for identification when a specific identification is crucial to establishing probable cause. The reliability of field test results will be explored along with their application to a specific case. Photographs that demonstrate the positive responses of the field test kits to non-controlled substances will be on display.

This presentation will serve the legal community as well as the general population by educating those who are involved in the prosecution and defense of controlled substances cases as to the reliability of controlled substance field test kits so as to properly assess their value in establishing probable cause to support a search warrant on a residence. It is recommended that attorneys be aware of the limited uses of field test kits to establish probable cause so as to properly challenge their misuse in securing a search warrant.

The field test kits used for cocaine detection are notably non-specific for cocaine and are susceptible to a number of false positives. These field tests give a non-distinctive, positive response to cocaine, other drugs and a wide variety of household food and utility products. Therefore, as a stand-alone basis for probable cause for a search warrant on a private residence, the use of results from a field test kit for cocaine should be limited to only those situations where there is corroborating evidence as to the identity of the substance being tested.

Controlled Substances, Field Test, Probable Cause

E2 Potential Role of Knee Prints in Forensic Identification

Nagy M. Al-Fadaly, MBBCH, MSC, PhD, Al-Azhar University, Cairo, Egypt, 130 Al-Geesh Street, Second Floor, Al-Zagazig City, Egypt*

After attending this presentation, attendees will understand the new forensic identification tool of the knee print, which might have a promising role in personal identification. This presentation will impact the forensic community by adding awareness of a possible new identification item to the forensic arsenal.

In this paper, the variability of knee prints among different individuals along with its potential role in personal identification for forensic field work will be reviewed from collection through preparation for comparative examination. The results of a pilot experiment to study the possibility of identifying persons from their knee prints will be explored. Results showed knee prints have shown a considerable degree of variability among different individuals making their role in solving forensic cases capable of being a useful identification tool.

Kneeprint, Forensic Science, Identification Tool

E3 Forensic Laboratories and Clinical Laboratories, ASCLD/LAB and CLIA, Apples and Oranges?

Garry J. Bombard, PhD, Forensic Institute for Research, Science, and Training, 3400 West 111th Street, Suite 116, Chicago, IL 60655*

The goal of this presentation is to provide a background in current processes and trends by several accrediting and certifying programs.

Over the last several years, there have been suggestions for more independent oversight and review of forensic science laboratories. Forensic laboratory results have been analogized to clinical laboratory results, suggesting the need for Clinical Laboratory Improvement Amendment-like standards. Recently, the Justice for All Act of 2004 calls for an independent auditor's review when a forensic laboratory utilizing federal grant monies has a technical problem.

The presentation compares the forensic science laboratory and the clinical laboratory on several levels, i.e., staff and operational responsibility, training standards, quality assurance, etc. The presentation continues with a comparison of processes and trends of the American Society of Crime Laboratory Directors/Laboratory Accreditation Board's (ASCLD/LAB) Program, the Centers for Medicare and Medicaid Services (CMS) Clinical Laboratory Improvement Amendments, and other professional organization's programs. The presentation concludes with recommendations on improving forensic science laboratories from both a medical technologist and a public policy analyst viewpoint.

Public Policy Analysis, Forensic Laboratory Accreditation, Clinical Laboratory Improvement Amendments

E4 Crisis Management in the Lab: Legal Considerations in Conducting Audits and Other Investigations

Sheri H. Mecklenburg, JD, Chicago Police Department, 3510 South Michigan Avenue, Chicago, IL 60653; Betty Layne DesPortes, JD*, Benjamin & DesPortes, PC, PO Box 2464, Richmond, VA 23218-2464; and Peter J. Neufeld, JD*, Innocence Project, Cardozo Law School, 100 Fifth Avenue, New York, NY, 10011*

Attendees will learn about the full investigation, disclosure, and correction of errors within the laboratory system is crucial to maintaining the integrity of the criminal justice system. This panel's presentation will demonstrate the erosion of professional and public confidence in a laboratory system threatens current investigations and prosecutions and creates a serious risk to the criminal justice system as a whole.

The lack of strict adherence to scientific protocol and the failure to follow quality control reporting obligations render results from a laboratory system open to serious challenges concerning reliability and accuracy. The erosion of professional and public confidence in a laboratory system threatens current investigations and prosecutions and creates a serious risk to the criminal justice system as a whole. Prosecutors, defense attorneys, judges and juries rely on accurate results from laboratories. Full investigation, disclosure, and correction of errors within the laboratory system are crucial to maintaining the integrity of the criminal justice system.

Disabling the quality control and oversight measures by failing to report the discrepancies in cases means systemic problems will not be

addressed before a crisis develops or before irreparable harm occurs. Contamination of evidentiary samples and the failure to recognize patently illogical results can falsely implicate individuals and lead to wrongful convictions. Contamination and error can also lead to the false exclusion of individuals, permitting dangerous criminals to remain at large. Finally, contamination and error can lead to the wrongful exoneration of guilty individuals and permit their return to society.

If an adequate investigation of the quality control lapses reflected in an individual case is not undertaken, a crisis within the laboratory system may develop. Insufficient review of an examiner's work contributed to a wrongful conviction and scandal at the Oklahoma City laboratory. The failure to correct systemic problems and to recognize warning signs of quality control deficiencies led to the Houston Crime Lab scandal which uncovered a wrongful conviction based on erroneous DNA evidence. The investigation of the Houston lab continues to garner front page headlines in the national media.

In 2005, the Commonwealth of Virginia received a critical audit by ASCLD-LAB for its work in the Earl Washington case. Peter Neufeld, counsel for Earl Washington, requested the audit from the Governor of Virginia after independent experts questioned the state lab's work. Betty Layne DesPortes, an attorney in Richmond, Virginia, also requested an independent audit of the state lab from legislators and the Governor. Neufeld and DesPortes will discuss these efforts to obtain an independent audit and need for established mechanisms to present claims of laboratory error or misconduct.

From 2001 through 2004, Sheri Mecklenburg was lead defense counsel on a series of cases alleging crime lab fraud against several scientists who had been employed by a public laboratory, which had been taken over by a State laboratory. The allegations generated headlines throughout the country and sent a shudder of concern throughout the legal and forensic communities. At the time that the allegations were first made, the State laboratory undertook an immediate investigation. That investigation proved to be crucial evidence in the litigation. Through these ground-breaking crime lab cases, Ms. Mecklenburg dealt with the legal ramifications of the laboratory's internal investigations, the potential audits, and public legislative hearings. Ms. Mecklenburg will discuss the legal lessons learned in laboratory responses to allegations of wrongdoing, and will review the response of labs around the country to allegations of wrongdoing and discuss the legal considerations of each of these responses. Ms. Mecklenburg will address privileges which potentially apply to these laboratory responses and how best to preserve and assert those privileges

Audits, Lab Error, Quality Assurance

E5 A Good Look at Blind Testing: Quality Assurance Systems and Bias

Chesterene L. Cwiklik, BS, Cwiklik & Associates, 2400 Sixth Avenue South, #257, Seattle, WA 98134*

The goal of this presentation is to provide the listener with an overview of the principles of quality assurance (QA) - the systems that laboratories use to track and prevent errors - in order to explore the impact of the systems on the work itself. The individual bias inherent in addressing the issues in individual cases will be contrasted with the unexamined system bias when the scientist is working "blind". Lastly, the unattained potential of using laboratory quality assurance to address concerns of the courts and the legal system will be explored through examples. The content is oriented to both technical and legal practitioners.

This presentation will demonstrate how good science means doing the right thing - addressing the case issues with work that can answer questions - and doing it right - with work that is rigorous, thorough, accurate, and reliable. Laboratories employ nuts-and-bolts quality control to ensure the integrity of tests and measurements, and quality assurance to ensure that work that is going out meets the laboratory standards. The very existence of quality assurance systems influence the work performed. This can introduce sources of error when the work is compliance-driven rather than question-oriented. Lawyers and judges who are concerned about the reliability of scientific work, when advocating for or evaluating systems to ensure the reliability of scientific work, would benefit from understanding the interplay of doing science with systems used to track what is done.

When crime laboratory errors are exposed by something other than internal laboratory scrutiny, not only the quality of work but also the quality assurance system – used to track and prevent errors – is called into question. There is usually a hue and cry for "blind testing" to eliminate examiner bias, and for a system of compliance with rigid protocols that assure minimum standards but do not permit the exercise of judgment. When this is implemented, new sources of error are introduced.

Blind testing –when the scientist either does not have information about the case issues or does not know the source of the samples being tested – is an effective quality control practice when a second opinion is solicited from another scientist on a reading of data and consequent results. The second scientist should know only whether the samples are reference samples or samples related to the crime. However, when all scientific work on a case is performed "blind", the scientist is not able to form and evaluate alternative hypotheses and test the significance of the findings. Although blind testing has seldom been implemented as crime laboratory policy, some laboratories do the equivalent by discouraging scientists from discussing the case with police detectives. Scientists then make testing decisions based upon the requests of detectives as listed on an evidence submission form. This can reduce examiner bias, but increases the effect on laboratory work of any police bias or misinformation, subverting the function of laboratory work in testing and questioning the police hypotheses and in providing objective and independent information that might not have been anticipated by police. This will be illustrated with case examples. Another effect, seldom noticed by lawyers, is that the police are deprived of investigative information that the laboratory can provide.

Testing protocols are a useful tool for performing routine analyses, and make is possible to compare data and results. However, when a scientist is required to follow the testing protocol even when it does not best address the questions in the case, useful information may be lost and the significance of the information may be skewed. This will be discussed with case examples.

Historically, the courts have turned to bodies such as the National Academy of Sciences in setting standards for DNA testing. This resulted in the forensic-scientist-based Technical Working Groups (now Scientific Working Groups) that were charged with developing guidelines for testing. The guidelines were instead implemented as protocols, and despite an initial good effort by ASCLD, the rest of the scientific process was no longer addressed in national level discussions of quality assurance. One of the models used for crime laboratory quality assurance is the medical testing laboratory, in which physicians direct and interpret the test results of medical technicians. Two major flaws in this model are that crime laboratory samples are far less standard than those in medical labs, and that lawyers and police, although responsible for using the information, cannot effectively direct and interpret the testing and results.

There are two general models for quality assurance: an approach that depends upon the expertise of the examiner (called the "artisan/craftsman" approach), and one that depends upon strict compliance with protocols. Although ASCLD accreditation currently emphasizes the latter, most laboratories would best use a blend of these approaches. Scientists can implement protocols for routine work and a written rationale for non-routine aspects of the work, allowing it to be reviewed in quality assurance checks including peer review. This could easily be implemented into standard quality assurance programs, as it is currently being done in some laboratories.

Evaluations of any type of analytical methods and testing plans – i.e., peer review of individual cases and quality assurance of laboratory systems - need to answer the following: How reliable is the data? How accurate is

the identification or comparison? How sound is an association or exclusion? How significant are the findings? How does the data fit together as a whole? Whether a conclusion is accurate (i.e., corresponds with reality) depends on whether the data is sound and whether the interpretation explains the data rigorously and completely. Whether the findings are significant depends on whether and how well the questions in a case are addressed. The soundness of an association or exclusion rests upon eliminating alternative hypotheses, and the fitting together of data into a coherent explanation is predicated upon it. A quality assurance system that addresses only some of these questions will drive scientific work away from providing comprehensive information, and will amplify the effects of outside biases on work performed and reported by the crime laboratory.

Forensic Science, Quality Assurance, Bias

E6 The Elephant in the Crime Laboratory: Negligence, Serious Misconduct, and Fraud; The Ray Krone and Other Horror Stories

Christopher J. Plourd, JD, Law Offices of Christopher J. Plourd, 1168 Union Street, Suite #303, San Diego, CA 92101*

After attending this presentation, attendees will understand that silence in the face of fellow laboratory personal publishing erroneous work has serious consequences. This presentation will remind the forensic scientists that the "Achilles' heel" of all science is human error.

The goal of this presentation is to demonstrate that innocent people can and have been convicted of serious crimes because of crime laboratory errors, omissions, and misconduct. The educational objective of this presentation is to identify common errors in forensic scientific investigations and suggest strategies for improving objectivity in crime laboratory analysis.

The problem of innocent people being convicted and unjustly imprisoned for crimes they did not commit is a growing national concern which is receiving public acknowledgment by politicians and is catching the attention of the general public. Advances in DNA identity testing have exonerated hundreds of innocent people. A significant number of exoneration cases involve crime laboratory errors relating to evaluation of trace and biological evidence.

Ray Krone was the 100th person in the United States convicted of and sentenced to death for a capital murder to walk free from prison since the reinstatement of the death penalty. Ray Krone maintained his innocence throughout his incarceration. Ray Krone was sentenced to death in 1992 for the brutal murder of Kim Ancona, a Phoenix bar manager. Krone spent three years on Arizona's death row before his death sentence and conviction was overturned. Krone was then retried and convicted a second time and sentenced to life in prison in 1996. Ray Krone, who had been branded as the "snaggletooth killer," was proved innocent of the murder of Kim Ancona by Post Conviction DNA testing in 2002. After being cleared by DNA, Ray Krone walked out of an Arizona State Prison a free man after 10 years and 4 months.

Bar manager, Kim Ancona, had been cleaning the CBS Lounge in Phoenix, Arizona on the evening of December 28, 1991. Her nude body was found in the men's restroom the following morning. She had been stabbed eleven times. An examination of Ancona body revealed that she had been bitten on the left breast. There were unidentified shoe impressions, fingerprints, and hairs. Other evidence indicated she had been sexually assaulted. There was blood at the crime scene and on the victims clothing. The blood was typed as ABO Type O, the same as Ancona, Krone, and some 43 of the population. Forensic DNA technology available at the time of the 1992 prosecution (DQ alpha) did not identify the blood or saliva of the perpetrator. Crime Laboratory errors and omissions that occurred in 1992 caused a misinterpretation of the blood, hair, and saliva evidence. This same evidence, with use of STR DNA testing, would expose these errors ten years later in 2002. A review audit of the case work done by the criminalist who worked on the Krone case evidence found the individual who performed the original testing is now known to have had a history of errors in casework (based upon re-testing of additional cases).

Ray Krone was a United States postal letter carrier who had no criminal record and had been honorably discharged from the U.S. Air Force. He knew the victim, as he had socialized with her and had been a customer of the CBS Lounge. There was little evidence that tied Krone to the killing except for evidence of a bite mark on the victim's breast, which an American Board of Forensic Odontology (ABFO), Board Certified Forensic Odontologist said positively, better than a fingerprint, matched the dentition of Ray Krone. This bite mark evidence was controversial and disputed by other ABFO Board Certified forensic experts. The laboratory errors were a significant factor in both of Krone convictions.

After appeals were exhausted following his second conviction Krone sought post-conviction DNA testing. Krone's lawyers asked that the victim's tank top, through which the bite mark may have been inflicted, be re-examined for saliva and DNA analysis. Not only was saliva identified, the results of DNA testing showed that neither Krone nor the victim Ancona could have been the genetic source of the saliva. Comparison of the genetic profile of the saliva donor against the FBI Combined DNA Index System (CODIS) database associated the DNA evidence (a cold hit) with a 36-year-old inmate in the Florence, Arizona State prison. The inmate was Kenneth Phillips, who had been arrested and convicted of child molestation after the date of the Ancona murder.

Not only did the DNA test show that Ray Krone was excluded as the perpetrator, it also identified a different individual who was incarcerated for an unrelated sex crime and due to be released. The odds were 1.3 quadrillion to one that Kenneth Phillips was the contributor of the saliva DNA found on Kim Ancona's tank top. After the saliva DNA match Phillips, his hair was found to be consistent with evidence hairs found on the victim's body. Phillips confessed to being present at the time of the murder of Ancona in a tape recorded interview. Phillips' blood was genetically identified on the inside and outside of the victim jeans and underwear. Phillips' fingerprints were matched to latent prints found in the men's room of the CBS lounge where Kim Ancona's body was discovered.

The Krone case is another in a growing number of cases where crime laboratory testing has been shown to be erroneous. Lessons should be learned from the Krone case and others like it. Errors, omissions and misconduct by criminalist does not occur in a vacuum. Other laboratory personnel were aware that flawed work was being conducted and published by the criminalist in the Krone case. Ray Krone is not alone as the innocent victim of laboratory errors and the victim of laboratory personal who turn a blind eye and a deaf ear when they know that misconduct is occurring within there laboratory.

An independent scientific technical working group of forensic scientists should be formed to objectively study exoneration cases such a Ray Krone's case.

Laboratory Errors, Ethics, DNA Exonorations

E7 Crime Scene Forensics: Reality vs. Entertainment

Thomas L. Martin, Jr., 5 Willard Road, Red Hook, NY 12571*

The goal of this presentation is to review actual cases and discuss the glaring differences between "real world" forensics, and the portrayal of police and forensic investigations in the entertainment industry. Emphasis will be placed on what to expect from a forensic investigation...and when not to expect too much.

The current fascination with forensic sciences has caused many misunderstandings regarding how forensic technology and interpretations should impact criminal investigations. It is important to separate fact from

fiction, and the investigator must understand and recognize, when expectations become unrealistic. This presentation will impact the forensic community and/or humanity by bringing us back to the basics of conducting a thorough investigation, and uncovering the truth.

The term "forensics" has come to mean much more than a tool to help in criminal investigations; it has become a world wide fad. Colleges, universities, and even high schools are introducing more forensic related courses every year to meet increasing demand. The entertainment industry has recognized this fascination with the scientific aspect of criminal investigations, and has responded by inundating the nightly television schedule with forensic related programming. This forensic programming has not only affected jury pools, but has also had an adverse impact on the way many investigators conduct criminal investigations. This presentation will explore the realistic expectations of forensic crime scene investigations, the time and patience needed to conduct an investigation, and will emphasize the concept of corroborating or refuting facts, circumstances, and statements.

Forensic Crime Scene, Investigation, Reality Entertainment

E8 The Role of the Lawyer in Negating Junk Toxicology in the Courtroom

Linda B. Kenney, JD, 15 West 53rd Street, Apartment 18 B/C, New York, NY 10019*

With the advent of a number of certifying expert agencies and the proliferation of junk science, it is important that the lawyer and the toxicologist understand the analysis and the investigation required to determine how to negate fraudulent science before or during the courtroom presentation by an adversary.

Both lawyers and forensic scientists have a duty to understand the implications of fudging, understating, or overstating their findings regarding toxicological analysis. This presentation demonstrates why it is important that both lawyers and experts alike develop an attitude that deals with the truth and statement of research findings honest competent and unbiased manner.

Many of the controversial and complex cases especially those involving alleged homicide, involve some type of toxicology presentation in the courtroom. Many times toxicologists usurp the role of the pharmacologist or a medical doctor. Many times an expert misstates or overstates qualifications. Many times an expert submits a report utilized in a courtroom that understates or overstates correct toxicological analysis. Many of these highly controversial cases are in the news including those involving deaths in hospitals, allegations of spousal murder; or a high profile accidental shooting such as the trial involving Jayson Williams. The author of this paper will discuss specific cases and review the legal concepts and presentation of evidence, testimony that is critical in order to rebut or refute phony toxicology.

Junk Science, Toxicology, Expert Qualifications

E9 Using Subsequent Blood Ethanol Determinations to Invalidate the Results of Breathalyzer Testing - The Best of Times, The Worst of Times

David M. Benjamin, PhD, 77 Florence Street, Apartment 107, Chestnut Hill, MA 02467*

Attendees will learn the importance of documenting the time blood samples were drawn from a subject when introducing the results of blood ethanol tests in court.

Miscarriages of justice can be avoided by paying attention to details, such as the time a blood sample was drawn. In this case, a defendant's rights were prejudiced because the judge failed to compel production of critical exculpatory evidence. This presentation will demonstrate why judges need to recognize that justice is not best served when trials are moved along too quickly prior to obtaining critical relevant evidence.

The Commonwealth of Massachusetts routinely utilizes infrared testing of expired air as a means of estimating an individual's blood alcohol concentration (BAC). While it is generally agreed that in the "typical" male, the mean ratio of the concentration of ethanol in blood compared to deep alveolar air will be 1:2400, breathalyzer testing is often criticized because it utilizes a fixed ratio (1:2100) for everyone, and does not account for the variability inherent in the population. In order to provide citizens who have been arrested for Operating Under the Influence of ethanol (OUI) with an opportunity to vindicate themselves and to demonstrate that a breathalyzer result was invalid, Mass. General Laws, Ch. 263, Sec. 5A, as amended provides that: "A person held in custody at a police station or other place of detention, charged with operating a motor vehicle while under the influence of intoxicating liquor shall have the right, at his request and at his expense, to be examined by a physician selected by him." Such an individual may request an independent testing of his/her blood for ethanol at that time or, proceed to a hospital, after release from custody. This case illustrates the complexities involved when a defendant charged with OUI tried to utilize a post-breathalyzer blood test result to clear himself.

Facts of the case: LW was a 40-year-old white male, approximately 6'2", 225 lbs. with a diagnosis of asthma. LW was stopped for alleged OUI just before midnight on December 26, 1996. Between 00:18 and 00:20, LW took a breathalyzer test on an Intoxilyzer 5000 utilizing infrared absorption which registered extrapolated BACs of 0.11% and 0.12%. Upon release from custody, LW took a taxi to the Massachusetts General Hospital where he was triaged at 01:15, the hospital note stating, "requesting blood test for ETOH". Beside the "triage time" on the hospital record are the numbers 0130. The laboratory slip bears a LOG-IN time of 05:15, and reports a plasma ethanol concentration of 585 mg/dl, which by decreasing the plasma value by 15%, converts to a whole blood ethanol concentration of 0.049%.

Prior to trial, the defendant requested a *Daubert* Hearing in an attempt to suppress the admission of the breathalyzer test results at trial, based on the fact that breathalyzer testing did not meet the criteria for scientific reliability in *Daubert v. Merrell Dow Pharmaceuticals, Inc.* 113 S.Ct. 2786 (1993). The defendant testified that he waited in the hospital for about 15 minutes before a technician came over and took his blood specimen, and then waited another 4 hours for the results of the test. This author testified as an expert that based on the mean burn-off rate for ethanol of 17 mg/dl/hr (0.017%/hr), a typical individual with a BAC of 0.049% at 1:15 am would have been more likely than not to have had a back-extrapolated BAC of 0.066% an hour earlier at 12:15 am than the reported breathalyzer result of 0.11%. During cross-examination, the Commonwealth asked the witness to assume that the blood sample had, in fact, been collected at 5:15 am, rather than the assumed 1:15 am, and asked him to calculate the back-extrapolated BAC under those conditions. The witness testified that assuming the 17 mg/dl/hr (0.017%/hr) burn-off rate over the 4-hour period from 1:15 am to 5:15 am, an individual with a BAC of 0.049% at 5:15 am would have had a back-extrapolated BAC of 0.049% + (4 x 0.017) =0.117% at 00:15, just as the breathalyzer had reported.

The judge would not suppress the results of the breathalyzer test. Following the hearing, the witness informed the defense attorney how important it would be to clearly establish the time the blood specimen was drawn from the client at trial, and urged the attorney to subpoena the hospital records showing the time of collection of the blood sample, rather than the LOG-IN time. Unfortunately, on the day of trial, the hospital had not responded to the subpoena and the witness encouraged the defense attorney to file a motion with the court to compel production of the critical laboratory slip before proceeding to trial. Despite the absence of the key laboratory slip, the court ordered the case tried on the appointed day, and the jury found the defendant guilty.

The defendant insisted that based on his body weight and the fact that he had consumed only 2-3 beers, he could not possibly have had a true

BAC of 0.11%, and that the breathalyzer test was erroneous. Due to procedural problems, the time of collection of the blood specimen was never established unequivocally, and the results of the breathalyzer test could not be refuted. Furthermore, the court's eagerness to try the case in the absence of relevant evidence contributed to this miscarriage of justice.

Critical Relevant Evidence, Miscarriage of Justice, Paying Attention to Details

E10 The Use of the Psychological Autopsy to Rebut a Defense of Suicide in a Prosecution for Murder

Bernard A. Raum, JD, MFS, University of Baltimore, School of Law, 7499 Swan Point Way, Columbia, MD 21045; Jerome A. Motto, MD, University of California, San Francisco, 424 Occidential Avenue, San Mateo, CA 94402; Neil S. Hibler, PhD, Special Psychological Services Group, 10520 Warwick Avenue, Suite B6, Fairfax, VA 22030; and William F. Hamilton, MD, Florida District Medical Examiner, District 8, 606 SW 3rd Avenue, Gainesville, FL 32601*

By attending this presentation, attendees will gain an understanding of the current status of the psychological autopsy and the legal and evidential issues surrounding its use in a criminal prosecution.

This presentation will impact the forensic community by raising the visibility of the psychological autopsy and the utility of its use in a criminal prosecution in general. The presentation will also provide a structure for the use of a psychological autopsy as well as sources of authoritative information for both the psychiatric/psychological expert witness and the prosecutor/defense attorney. Specifically, the presentation will assist in presenting a psychological autopsy by the prosecution when a defendant accused of murder asserts that the decedent/victim committed suicide.

In a prosecution for homicide, where the accused contends that the victim committed suicide, the use of a psychological autopsy should be seriously considered in order to rebut that defense. In recent years the psychological autopsy has gained substantial recognition, both in the courts well as in the literature, as a means of determining whether the victim has committed suicide. However, the use of a psychological autopsy for such purposes creates certain legal procedural and factual problems which must be addressed in order to successfully introduce an expert's testimony on the subject into evidence.

Psychological, Autopsy, Prosecution

E11 Report Wording - Information not Intimidation

Andrew T. Northrup, JD, and Brendan P. Max, JD*, Office of the Cook County Public Defender, 69 West Washington, 17th Floor, Chicago, IL 60602*

By attending this presentation, attendees will gain the ability to draft reports regarding their disciplines in a manner that it is understandable and useful to all participants in the criminal justice system.

This presentation will enable members of the forensic community in all disciplines to be able to view these reports that are generated from the reader's perspective and understand what consumers of these reports need to know.

The purpose of this presentation is to discuss the issue of how reports are written in the forensic community. After discussing the problems found in this area, the presented will discuss how reports should be written, and who the target audience for these reports should be. The presentation will end with examples of what good reports look like. Too often, when practicing law in this area, one receives a report that does not seem as if its purpose is to inform. It uses terms that are not defined or explained elsewhere in the report, it uses common terminology in unconventional ways, and it fails to explain the significance of any particular finding, whether it is a match or otherwise. Additionally, the reports sometimes seem to go to great lengths to insure that even exculpatory results appear to be inculpatory. Because all parties, based upon crime lab reports, make many judgments about cases, this area is very important.

The purpose of reports from the crime lab is to inform the relevant parties in a clear and concise manner of the results of any tests performed in an unbiased manner as possible. However, informing the parties of the findings themselves without placing them into context is meaningless. Thus, the reports should not only aim to discuss the test results, but also aim to explain the significance of these findings. That way, the detective can understand how these findings fit into an investigation and determine what further needs to be done, the prosecutor will be better able to decide which charges are appropriate to file for any particular case, and the defense attorney will be in a better position to determine how to proceed with a clearer understanding of the physical evidence that exists and how it inculpates the client.

Crime lab reports should be written in such a way that all acronyms, jargons, and terms are explained fully, and so that common words are used in the clearest way possible. Additionally conclusions should be worded in such a manner that it does not appear that the results are attempting to be inculpatory. Any actions taken or assumptions made by the crime lab in their analysis should be fully explained. Additionally, any limitations in the testing should be in the report itself. Only after these steps are taken are all parties able to utilize this information to its fullest.

Reports from the crime lab should be aimed at the educated layman. The educated layman standard assumes a certain level of basic education, as well as critical reasoning skills. This standard also assumes that when the terms are explained and defined, that the target reader will be able to understand them.

Every person in the criminal justice system has a vested interest in understanding the significance of the physical evidence in every case to the best of their ability. The crime lab should facilitate this by insuring that reports are written in a clear and concise manner with all terms defined either in the body of the work itself, or in an attached glossary. By doing this, the crime labs will go a long way towards insuring transparency and trust throughout the criminal justice process.

Report, Inform, Crime Laboratory

E12 Shaken Baby Syndrome: Medical Myth or Medical Fact? What Really Killed Baby Cooper?

Christopher J. Plourd, JD, Law Office of Christopher J. Plourd, 1168 Union Street, Suite #303, San Diego, CA 92101*

After attending this presentation, attendees will understand the need to fully and carefully investigate all aspects of a suspected Shaken Baby Syndrome (SBS) death case and describe the necessary steps to accomplish a complete investigation.

The goal of this presentation is to discuss the inherent limitation of the current state of medical knowledge on the subject of SBS, to identify medical controversies relating to SBS and recommend a comprehensive approach to the investigation of suspected child abuse shaken baby deaths.

For example, bilateral extensive retinal hemorrhages accompanying evidence of childhood head trauma (subdural or subarachnoid hemorrhage) are considered virtually diagnostic (pathognomonic) of SBS by most pediatricians and ophthalmologists. The association of retinal hemorrhages and SBS, with or without impact, is a subject of debate in the forensic medico-legal community. The purpose of this presentation is to describe the diagnostic dilemma and investigative challenge presented by the suspected

child abuse death case of 3 month 24 day old baby who was alleged to be the victim of SBS while in the care of his state licensed daycare provider. From this case a method for properly investigating a suspected "SBS" case will be explained.

On December 18th, 2002, Baby Cooper's daycare provider reported that he didn't look right as he lay sleeping 45 minutes after being placed down for his afternoon nap. Baby Cooper's "little cheeks were purple." He was picked up and it was described that "his little arms went limp," 911 was immediately called. Pending emergency personnel arrival, rescue breathing was started as the daycare provider talked to the 911 operator. The paramedics arrived within five minutes. By that time Baby Cooper was breathing again but had an irregular heart rhythm (bradycardia). Paramedic assessment in the field revealed no evidence of trauma. The daycare provider denied any intentional or accidental traumatic injury. Baby Cooper was quickly transported to San Diego Children's Hospital. Upon arrival, Emergency Department medical staff noted that Baby Cooper's pupils were fixed and dilated. He had no pulse, and could not breathe on his own. He was intubated and after 45 minutes of resuscitation, including CPR, Baby Cooper's heart began to beat on its own but his respirations had to be maintained on a ventilator. A CT scan two hours after hospital admission revealed brain swelling consistent with global hypoxic-ischemic injury, including complete obliteration of the sulci and basilar cisterns. The admitting pediatrician believed he saw a frontal lobe contusion on the CT scan. Abdominal and pelvic CT scans were negative. Possible blood was noted in the posterior chamber of baby Cooper's eyes. A neurological examination concluded that Baby Cooper was probably brain dead. A trauma surgeon examination concluded there was no external evidence of trauma except for a bruise on Baby Cooper's chest caused by the CPR done in the Emergency Department of the hospital. Baby Cooper's initial blood studies, done within one hour of hospital arrival, revealed that his blood sugar was 372, his blood gas had a pH of 7.02, his sodium level was elevated to160 and his potassium was elevated to 11.5. Baby Cooper's initial coagulation studies revealed a severe coagulopathy (a PT of 17, a PPT of greater than >130, and a low fibrinogen level of 44). Three hours post hospital admission an ophthalmology examination revealed bilateral retinal hemorrhages extending out to the periphery. Chest x-ray noted the child's lungs to be hyperinflated. A complete skeletal survey the following day was negative. One hour before a blood culture draw, Baby Cooper received several IV injections of an antibiotic. Brain death was declared 48 hours after admission. Organ donation took place 64 hours after admission, preceded by anticoagulant therapy.

Baby Cooper's prior medical history included normal birth weight, a prolonged vaginal delivery, mild jaundice and significant head molding. At two weeks Baby Cooper underwent an unremarkable circumcision. At six weeks Baby Cooper was diagnosed with microcephaly (head circumference below the 5th percentile). Baby Cooper's diet consisted of maternal breast milk either via nursing or via bottle. In the month before hospital admission Baby Cooper had sporadic episodes of constipation (up to four days) and days when he would not eat well.

At autopsy, anoxic cerebral changes ("respirator brain") with some lymphocytic infiltration, questionable "Traumatic Axonal Injury" ("focal retraction balls") and superficial hemorrhagic injury of the upper spinal cord and cerebrum were noted. No frontal lobe contusion, subdural hematoma, subarachnoid hemorrhage, or other traumatic brain injury was present. Baby Cooper had extensive bilateral retinal hemorrhages, and unexplained subdural bleeding in the lower thoracic spinal column. Toxicology was negative. After two months, the medical examiner signed an amended death certificate and concluded that Baby Cooper was the victim of shaken baby syndrome and ruled the manner of death as homicide.

The trial of the day care provider was a battle of conflicting medical experts. The prosecution contended that Baby Cooper died of Shaken Baby Syndrome because of the rapid onset of brain swelling, the superficial spinal cord and cerebral hemorrhagic injury and the bilateral retinal hemorrhages. Defense medical experts concluded that Baby Cooper stopped breathing because of a Sudden Infant Death Syndrome event (SIDS) that was resuscitated (known as "a near-miss SIDS" or a "resuscitated SID" case). All the findings at autopsy were the result of Baby Cooper being kept alive on a ventilator for more than two days day's before he was formally declared dead. The retinal hemorrhages were caused by the child being given vigorous CPR while the lungs were hyperinflated. The severe anoxic changes with swelling caused the superficial hemorrhagic and cerebral injury due to crushing against the skull, together with a patient having a severe clotting disorder upon admission to the hospital.

At trial, based solely upon the medical findings, the prosecution claimed that the daycare provider became increasingly irritated with Baby Cooper's crying, and in a moment of frustration shook him to death. In her defense the daycare provider testified she did nothing to injure the child and called numerous character witnesses who testified that, over a 15 year period, they had children in her daycare or were frequent visitors to the daycare. They testified to her love, understanding, and ability to care for the needs of children. Character witnesses also testified that children were always well cared for and that the daycare provider never lost her temper or became frustrated with a child. After two six-week jury trials (the first jury trial ended in a deadlock), the daycare provider was acquitted of all charges. Before the second trial two stored bottles of maternal breast milk found in the daycare providers freezer were genetically tested for bacteria. One sample was found to be positive for enterobacter cloace. The controversial medical evidence along with the character evidence convinced the jury that the daycare provider was not the type of person who would be capable of harming an infant child.

In reviewing a case of suspected Shaken Baby Syndrome death, all aspects of the case must be fully investigated before drawing any conclusion regarding cause and manner of death. Attention should be paid to post hospital admission medical treatment and diagnostic tests, along with a careful evaluation of secondary effects of medical care. Extensive peripheral retinal hemorrhages are part of a constellation of findings helpful to diagnose some cases of Shaken Baby Syndrome. Retinal hemorrhages in the absence of specific brain injury (subdural hemorrhage, subarachnoid hemorrhage, or contusions) present a diagnostic dilemma.

Shaken Baby Syndrome, Retinal Hemorrhages, SBS

E13 Shaken Baby Syndrome: Medical Myth or Medical Fact?

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This presentation will facilitate a bipartisan scientific discussion of the factual basis for and/or against the existence, diagnosis, and adjudication of cases of Shaken Baby Syndrome.

The diagnostic criteria and even the very existence of Shaken Baby Syndrome (SBS) have been called into question (at least by some) ever more frequently in recent years. Apparently conflicting expert medical testimony has fueled a perception of confusion and, in some cases, animosity. The net result of the present turmoil is that the very experts attempting to assist in clarifying the circumstances surrounding a sudden child death or injury fail the justice system.

In an attempt to determine a common ground in the ongoing debate regarding SBS the authors hope to present a multidisciplinary medicolegal primer covering both sides in the debate. Practitioners in the fields of forensic pathology and jurisprudence will discuss the evidentiary basis – pro and con – for the diagnosis of SBS.

Some practitioners are reported to hold up a triad of subdural hemorrhage, cerebral edema, and retinal hemorrhages as diagnostic of SBS while others suggest alternative mechanisms by which these findings may be found in concert. The question then becomes if there is a diagnostic triad for SBS, and if so, are these three physical findings the appropriate criteria. Are there other, more reliable findings? Can the diagnostic features of SBS be caused by or seen in association with other conditions? Is shaking alone sufficient to cause the features of SBS? Is impact required to cause SBS? Are short falls or other traumas sufficient to cause the same features as seen in SBS?

Beginning with a historical overview of the origin of the concept of SBS, this multidisciplinary explored presentation will present the present understanding of the medical literature potentially supporting and refuting SBS. Utilizing a case-presentation scenario, the clinical presentation of a severely neurologically damaged infant will be reviewed with a differential diagnosis considered. The ophthalmologic findings on admission with follow-up discussion of the types and nature of retinal findings in SBS-type and non-SBS-type cases will be presented. The medical examiner's findings at postmortem examination with a differential diagnosis will be presented. Vitally important ancillary procedures and examinations to be included in the complete autopsy examination will be reviewed. Postulated biomechanical mechanisms for the injuries observed will be reviewed. The courtroom presentation of the findings by the medical experts, with cross-examination, will conclude the case presentation. The audience will be left to act as jury.

Finally, the various experts involved in the case scenario will participate in an open panel discussion on the topic(s) covered in the presentation. The net result is an effort to establish a solid medicolegal consensus, or at least a dialogue amongst experts, on this highly emotionally charged and vitally important topic.

Shaken Baby Syndrome, Child Fatality, Controversy

E14 The VA Research Murders – The Dr. Paul Kornak Story

Bruce T. Sackman, MA, Northeast Field Office, Virginia Office of the Inspector General, Retired Special Agent in Charge, Bellmore, NY 11710*

The goal of this presentation is to assist the attendee in learning how patients in a hospital were selected for pharmaceutical research studies in spite of failing to meet strict medical inclusion/exclusion criteria. These patients were incorrectly administered investigational drugs, and expired as a result of that action. Determining cause of death and the steps involved in the successful investigation and prosecution will be shown.

This presentation will detail the first homicide conviction directly resulting from pharmaceutical research. It will open the eyes of the forensic community to criminal acts associated with pharmaceutical research, how patients can be victimized by unscrupulous physicians, what are the red flags that indicate patients can be in danger, and how to successfully investigate and prosecute allegations of this nature.

This presentation will focus on a step-by-step review of the medical research process beginning with the sources of funding, common contractual requirements, government oversight, informed patient consent, and the importance of adhering to medical inclusion/exclusion criteria.

A detailed discussion will then concentrate on how and why the VA hired a medical researcher in spite of his federal conviction for mail fraud, and having lost his license to practice medicine. This researcher had practiced medicine throughout the United States based on forged and fraudulent medical school transcripts. The role of the pharmaceutical companies in marketing and promoting medical research will be explored. What are the pharmaceutical research requirements, how are they audited, and what happens when researchers fail to meet them will be explained. The speaker will discuss which patient documents were altered, why they were selected for alteration, and what impact these alterations had on the case. A discussion of the criminal charges filed including criminally negligent homicide; the role of the forensic medical examiner in determining cause of death in this case; and finally the details of the conviction and sentenced imposed will be addressed. This may be the first research fraud resulting in a homicide conviction in the United States.

Medical Research, Criminally Negligent Homicide, Informed Consent

E15 Proof of Death: An Analysis of the Methods That the International Criminal Tribunal (ICTY) for the Former Yugoslavia Used to Establish Death

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By attending this presentation, attendees will learn how the International Criminal Tribunal for the former Yugoslavia's Trial Chambers establishes a victim's death via witness statements and exhibits. Specifically, the attending will learn how the Trial Chambers has changed its focus on particular types of evidence after the judges amended the ICTY's Rules of Procedures and Evidence in 2001.

This presentation will impact the forensic community and/or humanity by illustrating how forensic evidence is applied and relied upon in international prosecution.

Forensic evidence has been used to establish the occurrence of human rights violations in various countries, such as Rwanda, Central America, Argentina, and the Balkans. Since the 1990's, forensic scientists have collected evidence to aid the Office of the Prosecutor at the International Criminal Tribunal for Rwanda (ICTR) and the International Criminal Tribunal for the former Yugoslavia (ICTY) in establishing victim's deaths in war crimes, genocide, and crimes against humanities. In 2001, the judges at the ICTY amended their Rules of Procedure and Evidence to incorporate Rule 92*bis*, which allowed the Trial Chambers to admit confidential and lay witness written statements to establish a victim's death. The purpose of Rule 92*bis* was to shorten the trial process; however, this rule indirectly impeded the use of expert witness testimony and forensic exhibits in establishing a victim's death.

Methods: This study analyzed 594 citations, which included either witness statements or exhibits, from 13 homicide cases between 1997 and 2004. The data included 370 witness statements, which was roughly 63 % of the study. These citations were categorized into three different groups: confidential witnesses (n =189), expert witnesses (n=56), and lay witnesses (n=125). The data also included 224 exhibits. Thirty-seven percent of the study discussed three distinct types of exhibits: confidential exhibits (n=37), forensic exhibits (n=121), and non-forensic exhibits (n=66).

Each type of data was analyzed during three time periods: 1997-2000, 2001, and 2002-2004. These three time periods represented pre-Rule 92*bis*, a transition year, and post-Rule 92*bis* opinions. These classifications were critical because it evaluated the data in relation to the ICTY's Rules of Procedure and Evidence amendment. This perspective determined if a fluctuation existed in the Trial Chambers' citations before and after Rule 92*bis*. Nonparametric statistical analysis, the Mann-Whitney U test, was performed because of the small sample size.

Results: Throughout the eight years, the Trial Chambers favored witness testimony over exhibits. During the three time periods, the Trial Chambers' citation to witness testimony ranged from either 57% to 69% of the total number of citations. The fluctuation of witness citations between pre- and post-Rule 92*bis* judgments were not statistically significant because the Trial Chambers only decreased the number of citations by10%.

The Trial Chambers preferred particular types of witnesses in post-Rule 92*bis* judgments. In both pre- and post-Rule 92*bis* judgments, the confidential witnesses were the most frequently cited types of witness statement. The Trial Chambers increased the number of citations to confidential witnesses by 37% since Rule 92*bis.* Moreover, lay witness testimony was the second most popular type of evidence cited by the Trial Chambers between the 1997 and 2000 time period and between the 2002

and 2004 time period. Only a 15% decrease in lay witness citations existed between pre- and post-Rule 92*bis* judgments.

The Trial Chambers decreased the number of expert witness citations since Rule 92*bis*. Expert witness citations decreased by 81% from pre- and post-Rule 92*bis* judgments. This decrease in the number of citations resulted in a slip in ranking for expert witness citations. Between 1997 and 2000, expert witness citations were ranked the fourth most popular type of evidence cited by the Trial Chambers. Expert witness citations slipped to the least cited type of evidence in post-Rule 92*bis* judgments.

On an analytical level, the increase or decrease in confidential, lay, and expert witness citations were not statistically significant; however, this result conformed to the researcher's expectations because the fluctuation in the total number of witness citations was not statistically significant.

Since Rule 92*bis*, the Trial Chambers has altered their attitudes on exhibits. First, the Trial Chambers definitely increased its reliance on exhibits because the Trial Chambers increased the frequency of exhibit citations by 23% from pre- and post-Rule 92*bis* judgments. This resulted in a significant increase in the total number of exhibit citations from pre- and post-Rule 92*bis* judgments. Specifically, the Trial Chambers increased the number of non-forensic exhibit citations by five-hundred 88% between 1997 and 2000 time period and 2002 and 2004 time period, which resulted in a significant increase in the number of citations.

Second, the Trial Chambers decreased the number of citations to forensic exhibits by 44% from pre- and post-Rule 92*bis* judgments. Although the Trial Chambers increased the total number of citations from pre- and post-Rule 92*bis* judgments, the Trial Chambers consistently cited similar number of forensic exhibit citations during the three time periods. Forensic exhibit citations were not increased at a similar rate as the other forms of evidence. This inconsistency may infer that the Trial Chambers were not relying on forensic exhibits as heavily in post-Rule 92*bis* judgments as in pre-Rule 92*bis* judgments.

Finally, the Trial Chambers cited more confidential 92*bis* statements and standard 92*bis* statements than forensic exhibits to establish death in post-92*bis* judgments. The Trial Chamber cited 38 92*bis* statements while citing only 36 forensic exhibits between 2002 and 2004. Although the difference between the two categories was minimal, the increasing rate of the Trial Chambers' reliance on 92*bis* statements was remarkable. The Trial Chambers cited 25 more 92*bis* statements within a two year time period. This trend could signify that the Trial Chambers were placing more weight on non-forensic exhibits rather than forensic exhibits to establish death. This observation is corroborated by the fact that the composite increase in confidential 92*bis* statements and standard 92*bis* statements were statistically significant between pre- and post-Rule 92*bis* judgments.

Discussion and Conclusion: Eyewitness testimony and forensic evidence possess positive attributes as well as their downfalls. Within the justice system, both types of evidence compliment each other. Forensic evidence corroborates eyewitness testimony in order to improve the witness's creditability. Although this type of evidence is expensive and unnecessary, forensic evidence can also provide answers when eyewitness testimony may be lacking. However, forensic evidence can never replace eyewitness testimony because expert witnesses or forensic evidence could never fully describe the events during the trial proceedings. A balance between eyewitness testimony and forensic evidence will provide the courts with the most accurate information.

In post-Rule 92*bis* judgments, Trial Chambers citations to expert witnesses and forensic exhibits represent a small portion of the total number of citations. The decline in Trial Chambers' citations to expert witnesses and forensic exhibits signifies an imbalance between eyewitness testimony, forensic exhibits, and expert witnesses. Although 92*bis* statements may accelerate the trial process, the ICTY may be sacrificing accurate information. This sacrifice may be extremely significant because it may affect the Tribunal's integrity. Eventually, this imbalance could taint the policy justifications for this court.

International Criminal Tribunal, Forensic Evidence, Legal Proceedings

E16 A Successful *Daubert* Challenge: Trial Court Upholds the Law of Gravity

John J. Lentini, BA, Applied Technical Services, Inc., 1190 Atlanta Industrial Drive, Marietta, GA 30066*

After attending this presentation, attendees will have an understanding of the factors the trial court takes into account when considering a *Daubert* challenge in a fire product liability case. This presentation will provide attendees with the kind of evidence they may see in contested fire cases.

This will be a case study of a product liability lawsuit involving competing hypotheses put forward by fire investigators.

The Plaintiff, a ten-year-old boy was playing with fire and burned himself severely. He and his parents alleged that the utility lighter with which he may or may not have been playing with at the time was defectively designed because even without the childproof safety device being disengaged, pulling on the activation lever released iso-butane. The design of the lighter was such that the childproofing device prevented a spark from being introduced at the tip of the lighter, but did not prevent iso-butane from being released when the lever was partially depressed. Ambulance personnel and doctors who treated the boy both reported that he had told them he had been "playing with matches." Later, in a deposition testimony he stated that when he said "matches", he meant "a lighter."

Plaintiff's experts opined that the burning was caused by the ignition of fugitive iso-butane released from the lighter, and to prove his case released iso-butane from an exemplar lighter into a 250 ml beaker and ignited it. He further showed that the iso-butane burning in this beaker was capable of igniting cotton similar to the cotton tee shirt worn by the Plaintiff.

The Plaintiff's testimony was that he had held the lighter at his side pointing away from himself and depressed the actuation lever a few times for no more than "a few milliseconds."

Plaintiff's expert chose to disregard this testimony and opined that the youngster had placed the lighter against or under his tee shirt, and held the lever down for a much longer period of time releasing much more iso-butane. He based this opinion on the amount of damage to the tee shirt, and on the parts of the youngster's testimony that comported with his hypothesis, i.e., that he saw a bright flash of yellow flame immediately after igniting the lighter. The expert did nothing to quantify the amount of iso-butane required to cause the hypothesized explosion, nor did he test the behavior of iso-butane. He stated that iso-butane had flammable limits of 1.8% to 8.4%, and the lighter released a flammable mixture, therefore, the gas was only about 2% denser than air, a clever, but completely false analysis. Defense experts, including the author, used a shadowgraph to demonstrate that iso-butane released from a lighter would fall immediately to the floor, because it is twice as heavy as air. The necessary mixing with air occurs only after the fuel is released, a fact lost on the other expert.

A close examination of the tee shirt revealed that at least some of the burning occurred while it was folded on itself, i.e., after the boy had pulled it off. Tests were also conducted showing that it was impossible for a cloud of iso-butane to accumulate absent some confining vessel. A final series of tests was conducted wherein it was assumed that the law of gravity was suspended, and a 5% mixture of iso-butane and air was pumped into a plastic dry cleaning bag surrounding a cotton tee shirt. The tee shirt was surrounded with this flammable mixture containing the amount of iso-butane that would be released by the lighter if it were held open for fifteen minutes. Not surprisingly, when an ignition source was supplied, an explosion occurred, but the iso-butane burned so quickly that it did not release sufficient energy to ignite the cotton shirt.

Testing from both sides was presented to the Court in a motion to exclude the Plaintiff's expert from testifying. The Court ruled, in a detailed 35 page opinion, that Plaintiff's expert, though he claimed to be reliable and following the scientific method, selectively ignored data that did not comport with his theory. The testimony was excluded and the case was dismissed. The trial court was most critical of Plaintiff's expert's acceptance

of certain parts of the Plaintiff's testimony as true, and disregarding other evidence that refuted that testimony. He stated, "in a word, the expert failed to collect all available data prior to making his opinion, and in some instances, selectively disregarded pieces of data to the extent they conflicted with his hypothesis."

The Court acknowledged the applicability of ASTM and NFPA standards to fire investigation. This ruling exemplifies the use of *Daubert* challenges to prevent juries from being presented with junk science and speculation.

Fire Testing, *Daubert*, Product Liability

E17 Recent Developments in the Judicial Investigation of Sudden, Unexpected and Unnatural Death in England & Wales

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After attending this presentation delegates will have an enhanced understanding of recent and proposed changes in the law relating to the judicial investigation of unnatural death in England and Wales and the reasons for those changes.

This presentation will impact the forensic community by demonstrating to North American lawyers who may have to advise clients whose relatives have died in England and Wales and to forensic scientists and pathologists who have to work with English colleagues in investigating a single or multiple deaths. It will also be of interest to all those who would seek an illustration of Bismarck's aphorism: "Laws are like sausages, it is better not to see them being made".

Major changes in training are being implemented in the way in which sudden unexpected death is investigated in England and in which natural death is certified and registered prior to disposal of the body. These changes have had two main drivers; a number of scandals in relation to the retention of body parts after postmortem without the proper consent of the relatives and the ability of Dr. Harold Shipman to murder between about 220 to 240 of his patients without detection.

The UK Parliament passed the Human Tissue Act into law in 2004. Although it makes major changes in the law relating to the collection of tissue at postmortem and its retention as well as in relation a number of other areas such as the non consensual collection of samples for DNA profiling, backed up by significant – even draconian - criminal sanctions, it does not address a number of areas of concern to forensic practitioners. Indeed, on a black letter reading of the act it can be argued that it makes unlawful the retention of human tissue at a judicially ordered autopsy for purposes of a criminal investigation or for national security purposes when those purposes go beyond the limited jurisdiction of the coroner. All the coroner can do is retain tissue for a limited time to establish who the deceased was and the means by which they came to their death. Further, the act does not contemplate the retention of tissue, even with consent by relatives, for forensic research as opposed to medical research. The act, which was steered through Parliament by the Secretary of State for Health cannot be regarded as a triumph of "joined up government."

The UK Government has promised further legislation to reform the Coroners' system which, arguably, has not changed fundamentally since the Articles of Eyre in 1194. The same legislation will introduce a new system of death certification, the details of which have yet to be announced. However, it is widely expected that a system of independent of medical review of all deaths will be introduced. Whilst the hope that this can be funded by the savings produced by a reduction in the number of postmortem examinations that a medical chart review of each has been expressed, the available data suggests this may be optimistic. At the time of writing, the draft bill to revise the English coronial and death registration systems has not been published. A White Paper was expected before the General Election in May 2005, but did not materialize. However, a government minister has assured that the government remains committed to reform of the coronial and death certification system. Draft legislation is expected "real soon now." It is very unlikely that it will not be published before AAFS 2006 and the author anticipates being able to review it in this presentation.

The Human Rights Act 1998 made the European Convention on Human Rights (ECHR) part of English law. All English law now has to be compliant with ECHR and this has left English lawyers having to grapple with the alien concept of what is in effect a written constitution with a gloss provided by the judgments of the European Court of Human Rights in Strasbourg. The significant effect this has had on English coronial law will also be reviewed.

Coronial Law Reform, Death Certification, Parliamentary Processes

E18 Proving Premeditation Without a Motive Using Medical Forensic Evidence: Matricide With Attempted Body Disposal in a Freezer

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After attending this presentation, attendees will be able to evaluate absence of comprehensible offender motive as a factor in obtaining jury verdict of premeditated homicide in a matricide with body disposal in a freezer. Additionally, participants will be able to recognize the uses and drawbacks of medical and forensic evidence of a variety of types in obtaining a conviction for premeditated homicide in a matricide without visible motive.

A 22-year-old man was observed by a police officer leaving a high drug area parking lot with a broken license plate light. As the officer began to follow, the suspect began driving recklessly, and accelerating as he left. The police officer followed, and the driver, after attempting to escape, led the cruiser to his house, where he got out of his car, and ran inside. The officer was unable to attempt an arrest on the traffic infraction. However, after running his license number, he recognized the driver's name, and knew that he had a history of illicit substance use. His familiarity with the defendant's criminal history encouraged the officer to search the garbage bin for the household, which had been placed at the curb for retrieval. Search led to the identification of two plastic bags containing material suspicious for marijuana residue and stems. The officer then obtained a warrant to search the house.

The officer and his backup entered the house and found the defendant standing at the head of the stairs with a gun to his head, threatening suicide. They succeeded in calming him and talking him out of shooting himself. At some point during the ensuing discussion, he allegedly stated, "I'm a monster." He then directed them to a stand-alone chest freezer. In the freezer was a body, hidden by a tarpaulin, on top of which was a package of frozen hamburgers. The body was that of the suspect's mother, folded into a fetal position. She was fully frozen. The only other tenant of the house, besides the defendant, was his teenaged sister. She told police he had told her that their mother had gone away on vacation. The father, who spent a large amount of time in Hawaii, was unaware of the event. A younger brother was incarcerated for grand larceny, and first learned of the event from a television news program.

The autopsy, which could not be undertaken for three days until thawing commenced, showed three gunshot wounds to the head. The first was fired into the back of the victim's head from more than three feet away. Because the gunpowder in the ammunition was weak and the gun of small

caliber, this round fragmented inside the scalp, causing no significant injury. The second gunshot wound was fired at the face, from a close enough range to deposit fouling and stippling on the skin. This bullet entered the head beneath the eye, and was not fatal. The final gunshot wound was from very close range; the bullet entered the side of her face between the eyebrow and the ear. This gunshot wound was fatal. The autopsy further showed no evidence of sexual assault. The main findings, besides the gunshot wounds and some small injuries that might easily have been incurred during struggle, were postmortem changes due to freezing and thawing.

The defendant gave a statement in which he described an altercation, during which he and his mother struggled over the gun. Allegedly, she stated at one point, while she had her hands on the barrel, "I love you," and he responded, "I love you." However, she was still shot to death. Reporters quoted the incarcerated younger brother as saying, "This came out of the total blue. … Not in a million years would I thought [sic] he'd do something like this." How can a jury comprehend an act like this when there is no motive? Although it is not the obligation of the prosecutor to provide the jury with a motive, convictions for premeditated murder may be difficult to obtain when there is no comprehensible reason for a homicide, particularly one that ruptures a primal human bond. Matricide has been reported in the literature as an act performed by paranoid schizophrenic offspring, who murder while delusional. It has been reported as following mother-son incest. There was no diagnosed history of mental illness or incest in this case.

This case study is used to consider how to use medical forensic evidence to present a convincing prosecution to a jury of a premeditated homicide that takes place within the nuclear family, without a motive. Other points of discussion will include the use of defendant statements, crime scene evidence recovery, use of forensic psychology, application of DNA analysis, and working with a family coping with the after effects of matricide.

Matricide, Premeditated Homicide, Motive

E19 Presenting Expert Testimony: The Expert's Perspective

Susan E. Morton, BA, San Francisco Police Criminalistics Laboratory, 850 Bryant Street, San Francisco, CA 94103*

Attendees will learn the expert's perspective on presenting courtroom testimony. This presentation will promote better understanding and communication between experts and attorneys. Attorneys will then be able to facilitate more effective testimony by expert witnesses.

Encounters between experts and attorneys sometimes produce astonishment on both sides. Scientists and jurists have very different world views and purposes. In general, scientists believe that the very latest word on a subject that has been replicated and verified is the controlling principle. Attorneys, conversely, will look to the oldest precedent. The author was once cross examined by an attorney about the possibility of developing fingerprints on paper. The text the lawyer was using to formulate his questions was Wigmore's 1895 treatise. The attorney exhibited befuddlement when told that time had marched on in the intervening century and that new techniques were now available as considerable effort had been spent in finding the oldest reference possible on the subject.

Attorneys, being advocates, sometimes forget that experts are not. An honest expert may be called to the stand by one side in a case, but does not, or at least should not, be perceived as "on that side". Obvious bias in an expert will render that witness ineffective more quickly than incompetence. Juries may have some sympathy for an honest fool, even as they dismiss evidence he has proffered. However, a "hired hack" will produce not only a rejection of the evidence, but suspicion of the side that offered it. A jury may conclude that they are being conned because there is no real evidence for that side to present.

Another area that causes misunderstandings is language. Both Attorneys and scientists use language in very precise ways. Unfortunately, they may be using the same words, but attributing different definitions to them. An example is an encounter between a prosecutor and a Forensic Alcohol Supervisor in a DUI case. The alcohol level test was performed on and Intoxilyzer® breath alcohol instrument; the expert was to testify to these results. During a pretrial conference the prosecutor posed the question to the expert whether is was possible for the expert to infer and testify to the defendant's state of impairment based on field sobriety tests and other observations made by the arresting officers, even in the absence of the chemical test. Forensic Alcohol Supervisors are trained and qualified to testify to such conclusions and regularly do so. Once familiar with the pertinent information, the expert in this case agreed that testimony could be offered that the individual was impaired, even in the absence of the chemical test. However, the question that the prosecutor asked in court was somewhat different from the agreed upon question. The prosecutor asked the expert if, based on the field sobriety test and other observations by the arresting officers and even in the absence of the chemical breath test, the expert could conclude that the defendant was under the influence of alcohol. The terms "impaired" and "under the influence of alcohol" may have sounded interchangeable to the attorney, but they certainly are not to a scientist. The expert answered in the negative to the great surprise and distress of the prosecutor. To a scientist, impairment can be inferred from behavior. It is not possible to know without chemical tests or other information whether that impairment is due to fatigue, illness, talking on a cell phone, illicit drugs, prescription medications or alcohol.

These different perspectives can lead to misunderstandings and miscommunications. The author has been an expert witness for many years. She will describe some of the more instructive encounters she and her colleagues have with attorneys in hopes that both sides can learn how to communicate better. Her insight into what attorneys have done wrong, as well as what they have done right, in attempting to present her scientific findings to courts will help practicing attorneys hone their skills. Poorly worded questions can handicap an expert witness and fail to elicit compelling evidence. Properly couched questions can make scientific findings tell powerful stories. Experts and attorneys need to learn to listen carefully to each other and pay attention to the other's language. Society needs for justice and science to work together.

Expert Witness, Communication, Effective Testimony

E20 Breaking the Silence of Asian Youth Gangs: A Rising Epidemic Confronting Medical Examiners/Coroners From California to Pennsylvania

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This presentation will provide timely data on Asian and Pacific Islander Americans (API) youth gangs and offer strategies on how to recognize and interpret various behavior, tattoos, and graffiti associated with these gangs, which could assist the medical examiner/coroner and death investigator in the positive identification of the decedent in the field and/or in the autopsy room. Most importantly, it is imperative that the medical examiner/coroner community understand the "signs and symptoms" of API gangs in order to keep themselves and those around them safe when investigating the deaths of gang members.

With the population of API continuing to rise in the United States, so do their healthcare needs. Unfortunately, not all Asian Americans are as uniformly educated, acculturated, and financially stable, as the myth of the "model minority" would have us suggest. Although adults from many nationality groups between Asian and Pacific Islanders have adapted well to life in the United States, serious problems have emerged among Asian

American youth. In particular, youth gang violence in the Asian and Pacific Islander community has dramatically increased in the last few years by nearly 20% nationwide according the U.S. Department of Justice, Office of Juvenile Justice and Delinquency Prevention. In Los Angeles County California alone, there are currently 155 Asian youth gangs, with a total gang membership of over 6,000. In neighboring Orange County California, gang involvement has reached an all time high with over 65 documented gangs and a membership of 2,000. Demographics show gang member (male and female) age average of 15 with a range of 8-22 years. Even more disturbing is the increase of Asian females involved in gang activity. In Orange County, where the Asian gang population makes up 12%, there are 140 Asian female gang members, up 60% from last year. Other surrounding counties in California and the cities of Philadelphia, Pennsylvania, Fairfax County Virginia, and Portland Oregon have seen similar trends in the rise of Asian youth gangs. The author interviewed over 400 gang members in the streets, the jails, and the juvenile halls, using a target questionnaire; concomitantly went a step further disguised as a gang member. This study identified a distinct difference between Southeast Asian gangs and Pacific Islander gangs. Southeast Asian gangs were often seen as "non-traditional" gangs by the author, whereas Pacific Islander gangs (i.e. Filipino, Samoan, and Chamorro) were considered more "traditional." Moreover, the author identified seven contributing factors, which lead to involvement in both male and female Asian gangs (i.e. substance abuse, lack of adult supervision, breakdown of the family, victimization due to racism, culture shock, need for survival, and monetary profit).

Juvenile Offenders (Youth Gangs), Asian American, Violence Prevention

E21 Exonerations From Death Row: A Mass Disaster for the Criminal Justice System

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After attending this presentation, attendees will understand the advantages of applying the model of public safety commissions to the analysis and understanding of the causes of wrongful convictions in capital cases.

This presentation will demonstrate why forensic scientists should lead the demand for thorough, objective review of the causes of wrongful convictions, modeled on the response to mass disasters such as train or airplane crashes by the National Transportation Safety Board.

In the past 16 years, primarily because of 159 DNA exonerations, it has become clear that wrongful convictions are far too common to be acceptable in the criminal justice system. There is no reason to assume that the rate of DNA exonerations would not hold true in the majority of cases where there is no testable biological evidence which is indicative of guilt or innocence. Since 1973, 119 people have been released from Death Row with evidence of innocence; 14 of these cases involved DNA evidence of innocence. In several capital exonerations, DNA testing led to the identification of the real perpetrator.

Exonerations in capital cases complete the conclusion that there is an unacceptable risk of executing the innocent; it is a certainty that innocents have spent hundreds of years condemned to die for a crime another committed. The numbers are sufficient to give rise to the label of "mass disaster." The damage done by these wrongful capital convictions is not confined to the suffering of the innocent alone, but includes the loss of faith in the judicial system as an institution capable, for the most part, of getting it right, and a growth in public mistrust of the actors in that system, including forensic scientists. The response to this crisis should be similar to those triggered by plane crashes and train derailments. An independent commission should be empanelled and permitted sufficient time and tools to uncover the causes and remedies of specific wrongful convictions. The commissions should have subpoena powers, appropriate experts as members and consultants, and access to all relevant information. The commission report should be public, and include specific legislative and judicial reforms uncover and redress existing wrongful convictions and to prevent wrongful convictions in the future.

The Innocence Project's work in the DNA felony exonerations has produced a now-familiar list of causes, and a growing literature on the remedies which now has wide, if not unanimous, acceptance in the forensic community. Among the cause of wrongful convictions are: suggestive eyewitness identification, (and a misunderstanding of the nature of memory and facial recognition); improper interrogation techniques leading to false confessions; inadequate defense resources and poor quality of lawyers for indigent clients; police and prosecutorial misconduct. In addition, the DNA exonerations in serious felonies have exposed significant problems with the quality of some crime labs, with the training, practices, and bias of some forensic scientists, and with the applicability of dubious or novel forensic theories to criminal cases. Important evidence has been contaminated, misinterpreted, lost or purposely hidden; experts have lied about their credentials, misled juries and courts about their results, exaggerated conclusions or statistical probabilities, and testified to the results of tests never conducted.

The exonerations from death row should trigger review in every capital jurisdiction along the lines of the mass traffic fatality commissions. It is now a principle established under federal law that even-handed audits of crime labs are required for serious acts of misconduct or serous negligence. Wrongful conviction in capital cases should trigger an independent audit of all aspects of the case for any sort of misconduct or negligence that brought about the condemnation of an innocent person. Forensic scientists, in particular, should take the lead in insisting on a review process in cases of wrongful conviction that is both retroactive and proactive, concentrating on what went wrong, the likelihood that there are other wrongful convictions caused by the same errors, and prevention of future cases. Nothing less will restore confidence in the objectivity and fairness of forensic scientists, particularly in capital cases.

Death Penalty, Commissions, Exoneration

E22 The Examination of Non-Functional Data-Storing Electronic Devices

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The goal of this presentation is to describe the types of damage and approaches to repair as well as details regarding the extraction of data from severely damaged devices, with emphasis on cellular telephones. This presentation will provide information and techniques to forensic examiners which will enable them to assess options when faced with the need to examine damaged devices.

The conventional forensic examination of fully functional data-storing electronic devices such as cellular telephones can be an involved and time consuming task with its own set of technical challenges. However, when confronted with a device that has been rendered non-functional due to physical or electronic damage, the examiner must weigh the potential evidentiary value of such an examination against the time and expertise that will be required to bring the device to a point where data acquisition can take place.

The Centre of Forensic Sciences Digital Evidence Unit has been examining non-functional and/or damaged electronic devices, with particular emphasis on cellular telephones, since 2003. This approach to case item repair and data extraction was borne out of necessity, as although it could

be argued that repairs could most easily be done by the manufacturer, chain of custody issues and the lack of local service representatives often made such an approach either unacceptable or simply infeasible. These inconveniences led to the development of damaged device repair techniques, which range from correcting basic power-related problems to the imaging of data directly from non-volatile memory chips that have been physically removed from the circuit board of a device.

The thought of attempting a repair of a device as small and as technologically advanced as a cellular telephone may be intimidating to many examiners, but the majority of causes that render these devices non-functional are relatively straightforward to correct, requiring little more than a small amount of work and an identical phone, i.e. an exemplar, from which parts can be harvested. Examples of such causes of malfunction include broken or dirty connectors, corrosion from liquids such as water or blood, cracked or defective displays, fatigued solder joints, and defective batteries, among others. While it is sometimes impossible or impractical to repair a severely damaged device, experience at the Centre of Forensic Sciences laboratory suggests that basic repair of damaged devices could fall well within the existing capabilities of many forensic laboratories, and that damaged items should be considered for inclusion in evidence collection and examination policies.

Even when a device has been damaged to the point where it is beyond repair, it may still be possible to extract usable data. Should the memory "chips" themselves on the phone's circuit board be undamaged, it is sometimes possible to physically remove the chips from the board and perform a bit-level examination. While being more technically involved than a conventional examination, as well as being time consuming, this is an option that can be explored should the data need to be retrieved at any cost.

This presentation first examines the types and extent of damage that have been encountered in routine casework, and the level of technical training required to perform each type of repair. Discussion will include potential difficulties, information and material resources, data recovery techniques and related success rates. Particular emphasis will be placed on basic repair of cellular telephones, with examples of specific techniques being given. This will be followed by an overview of the process used to extract data from more severely damaged devices, and will include a discussion of the details of populating the memory of an exemplar, removing and imaging the memory chip, building a memory map using a hexadecimal editor, creating a procedure, and carrying out the examination on the submitted device.

Digital Evidence, Electronic Device, Cellular Telephone

E23 A Methodology for the Forensic Examination of Cellular Telephones

Peter V. Mosher, Scott Thompson, BSc, and Greg Hudson, BSc, Centre of Forensic Sciences, 25 Grosvenor Street, Toronto, Ontario M7A2G8, Canada*

The goal of this presentation is to describe a newly developed advanced cellular telephone examination methodology. This presentation will also demonstrate the significant reduction in cellular telephone examination time while also eliminating data loss and reporting errors.

The affordability of cellular telephones has ensured their wide use in today's society, and the timely examination of this type of evidence can have a significant impact on an investigation. Cellular telephone examination requests were first accepted at the Centre of Forensic Sciences in 2000 and have steadily increased in number to represent over 60% of digital evidence casework. The modern cellular telephone can contain a significant amount of information, ranging from call detail logs and phonebooks to multimedia data such as audio, images and video, all of which may be relevant to an investigation.

There are three basic methods of acquiring cellular telephone data: memory imaging, downloading through data cable, and physical manipulation of the device while photographing sequentially displayed screen images. All three approaches have their strengths and drawbacks. Imaging can yield all data stored in memory, but it may sometimes be necessary to physically remove the internal memory from the telephone's circuit board in order to accomplish this task. This can be challenging, requiring a skill set and equipment that may be unfamiliar to many digital evidence examiners. The second method, downloading data through a cable using appropriate software, appears at first sight be a workable option but can carry with it two significant problems: software manufacturer delay time in keeping up to date with the latest devices, and verification of the software to ensure that the process of downloading information is reliable.

In the third method, the cellular telephone is manually manipulated while observing information presented on the display screen. When cellular telephone examinations were first undertaken at this laboratory, call log and phone book data were captured by scrolling through the telephone display screens and manually transcribing the data. This system was time consuming, subject to transcription error both in collecting the data and in generating the report, and carried the additional risk of the possibility of altering data by accidentally initiating a call or deleting records. An interim solution incorporated the use of a digital still camera to capture display screen information. Although lessening the probability of transcription error, this system remained labor intensive and time consuming. Full images were presented as a contact sheet attached to the report as an appendix, which often resulted in reports 20 to 30 pages long, an undesirable increase over the four to five page transcribed reports.

A new manual manipulation system was developed at this laboratory to streamline workflow, maximize the quality of product provided to the client, and improve timeliness of service. The system, consisting of hardware and software, allows the acquisition of excellent quality images from the cellular telephone display in an extremely reduced timeframe, using a digital video camera and computer workstation. The essential information from these images is then electronically imported directly into a report for the client. Risk of transcription errors has been removed with this system, and procedure refinements minimize the likelihood of data loss through inappropriate button manipulation. Furthermore, the system is not nearly as labor intensive and time consuming; now hundreds of images can be captured within minutes instead of over the course of hours as with the digital still camera. The markedly improved image quality allows the direct importation of image elements into a report for the client, and with the ability to select and extract only essential information from the images, to be displayed as linear text entries in a table format, report length is once again reduced to four or five pages. The critical element to the client, however, is that turnaround time for such an examination has been reduced from one week to one day.

Digital Evidence, Cellular Telephone, Forensic Science

E24 Data Privacy

Ingrid A. Gill, JD, Law Office of the Cook County Public Defender, 69 West Washington, Suite 1500, Chicago, IL 60602*

After attending this presentation, attendees will understand the strategies of finding digital evidence while maintaining attorney client privilege digital communications when using third party providers. This presentation will impact the forensic community by changing current practices in light of recent U.S. Supreme Court decisions governing data privacy and discovery.

The use of the internet, portable cell phones, PDA, and other wireless devices has increased reliance on electronic data in the forensic community. Law enforcement agencies, crime labs, prosecutors, defense attorneys, and court clerks are increasingly relying on communications via the internet

maintained by ISPs or network administrators. The impact of two recent United States Supreme Court decisions dealing with information maintained via third parties is discussed for its impact on the practices within the forensic community and the criminal justice system.

In *United States v. Miller*, the Supreme Court concluded that the Fourth Amendment did not apply to records maintained by a bank. Consequently, federal agents did not need a warrant to compel the production of defendant's bank records. The records sought were not secret since they were exposed to employees in the ordinary course of business. In *Smith v. Maryland*, the Supreme Court held that a warrant was not required where law enforcement sought the record of the numbers dialed by the defendant that had been captured by an electronic device, "the pen register". If information is not completely secret, it is not subject to protection under the right to privacy; thus, the government can use the power of the subpoena to acquire the records. At the same time, mistakes by court personal in emailing non-public crime lab reports concerning a high profile sexual assault can be argued by the defense to be waivers of secrecy requiring only the use of subpoenas rather than a court order by the defense to acquire the emergency room medical records of the sexual assault victim to prepare for trial.

For the defense, the major issue becomes how to challenge the reliability and accuracy of digital records maintained by the third party providers or the users of such digital evidence. The defense must motion for the discovery of all drafts and versions of digital documents to adequately challenge the accuracy of the records maintained by the custodian of digital records. How far back to the source document is the defense entitled to? Who decides what constitutes the "best evidence" to tender to the defense in discovery when it comes to digital discovery or imagining technology? Is a logical copy or a hash copy of a file sufficient for discovery? When does spoliation occur in the digital environment? Practical considerations will be given to the emerging field of computer forensics, imaging technology and the standards of admissibility for civil and criminal courts.

The presenter will discuss some of the federal statutes governing data privacy such as the Electronic Communications Privacy Act, the Pen Register Act, The Financial Privacy Act, The Cable Communications Act, and the Health Insurance Portability and Accountability Act of 1996. The impact of these statutes on those who practice in the criminal justice system will be discussed.

Data Privacy, Discovery, Digital Evidence

E25 The "Last Responders": Working to Uncover Wrongful Convictions in Death Cases: Some Forensic Science Problems, Considerations, and Applications in a Capital Post-Conviction Fact Investigation

Gary Eldredge, JD, and Jennifer Vitry, Gary Eldredge & Associates, 6155 Catina Street, New Orleans, LA 70124; and Denise LeBoeuf, JD, Capital Post-Conviction Project of Louisiana, 144 Elk Place, New Orleans, LA 70119*

Attendees will be provided with an overview of systematic procedures for conducting an investigation in a capital post-conviction case by the defense. This presentation will demonstrate a systematic approach to collecting, evaluating and forensic testing of physical evidence in a capital post-conviction investigation improves the likelihood of exoneration and increases the chances of a fair resolution of the case based on the evidence.

In recent years, forensic evidence developed by the defense has contributed greatly to the release of dozens of wrongfully convicted men – many of them on death row. It is widely believed that the exonerations so far are only the tip of the iceberg and that America is faced with a crisis situation. With the Innocence Project in the lead, defense attorneys, investigators, and the forensic experts working with them, are reviewing the cases of hundreds of prisoners facing the death sentence.

In a post-conviction case the investigator must find and review physical evidence collected pre-trial, much of which may not have been used at trial; testing done by any forensic experts; and expert testimony at trial. The investigator must consider if new developments in forensic science require a fresh look at the evidence and whether additional testing is necessary.

Experience in capital post-conviction exonerations demonstrates that the orderly and creative investigation of these cases can produce probative forensic evidence of innocence, even many years after conviction. Since an orderly, organized approach is the best way to respond to any emergency, the purpose of this brief presentation is to suggest methods of proceeding to attorneys and investigators undertaking this type of post-conviction case for the first time. This requires a systematic approach to finding all (still-existing) physical evidence collected during the original police investigation, and the records underlying any forensic testing done at that time; a protocol for the examination and preliminary (investigative) assessment of that evidence, to help decide what forensic testing and evaluation should be done post-conviction; and attention to some narrow, potentially productive, lines of forensic investigation which should not be overlooked.

Some of these less common lines of investigation include: DNA testing of less-commonly tested items of collected evidence which may have been touched by the perpetrator (e.g., beer cans, cigarette butts, etc.), some of which may or may not have been tested by law enforcement; hairs possible left by the perpetrator not DNA tested by law enforcement; the possible significance of DNA partial profiles for exclusion; obtaining DNA samples from a person considered to possibly be the tru killer; CODIS for the defense; latent prints not identified by law enforcement; partials not considered by law enforcement to be "prints of value" for exclusion; AFIS for the defense.

In addition, the investigator should consider re-examining the firearms evidence presented at trial in light of changes such as "bullet batching" developments; IBIS for the defense; and any hairs and fibers in light of new identification developments.

Other practical suggestions for the investigative management of these cases will also be discussed.

This presentation will provide investigators undertaking their first capital post-conviction case with a preliminary checklist and some potentially productive areas of forensic inquiry, which, in a case of suspected wrongful conviction, will enhance the possibility of exoneration.

Death Penalty, Investigations, Exonerations

E26 Medical Liabilities of the French Physician Passenger During a Commercial Air Flight

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The French physician passenger (and maybe the international physician passenger) who often travels on a commercial air flight should be aware of the risks encountered if the physician does not respond to the well-known call "Is there a physician on board?" or if the physician decides to assist a sick passenger.

Two billion passengers travel each year on commercial air flights. More elderly people, some with pre-existing physical conditions are taking

to the air and with the anticipated growth of air travel. Likewise, in-flight illnesses and injuries are expected to increase as well. Even if in-flight medical events and deaths are still uncommon, physician passengers are occasionally called upon to render care.

According to an "Air France" study conducted for two years, one medical event occurs for 20,000 passengers, with one death for every three million passengers (this represents 20 deaths during the study). Among these 20 deaths, seven involved chronically sick passengers and were foreseeable; 13 were not foreseeable and resulted in one unexpected death for five millions travellers. During these two years, 38 aircraft diversions were required. In 89.6% of the cases, a physician was on board and looked after the sick passenger. Medical events during commercial aircraft happen more frequently aboard long distance flights (80% of the medical events). The authors will review the main common medical events.

The type of medical material available on aboard will be described. The principle of a ground-based medical assistance will be explained. When a medical event occurs aboard an aircraft and the captain or a crew member calls for a physician, two possibilities are presented; either the physician decides to assist the sick passenger or not. In the cases researched here, the various liabilities will be studied.

What are the responsibilities of the French physician passenger if he/she does not respond to the call of a medical event aboard an aircraft? Are there different possibilities according to the passenger number on the plane, the country flown over, or the nationality of the sick passenger? What are the different sanctions encountered by the French physician passenger who did not respond to the emergency call? Is the French physician passenger condemnable in a foreign country? Is the physician diploma universally accepted? What are the responsibilities of the physician passenger providing assistance to a sick passenger?

The different responsibilities of the French physician passenger will be described and explained. Civil, penal, and ordinal responsibilities are applicable in this case. The authors will answer the many questions: Does the civil responsibility depend on contractual right or tort-based right? In which cases does the wrong exist? May the French physician passenger be paid? Does the air carrier company have an assurance which protects the physician passenger? Have the country of citizenship of the plaintiff or defendant also have jurisdiction? Must the French physician passenger be a specialist of the illness the patient is suffering from? The authors will respond to these questions with the help of the Tokyo Convention, the Warsaw Convention, the French legal code and the French deontology code.

The intervention of the physician passenger may be interpreted as conducting business as a quasi-contract or agent of the air carrier company. These possibilities will be detailed and discussed. The legal responsibility of the French physician passenger in cases of neglect as well as in cases of involuntary or voluntary manslaughter, unintentional injuries, and assault, will also be reviewed. The types of infractions for a physician which have penal consequences will be explained. Lastly the consequences of physician passenger looking after a sick passenger without the authorisation of a crewmember or the aircraft captain will be researched.

Flight, Physician, Responsibility

E27 Mandatory DNA Testing

Ingrid A. Gill, JD, Law Office of the Cook County Public Defender, 69 West Washington, Suite 1500, Chicago, IL 60602*

This presentation will discuss how wrongful convictions can occur based on faulty eye witness recollection, self motivating jail house snitch testimony, and police coercion and describe how reliable DNA testing can prove actual innocence for the wrongfully convicted. For the wrongfully executed, DNA testing may finally allow them to rest in peach. Attendees will learn about one jurisdiction taking a hard look at wrongful convictions by reopening cases for DNA testing including those that may have been wrongfully executed.

In St. Louis, the top prosecutor is going where no man has gone before. That is because Prosecutor Jennifer Joyce is reopening over 1,400 old cases to perform DNA testing. The boldest move is the reopening of a case where the defendant may have been wrongfully executed. Larry Griffin was executed in 1995 for the shooting death of Quentin Moss in 1980. While many legal scholars have relied on the finality of judgment to justify the denial of DNA testing for the those relatives that remain after the execution of their potentially wrongfully convicted relatives, St. Louis prosecutors have taken an independent review in their pursuit of justice for the potential victims of the miscarriage of justice that are inevitable in any criminal justice system.

Ten years after the potential wrongful execution of an innocent man, Illinois is faced with the proposed legislation that would mandate DNA testing of detainees prior to arrest where there is biological evidence available that could exonerate them. From 2004 to the summer of 2005, a young father spent almost eight months in jail charged with the murder of his young daughter. Despite the young father's requests, the local prosecutor did not seek prompt DNA testing. Instead, as head prosecutor he publicly sought the death penalty for the brutal murder within weeks of the arrest as he campaign around the county for reelection as the county prosecutor. Not until the defense attorney demanded DNA testing, was the evidence from the crime scene sent to an independent private lab. After almost eight months, the science of DNA exonerated this young father and the charges against him were dismissed. The prosecution and law enforcement is now left to resume an investigation where the biological evidence was available from the first day the body of the missing child was recovered. Since then, the young father has filed a civil lawsuit against the county and the previous prosecutor.

As a case study, the forensic community can learn from these cases. This presentation will discuss the advantages of outsourcing, automation, and proposed legislation that would mandate reliable DNA testing prior to arrest.

Actual Innocence, Mandatory DNA Testing, Capital Punishment

E28 Causation Issues in Fear of Cancer and Medical Monitoring Cases

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After attending this presentation, attendees will understand some of scope and complexity of fear based liability and medical monitoring. This presentation will provide an understanding of the scope and complexity of fear based liability and medical monitoring through an exploration of the issues and the case law surrounding same.

The potential scope of such litigation is vast: Environmental /Occupational Toxic exposures (perchlorate/heavy metals/solvents) radiation, mold, medications/vaccines (Thimeresol/Gulf War Syndrome/ Hormone Therapy), HIV AIDS exposure/needle stick, breast injury, risk of developing depression from using medications used to treat ADHD, risk of developing tardive dyskinesea/diabetes/infertility from using antipsychotics/mood stabilizers, noise exposure, and hearing loss.

An action to recover damages for fear of future disease is based on theories of intentional infliction of emotional distress, negligent infliction of emotional distress, or as an element of damages based on some independent underlying liability. The most important elements of proof for both parties in such cases is the reasonableness of the plaintiff's fear, which, depend primarily on the degree of certainty that the plaintiff was actually exposed to a disease causing agent, and the probability that the plaintiff will actually contract the feared disease. Jurisdictions have used "more likely than not" standard even while acknowledging that individuals may have reasonable fear below such a standard. In a fear-of-AIDS case, the court held that a plaintiff who had tested HIV-negative had not met the "more likely than not" standard. (As opposed to the scientific evidence that there is a high

probability that a person infected with HIV will eventually develop AIDS or ARC if HIV-positive plaintiff).

Medical monitoring may represent a substantial portion of compensable damages. Factors that determine such awards include increases in the degree of risk of contracting disease; seriousness of the disease; severity of the exposure; and the diagnostic value of the medical monitoring.

Causation, Exposure, Medical Monitoring

E29 Racial Profiling: Forensic DNA on Trial?

Ingrid A. Gill, JD, Law Office of the Cook County Public Defender, 69 West Washington, Suite 1500, Chicago, IL 60602*

Attendees will learn about the challenges to the admissibility of race identifying SNPs use in forensic casework and court. Attendees will learn the potential problems this novel forensic technology presents to the criminal justice system.

The emerging field of population genetics to trace the migration of man has grasped the public's fascination. As more books are published illuminating that humans share a common ancestor by tracing the Y chromosome SNPs in modern man across many continents, scientists are forcing humanity to reexamine racial perceptions. The forensic community has been quick to develop applications utilizing single nuclear polymorphisms (SNPs) to narrow the pool of suspects based on physical characteristics arising from the biological samples left at the crime scene. Forensic scientists have used SNP technology that can identify with an alleged degree of scientific certainty the racial make up of unidentified remains from mass disasters.

However, this new technology presents potential bioethical and legal questions of first impression that the courts, the legislature and the executive branches will have to address in the coming years. The presentation will discuss the potential hurdles this technology faces in the courtroom. Issues such as DNA dragnets, privacy and mandatory DNA testing will be discussed. The use of SNPs for racial identification in mass disaster recovery work will be discussed as to the potential legal issues that may arise from later criminal and civil actions. These thought provoking situations and the constitutional implications of this novel technology will be discussed.

SNPs, Search and Seizure, *Daubert*

F1 Italian Forensic Casework: Pitfalls in Dental Identification

Francesco Introna, MD, PhD, and Valeria Santoro, DDS, Section of Legal Medicine (DIMIMP), P.zza Giulio Cesare, 11, Bari 70124, Italy*

After attending this presentation, attendees will learn importance of personal dental identification by standardized acquisition procedure of dental charts in Europe and in other European countries. This presentation will demonstrate the real problem of incomplete antemortem dental charts in personal identification cases.

The main factors involved in successful dental identification are the collection of antemortem dental records and the accuracy of the collected information.

In Italy, regulations requiring dentists to record and file a patient's dental charts do not exist. The quality of the archived dental records available for comparison with the postmortem remains may be inadequate or even non-existent. Additionally, the large immigrant population in Italy and in Europe increases the difficulty of identification due to the lack of a uniform collection of dental charts in every European Country.

The authors describe eight cases of identification in which many peculiar features in dental charts existed. However, because of the absence or poor quality of dental records, it was impossible to compare the data obtained by the examination of the cadavers with antemortem records.

In three cases (one extensive charred body and two skeletonized) much of the anthropomethric data matched three possible known persons, however the dental evidence was incomplete. Two of the three cases two extracted teeth recorded in dental files were present in the cadavers. In the other case all the dental features were in agreement and the only incongruity was a fixed dental bridge from 44 to 46 on the corpse that was recorded as 45 to 47 in antemortem dental chart.

In another case (skeletonized remains), there was a contradiction between the dentist's undocumented "memories" (an extraction of 36 and a filling of 37) and the dental evidence in the corpse. This permitted probable but not conclusive identification, although every anthropometric date was in agreement with a known person.

In the fifth case (burnt body), the dentist recognized the undocumented dental prosthesis (an upper circular fixed bridge from 16 to 27). Thus, it was not possible to perform a comparison. In this case, a positive identification was possible on anthropometric data and on personal effects.

In three other cases (one severely decomposed corpse and two skeletonized bodies), there were many peculiar dental features but, without antemortem records, it was not possible to utilize this data because of the absence of antemortem records. One corpse with three fixed bridges and many fillings and was ultimately identified by a parametrized technique of skull-photo superimposition. To this day the other two bodies remain unidentified even though one body had an upper circular fixed bridge and a specific "Steffe" titanic vertebral spacer (number of register: Delta L 3/16 S 200 30 L T2492 H) and the other a full maxillary denture and a removable partial denture on the lower arch.

In light of the above reported cases, the authors underline the importance for regulation requiring practicing dentists to maintain detailed dental charts for every patient, and creating standardized methods of collection and registration of this data. Accurate reporting can also be an ethical duty. Not only is maintaining good dental records important to a patient's health, these records could be used to help restore their identify if sadly necessary.

In conclusion, a computer standardized acquisition procedure of dental charts allowing a simple, quick, and sure comparison between ante and postmortem dental findings to make a positive or a negative identification is vital. The standardized process should then be extended to every European, and also extra-European country.

Forensic Dentistry, Dental Charts, Personal Identification

F2 Photographic Superimposition of Dental Remains Over an Antemortem Photograph Used as an Adjunctive Means of Identification: A Case Presentation

James M. Lewis, DMD, 577 Hughes Road, Madison, AL 35758*

After attending this presentation, attendees will have a means to aid dental identification of an individual when antemortem records are absent or incomplete.

This presentation will impact the forensic community by validating a technique to aid in the identification of individuals where antemortem records are insufficient.

The purpose of this presentation is to demonstrate the feasibility and methodology to augment dental identifications utilizing photographic superimposition of dental remains with anterior dentition to an antemortem photograph of an individual.

Background: Dental identification of human remains requires accurate and complete antemortem dental records containing written and radiographic records to be used in comparison to the postmortem remains. When all or some of these components are missing or insufficient, positive dental identification of an individual may require adjunctive procedures to positively identify the individual. At the 2005 AAFS Meeting, Susan Bollinger, DDS, et al. introduced the Grin Line ID System (GLID) as an adjunctive procedure to be used in dental identifications. This system utilized digital photographic superimposition of historic photographs and current photographs of individuals to allow for exclusion or possible or probable identification.

In August of 2004, skeletal remains of an individual were found inside a van that had been missing for approximately one year. The van was discovered in an enclosed storage rental unit in Alabama. The maxilla and mandible were presented for dental identification with two sets of dental records of the same individual from different dentists. The first contained only a written record indicating no dental restorations other than sealants on the first and second molars. The second record contained written records and three (3) sets of horizontal bitewing radiographs. These written dental records indicated two (2) posterior composite dental restorations consistent with the remains; however, additional restorations were noted postmortem. The most recent bitewing radiographs were fuzzy and only faintly revealed one composite dental restoration.

Two digital techniques were used to further support identification of the individual: 1) bilateral digital overlay comparison of the posterior antemortem bitewing radiographs onto the postmortem posterior bitewing radiographs; 2) digital photographic overlay comparison of the dental remains over an antemortem photograph of the individual provided by the family.

Methodology: A high quality digital camera with a 28-200 mm lens was placed on a tripod and used to take a digital image of the photograph of the individual provided by the family. The dental remains (maxilla and mandible) were articulated and photographed using the same camera body with a 105 mm lens on a tripod. Multiple angulations similar to that of the

antemortem photograph were taken. The postmortem photographs were evaluated and the one best representing the antemortem angulation of the individual was selected for analysis. Both images were imported into Adobe® Photoshop® 6.0. The image resolution was verified to be the same and then the distance between furthest discernable points along the dentition in both photographs (in this case, the cusp tip of tooth number 6 to the facial cusp tip of tooth number 12) was measured using the measure tool in Adobe® Photoshop® on the antemortem photograph. This distance was then used to resize the postmortem image to a 1:1 image in relation to the antemortem photograph. Next, the postmortem photograph was cropped leaving only the dental structures desired for comparison. The cropped and 1:1 postmortem image was then superimposed over the antemortem photograph aligning the dental structures of the two images. Using the opacity slide located on the layers tab, the opacity of the postmortem image was adjusted allowing for analysis for points of concordance with the antemortem photograph.

Conclusions: Although this case was worked prior to the presentation of the GLID system, a similar technique was used to compare "grin lines" as an adjunctive means to dental identification. This technique substantially aided in the positive identification of the individual thus substantiating its usefulness in dental identification cases where antemortem dental records provided are not available or insufficient for positive dental identification.

Odontology, Forensic Identification, Digital Photographic Comparison

F3 Identifications - Awfully Simple vs. Simply Awful

Linda B. Edelson-Slocum, DMD, 5 Cherry Blossom Drive, Churchville, PA 18966-1061; and Norman R. Goodman, DDS, 44 Sagebrush Lane, Langhorne, PA 19047*

Attendees will learn what how to prepare when presented with a case involing identification. This presentation will impact the forensic community by providing attendees with a means to prepare for different problems and bring everyday skills into play.

The author was called to do two very different identifications.

In the first case, an intact body was found. The woman had been spackled into a wall, surrounded by sheetrock, and wrapped in a yellow tarp. Her treating dentist provided a complete charting and x-rays. He also said, "notice her veneer on tooth #8, it matches #9 perfectly." The veneer was fractured, but the remaining fragment did match perfectly. With all the information provided it was very simple to make an identification.

The story associated with the second case was that a man had shot his girlfriend, and then strangled his son. There was a cabin fire 160 miles away from the homicide site. Was this the murderer and was he the only person in the cabin at the time of the fire? The "body" was 16 fragments, including 15 teeth not associated with any bone at all, and one segment of the angle of the mandible with roots of two molars. Since most teeth were free of bone, the first question was "Is this, indeed, only one body, or did he take someone else down with him?"

Drs. Goodman and Edelson-SclocumI laid out the teeth in proper dental order, the were no extra teeth present, i.e. there weren't three upper left first molars or other inconsistencies. X-rays were acquired with the available equipment. Medical x-rays of the teeth were oriented and an identification finally obtained.

Identifiers in these cases will not be provided for public viewing, however the woman in the first case was a New Jersey resident although the body was found in Philadelphia. The second case was a Lancaster resident named.

Identification, Veneer, Fragments

F4 Questionable Bite Mark Demographics

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The goal of this presentation is to motivate investigation and discussion regarding the disparity in demographic reporting of the number of bite marks.

This presentation will impact the forensic community by inspiring different agencies to look into a question of possible missed evidence.

Incidental to writing an article to help hospital pathologists distinguish between bite marks and other pattern injuries, it became obvious there was a wide variation in the number of cases reported in jurisdictions within the United States and Canada. Consideration was given to the following causes:

- lack of education and information
- financial restrictions or insufficient funding
- lack of interest

In order to establish a baseline of bite marks seen and/or recognized, the members of the American Board of Forensic Odontologists were surveyed. At the end of 2004, information was compiled by sending a survey through email requesting amounts of pattern injuries referred and bite marks seen in 2002 and again in 2003. Thirty-one members replied. A second survey slightly modified, was handed to members during the 2005 AAFS Conference in New Orleans, this time inquiring about the number of pattern injuries seen from 2002-2004 and number of bite marks seen from 2002-2004. The latter survey received forty-one responders, with some members having answered both of the solicitations. It must be noted that not all states were represented.

Early responses were unremarkable; most replies were below 5 for pattern injuries and for bite marks discerned. However, 9 odontologists reported a range of bite marks seen from 10- 288. This same group reported pattern injuries from 0- 2160. The odontologists who replied were from 27 unique states and one from Canada.

This poster presentation is intended to motivate further investigation and stimulate discussion in order to determine why such a large disparity exists in the demographics.

Bite Marks, Demographics, Pattern Injuries

F5 Third Molar Development as an Estimator of Chronological Age in American Blacks and Whites

Jane A. Blankenship, DDS, Kenneth M. Anderson, DDS, Marjorie A. Woods, DDS, Eddie L. Burton, DDS, Harry H. Mincer, DDS, PhD, and Edward F. Harris, PhD, University of Tennessee College of Dentistry, 875 Union Avenue, Memphis, TN 38163*

After attending this presentation, attendees will be able to assess the value of age determination based on third molar development in African Americans. This presentation will impact the forensic community by assisting in assessing the value of third molar development in age determination in African Americans.

The goal of this presentation is to describe the chronology of third molar (M3) development in an African American sample and to discuss its application as a method of forensic age determination during late adolescence and early adulthood. The tempo of M3 development in blacks (n = 635) is contrasted against a sample of American whites (n = 550). The information will assist the forensic community in assessing the value of third molar development in age determination in this ethnic group.

Stages of third molar development as depicted on dental radiographs from African American dental patients in Memphis, Tennessee, and inmates in an Arkansas state penal facility of known age and gender were used for the study. Identification of ethnicity was made according to demographic information in the patients' records. The age range was limited to between 14 and 24 years. Each M3 was scored for its stage of development using the eight-grade scheme developed by Demirjian (stages A through H, with H denoting complete root formation). Every interpretable third molar was scored, and descriptive statistics were generated for each developmental stage by race and sex. Race and sex differences were assessed using probit analysis, specifically the parametric proportional hazards model. Also evaluated for each stage was the probability of whether an individual was at least 18 years of age, which is an "adult" in most legal jurisdictions.

Within the age range studied, only M3 stages D through H were represented. When both teeth were present, left and right third maxillary molars were at synchronous stages in 91% of cases, and mandibular third molars in 83% of cases. In these African Americans, maxillary M3 development was slightly advanced over mandibular M3 development. Black-white differences are substantial and highly significant in this study, with each developmental stage occurring in blacks a year or so ahead of whites. Of note, however, sex differences in M3 development vary significantly, both with increasing age and between blacks and whites, so age estimation depends considerably on knowing the race, sex, and stage of M3 development.

The empirical likelihood that an individual is at least 18 years old is 91% for African American males with fully developed third molars (stage H). This likelihood for an African American female is 79%. Corresponding risks for American whites are 85% and 92%.

As with studies of other populations, determination of chronological age of African Americans by assessing M3 development radiographically seems to be an inaccurate exercise because of the substantial ranges of variation. Rather than discrete age groupings, we found that examples of M3 grades D, E, F, G, and H occurred for each group (blacks, whites, males, females) throughout the 14-to-24 age range. While there are highly significant modal differences, the age ranges of each grade overlap considerably.

This study indicates that third molar development is not particularly useful for forensic estimation of chronological age in adolescents of young adults of African descent or, more specifically, in differentiating whether an individual is legally an adult. The ethnic make-up, the sex, and the stage of M3 development significantly affect the likelihood of a person being an "adult," even discounting the observed ranges of variability within each M3 stage.

Age Determination, Third Molars, African Americans

F6 Practical Application of the Grin Line Identification Method

Margery Floyd Friday, DDS, 27 Barkley Circle, Fort Myers, FL 33907; and Paula C. Brumit, DDS, Bruce A. Schrader, DDS, and David R. Senn, DDS, Center for Education and Research in Forensics, University of Texas Health Sciences Center at San Antonio, 7703 Floyd Curl Drive, San Antonio, TX 78229*

The goal of this presentation is to further test the feasibility and to investigate the practicality and accuracy of the Grin Line Identification System (GLID) in a "real world" setting. This presentation is intended to inform the forensic community of the efficacy and practicality of applying this technique to actual forensic identification cases.

Background: At the 2004 AAFS meeting in New Orleans, Dr.Susan Bollinger presented a paper on the Grin Line Identification System. She applied the acronym GLID to the system. The GLID method utilized Adobe Photoshop software to compare historical antemortem photographs with present day photographs. Ten (10) subjects provided historical photographs of themselves smiling wide (grinning). These historical photographs were designated as antemortem photographs. Present day photographs were taken by Dr.Bollinger of the same subjects smiling. The present day photographs were designated as postmortem photographs for the purpose of the study. Using the tools in Adobe Photoshop, the photographs were resized and digitally compared.

Objective: 1) review, apply, and analyze the GLID system; 2) test the feasibility and practicality of this system in a setting that is familiar to many forensic dentists (i.e., a medical examiner's or coroner's office); 3) make contact with the next of kin and retrieve the best possible full face smiling photograph of the victim.

Methodology: 1) Photograph a large number of postmortem cases in a medical examiner's office using a Canon 20D digital camera with both a macro(Canon Macro EF 100mm) and a standard lens (Canon Zoom EF 28-105mm); 2)Expose postmortem photographs with both lenses using varied projection geometry to increase the probability of approximating the photographic angle of the antemortem photographs; 3) Take impressions, if possible, of both the mandibular and maxillary anterior teeth using Pentron impression material (Correct VPS vinyl polysiloxane material) and pour up in Type III yellow dental stone; 4) Obtain the most recent and best antemortem photograph of the decedent that shows the anterior teeth along with a consent form from next of kin or the legally responsible party of the victim; 5)Select ten (10) postmortem cases for this study based on the best antemortem photograph of the decedent showing the anterior teeth; 6) Take a digital photograph using a Canon 20 D digital camera of the "smiling face" antemortem photograph. Import the photograph into a Dell Inspiron 9200 laptop via a card reader (or)scan the "smiling face" antemortem photograph using an Epson 1680 flatbed scanner at a high resolution into Adobe Photoshop on the Dell Inspiron 9200 laptop; 7) Use Adobe Photoshop 7.0 to fabricate overlays of the anterior teeth on the antemortem photograph and the postmortem photograph; 8) Digitally move the postmortem overlay to a position over the antemortem photograph for comparison using a variety of Adobe tools.

Conclusions: Using the GLID system to identify victims in a practical situation is challenging and time consuming. However, it may be used as an adjunct technique. In some cases the GLID system may be the only tool available to the forensic odontologist and therefore of value. The technique will most likely be of value under the following circumstances:

1. a single or very small number of decedents requiring identification
2. the decedent(s) have incomplete, inaccurate or non-existent dental record/radiographs available
3. investigators are unable to identify or locate the decedent's dentist
4. missing children cases: Many children may not have had dental radiographs or dental restorations but they may have good smiling photographs available and parents willing to provide them

Securing a good "smiling face" antemortem photograph from the next of kin was the critical factor of this feasibility and practicality study of the GLID system of forensic identification. Approaching the next of kin with compassion and good listening skills is necessary.

Forensic Odontology, Digital Photographic Comparison, Identification Method

F7 Dental Identification of Cremains

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Attendees will learn how principles and procedures used in routine indentifications can be applied to an unsusal identification scenario. This presentation will impact the forensic community by expanding application of proven dental identification techniques.

A case is presented where the dental remains were restorations recovered from cremated remains. The client had discovered that cremains had been mislabeled at the mortuary. After investigation by the Mortuary Board, the proper remains were returned to the client. A dental identifi-

cation was done at the client's request to verify the identity of the cremains. Dental restorations were segregated from the cremains. Each restoration was examined and radiographed. Dental records for the deceased were obtained. Treatment records were analyzed and all dental restorations recovered were documented in the dental record. Antemortem-postmortem radiographic comparison was done and all restorations were consistent with or matched. The client was provided the opinion that the remains were those of her husband. Following the identification, final memorials and closure for the family proceeded.

Dental Identification, Odontology, Radiology

F8 The Problem of Identification by Dental and Skeletal Morphology: A Quantitative Issue?

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This presentation will demonstrate how both dental and osteological morphology may be quantified when dealing with identification of human remains. This implies that the odontologist or anthropologist may supply courts with a numerical possibility of identity.

Identification by odontological and skeletal methods is frequently based on a qualitative assessment. Very rarely can one quantify morphological aspects (e.g., the shape of teeth, bones, or dental work) and thus quantitate identification. Forensic odontologists frequently assert that quantification is not necessary, whereas radiologists and anthropologists who strive to identify human remains via bone morphology say that it is sufficient to find 8-10 distinctive morphological traits when comparing antemortem and postmortem data. However, it is not clear what distinctive morphological traits are, both in the dental and osteological scenario. The authors set forth to verify whether it is possible to apply a semi-quantitative method when comparing dental and bone morphology in order to supply courts with a "number" or probability when identifying human remains. The scope of this study was therefore to verify the possibility of identifying a subject according simply to dental and bone (1st thoracic vertebra) morphology.

Dental study: A radiographic study was performed on 50 orthopantograms (OPTs), two for each subject performed at different times (within a ten year range). Every OPT of an individual was superimposed with all OPTs of the other individuals. Dental morphology was compared by examining the profile of each tooth, also by superimposition. A scoring system was then adopted for each dental profile.

Osteological study: In the osteological study 10 vertebrae (1st thoracic) were used (from ten different individuals), and each radiographed in 15 different positions (which diverged of a maximum of 15 degrees from each other). All images were compared, similarly to the dental study, by examining the bone profile and by superimposition with all others. A score was also given in these cases.

Finally, from the score, a correspondence index was calculated, both for the dental and osteological study. In all cases, correspondence indices allowed the authors to find thresholds that allowed them to exclude or identify individuals by comparing X-rays or bone morphology.

This study, though certainly not conclusive, shows that dental, bone (1st thoracic vertebra) morphology is extremely specific, and that a scoring method for comparing morphology may be useful as a quantitative tool for identification.

Forensic Odontology, Identification, Forensic Anthropology

F9 Antemortem Records of Forensic Significance Among Edentulous Individuals

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Following this presentation the attendee will be familiar with a) the problems of identifying edentulous individuals with case examples; b) materials that can be of use when identifying edentulous individuals from dental prostheses or examinations; and c) the incidence of these materials in dental records.

Individuals with complete dentures continue to represent an identification dilemma. This presentation will impact the forensic community by reminding odontologists of the additional materials available to them for such cases, but will provides evidence that such materials are rarely available in the dental records.

Introduction: Over 300,000 patients in the UK alone will be rendered edentulous this year. Dental identifications are requested for found human remains where visual identification is no longer possible or desirable. Many elderly people (a large cohort of those persons wearing full dentures) die alone in their own homes and are not discovered for some time. In such cases, the Coroner will request the services of the forensic dentist to identify the individual based upon a tentative lead. In cases where dentures are not marked and no other method for identification is possible, i.e., fingerprints, serial number on pace-maker, other prostheses, etc. identification may prove very problematic. There is however, a role for the odontologist in these cases. The presence of, for example, a panoramic radiograph taken prior to the complete denture construction, may provide sufficient information for a comparison to be conducted.

Materials: The range of materials used in such identifications will be presented with examples of each given from case work to demonstrate their value:

a) Post extraction DPT films
b) Photographs
c) Study models
d) Cranial imaging techniques demonstrating the frontal sinusese
e) Bony pathologies or other anomalies
f) Comprehensive written notes

A case example is provided where the use of a photograph of a denture wearer was superimposed over the denture found at a murder scene. The victim was a wealthy antiques dealer who had been attacked with a large kitchen knife. The body, along with that of his wife's' were left in the family home for six weeks before discovery. The unusual diastema and natural placement of the anterior teeth enabled a positive identification to be made.

Study: A total of 200 subjects' receiving complete dentures at the University Dental School of Manchester were examined using a proforma. All materials that were deemed useful in the identification process were recorded and duplicated.

Conclusions: There is a paucity of effective antemortem information available in the dental records of edentulous individuals. This must be addressed by educating dentists on the importance of accurate and detailed record taking. This lack of effective material for identification strengthens the case of those asking for denture marking to be made compulsory.

Odontology, Edentulous, Identification

F10 Implantation of an RFID Tag Into Human Molars Reduces Hard Forensic Identification Labor: Part I - Modification and Implantation of an Existing RFID Tag for Forensic Purposes

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After attending this presentation, attendees will be familiar with the use of an RFID tag for human identification. This presentation will impact the forensic community by demonstrating a new possible approach for human identification is discussed. The objective of this presentation is to explain a human radio frequency identification system, which allows to identify a body immediately after it is found.

The tsunami disaster in Takuapa (Thailand), and more recent the bombings in London showed once again, the need of an accurate, quick and easy to handle human forensic identification system. The implantation of a radio frequency identification (RFID) tag into a human tooth and the read out of its information may give answer to this problem. One forensic odontologist would be able to detect and read the protected identifying data with a portable interrogator, avoiding time and money consuming identification procedures.

A worldwide use of the worked out RFID set-up, could register the identity of the human remains from the moment they are found. The families and acquaintances of the deceased person could start immediately the grieving process and all their legal issues could be resolved at once. The forensic odontologist's identification work would be accurate, instant, easy and cheap.

A description is given of the modification of an existing RFID-tag for veterinary use. This modified system was implanted in extracted human molars using directly bonded resin composites. A protocol for tooth preparation and tag implantation in vitro was developed. A study of the read-out patterns of two different tag types revealed the readout distance, as well as the optimal place of RFID-tag implantation, assemblage of its components and dimensions of primary coil.

It was found that disassembling and implanting RFID tags in human molars was practically feasible.

Radio Frequency Identification Tag , Tooth, Composite

F11 Implantation of an RFID Tag Into Human Molars Reduces Hard Forensic Identification Labor: Part 2 - Resistance of the Modified and Implanted RFID Tag Against Pressure and Temperature Fluctuations

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Attendees will learn that RFID tags implanted in human teeth for identification purposes resist high pressure and temperatures. This presentation will impact the forensic community by demonstrating how the use of RFID tags in human molars for identification purposes withstand chewing pressures and varying temperature settings.

In the previous presentation the possibility of using a commercial RFID tag as a properly working device for human forensic purposes was explained. It was found that disassembling and implanting commercial RFID-tags in human molars was practically feasible and resulted in a properly working set-up.

If used as a forensic identification device , the implanted RFID tag has to be resistant against the normal oral pressure - and temperature fluctuations and against extreme pressure and temperature rises. Maximal vertical occlusal load on which the implanted ID-tags kept their readout activity was investigated. The test revealed that, in vitro, the system can stand forces higher than the maximal human chewing force. Fatigue was induced on the implanted samples by thermocycling. The results of this examination opened the discussion of putting an extra isolating layer on the modified ID-tags before implantation. The behavior of the implanted ID-tags during extreme high temperatures was inquired in a temperature test. The maximal read-out temperature of the integrated tags was detected.

The conclusion of these tests was that the modified and implanted RFID tag resists fatigue and can stand maximal human chewing forces and extreme temperatures. Further research and tests are needed in order to optimize the design and stability of these RFID-tags and their interrogator and to detect the physical properties of the system for human identification purposes.

Radio Frequency Identification Tag, Thermocycling, Chewing Pressure

F12 Dental Identification of Human Remains From Orthopedic Metallic Fixation Appliances

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After attending this presentation, attendees will better understand the methods in facial reconstruction that can aid in dental identification of human remains. This presentation will impact the forensic community by educating the forensic community of the possible orthopedic fixation methods that are used in treating facial fractures in reconstructive cases. The Identification of human remains through dental means is a comparison methodology that has proven effective through the years of forensic science. Through attending this presentation, the participant will better understand the methods in facial reconstruction that can aid in dental identification of human remains.

The objective of this presentation is to educate the forensic community of the possible orthopedic fixation methods that are used in treating facial fractures in reconstructive cases. The Identification of human remains through dental means is a comparison methodology that has proven effective through the years of forensic science. Through attending this presentation, the participant will better understand the methods in facial reconstruction that can aid in dental identification of human remains.

Facial fractures can be either accidental as a result of trauma or intentional in the case of orthopedic surgery. The materials presented are intended to familiarize the forensic community with possible materials or

fixation methods they may encounter in missing/unidentified person cases. Material will be presented to demonstrate the probable location of plate placement in surgical fixation. The current methodologies in facial reconstructive surgery will be discussed to demonstrate the most common facial fractures and their reduction.

Case presentation—John Doe: In February 2001, the body of an individual was discovered in the Rio Grande River in Laredo, Texas. Laredo police recovered the body and, the remains were transported to the Bexar County Medical Examiner's office for autopsy. Robert Bux, MD performed the autopsy. External findings of the examination reveal a Caucasian or Hispanic male 25-35 years of age. The decedent was found to be wearing multiple layers of clothing most indicative of a transient/homeless individual. The maxilla and mandible were resected by the Medical Examiner and CERF was requested to perform a dental profile as a means of possible identification of the decedent. The dental examination revealed an occlusal amalgam restoration to tooth #3 and teeth #'s 14 & 31 missing.

Other remarkable findings of the resected specimen include the discovery of stainless steel plates to the decedent's left angle of the mandible and to the mental symphysis. The plating at the angle of the mandible is supplemented with a titanium 'Champy plate' or stress breaker. This combination of plates constitutes a unique combination due to its mixture of materials and the placement of the fixtures.

Digital panographic and intraoral radiographs and, digital photographs were taken of the specimen. The prosthetic plates were removed and examined using magnification. Viewing under magnification revealed a company logo and numbers on each of the plates. The logo was discovered to be that of the Synthes Company following an Internet search. Communication with the Synthes Company revealed that the numbers on the removed plates are lot numbers that cannot be traced to an individual as with other prosthetic appliances that require tracking. The information contained on the plates was lot numbers that provide a time for production of the items and their release for availability to practitioners. The Synthes Company maintained no documentation to allow tracing the sale of the products to individual customers. Further discussion with Synthes' representatives reveals that the plates were possibly distributed to Hospitals, Oral Surgery offices and Veterinary clinics.

Review of photographs and radiographs of the specimen by several Board Certified Oral and Maxillofacial Surgeons reveals that the reconstructive repairs were performed following facial trauma as was initially presumed. The mixture of titanium and stainless steel plates also indicates a high probability of the surgery being performed outside of the United States. The information collected from the metallic plates and the progression of healing indicate that the surgery would have occurred between the latest distribution date of the appliances in November 1994 and, approximately June 2000.

At the time of submission of this abstract the disposition of this case with the Laredo Police Department remains as unidentified.

Dental Identification, Forensic Odontology, Facial Reconstruction

F13 Radiologic Procedures in the Thai Tsunami Victim Identification Procedure: Do It Nice or Do It Twice

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After attending this presentation, attendees will understand that radiology provides the basis for most dental identification. Adequate numbers and types of postmortem films must be taken. Rigid attention to the requirements of film selection, exposure and processing is required. The chemical method of film rescue will be reviewed.

This presentation will impact the forensic community by providing case examples of what can go wrong in a large mass disaster and what was done and can be done to make sure that things go right in future mass disasters.

In the aftermath of the Thai tsunami, a multidisciplinary team was tasked with the identification of a large number of human remains. For the first six months of the process, dental identification was the primary means of establishing identity. Dental radiographs provided objective data for data entry, and later, reconciliation of antemortem and postmortem records. In the process of acquiring the antemortem records, and obtaining archival-quality postmortem radiographs, a number of issues arose, that could have been improved upon or avoided altogether.

The problems with radiography at the TTVI can be divided into antemortem and postmortem ones. Antemortem issues included image quality, quantity, and accessibility. Some practitioners elected to ignore multiple requests from Interpol for original AM records. In other cases, the images were either few or of low quality. In many instances copies or copies of copies were sent with no indication of right and left. Finally some practitioners produced photographic contact sheets wherein radiolucency and radiopacity were reversed. The quality of images received from the country of origin was beyond the control of dentists at the TTVI and this limited the ability to identify decedents.

Postmortem (PM) image problems were more complex but should have been more controllable than AM ones. Improvements in the system were done as the process proceded. There were problems with the following:

1. Radiographs were exposed after the dental autopsy rather than before it in many cases.
2. An inadequate radiographic examination (bite wings only) was done in most cases which necessitated re-examination.
3. The radiographic examination was conceptualized in terms of a typical clinical radiographic examination rather than a forensic dental radiographic examination.
4. There was a mix of analog and digital images and integration of both into one system was problematic.
5. Numerous analog imaging problems occurred including cone-cut, reversed film position, under exposure, over-exposure, under development, under fixing and under washing. These resulted in some radiographs with "temporary archival properties" that looked fine in the mortuary but weeks or months later had become useless.
6. Errors in tooth identification and positioning in the cadavers sockets occurred.
7. There were problems in the use of different automatic developers requiring different chemistry that could have been avoided.

Finally there were safety issues. There was no barrier lead shielding, exposure to adjacent personnel occurred and there was little or no personal dosimetry monitoring.

Most of the problems encountered could have been avoided if there was a single radiographic quality control person on-site with sufficient background knowledge and access to experts to deal with problems that would inevitably arise. This would have increased the speed of the operation. Many other problems could have been avoided and re-autopsy or re-examinations reduced by being flexible in the approach to the radiographic needs, keeping the mission goals and the nature of the antemortem imaging in mind. The authors of this paper will show case examples and describe how to improve the procedure for controlling radiographic quality at large mass disasters.

Disaster, Radiology, Radiography

F14 Coordination: A Multidisciplinary Approach to Identification Utilizing the DPMU

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Attendees will learn how integration with different forensic specialists facilitates identification of remains using the Disaster Portable Morgue Unit (DPMU) of the Disaster Mortuary Operational Response Team (DMORT). This presentation will provide an appreciation of the multidisciplinary teamwork approach of the operating procedures of the DPMU in accurately and expeditiously identifying decedents in a mass fatality incident.

The objectives of the presentation are to provide the forensic odontologist with an appreciation of the synchronization of the operating procedures of the DPMU and its adaptability in rustic environments.

The DPMU concept was developed in the late 1980s by the National Funeral Directors Association in response to the need for equipment and personnel to be close to the site of a mass fatality incident. It was refined in 1997 in Guam at the Korean Flight 801 crash. By June 1998, FEMA had completed assembling the DPMU, storing it at the Logistics Center of FEMA in Rockville, MD. The morgue consists of 10,000 pieces of equipment, containerized and palletized ready for shipment by truck, rail, boat, or aircraft, requiring 8,000 square feet of working space. A second DPMU is now stored in San Jose, California.

In Guam, the morgue was placed in an airport hangar. The Hurricane Floyd Cemetery Flood of 1999 presented unique challenges. Most of eastern North Carolina was flooded and the municipal water and sewer systems were non-operational in Tarboro. The DPMU was set up in the back of a warehouse shared by a Red Cross feeding center. With no potable water locally, the personnel were bussed in from 30 miles away for the first 7 days. Security and a facility were issues in the tiny community of Noble, Georgia, location of the Tri-State Crematory in 2002. With no building available, 2 – 10,000 square foot tents were erected – one for the DPMU and the other for storage of remains until processing could be completed. The site was a Georgia Department of Transportation highway equipment maintenance and storage facility, surrounded by a high chain link fence. The information resources (antemortem) section was located in a mobile trailer adjacent to the postmortem section to facilitate computer communications via WiFi.

There are eight postmortem stations established in the DPMU: 1) Admissions, 2) Pathology, 3) Radiology, 4) Fingerprint, 5) Dental, 6) Anthropology, 7) DNA, and 8) Dismissal. The goal in postmortem is to gather as much information as possible on the remains in an accurate and efficient manner.

The admission section verifies there are remains to be examined and assigns a mortuary officer (usually a funeral director) to that set of remains. The officer is responsible for taking his charge to each station for proper examination and documentation. The admissions officer logs into the Victim Identification Profile (VIP) computer program a unique alphanumeric symbol for each set of remains. As the decedent is examined at each station, information is entered and sent to the server in the information resources area for comparison with antemortem records.

The pathologist checks for personal effects, height, weight, sex, race, unique markings, scars, tattoos, piercings, previous surgeries, joint replacements, etc. After noting all finds in the VIP program, the remains go to the x-rays section. Whole body radiographs are taken and if anything unusual is observed, the pathologist, anthropologist, or dentist may be consulted. For example, if a joint replacement is observed, the pathologist will remove the appliance, note the serial number, and call the national registry for identification. Even if a positive ID is received, the remains are never removed from the DPMU system until each station has completed its examination.

Depending on the flow of decedents, the next station is either fingerprint or dental. The fingerprint specialists may be able to lift prints off remains that have been buried for several years as occurred during the cemetery flood.

In the dental station, the use of the Win ID3 program is critical in communicating and coordinating with the antemortem area for identification comparisons. A complete dental examination and charting is accomplished if possible, along with a full series of digital radiographs. Postmortem charting is entered into the Win ID3 program. Antemortem radiographs are scanned, digitalized, and entered into the program along with dental charting. All workstation data entry is communicated to the central server via WiFi. Comparisons for matching can begin immediately.

The anthropology station is utilized for evaluating whole body radiographs, skeletonized remains, and determination of age, race, sex, and separation of fragmented body parts from foreign material.

The most recent addition to the DPMU is the DNA area. DNA is harvested, catalogued, and stored for future comparisons. If the decedent is not identified by other means, then the DNA is tested and comparisons made.

The final station is dismissal. Paperwork is checked to verify all stations have signed off on each decedent. The remains are then placed in storage until identification is made. Using the data from this multidisciplinary approach, the medical examiner is able to identify and release the remains to the family.

Mass Fatality, Identification, DPMU

F15 Privacy Issues Related to the Acquisition of Antemortem Dental Records

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After attending this presentation, attendees will understand how federal, state, and dental licensure agencies have made provisions for the release of privileged dental records requested by medical examiner offices, coroners, or law enforcement agencies for use in dental identifications.

This presentation will by provide practical information to enhance the collection of dental records from practicing dentists, who might otherwise be reluctant to release antemortem dental records in light of current legal ramifications of releasing privileged patient information.

Dentists and custodians of dental records have been taught to consider patient dental record information as privileged. Most dental offices operate under the assumption that all requests for release of information require a written consent by the patient, or patient's guardian if the patient is a minor. Consequently, when asked to provide a patient's dental records to serve as evidence in a dental comparison, the custodian of dental records may question if releasing the requested information is permitted without their patient's consent.

Since the implementation of the 2003 Health Information Portability and Accountability Act (HIPAA) regarding privacy issues of privileged medical and dental records, the author has noticed an increased reluctance on the part of dentists to comply with requests from medical examiner offices for dental records to assist in the identification of deceased individuals. But the HIPAA Act directly addresses the need for antemortem dental records to be made available for dental comparison. Section 45 CFR 164.512.g.1 clearly states that the release of information requested by a medical examiner for the purpose of identifying a deceased person is permissible without patient consent. This section states: Uses and disclosures for which consent, an authorization, or opportunity to agree or object is not required. (g) Standard: uses and disclosures about decedents. (1) Coroners and medical examiners. A covered entity may disclose protected health information to a coroner or medical examiner for the purpose of identifying a deceased person, determining a cause of death, or other duties as authorized by law. A covered entity that also performs the duties of a coroner or medical examiner may use protected health information for the purposes

described in this paragraph." In addition, many state dental licensure agencies and occupations codes include specific information regarding exceptions to the privileged relationship of protected health information when records are being requested for the purpose of confirmation of identification. For example, the Texas Occupations Code Chapter 258.105(d) includes the provision that privileged information is discoverable and admissible in a criminal prosecution if certain conditions are met. First, the patient must meet the criteria as a victim, and second, the court in which the prosecution is pending rules that the requested information is relevant.

It is expected that there will be continuing updates concerning the complex group of regulations governing the privacy of protected health information. For example, in March 2005 Texas bill 79(R)1328 was filed in the Texas Senate that would seek to align Texas statutes with HIPAA privacy rules. Some proposed changes include how long a record with protected health information must be kept, authorizations for disclosure, consent to disclosure, collection of data with privileged health information by the Texas Health Care Information Council, and when a request for a copy of a medical record may be denied.

Dental offices can remain compliant with rules concerning patient privacy and the release of protected health information, while still meeting the requests of medical examiners and law enforcement agencies. The author hopes that the information delivered during the presentation will encourage attendees to become familiar with privacy regulations in their own states, countries, and jurisdictions. Dentists, dental auxiliaries, and dental staff members can be proud that in many instances, their diligent treatment documentation, photographs, and quality radiographs serve as the best evidence for their former patient to regain their identity, allowing them to be returned to their family for emotional closure and proper burial. The information contained in the presentation is not intended to be regarded as legal advice. Instead, the presentation will demonstrate that federal, state, and dental licensure agencies have made provisions for the release of dental records for use in dental identifications, when it is obviously not possible for a patient to give consent for the release of the private information.

Forensic Science, Forensic Dentistry, Odontology

F16 A Comparison of the Quality of Color Produced by Photographic Film and Digital Imaging as a Function of Degrees Kelvin

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The forensic odontologist relies on the faithful reproduction of film and/or digital photographs for investigative and evidencary purposes. The goal of this presentation is to deal with an evaluation of the differences in color reproduction from these two modalities. This presentation will impact the forensic community by encouraging further investigation utilizing more specialized equipment.

The development of digital imaging has empowered the forensic scientist with a multifaceted investigative instrument. Digital imaging offers instantaneous recording of evidentiary material and a wider range of storage and reproduction modalities. The forensic odontologist relies on image recording and reproduction to evaluate the evidence obtained on the initial investigation and to document the conclusions achieved from the painstaking processes of bite mark analysis and/or victim identification. It is vital to all investigators that accurate reproducibility of evidence imaging must be unquestionably accurate. While there has been much documentation on the comparison between photographic and digital imaging with respect to resolution vs. graininess, the literature is notably sparse on comparing the ability of the two media to faithfully reproduce evidence quality color documentation. Recognizing the need for such an evaluation, this paper shall concern itself with some of the preliminary findings from a project designed to measure the temperature in degrees Kelvin of color images produced by the two media while maintaining the inherent variables as constants.

The objects to be imaged consisted of three plastic report binders: a red; a blue; and a green. Because of the inherent ability of certain polymers to fluoresce, all binders were manufactured by the same company and of the same material to ensure consistency thereby removing this variable from the equation. Two cameras from the same manufacturer were used: a Nikon F4 35mm film camera; and a Nikon D-100 digital camera. The same lens, a Nikon 35-70mm macro zoom, was used on both cameras. The lens was used in the macro mode with a lens to object length of approximately 40 centimeters and secured in a Quadrapod copy stand and a LabJax was used to aid in focusing the image. A 3,200^{o} Kelvin (tungsten equivalent) and a 4,800^{o} Kelvin (daylight photoflood) light bulb were alternatively placed in a single bulb light socket with an 8" reflector for illumination. Kodak Gold 35mm 200/ISO film was used and the digital camera was set to the same ISO setting. Because the film chosen was balanced for daylight, the digital camera's "white balance" setting was adjusted for "daylight". Setting the resolution of the digital image was not considered a factor in this experiment.

Each object, the red, blue and green binders, was imaged according to the following protocol: tungsten on film and then digital, daylight on film and then digital. A total of three exposures for each parameter per binder were made.

The film was developed by a commercial laboratory utilizing a C-41 process with instructions to not make any color corrections to the final 4x6 prints. The negatives of these images were scanned on an Olympus ES-10s 35mm scanner and stored on a CD. The digital images were printed on 4x6 photographic paper without color correction by direct placement of the compact flash card from the camera into a Hewlett-Packard #7550 printer. These digital images were also stored on a CD. In addition, all images were printed on ink-jet transparency film.

A Spectra #4143 Color Temperature Meter was used to measure the color temperature of the various images in degrees Kelvin. Measurements were taken of:

1. The 4x6 film & 4x6 digital prints from reflected daylight & tungsten light sources.

2. The CD stored film & digital images from an LCD computer monitor projected by Photoshop.

3. The transparencies through opaque glass backlit by daylight & tungsten light sources.

All measurements were taken in a darkroom environment. An initial analysis of the measurements showed that all the images taken in triplicate produced the same measurement. Because the measurement for each parameter would have been universally tripled, it was decided to reduce the statistical evaluation to one measurement for every triplicate image analyzed.

A total of ten parameters were considered for each color. The resultant measurements were entered into a spreadsheet, average differences were calculated, and graphs were promulgated and analyzed. While empirically one could say there may not have been any visual differences the measurements clearly illustrates a differences in color temperatures of 1,300^{o}, 1,370^{o}, and 650^{o} for red, blue and green respectively. No conclusions should be made on the results of this preliminary report. What the forensic odontologist should be aware of is the possibility that any judgment made on the basis of the color film or digital record may be different from the actual color seen with the naked eye. If one should present evidence based on film or digital reproduction the possibility exists that the defense might posture this as exculpatory evidence. Further investigation is encouraged.

Color, Variation, Imaging

F17 ABFO No. 2 Photographic Scales – Quality Assurance is now Left to the User

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The goal of this presentation is to caution the forensic disciplines about the critical importance of assessing the validity of photographic scales at the time of purchase. This presentation will impact the forensic community by showing the significance for any forensic specialists that are concerned about the quality, accuracy and precision of their phtographic evidence.

The American Board of Forensic Odontology (ABFO) developed the unpatented "ABFO No. 2" photomacrographic scale. The vast majority of forensic odontologists and crime scene investigators have used this scale since 1987 to aid in the proper collection of photographic evidence. Development of this scale by ABFO and allowing the ABFO acronym to be imprinted on it, in turn, implied an acceptable standard for photographing bite marks and other patterned injuries, such as evidence of trauma, disease, scars, tattoos and other marks.

Following development and validation of the scale, the ABFO allowed private suppliers to produce, market and sell the scales without benefit to the ABFO. With increases in recent years in the number of suppliers of evidence collection and preservation accessories, the ABFO No. 2 scales have been produced by more than the single manufacturer that once produced them.

This British Columbia Coroners Service is mandated with the responsibility to identify persons that die under suspicious circumstances in British Columbia, Canada. In the majority of cases, this responsibility involves accurately recording postmortem photographic evidence. In 2005, 120 photomacrographic scales, which were advertised as "ABFO No. 2 scales", were purchased from a supplier as part of the implementation of Standard Operating Procedures for Digital Imaging for the British Columbia Coroners Service. Inspection of the scales received from this purchase revealed an unacceptable level of quality. Deficiencies were found with respect to consistency and accuracy of a) the metric scale, b) the 18% grayscale area, and c) the scales' linearity.

Inaccurate and substandard photomacrographic scales can produce serious consequences for experts that depend on photographic evidence. Use of deficient scales fails the established standard for proper documentation of evidence. This can and will impact on the accuracy and precision of any subsequent examination or analysis. Moreover, comparison of images captured from different cases with different scales is precluded.

This paper illustrates the tests that can be completed by the forensic specialist to check the accuracy of scales manufactured by different suppliers. It also presents the results of these tests in the authors' experience, and attempts to caution forensic specialists that use photomacrographic scales to assure the accuracy of their supplies and materials.

ABFO No. 2 Photomacrographic Scales, Quality Assurance, Photography

F18 Suggested Protocol for Jaw Resection During Mass Fatality Incident Response

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The goal of this presentation is to understand when the decision making process for resection begins, understand the indications for jaw resection, and understand a suggested resection technique to minimize destruction of anatomic structures.

By consulting with other colleagues early in the process, the odontologist is able to obtain needed information to facilitate the identification process while preserving anatomic structure for other forensic specialists and funeral directors. This presentation will impact the forensic community by expediting the indentification process and facilitate the return of remains to family and loved ones.

The objective of dental operations in the morgue during response to a multiple fatality incident is to identify remains accurately and efficiently in the most expeditious manner possible. An ideal protocol calls for a thorough clinical examination of the remains in addition to radiographic examination to the greatest extent possible. The identification process is certainly facilitated by utilization of WIN ID and incorporation of the Dexis Forensic Software.

In order to obtain adequate access for a thorough clinical examination, there are times when jaw resection (dental autopsy) is indicated. A decision should be made early in the morgue process, preferably at triage. This decision should be multidisciplinary in scope evolving through input from the forensic odontologist, forensic anthropologist, forensic pathologist and funeral director.

Jaw resection is typically indicated for burn victims, decomposed remains or otherwise mutilated remains. This presentation suggests a technique which involves a total mandibulectomy via access from perioral soft tissue excision, low horizontal cervical incision or extension of dissection in a superior direction through a conventional full autopsy incision. A determination can then be made as to whether or not maxillary resection is indicated. If so, a high LeFort I osteotomy is recommended, incorporating a vertical step in the area of the zygomatic buttress to aid in replacing the maxilla as close as possible to it's original position.

The above mentioned techniques will facilitate clinical examination and x-ray, while allowing the structures to be replaced to anatomically correct positions should anthropological studies be indicated or the remains be deemed viewable by the funeral director. Flexibility on the part of all concerned disciplines is mandatory.

Mass Fatality Incident, Forensic Dental Identification, Jaw Resection

F19 Problem Solving in Response to the World's Worst Disaster: The Canadian Perspective

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The goals of this presentation are to present to the forensic and dental communities and overview of the Canadian dental response to the Thailand tsunami victim identification effort and to illustrate the use of the internet to transmit identification data to remote locations for use in DVI efforts.

This presentation will impact the forensic community by providing a large impact by providing insights into new problems that arose after the Thailand tsunami and the solutions that were developed to solve these problems.

The devastating Indian Ocean earthquake in late 2004 and the subsequent tsunami that was spawned by the changes on the ocean floor caused changes to the planet and mankind that could never be predicted. The Earth was physically altered forever; an unprecedented outpouring of support from all corners of the planet occurred; a staggering number of victims were lost; and the way that forensic disciplines reacted to the need to identify the deceased was extraordinary.

The west coast of Thailand was one of the worst affected tourist resort areas. A large team of international experts was deployed to Thailand over a long period of time to search for, identify and repatriate the victims' bodies. Forensic dentistry played the most significant role of all the responding identification disciplines. In the first five months, over 90% of the found bodies were identified using dental records. Subsequently, as

other methods were needed due to a lack of available dental data, forensic dental methods continued to play a strong supporting role to mediate probable identifications, narrow populations for targeted searches and confirm putative identifications concluded from other evidence.

Although each team of dentists worked as part of an international effort, individual countries sponsored their own teams. Canada's efforts to identify its own victims and to assist as a member of the international victim identification effort extended over a 8-month period. The effort involved on-site personnel (15 dentists, 5 fingerprint experts, 14 Royal Canadian Mounted Police officers, including anthropologists, forensic identification specialists and experts in DVI logistics, communications and security) and laboratory-based personnel (DNA analysts and allied dental personnel).

An overview of this international effort along with the intricacies and complexities of the response from the Canadian perspective are presented in this paper. This includes the problems associated with remote transmission of dental records to a disaster site, solutions that were developed to solve logistical problems with dental, medical, fingerprint and personal records, and a summary of the evolution of the disaster response efforts. Special emphasis will be given to the use of the internet in the transmission of identification data and the use of computer technology to solve various issues that occurred during the response.

Disaster Victim Identification, Internet Data Transmission, Mass Disaster Response

F20 Interpol – It's Role in Mass Fatality Incidents Such as the December 26, 2004 Tsunami in Southeast Asia

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The author familiarize the attendee with the International Criminal Police Organization – Interpol and its supportive role in major disaster or mass fatality incidents such as the December 26, 2004 tsunami that struck southern Asia on December 26, 2004.

This presentation will by provide information that will encourage a greater sharing of information and co-operation amongst those who have assisted or will assist the operations of the United States Disaster Mortuary Operational Response Team (DMORT) or the Interpol Disaster Victim Identification (DVI) Team. This "will only serve to enhance the compassionate treatment of the next of kin and the scientific identification of the deceased."

J. Kenney, the European IOFOS Meeting, Belgium, August, 2000.

Interpol, now recognized as the second largest organization in the world, next to the United Nations, was founded in 1923 with its headquarters being established in Lyon, France in 1989. Interpol's constitution prohibits any intervention or activities of a political, military, religious or racial character. It is not an international police force; it is an international organization that encourages co-ordination and co-operation amongst the national police forces of member countries, even when diplomatic relations do not exist between some of those countries. It does not conduct investigations on its own; they are conducted by the national police force of each member country, abiding by its laws and keeping to the spirit of the Universal Declaration of Human Rights. The 182 member countries maintain a National Central Bureau (NCB) staffed by their own law enforcement officers. The NCB is designated as a contact point for rapid and secure communication between each member's national police force and Interpol and between the national police forces of individual countries. Interpol's fully encrypted electronic communication system is known as I-24/7.

Although it maintains its focus on such interests such as fugitives, public safety, terrorism, drugs and organized crime, Interpol has created various specialty working groups bringing together experts from around the world. In 1980, the General Assembly, at its 49th Session in Manila, established a working group to draft a DVI Form. The Interpol Standing Committee on Disaster Victim Identification, composed of police officers, forensic pathologists and forensic odontologists, was established in 1986. At its 1996 Session, Interpol introduced an updated and computerized version of its DVI Form accompanied by the revised manual "The Disaster Victim Identification Guide". It called upon member countries to establish national DVI teams consisting of police officers, forensic pathologists and forensic odontologists and to insure that such teams are made available when a request to observe or to assist in a disaster investigation is made by a member country. It encouraged member countries to share information and experience and to help to refine common procedures and standards to the benefit of all. And finally, it encouraged co-operation in the planning for and the response to mass fatality incidents.

Interpol has coordinated or assisted in tragic mass fatality incidents around the world. Recent involvement includes the 2002 terrorist bombing in Bali (Indonesia), the 2004 crash of an airliner in Uzbekistan, the 2004 terrorist bombing in Madrid (Spain), the massive supermarket fire in Asuncion (Paraguay), and still ongoing is the biggest single forensic operational response in history, providing communication, co-ordination, and logistical support to the governments in Southeast Asian countries hit by the December 26, 2004, tsunami.

The identification of the victims of these multiple fatality disasters was, and is, based on the internationally recognized DVI process; this process will be explained. The communication, co-ordination and logistical support provided in Thailand will be discussed and the international DVI team described.

This presentation will provide a better understanding of Interpol and its role in the development of the mass disaster investigative process in other parts of the world and will promote greater co-operation and sharing among investigators planning for or working on the ever increasing number of multinational mass fatality incidents.

Interpol, DVI, SE Asia Tsunami

F21 Back to the Basics: How the Responder, Trained or Untrained, Can Assist in the Identification of Mass Fatality Victims

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After attending this presentation, attendees will understand the importance of collecting and maintaining images, namely photographs, that can be taken at a moments notice by anyone due to the simple nature of the technique. The images can be stored and further analyzed at a later date through video superimposition.

This presentation will demonstrate a simplistic technique and viable option to use today, in mass disasters such as; catastrophes, air disasters, or acts of terrorism. Especially in non-western societies where dental record keeping as well as advanced technologies like WinID are non-existent, or inaccessible.

The goal of this presentation is to emphasize the need to develop and expand the use of this type of technology to all who assist in disaster recovery protocols. The authors will demonstrate this simple photographic technique and explore the three data sets that validate the concept. Additionally, the data strengthens the scientific basis for the preliminary identification of human remains through the use of video superimposition.

While the comparison of photographic media is widely accepted and shown to be fundamental to the field of forensic odontology, there still remains a need for alternative methods of comparison. Currently most research is focused on modern technologies that rely on advanced software programs, which require training for correct utilization. In light of recent events both natural and man-made, the need for this type of hands-on, individual photographic recording seems evident and very ascertainable. Video superimposition is a simple technique that can be used to assist in the preliminary identification of human remains. For this technique, any type of camera that has the capacity to capture the anterior dentition of human remains can be used.

The initial data set (presented in 2002) utilized 100 photos of unknown male/female subjects compared to a known male and female subject. The second data set (presented in 2005) utilized 100 unknown male/female subjects compared to a known female skull. The third data set utilized 100 unknown male/female subjects compared to a known female subject. Each data set focused on the use of video superimposition as a discrimination technique by focusing on the individualizing patterns of anterior dentition, specifically noting incisal edge configuration, arrangement patterns and morphology. Other discriminating factors, included were: size/wear/trauma/disease/and or identifiable dental characteristics.

As seen in the recent tsunami disaster, family members can produce photographs of their missing loved ones rather quickly. In some places the citizens were the only ones able to respond and dispose of the dead for days. In such instances the average citizen with nearly any photographic media and any photographic implement can take the photographs of the unidentified, which are needed for comparison to those produced by family members. This technique is easily adapted to protocols currently used in disaster recovery and can be easily digitized. Data sets from additional demographic groups are needed to further define the statistics. Additionally, further development of software databases, such as Grin Line ID Systems (GLID), ones that are capable of comparing larger volumes of photographic data are needed. While the more modern and advanced technologies are improved and expanded to other countries, this technique, though simple, can be used right now, today!

Video Superimposition, Mass Fatality Photographs, Dental Identification

F22 Disasters at the Grand Canyon

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After attending this presentation, attendees will understand the difficulties of identification of American and foreign visitors in remote areas of the Grand Canyon and the problems resulting from these man made and natural disasters.

This presentation will impact help the forensic community to understand how the Grand Canyon, being one of the Seven Natural Wonders of the World, can also be responsible for many tragedies by accident or by suicide and how the investigation of these tragedies requires a multidisciplinary approach.

The authors will present case studies of identification of victims of accidents over the Grand Canyon. The problems that result from these accidents consist of trying to recover the victims in these very remote areas, identifying them, and returning the victims to their hometowns, nationally and internationally.

Since the Grand Canyon has many foreign visitors, victims of these accidents require a major role in communication with foreign countries and also understanding different antemortem dental records as compared to our universal system of dental charting.

Suicides are also seen at the Grand Canyon and must be analyzed by medicolegal death investigators to establish that the death was a suicide, homicide, natural or accidental. Many victims succumb to natural disasters such as flooding or other weather related accidents. Some victims are found in the spring after the snow has melted and must be fully investigated.

One case study in 2001 required patience and understanding because of religious beliefs. In August of that year, a Papillion helicopter was boarded by six tourists in Las Vegas for a sightseeing expedition over the Grand Canyon. The helicopter crashed near the lip of the canyon in very rugged territory killing five tourists and the pilot and critically injuring the sixth tourist. Since the Grand Canyon is in Mohave and Coconino County, the local authorities asked for assistance from the Maricopa County Medical Examiner's Office in Phoenix, Arizona. The bodies were transported to the larger facility in Phoenix and the task was to identify those victims and return them to their hometown. With cooperation from the families of the victims, some of the antemortem records were at the Medical Examiner's office before the victims arrived from the Grand Canyon. With the help of many of the staff at the Maricopa County Medical Examiner's Office, the task was completed and the bodies were transported back to their hometown for funerals the next morning.

We must realize that the pressure to identify these victims must not interfere with the proper course of identification because of religious beliefs or family involvement. Religious issues also in the recovery effort were discussed and the proper respect and protocol in handling of the bodies was observed. After a thorough investigation by the National Transportation Board, pilot error was the cause of the crash.

Another case study was also a helicopter accident in the Grand Canyon in September of 2003, killing seven people. The cause of this accident was a rotor blade striking the vertical wall of the canyon upon descent and these victims were also brought to Phoenix, Arizona. Two victims were from Germany, two victims were from Japan and two victims were from the United States. The victims from foreign countries require an understanding of a different dental nomenclature and translating hand written treatment plans in German and Japanese proved to be interesting and challenging.

An interesting case study that will be discussed was a suicide that occurred in June of 2004. A distraught young man requested a front passenger seat on a helicopter for a better view of the Grand Canyon. He boarded the helicopter with an elderly couple in the rear seats and a female pilot. Over the canyon he unbuckled his seat belt and opened the door and as the female pilot tried to restrain him with her right hand, she began losing control of the helicopter. The passenger finally jumped only to hang on to the rungs of the aircraft momentarily and finally lettting go. The pilot gained control of her aircraft and landed safely and eventually determined that this passenger tried previous suicide attempts, this time successfully. Ironically he was still viewable after jumping from 7500 feet.

One must realize the Grand Canyon averages 5 million visitors annually, with 800,000 people hiking into the canyon and 700,000 tourists fly over the Grand Canyon. Many search and rescues are performed mostly for unprepared hikers, who suffer from dehydration and heat exhaustion.Over 250 people are rescued annually from the depths of the canyon.

In this presentation, the author will also show why the Grand Canyon is one of the Seven Natural Wonders of the World.

Disaster, Identification, Investigation

F23 The Role of the American Red Cross in Mass Disasters

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The goal of this presentation is to acquaint the forensic scientist with the responsibilities and activities of the American Red Cross in Mass Disaster Relief Operations. This presentation will demonstrate the interrelationships between the American Red Cross and other entities responding to the aftermath of Mass Disasters, both man-made and natural.

The Mission Statement: "The American Red Cross, a humanitarian organization led by volunteers and guided by its Congressional Charter and the Fundamental Principles of the International Red Cross Movement, will provide relief to victims of disasters and help people prevent, prepare for, and respond to emergencies".

Chartered by the U.S. Congress in 1905, the American National Red Cross is the lead organization to carry out the United States treaty obligations of the Geneva Conventions. The "American Amendment" to the 1864 Geneva Convention, applied the Fundamental Principles of the International Red Cross Movement in armed conflict and chartered the American Red Cross to "carry on a system of national and international relief in time of peace and to apply the same in mitigating the sufferings caused by pestilence, famine, fire, floods, and other great national calamities, and to devise and carry on measures for preventing the same."- *U.S. Congress, act of January 5, 1905, as amended, 36 U.S.C.*

In our modern world, terrorism has brought new meaning to the word 'calamities'.

Aviation Disasters: The National Transportation Safety Board (NTSB) was directed by the U.S. Congress via the *Aviation Disaster Family Assistance Act of 1996* and the *Foreign Air Carrier Family Support Act of 1997* to meet the needs of aviation disaster victims and their families. In 1998, the NTSB signed a Statement of Understanding with the American Red Cross to designate it to coordinate the emergency care and support of families of passengers and crew involved in commercial airline disasters under the guidance of the NTSB. In the Statement, the American Red Cross agreed to:

1. Provide mental health services
2. Provide an environment in which families may grieve in private.
3. Meet with the families who have traveled to the accident location, contact the families unable to travel, and contact all affected families periodically thereafter.
4. Communicate with the families of passengers and crew as to the roles of agencies in the activities involving the accident and post-accident.
5. Arrange suitable memorial services in consultation with the families, NTSB, air carrier and local officials.
6. Provide liaisons with the air carrier to track the status of injured passengers and crew.
7. Participate in drills, exercises and training activities to enable successful execution of assigned responsibilities.

Particular relevance to the forensic community is that information required in the identification of deceased passengers and crew is relayed via the Family Assistance Centers coordinated by the American Red Cross.

In order to carry out its mission in aviation disaster, the American Red Cross maintains "Critical Response Aviation Teams" on standby for deployment within four hours of being activated.

Disaster Relief Operations: Other types of disasters, whether they are natural or man-made, include fires, floods, hurricanes, tornadoes, ice storms, chemical spills, S.W.A.T. actions, W.M.D., earthquakes, transportation wrecks, explosions, tsunamis and acts of terrorism. The American Red Cross is capable of organizing a disaster relief operation that is the size of a 'Fortune 500' company within 24 hours. Emergency relief is intended to provide the basic human needs of food, shelter, clothing, medication or crisis counseling. Tens of thousands of volunteers are trained to respond to disasters both small and large. When a 'Call-Down' for volunteers is engaged, they are put on stand-by to travel within 24 hours for major disasters.

Services provided on Disaster Relief Operations include:

1. Mass Sheltering
2. Mass Feeding
3. Canteening (food and hydration) for First Responders-such as Fire and Police
4. Crisis Counseling/Mental Health Services
5. Health Services (adjunctive to sheltering activity)
6. Spiritual Care Services
7. Liaisons to Government agencies, Community groups, Labor unions and other Voluntary agencies
8. Individual Family Assistance
9. Disaster Welfare Inquiry (communications)
10. Public Affairs

In summary, mass disasters not only have the potential to cause mass casualties, but will impact many more people. Whether they are direct victims of the disaster, or family and friends concerned about the victims' welfare, the American Red Cross provides humanitarian relief.

Mass Disaster, American Red Cross, Disaster Relief Operations

F24 Tsunami: What Went Well and Not So Well

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After attending this presentation, attendees will understand some lessons learned as an odontologist after the tsunami disaster. This presentation will outline the conclusions reached while considering various aspects of the strategy implemented in the identification procedures in the wake of the tsunami disaster of December 26, 2004

The purpose of this presentation is to outline the conclusions reached while considering various aspects of the strategy implemented in the identification procedures in the wake of the tsunami disaster of December 26, 2004. Lessons to be learned will also be discussed.

Everyone can understand that the magnitude of this particular disaster translates into a tremendous amount of work for the different teams to reach their respective objectives. At the same time, no one can realistically expect high success rates in solving all the problems. In this sense, the situation is comparable to that of the NYC disaster of September 11, 2001.

Among the positive achievements in carrying out this titanic enterprise was the spontaneous, immediate readiness of several competent international DVI teams to cooperate, to reach and remain on the different locations, and to use a coordinated standardized identification program, the ID-sys of the

The not so positive aspects included the initial chaos that slowed down and sometimes jeopardized optimal action, occasional mix-ups of different nomenclatures, difficulties in finding antemortem records, and the intrusiveness of the media.

Issues specific to odontology will also be discussed. These include the efficiency of the professionals involved, the working conditions, cooperation with other teams, and the advantages and disadvantages of using a digital program. It should be emphasized that over 90% of the identified victims were identified thanks to dental evidence. This fact represents an interesting and encouraging challenge for odontologists.

To illustrate this presentation, two particular cases will be presented. The first case concerns a young woman that could be identified on location.

The second case was that of an already identified body that was returned to the family. The relatives decided to seek a second opinion and received substantial support of the media and of political figures. Difficulties arose when it became necessary to re-examine the appropriate dental antemortem records.

Forensic Odontology, Mass Disaster, Identifications

F25 The Mission of the German DVI-Team in Sri Lanka After the Tsunami 2004

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After attending this presentation, attendees will have an overview about the Mission of the German DVI-Team in Sri Lanka after the Tsunami 2004. This presentation will provide information about the situation in Sri Lanka after the tsunami.

Sri Lanka was extensively devastated by the tsunami on December 26, 2004. Numerous German tourists were reported missing. A disaster victim identification (DVI)-team consisting of three police officers, one forensic odontologist, and one forensic pathologist The team, deployed by the German Federal Crime Police Office (Bundeskriminalamt, BKA), was later enlarged. The work was centred in Colombo, the capital of Sri Lanka. An office with equipment for communication and data handling could be adjusted in the German embassy. Permission to work in the mortuary of the Judicial Medical Officer was obtained. Networking with the DVI-teams of the other nations such as Austria, Denmark, France, Great Britain, Japan, Holland, and Norway was mandatory. International standards following the Interpol victim identification report were constituted; multinational teams were working together. The identifications were mainly based on dental findings or on results of DNA-examination performed in Austria.

When the mission was completed at February 25th, 2005, no more German citizen was reported missing in Sri Lanka. The success of this extraordinary and challenging mission was based on the gracious support of the local authorities and the commitment of each member of the multidisciplinary teams of all the different nations working together for a common purpose.

Dental Identification, Tsunami, German DVI Team

F26 Thai Tsunami - Lessons for DVI Managers

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The goals of this presentation are to increase understanding of unfamiliar aspects of DVI in an offshore situation and to provide strategies and tools to implement this increased awareness.

This presentation will demonstrate enhanced analysis of issues that will allow increased understanding of specific aspects of DVI management in mass casualty incidents offshore. This is aimed at facilitating co-operation at an international level and contributing to efficient and timely return of accurately identified human remains to families.

The Disaster Victim Identification (DVI) operation in response to the Boxing Day Tsunami or Thai Tsunami on the south west coast of Thailand on December 26 2004 is examined. Four issues that inform planning decisions for DVI managers of future incidents of this scale are discussed. These are cultural, jurisdictional, credentialing and the relative rates of identification between standalone methods of identification.

Cultural: This event took place in the Kingdom of Thailand. All DVI workers were guests of the Thai people. A sensitivity to Buddhist and Thai cultural issues needed to be maintained and incorporated at all levels of DVI activity. This sensitivity informed an understanding of such issues as: the role of monks; the reluctance to allow transport of bodies from one province to another across a waterway; apparently differing command and loyalty relationships within the Royal Thai Police in different provinces; the timing of the response during a national election; mortuary practices of one nation being offensive to many others; the inappropriate display of the national flag of one nation; and the constant awareness by Thai officials that the number of Thai citizens identified was miniscule in comparison to the numbers of foreigners identified.

Jurisdictional: The host country has jurisdiction. DVI managers need to be aware of the authority of people with whom they are dealing. The relative authority of army, police and executive branch of government may not be the same as that to which they are accustomed; it may not be the same in different parts of the country, and it may change during the process. These factors impact on the ability of DVI managers to both gain the necessary approval for actions and to successfully implement those actions. Clear chain of command needs to be established and maintained.

To this end it is proposed that the positions of Fingerprint DVI Co-ordinator, Odontology DVI Co-ordinator and Molecular Biology DVI Co-ordinator be established in early days of the response. These personnel would report to and liaise with the DVI Commander. They would have authority for and be responsible for establishing and ensuring adherence to Standard Operating Procedures; for keeping senior management informed; orientation, credentialing and welfare of incoming experts; and relations with local experts. This authority must necessarily include the authority to recommend exclusion of personnel from the operation.

Credentialing: Team leaders of the disciplines need to exercise a rigorous vetting, credentialing and orientation process. Personnel may be sent to the operational theater for all kinds of reasons: rank, seniority, academic status rather than field expertise; because some nations feel that the number of their experts involved should be proportional to the number of "their" victims; because they were " good at computers" in a DVI operation where the scale necessitated electronic data storage and management; or in the belief that this could be used as a training exercise.

This process could unavoidably be perceived as confrontational and embarrassing.. Credentialing needs to be firm in principle and flexible in execution and can be managed with sensitivity. The approach is based primarily on placing experienced personnel with those less experienced, and mixing the international teams. The jurisdictional issue is relevant here, in that the DVI Co-ordinator for each specialty must have the authority to drive the credentialing.

Relative Rates of Identification Between Standalone Methods of Identification: Experience in the response to the Thai Tsunami and indeed the Bali bombings – a more likely scenario in a terrorist attack and where fragmentation was considerable - has shown that the early identifications will be on a dental basis. Fingerprints may well soon contribute significantly to numbers of identifications. Molecular biology, while an invaluable tool, by its nature takes significant time to set up in terms of postmortem and antemortem sampling; choice of laboratories; decisions on statistical boundaries, storage and transport issues and funding.

Consequently, after an assessment of the features particular to any mass casualty incident, staffing and equipment decisions should reflect this relativity, and should support the appropriate specialist teams as their efficacy changes during the evolution of the DVI process.

Thai Tsunami, DVI, Cultural Issues

F27 WinID 3 Training for Dental Disaster Team Members Utilizing PowerPoint Presentation Modules

Richard M. Scanlon, DMD, 27 Sandy Lane, Suite 206, Lewistown, PA 17044; and John M. Carson, DDS, Office of the Chief Medical Examiner, 3132 Collins Ferry Road, Morgantown, WV 26505*

Attendees will learn about a program to effectively, yet at low cost train disaster team forensic odontologists in the use of WinID 3. This presentation will provide an effective and low cost program to train essential WinID 3 skill to forensic odontologists who are members of a disaster dental team

WinID 3 a computer based program facilitating the comparison of antemortem and postmortem dental records and radiographic images, and has been used successfully in numerous mass fatality incidents by odontologists providing dental identifications. With the advent of digital radiology in disaster dental procedures, basic and advanced WinID 3 skills will be a required skill for many, if not all odontologists on dental disaster teams.

While WinID 3 skills are not difficult to learn, few forensic odontologists use these skills on a regular basis, and therefore require initial and remedial training to maintain a level of adequate WinID 3 proficiency.

The presented program will demonstrate how PowerPoint training modules developed by the author can facilitate the initial and remedial WinID 3 training of forensic odontologists, to a level of proficiency required for members of a dental disaster team. The presented training modules accomplish this critical learning task through a low cost, yet effective program of individual home study and regular review.

WinID 3, Forensic Odontology, Disaster Identification

F28 Bite Mark Research – Antemortem and Postmortem Bite Marks

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This presentation will demonstrate new technique of excising skin (Dorion - Type 5) and making attendees aware of some of the factors influencing bite mark analysis.

Module 5 is a bite mark practicum for McGill University's Faculty of Dentistry and the Laboratoire de sciences judiciaires et de médecine légale (LSJML) forensic dentistry web course.

The Laboratoire de sciences judiciaires et de médecine légale (LSJML) and McGill University's Faculty of Dentistry collaborated in a project for Module 5 where live piglets were bitten to study the influence of various factors and cellular changes in tissues (1).

Human bite marks by means of mounted dental casts on a Vice-Grip were inflicted at various intervals on piglets from 1 hour before to one hour after death.

This project included the use of videography, photography (color, IR, UV, ALI), excision by a new technique (Dorion - type 5), transillumination, tissue preservation and fixation.

Various factors including those attributed to the perpetrator, the recipient, the recording, tissue preservation, extrinsic factors, transportation and storage issues are discussed in relation to the project.

The various techniques utilized for bite mark comparison using Photoshop are also demonstrated.

Reference:

(1) Dorion RBJ ed., Bite mark Evidence, Marcel Dekker, New York, 2004.

Bite Marks, Research, Experimental

F29 Factors Affecting Bite Mark Analysis

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Attendees will learn about new research in the histopathology of bite marks. This presentation will demonstrate a better method in timing injury pattern (bite marks).

Documentation and interpretation of a bite mark is a complex subject raising many questions. One such issue may pertain to the temporal relation of the bite. Bite mark infliction may have occurred before, at the time of, or after death.

The healing response to injury applies only to living tissue. Conversely, bite mark injury occuring after death cannot produce this response. Many variables impact the precision of such estimates (1).

One of the purposes of the study is to evaluate whether greater precision on the timing of the injury can be estimated by analysis of the different variables involved.

Bite marks were inflicted on anesthetized piglets that were eventually euthanized. Mounted human adult dental casts were mounted on a Vice-grip and the bite marks produced at various intervals in vivo and postmortem. The advantages and disadvantages of using different casts materials are outlined.

The bite marks were analysed for factors including: color changes, distortion, indentation of the epidermis, hair, tissue crushing, variables of skin tissue thickness, abrasions, contusions, laceration, positional relationships, gravitational influence, intradermal capillary hemorrhages, lividity, antemortem and postmortem cellular damage, temporal changes and content.

The bite marks were photographed, bite mark impressions taken, the samples excised, transilluminated, fixed and analyzed for histopathological changes.

The results of the findings are described and discussed.

Reference:

(1) Dorion RBJ ed., Bite Mark Evidence, Marcel Dekker, New York, 2004.

Bite Marks, Research, Timing of Injury

F30 The Significance of Intercanine Distance in Bite Mark Analysis: A Critical Analysis of Juvenile vs. Adult Dimensions

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The goal of this presentation is to demonstrate the importance of scientific study and careful analysis of features used in bite mark analysis. Assumptions that seem to be obvious may lead investigators to make erroneous assumptions. This information may be used by medical examiners, forensic odontologists, or other investigators to assist in the identification of the correct perpetrator, adult or juvenile, of human bite marks. It is the hope of the author that the study will incite further research and analysis into this subject matter.

This presentation will impact the forensic community and/or humanity by providing information to medical examiners, forensic odontologists, or other investigators to assist in the identification of the correct perpetrator adult or juvenile, of human bite marks.

The purpose of this paper is to collect data on the intercanine widths of children from age 3 to 18 and to compare that data to previously collected data from known adult populations. The authors' intent is to examine the reliability and validity of distinguishing adult from juvenile bite marks using metric analysis in general and intercanine dimension specifically.

Background Information: It is perhaps an intuitive assumption that adult arches and adult intercanine dimensions are larger than their juvenile analogues. Dental arch size is one of the primary considerations in evaluating a bite mark injury on human skin. However, using metric analysis of arch size or intercanine dimension as the sole determinant may lead to false conclusions in considering possible perpetrators.

There has been little research done since 1976 in analysis of dental arch form, specifically inter-canine distance in children. A study done at the Center for Human Growth and Development at The University of Michigan in 1976 has served as the foundation upon which standards in juvenile arch form are relied upon for orthodontic treatment. This study sampled 208 children from ages 3 to 18 with equal percentage of males to females. Extensive analyses of subject casts were preformed to aid the orthodontic investigators to formulate statistical measurements of development. Forensic Odontologists have not universally applied those measurements or standards in their analysis of bite marks. There are no recent studies in the forensic literature noted that examine the question of the intercanine dimensions of children as compared to adults.

Dorion states in bite mark Evidence (2004, Marcel Dekker Ltd) that the upper arch has an average intercuspid distance of 32.3mm to 33.6mm, and the mandibular intercuspid distance averages 25mm to 33.0mm in the adult population. He further states that the difference between males and females averaged 1.6mm for the maxilla and 1.0mm for the mandibular with considerable overlap. In children he states the mean maxillary intercuspid distance measures 28 – 29mm from ages 3 to 6, and the respective mandibular intercuspid distance is 22.6 mm. Given that canines are often a distinctive feature in bite mark analysis a larger study should be initiated which would allow conclusions to be made comparing juvenile to adult patterns.

Hypothesis: Comprehensive analysis of the variability in arch size and intercanine dimension will show that there is a statistically significant difference between the arches and intercanine distance of children and adults. The null hypothesis is, of course, that there is not a statistically significant difference.

Methods and Materials: Arch size and intercanine dimension information was collected from juveniles between the ages of three years and eighteen years old. Data was collected from private patients in general dentistry, pediatric dentistry and orthodontic practices. Data was also collected from orthodontic pre and post treatment diagnostic casts. The information was collected in one of two ways. 1. The fabrication of "wax exemplars" directly from the subject's mouths. These wax exemplars were then scanned and analyzed. 2. Pre and post treatment orthodontic models were scanned and analyzed. Both were analyzed using Adobe Photoshop 7.0. All personal information was redacted except age, race and gender.

Results: The results of this study demonstrate the importance of scientific study and careful analysis of features used in bite mark analysis. Assumptions that seem to be obvious may lead investigators to make erroneous assumptions. This information may be used by medical examiners, forensic odontologists, or other investigators to assist in the identification of the correct perpetrator adult or juvenile, of human bite marks.

Forensic Odontology, Bite mark Analysis, Human Bite Mark

F31 Child Abuse: A Pediatric Perpetrator

Gregory T. Dickinson, MS, DDS, 1851 Arlington Street, Suite 103, Sarasota, FL 34239*

After attending this presentation, attendees will understand the dynamics of various types of pediatric bite marks and the resultant characteristic wound patterns. This presentation will familarize practioners with the recognation of rarely documented pediatric bite marks on human skin.

Human bite marks are not uncommon in sexual assaults and/or homicides. Bite marks on human skin are pattern injuries, usually in a double arch pattern. They have class characteristics that identify them as human bite marks, and individual characteristics that can relate to an individual dentition. The individual characteristics may be analyzed to include by points of concordance or exclude by dissimilarities the identity of the perpetrator. The accuracy of these conclusions are influenced by many factors, i.e. clarity of the bite mark, accuracy of the photographs (focus, scale, light source) and age of the bite mark.

It is quite uncommon to see bite marks inflicted by the pediatric age group.

On May 5th, 1999, I was asked by our Child Protection Team to evaluate what appeared to be human bite marks on a young child. On May 6th, I examined and extensively photographed one Brittany G.; a cheerful, active 14-month old girl. Present were her mother Gail, Katherine Keeley, MD, Sarah Crane of the Child Protection Agency, and Glori Enzor, DDS.

Brittany resides with her single mom in Arcadia, Florida, in rural DeSoto County. She had been dropped at her babysitter's home at 8 a.m. and her mom, upon picking her up at noon after her work, noticed the bite marks and called authorities. Only Brittany, the babysitter, and the sitter's 2-year-old son were present in the house during those hours.

The bite marks were documented with and without an ABFO #2 scale. Slides, color and black and white photos were made using Kodak T-Max 400, Kodak Tri-Max 400, Kodak Elite 400, and Kodak Gold 200 film.

There are a total of 19 bite marks: one on the left face; two on the posterior shoulder; two on the right arm and forearm; eight on the back; two on the right buttock; two on the left buttock.

The arch form and measurements indicated that these were made by a deciduous dentition.

The bite marks were forceful enough to cause both abrasions and contusions. All appeared to be in a similar stage of healing. Nine of the bite marks appeared to be double bite patterns. This occurs when two bites are inflicted very quickly in the same location, or the skin slips and the teeth quickly contact a second time.

The bite marks on the buttocks could not have been inflicted through a diaper. Brittany's mom stated that to her knowledge, Brittany did not in the past remove her own diaper.

No exemplars or interviews were made of the 2-year-old son.

Unfortunately, due to funding constraints or inertia, to my knowledge there has been no follow-up on this case.

Quoted from the report, the facts of the number and force of the bites, in addition to the probable removal of Brittany's diaper, certainly raises warning flags. The suspected biter should be carefully followed for further aberrant behavior, with intervention and counseling should the facts so warrant.

Child Abuse, Bite Marks, Pediatric

F32 Development and Validation of a Human Bite Mark Severity and Significance Scale

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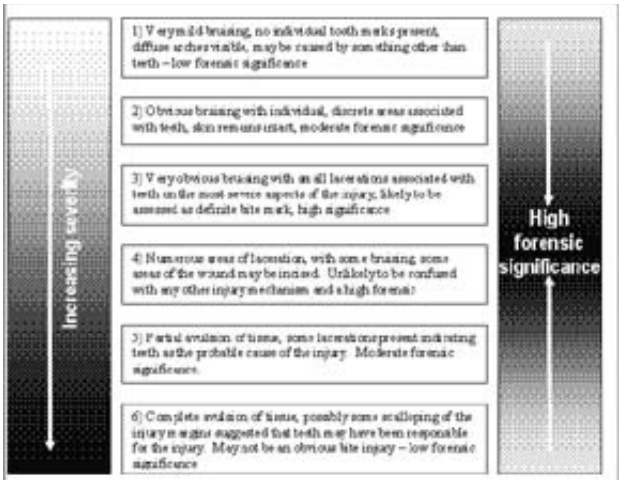
After attending this presentation, attendees will understand the need for assessment of bite injuries for their severity and significance and that severity is linked to forensic significance. That bite marks with poor significance should be treated with caution when considering analysis

Numerous methods for describing bite marks have been suggested. Common methods include the use of descriptors for the severity of the injury, the location of the injury or the presence of gross, class or unique characteristics. However, there is no universally accepted means of describing bite injuries and hence communication between professionals dealing with such injuries is complicated. A review of the literature found no studies that examined the use of such an index, or any attempts to characterize any bite mark descriptors by means of reliability and validity testing.

There is a clear link between the severity of a bite injury at presentation and its forensic significance. For example, a bite injury that presents as a diffuse, non-discrete bruise is unlikely to possess unique characteristics suitable for analysis resulting in the positive identification of the perpetrator. However, on the other end of the severity spectrum, very aggressive, avulsive injuries are frequently poor candidates for analysis. A combination of factors including the loss of tissue, tearing and distortion of wound margins and the need for urgent medical treatment generally render such injuries poor candidates for analysis. Bite injuries that present in the middle of these extremes, *i.e.,* injuries made up of discrete, individual bruises, small abrasions and lacerations frequently and considered by odontologists to present the highest level of significance and many will enable the exclusion and inclusion of potential suspects.

A novel index, relating severity to forensic significance was developed. See scale at end of this abstract A text version and accompanying visual index were produced and distributed (via the web) to three groups; odontologists, forensic pathologists and police officers. A total of 35 bite marks were assessed and rated using the new index. Intra-class correlation co-efficients (ICC) were used to analyse the agreement data both between and within groups and individuals. ICCs demonstrated a high level of intra-operator and inter-operator reliability. Weighted kappa scores ranged from 0.89 to 0.93 for inter-examiner agreement and 0.90 and 0.98 for intra-examiner agreement. There were no statistically significant differences between the three groups of professionals suggesting that the new scale is both a valid and reliable means of reporting bite marks between professionals.

The proposed bite mark scale.



Bite Marks, Significance, Severity

F33 Bite Mark Comparison and Analysis Using Image Perception Technology

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A new approach to bite mark analysis will show how a more detailed and thus less error prone image can be achieved using image perception technology and showing a method of visualising more detail in bite mark photographs, making a more accurate comparison of a bite mark and a suspect's dentition possible.

Method: A photograph of a bite mark is opened with the image perception software, and a region of interest (ROI) is then selected. After such selection, one can add colour to different greyscale areas of the image. The assigning of selected colours to levels of grey values enables the forensic odontologist to select regions with similar grey values or to enhance subtle differences of grey values in the picture. The human eye can only distinguish about 30 shades of grey in a monochrome image, but it can distinguish hundreds of different colours. This will make it easier to establish which regions of pixel intensity are part of the bite mark and which are not. By omitting certain areas of pixel intensity, it is possible to isolate the region of the image which shows the bite mark. A satisfactory detailed image of the bite mark is produced. The resolution of the image is then altered to be compatible with the resolution of the original photograph. Most bite mark images are scanned at 300dpi. Part of the ABFO No.2 scale has to be visible to accommodate the placement of the image over the original photograph with 100% exactitude. The coloured image of the bite mark is now layered over the original bite mark photograph using Photoshop® of Adobe Systems®.

The opacity of individual layers can be increased or decreased according to the requirements of the forensic odontologist. The enhanced image can now be used to accommodate an overlay of the suspected biter's dentition. Both hollow and compound overlays can be used, depending on the amount of incisal detail. With this improved degree of information, it is not uncommon to distinguish aspects previously invisible. With image perception software (Forensic IQ, LumenIQ Inc., Bellingham, WA, USA) it is also possible to turn a 2D picture into a 3D surface object. Different pixel intensities are turned into different surface heights, yielding additional information contained in 256 intensity values. These 3D images can be freely moved, rotated, or zoomed to any specific region of interest.

The forensic odontologist is now able to combine the information of the 2D and pseudo-3D images to investigate the bite mark and establish its origin with a higher degree of certainty.

Conclusion: Human bite mark analysis is by far the most demanding and complicated part of forensic dentistry. There is no dependable way of stating that one or more tooth marks seen in a wound are irrefutably unique to just one person in the population. Bite mark distortion through skin elasticity, anatomical location, and body positioning is a recurring problem. However, with the help of image perception technology it is possible to visualise more details in a bite mark photograph. The availability of additional colouring of selected areas with similar intensity values as well as rendering 2D photographs as pseudo 3-D images will enable the researcher to analyse the image more extensively and come to a more accurate conclusion regarding the source of the bite. However, bite mark analysis alone should not be allowed to lead to a guilty verdict, but it will offer the opportunity to exclude a suspect from a crime when the data do not correspond.

Bite Marks, Image Perception Technology, Overlay Comparison

F34 How to Make a Good Impression - Polyurethane and Pattern Injury Analysis

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After attending this presentation, attendees will understand the utilization of forensic odontology methods and procedures in pattern injury analysis for medical examiner's and investigators.

This presentation will impact the forensic community and/or humanity by demonstrating how forensic ododntology methods and materials in select toolmark and pattern injury can provides an over-looked investigative tool in death investigation. The techniques used in bite mark analysis, including dental impressions, diagnostic models and digital photography, can be applied to various other toolmark and pattern injuries.

This presentation will present an overlooked diagnostic tool to assist the medical examiner and law enforcement in death investigation involving select blunt and sharp force pattern injury analysis. Evaluation and preservation of the wound pattern can be beneficial in determining the implement used. The authors will present a case study involving blunt force trauma resulting in several well-defined pattern injuries. Using materials and methods common to forensic odontology, a permanent record of the pattern injury was made and digital photographic documentation was collected.

In November 2004, the Medical Examiner's office was called to investigate a police involved death of a white male who had been evading pursuit by law enforcement. The suspect sustained multiple dog bites and the forensic odontologist was requested to assist in the investigation. In addition to the multiple bite marks on the extremities and head, there were several well-defined pattern injuries on the left temporal region of the scalp. Utilizing a vinyl polysiloxane impression material an extremely accurate impression was made of the pattern injury. In addition, using the same dental material, an impression was made of the object suspected to have caused the injury. The impressions were cast in polyurethane polymer to create a three-dimensional duplicate of the pattern injury and surrounding tissue. Digital color photographs were taken of both the pattern injury and suspected object using a Konica-Minolta 8-megapixal digital camera. The images were downloaded into Adobe Photoshop™ v7.0 and made life-size for metric analysis and comparison purposes. Utilizing the dental impressions, urethane models and digital images, the pattern on the scalp was determined to match that of the base of a radio collected at the scene.

This case clearly illustrates how investigators and medical examiner can utilize a forensic odontologist and dental procedures to investigate pattern injuries. The urethane models provide a virtually indestructible record of the pattern injury while Photoshop™ provides for metric analysis. With the exception of teeth and oral structures, the odontologist is not an expert in toolmark analysis. However, the odontologist can provide technical expertise and methodology for evidence collection in pattern injuries.

Medicolegal death investigators and medical examiners should consider using a forensic odontologist for pattern injury analysis.

Pattern Injury Analysis, Toolmark Analysis, Forensic Odontology

F35 Non-Sexual Biting During Sexual Assault: A Comparison of Two Cases

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The goal of this paper is to show the comparison of what is traditionally considered non-sexual biting in two separate sexual assault cases.

This presentation will impact the forensic community by demonstrating how "sexual" biting is usually categorized as those bite marks which are found on the breasts, buttocks and/or genitals in heterosexual assault cases. "Non-sexual" bites are often on the shoulders, abdomen, and thighs as compared in these two cases.

"Sexual" biting is usually categorized as those bite marks which are found on the breasts, buttocks and/or genitals. In the following two sexual assault cases the bite marks were of a more "nonsexual" nature in their location.

In October 1996 a party was held on the campus of Northwestern University in Powell, Wyoming. Many of the students admitted to the consumption of alcoholic beverages prior to the commencement of the dance. According to witnesses, Levi Collen and his date were no exception. They were both seen leaving the dance shortly after it began.

Levi Collen returned to his dormitory room, reportedly spattered with blood, at approximately 1: 00am. Following several fabricated alibis, Collen admitted that he had taken his date to Polecat bench on the outskirts of Powell. The area is reported to be a popular hangout for underage partying and other lascivious behavior.

Mr.Collen initially reported that following consensual sex in the passenger seat of his Pontiac Grand Prix, his date got out of the vehicle to urinate. He decided to do the same on the driver's side of the car. While he was relieving himself he claimed that this 115-pound female rushed toward him and hit him on the head with a Coor's Lite bottle. She then allegedly started "pinching" him on the neck to the point that he reportedly feared for his life. He said that he then returned to his vehicle, retrieved a knife from the glove compartment, and stabbed her in self-defense.

According to the autopsy report, during Collen's period of "defending himself" the victim was apparently stripped of her clothing, sexually assaulted, bitten at least six times on the face, left arm, and inner right thigh, and stabbed about the face and neck approximately twenty times.

In July 2004 the victim of the second case was allegedly drinking at a bar in Cody, Wyoming. Prior to the closing of the bar for the night, she struck up a conversation with one of three men who were partying together. Apparently, she liked one of the men and gave him her address and phone number. She proceeded to her home in hopes that the one young man would follow. He did go to her house, but also brought his two friends. The man with whom she was enamored had what was reported by all parties as consensual sex. The details of what followed were apparently somewhat blurred by the effects of the alcohol.

The lady states that one of the other three started to have intercourse with her and she told him that she wanted him to stop. During that period he allegedly bit her above her left breast on her chest. He then moved his head to a position between her legs and bit her severely just below the umbilicus. He then bit her several times on the inside of her left thigh hard enough to cause extensive bruising. She claims that she continued to yell at him to stop, but her pleas went unanswered.

Both victims were sexually assaulted but all of the bite marks were observed to be on "non-sexual" areas of the body. No bite marks were found on either of the women on the breasts, buttocks, or genital areas. Mr.Collen was known to have a history of biting women in previous cases. The perpetrator in the latest incident apparently has no history of sexual assault or battery. However, one of his friends said that the biter was "always shy around women" and was surprised that he bit her that hard.

It would be an interesting and possibly helpful project to accumulate more cases of this type to evaluate the perpetrators and the details of the crimes committed.

Bite Marks, Sexual Assault, Homicide

F36 Age Dating Dental Enamel With Bomb-Pulse Radiocarbon

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After attending this presentation, attendees will understand how biological samples produced in the past 50 years can be dated using the radiocarbon bomb-pulse. Specifically, they will learn how the 14C content of dental enamel can be used to determine year of birth of persons born after 1950.

This presentation will demonstrating how the analysis of dental enamel for radiocarbon (14C) is a new tool for narrowing the identification skeletal remains. The 14C content of dental enamel is an excellent chronometer of date of birth for people born since 1950. Persons born prior to 1940 do not have any bomb-pulse carbon in their enamel.

Background: Determining the age of an individual is an important step in identification and a common challenge in forensic medicine. Age determination can be performed with high precision up to adolescence by analysis of dentition, but establishing the age of adults has remained difficult. The enamel of individual permanent teeth is formed at distinct, well-characterized time points during childhood. After being laid down, there is no turnover of enamel, and the ^{14}C concentration reflects the level in the carbon sources at the time of enamel formation. Atmospheric testing of nuclear weapons doubled the global $^{14}CO_2$ level between 1950 and 1963. After adoption of the Partial Test Ban Treaty in 1963, the level of atmospheric $^{14}CO_2$ started to decrease exponentially with a mean life of about 16 years due to transport into large carbon reservoirs such as the oceans. The enhanced level of ^{14}C worked its way up the food chain from CO_2 so that all living things are labeled with the pulse.

Material and methods: We measured the concentration of ^{14}C in tooth enamel from individual teeth and related it to the known concentration in the atmosphere over time (1950 – present) to establish the time of tooth formation. The dates were then used to estimate the year of birth of the person. To this end, the crown of the tooth was cut away from the root at the level of the cervical line. The crown was then immersed in 10N NaOH, before being placed in a water-bath sonicator. The enamel was then washed with DDH_2O and re-submersed in 10N NaOH every 24 hrs for several days until only enamel remains. Samples were rinsed with DDH_2O and shipped overnight for isotope analysis. Upon arrival, enamel samples were pretreated in 0.25N HCl for 10 minutes, rinsed 3 times with DDH_2O and placed on a heating block at 95°C to dry overnight. Enamel splits were hydrolyzed to CO_2 in individual reaction chambers, evacuated, heated and acidified with orthophosphoric acid at 90°C. The evolved CO_2 was purified, trapped, and reduced to graphite in the presence of iron catalyst in individual reactors. Graphite targets were measured for ^{14}C content by accelerator mass spectrometry (AMS).

Results: The technique matched ^{14}C content in enamel to known age to 1.6 ± 1.3 years in individual measurements. Much of the variability can be attributed to inter-individual differences in tooth formation and possible variations in carbon food sources at the time of enamel formation. Enamel formed prior to 1950 contains no ^{14}C elevation above atmosphere at the time. Analyzing multiple teeth with different formation ages (*e.g.*, incisor and molar) from a single individual can place date of birth on the ascending or descending side of the anthropogenic ^{14}C spike and improve the temporal precision.

Conclusion: AMS analysis of teeth offers a precise age determination that can be applied in forensic casework, particularly to assist in investigations of unidentified human cadavers.

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Enamel, Radiocarbon, Dating

F37 Fractured Jaw, Lingual & Inferior Alveolar Nerve Parasthesia: A Result of Third Molar Extraction-An Interesting Standard of Care Case

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This case involves a standard of care issue in which an unusual occurrence happens subsequent to the removal of a partially impacted wisdom tooth. General dentists and plaintiff and defense attorneys will learn that interpretation of the fact from plaintiff and defense point of views can be markedly different. When the "common sense" standard as used by the jury is applied, then the outcome will make sense. Dental practitioners can learn that good record keeping, accurate x-rays and timely care will result in prevention of a lawsuit and or a defendant verdict.

In November of 1998 Mr. Harvey goes to his general dentist, Dr. June, for removal of wisdom tooth #32. A panoramic x-ray was taken, #32 was removed and healing was uneventful.

In May of 2000 Mr. Harvey returns to Dr. June with pain in the #18 area. A periapical x-ray is taken, a diagnosis of pericoronitis with a mesial periodontal pocket on #17, the treatment recommended was the removal of #17. The post operative course was normal for three days at which time the patient, Mr. Harvey, called with pain in the area of #17 extraction site. A dry socket was diagnosed and was treated with proper medication. No x-ray was taken of the dry socket. Approximately two days later (over a holiday weekend) Mr. Harvey calls Dr. June's answering service, leaves a message that he is in pain and that he thought he felt his jaw crack. He was seen the following Tuesday morning, a panoramic x-ray was taken by Dr. June and a diagnosis of fractured jaw was made. He was immediately referred to an oral surgeon. Lingual and inferior alveolar nerve paresthesia was diagnosed by the oral surgeon prior to his reduction of the fractured jaw. The oral surgery consisted of both external and internal mandibular fixation.

Mr. Harvey sues Dr. June stating in the initial complaint that there was deviation from the standard of care in the following areas: 1) #17 was extracted without a proper x-ray. 2) Excessive force was used in the removal of #17 causing the fractured jaw. 3) The tooth was not sectioned but should have been sectioned prior to its removal. 4) The lingual and inferior alveolar nerve parasthesia was a result of improper surgical care by Dr.June at the time of the removal of the tooth and or resulted from the displaced mandibular fracture. 5) When he returned for the dry socket an x-ray should have been taken of the area at that time.

In his deposition, Mr. Harvey stated that it took Dr. June approximately 2 ½ hours for the removal of the wisdom tooth. The tooth was delivered using forceps and elevator and was removed in one piece. There was no fracture of the root of tooth #17. Mr. Harvey's upper full maxillary denture was not used in the treatment of the mandibular fracture.

The case was tried in circuit court with a six member jury panel. The plaintiff's expert was chairman of the Department of Oral Surgery of a large teaching institution and testified that the standard of care was breached because the tooth was not sectioned, the x-ray was improper, the fracture occurred (hairline) at the time of the removal, excessive bone was removed, the purchase point was too low on the tooth causing excessive force which resulted in the fracture. He further stated that it was impossible even for the best oral surgeon to have removed this tooth in 15 minutes as

described by Dr. June. Defense used a general dentist who testified that an 18 month old panoramic x-ray met the standard of care for the removal of the wisdom tooth on a 38 year old adult that the tooth did not need to be sectioned because it did not have divergent roots. The 15 minute removal give or take a few minutes was reasonable because there was periodontal involvement around tooth #17 and that the jaw fractured sometime after the dry socket treatment was performed and prior to the emergency visit on Tuesday morning following the holiday weekend. Both experts agreed that the paresthesia that was present in the lip and tongue more likely than not resulted at the time the mandibular fracture became displaced.

The jury returned a verdict in this case for the defendant dentist.

Parasthesia, Pericoronitis, Internal Mandibular Fixation

F38 Oral Lesions and Increased Risk for HIV Infection Associated With Methamphetamine Abuse

John D. McDowell, DDS, and Marin E. McDowell, University of Colorado School of Dentistry, PO Box 6508 Mail Stop F844, Room 130, Aurora, CO 80045*

After attending this presentation, attendees will be able to: 1. Identify the common oral signs and symptoms of methamphetamine abuse, 2. Identify the behaviors associated with methamphetamine abuse that place the individual at risk for HIV infection, and 3. Identify the common oral/perioral opportunistic infections and malignancies associated with HIV infection.

This presentation will impact the forensic community by showing attendees how to identify the oral signs/symptoms of methamphetamine abuse and recognize that this behavior places the individual at risk for HIV infection.

Methamphetamine abuse is rapidly increasing in the United States. The most commonly available form of this illicit drug has been called "crystal meth", "crystal", "tina", "krank", "tweak", "ice" and simply "meth". This drug is widely reported to be easily available in the urban, suburban and rural environments. Owing to the increasing availability of methamphetamine, the addictive properties of the drug and the behaviors associated with acquisition and use of the drug, many public health officials and law enforcement agencies have described methamphetamine abuse as a significant threat to the American public health and safety. In the crystalline form, methamphetamine is a central nervous system stimulant that is described as a "party drug" that can be injected, smoked, eaten, inhaled or inserted anally. Although this drug is used by all ages, races, genders, socioeconomic groups, its use is not uncommon in young, urban gay and bisexual men. Several lay and professional publications have described methamphetamine as the illicit drug most often abused by urban gay men. Anecdotal reports indicate that with "crystal meth" use there is an increased need for frequent and urgent sexual activity and the ability to have sexual relations for extended periods of time without ejaculation. Because dentists are often the health care provider to diagnose and treat the oral and perioral lesions associated with methamphetamine abuse and HIV infection, this paper will review the most common oral lesions associated with using "crystal meth". These oral signs and symptoms include oral/dental pain, xerostomia, rampart caries, fractured and missing teeth, periodontal disease and mucositis. Additionally, the authors will present data demonstrating how the use of "crystal meth" has been associated with shared needles and unsafe sexual activities which place the user at increased risk for HIV infection. A brief review of the common oral and perioral opportunistic infections and malignancies associated with HIV/AIDS will also be presented.

Oral Signs of Drug Abuse, Methamphetamine Abuse, HIV Infection

F39 Extraoral Skull Films Used to Age Dental Injury

John D. McDowell, DDS, MS, University of Colorado School of Dentistry, PO Box 6508 Mail Stop F844, Room 130, Aurora, CO 80045*

After attending this presentation, attendees will be able to: 1. List the commonly used imaging modalities to assess maxillofacial injuries, 2. List the radiographic features used to age maxillofacial injuries, 3. List the changes to the dental pulpal structures that can be used to differentiate between recent and distant trauma.

This presentation will providing understande of the changes that might occur in the hard tissues of the maxillofacial useful in aging dental/maxillofacial injuries.

Victims of significant oral and maxillofacial trauma are often evaluated, stabilized and treated in the emergency department prior to definitive treatment by dentists. Depending on the severity and location of the injuries, health care providers will choose between a number of different imaging modalities. In the emergency department, flat plane extraoral skull films are often used to assess injuries to the maxillofacial complex. When indicated, flat plan radiography can be supplemented with computed tomography and magnetic resonance imaging to develop a final diagnosis regarding hard and soft tissue injuries. Although skull films are rapidly available and can be invaluable in assessing hard and soft tissue injuries, these extraoral projections are not frequently used to assess trauma to the dentition. A case will be presented wherein skull films were used to diagnose and treat dental and soft tissue injuries resulting from a fight. Following the fight, criminal assault charges were filed against one of the combatants. A trial followed with the author presenting expert witness testimony regarding aging of dental and alveolar injury patterns. This presentation will provide information to the attendee regarding conclusions that can be reasonably gleaned from evaluating skull films and intraoral films and how that information can be conveyed to the trier of fact in either civil or criminal cases.

Aging Maxillofacial Trauma, Internal Pulpal Resorption, Dental and Alveolar Bone Trauma

F40 Key Principles of Dental Evidence Processing Taught to Criminal Justice Students

Judy Y. Marshall, DMD, Marshall Family Dentistry, 3443 Tamiami Trail, Suite F, Port Charlotte, FL 333952; and David A. Lounsbury, PhD, Florida Gulf Coast University, Division of Justice Studies, 10501 FGCU Boulevard, South, Fort Myers, FL 33965*

After attending this presentation, attendees will understand the principles of forensic odontology taught to criminal justice students at Florida Gulf Coast University. Emphasis is placed on a thorough understanding of the techniques involved in the recognition, documentation, collection, and preservation of dental evidence.

This presentation will impact the forensic community by demonstrating the steps necessary for the processing of dental evidence from recognition to interpretation. With this knowledge they will be able to assess during which steps of dental evidence processing they desire the consultation and involvement of the forensic odontologist.

By attending this presentation the participant will understand the principles of forensic odontology taught to criminal justice students at Florida Gulf Coast University. Emphasis is placed on a thorough understanding of the techniques involved in the recognition, documentation, collection and preservation of dental evidence. These steps are prerequisites for the interpretation of dental evidence.

Recognition that evidence of dental origin may include bite marks, saliva, or teeth is the first step in processing dental evidence. Saliva and bite marks may be found on foodstuff, other inanimate objects, and/or the victim. Several types of bite marks are presented utilizing the ABFO image series and ABFO descriptive terms explained in the *Manual of Forensic Odontology*, third edition. Alternate light sources, which may enhance the detection of saliva and the photographing of bite marks, are discussed.

Principles of proper photographic documentation are discussed and types of photographic distortions are reviewed. The photographic technique of "splitting the bite" is demonstrated. The value of the ABFO#2 ruler in evaluating the presence or lack of photographic distortion and analyzing dental evidence is stressed.

After proper documentation, evidence must be collected and preserved. The double swab technique as originally described by Dr.David Sweet et.al., is taught as the preferred swabbing method for DNA sampling.(1) A sample collection kit commonly used in Florida is utilized in the swabbing demonstration.

While the preservation of most inanimate objects is fairly straight forward, the preservation of food, the preservation of the three dimensional aspects of bite marks, and the preservation of the cutaneous human bite marks found on deceased victims are more specialized. Only the impression technique for the preservation of the three dimensionality of bite marks is included in this presentation.

Commonly a forensic odontologist is consulted regarding a case involving dental bite marks when a suspect is in custody and processing of the suspect's dental evidence is requested. Then the forensic odontologist performs a comparative analysis of the suspect's evidence to the crime scene evidence. Using Adobe Photoshop™ crime scene photographs are rotated, cropped, and sized to actual life size. The suspect's models, wax exemplars, and acetate overlays are compared to the crime scene evidence. After analysis is completed the forensic odontologist can render and expert opinion regarding the evidence.

Reference:
(1) Sweet D, Lorente M, Lorente JA, Valenzuela A, Villanueva E, An improved method to recover saliva from human skin: the double swab technique. *J Forensic Sci* 1997;42(2): 320-2

Dental Evidence Processing, Forensic Odontology, Bite Marks

F41 A Field Guide to the Anthropology of the Skull for Forensic Investigators

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After attending this presentation, attendees will understand a "user friendly" field-guide for anthropologic analysis of the skull is a valuable tool for the forensic investigation especially when no forensic anthropologist is available for the investigation. The use of the guide is intended to enhance the working relationship between disciplines and to give other forensic investigators a greater appreciation for the role that forensic anthropology plays in the identification process.

Objective: 1) To review and photograph specimens in the Robert J. Terry Collection and selected skulls from other collections located in the Museum of Natural History at the Smithsonian Institution. These skulls were examined for information relative to morphological variations of the skulls that give clues to their age, ancestry, and sex. 2) To place those criteria most commonly cited in the literature in a field guide to aid forensic investigators in determining age, race, and sex in identification cases. 3) This field-guide is a follow-up of the study presented by Brumit, Senn, and Alder in 2001.

Method: Selected skulls were examined and digitally photographed. The Terry Collection consists of 1728 specimens of known age, sex, ethnic origin, and cause of death. These specimens were collected between 1915 and 1967 by Dr.Robert J. Terry and Dr.Mildred Trotter of Washington University Medical School, St. Louis, MO. The study was augmented with skulls from other Smithsonian collections as the Terry Collection contained few Mongoloid specimens.

The field-guide is a distillation of "non-metric" methods of evaluation of the skull. These methods are preferred to a "metric" analysis because they do not require delicate or expensive laboratory equipment and can be accomplished rapidly while assessing many different features. The guide contains key elements for determining age, race and sex in the identification process. All of these anatomical landmarks are found in existing published anthropology works. Determining the biological profile of a decedent is one of the tasks of the forensic team. Correctly assessing the skeleton in the areas of race, sex and age will increase the probability of a positive identification. A "user friendly" field-guide for anthropologic analysis of the skull in these categories is a valuable tool for the forensic investigation especially when no forensic anthropologist is available to the investigation. The use of the guide is intended to enhance the working relationship between disciplines and to give other forensic investigators a greater appreciation for the role that Forensic Anthropology plays in the identification process.

Race: The anthropology sources indicate that there is a significant difference between the skulls of: 1) European (Caucasoid), 2) Asian, Hispanic, Native American (Mongoloid), and 3) African/African American (Negroid) groups. The morphology of one or two skeletal landmarks is not enough to make these determinations. Although morphological and/or size differences exist between the racial groups in certain anatomical markers, the patterns of these characteristics do not significantly differ between the sexes or between individuals of certain ages.

Age: In early development of the skeleton, when most growth is taking place, it is relatively easy to estimate age by dental development. Once the second permanent molars are fully formed development of the third molars or wisdom teeth may be used to estimate age. Current methods of estimating age by third molar development are complicated by the use of linear rather than sigmoid progression in statistical analysis. This limitation is especially significant during the early teen years and less so around the important legal age of 18. After about age 18, the skull is less helpful and age estimation is most accurately reflected by features seen in the post-cranial skeleton. When growth is complete, estimating age is more difficult due to the variable and subtle changes that take place in the adult skeleton.

Sex: Various studies have attempted to differentiate between male and female based upon size differences, males being larger than females. The idea that the cortical bone in the skeletal morphology of males is thicker and individual bones heavier and much larger is commonly held. Also areas where muscle attaches to bone are more pronounced in males. Areas such as the mastoid process, the angle of the mandible, inferior angle of the zygomatic arch and the temporal lines tend to be better defined in males. By comparison, females tend to have higher and more rounded orbits with thinner zygomatic arches and supraorbital areas. The female is also expected to have more vertically aligned frontal bones.

It is important to remember that more than one anatomical characteristic is required to support an accurate estimation or determination of age, sex, or race. Forensic scientists must use all available features and techniques before reaching a conclusion. Identification accuracy is enhanced by the use of multiple analysis techniques.

Forensic Anthropology, Forensic Odontology, Identification

F42 Cosmetic Odontology and the Law

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The goal of this presentation is to provide information about the current state of affairs regarding non-therapeutic cosmetic dental treatments in France and United States and to compare and contrast the professional regulations specific to both countries.

This presentation will impact the forensic community and/or humanity by demonstrating how certain cosmetic treatments discovered during dental autopsies are the result of treatment of a non-licensed individual and will involve a problem when requesting the dental records to aid in identification.

This presentation will impact the forensic community by providing insight into whether certain cosmetic dental treatments discovered during dental autopsies are the result of treatment by a licensed dentist, or that of a non-licensed individual. This information will be helpful when requesting dental records to aid in the dental identification of unknown persons.

The decision to provide elective cosmetic dentistry involves many legal and professional responsibilities and obligations on the part of the practitioner. However, refusing to provide these services as part of a traditional dental practice obligates the patient to turn to aesthetic institutes, tattoos shops, or non-licensed individuals for these services, with a possible loss of sanitary security and quality control for the patient. A contrast and comparison of the French and American systems will be presented. Cosmetic dental procedures, such as tooth whitening or the placement of dental jewels are increasingly in demand by patients in both France and the United States. An increasing number of websites and advertising campaigns propose the purchase of these cosmetic services in aesthetical institutes or tattoos shops. The French jurisprudence recommends a high standard of care for general dental treatment, and is especially demanding of a higher set of expectations regarding what constitutes acceptable results in the field of aesthetics. The French dental professionals seem reserved about providing cosmetic dental procedures that are not directly therapeutic, and in which their professional reputation could be called into question in view of the higher obligations and expectation of cosmetic results. In France, crowns placed for cosmetic purposes can be considered as medical devices and submitted to similar laws. The placement of such a medical device involves an obligation for the dentist to authenticate and track the materials used in its fabrication, and gives to the dentist the sole responsibility for the treatment outcomes. It is very difficult for French dentists to accept this responsibility if the crown or dental jewellery is not fabricated in the traditional dental laboratories, but by private manufacturers making cosmetic, non-medical products without any obligation of authenticity of materials. To the French dentist, it may seem easier and less dangerous to refuse their patients who request the placement of these crowns or dental jewels. However, their non-dentist competitors provide and advertise these services and are quite free to use publicity campaigns and promotional sales that are forbidden to the dentists by their professional regulatory ethics. One factor for both French and American dentists to consider in deciding whether to provide non-therapeutic dental treatment is the risk of not meeting the higher expectation of patients, and might cause them to leave the dental practice entirely. On the other hand, if patients seek the services of a non-dentist to provide these services, the procedures might be provided in unsanitary conditions that could have long-term effects on a patient's general health.

During the presentation, regulations and ethics governing French and American dentists choosing to provide cosmetic dentistry will be reviewed. Also explored will be factors influencing both French and American dentists in their decisions to participate, or to not participate, in providing purely elective non-therapeutic treatments.

Forensic Sciences, Cosmetic Odontology, Dental Jurisprudence

F43 Dishonest Dentist Descend - Despite Denial

Norman D. Sperber, DDS, 3737 Moraga Avenue, Suite A-302, San Diego, CA 92117-1133*

After attending this presentation, attendees will understand the impact of not being honest in all of their financial arrangements with patients and insurance companies. They should remember that consultants to insurance companies and law enforcement will be diligent in their investigations and understand that the citizens of the United States regard dentistry very highly and it is up to every practitioner to maintain that status.

This was a case brought by the Dental Board of California against a dentist who allegedly charged for work he didn't perform. The subject dentist has an established general practice in Southern California. A family of four continued to visit him after they moved to Northern California. Once a year, the family would make the 500+ mile drive down to Southern California on a Friday. The entire family would be seen by the dentist on Saturday and then drive back on Sunday.

The family's dental bills were covered by an employer-sponsored dental plan. The employer became suspicious when he received several invoices for services in Los Angeles on days that the employee was doing highway construction in Northern California. The dentist's records show that the family returned on multiple occasions for treatment. For example, in one year, the dentist's records revealed that the family visited the dentist around Thanksgiving and returned every week until Christmas, including the day before Christmas. The dentist's records showed that some of the treatment consisted of nothing more than minor restorations which the dentist conceded would have only taken a few minutes. Further, the employee's definitely established that he was at work on many of the dates identified. The employer requested that the family be examined by a local dentist in their area, who confirmed after taking x-rays, that not all of the procedures invoiced had been performed. X-rays were taken prior to the treatment being performed in each of the two years of issue. When an investigator inspected the dentist's files he found no x-rays. The dentist claimed he had provided them to the employer. The employer confirmed he had received x-rays for the first year but did not have any x-rays from the second year.

Shortly before trial, the dentist claimed to have located a copy of one of the missing x-rays of one of the children. During the trial, the dentist who examined the patients for the employer testified that this x-ray of the child did not match the x-rays he had taken. The accused dentist offered the testimony of a faculty member of UCLA's dental school, who testified that he believed the x-rays were of the same person. On cross-examination, he testified that he was ninety percent certain it was the same person. In support of this opinion he testified that the pulp chambers at teeth #3 and 30 looked identical in both x-rays. He testified that the pulp chambers are unique and analogized them to fingerprints. He also said that the occlusal surface looked the same in both x-rays. Accordingly, a California Deputy Attorney General contacted the author in order to resolve this issue. The x-rays and documents in the case were subsequently forwarded by the enforcement unit, Dental Board of California.

On February 4, 2005, the author was sworn and testified at an administrative hearing in Los Angeles. Differences between restorations and anatomical landmarks were explained to the judge. After the author was dismissed, at the end of the morning session, it was announced that the accused dentist was going to present a second faculty member from the radiology department of UCLA.. At the afternoon session, the faculty professor who had written several books on dental radiography, examined the involved radiographs and within a few minutes into his testimony, agreed with the author that the films were not of the same person. At this point, the accused dentist may be put on probation or have his dental license revoked or suspended, if the allegations are upheld. The decision has not yet been made.

Insurance Fraud, Dishonesty, Administrative Hearing

F44 Quantification of Individual Characteristics of the Human Dentition: A Preliminary Report

L. Thomas Johnson, DDS, Marquette Thomas W. Radmer, DDS, and Peggy J. vanScotter-Asbach, MS, Marquette University School of Dentistry, PO Box 1881, Milwaukee, WI 53201-1881*

Attendees will learn the importance of establishing a database which will enable the Odontologist to eliminate the subjective assessment of objective observations in bite mark analysis.

This presentation will impact the forensic community by providing the forensic Odontologist and the criminal justice system with a valuable tool in providing hard science for the objective statement of probability, in either exculpating or incriminating a suspect from patterned injuries caused by human teeth.

Those attending the presentation of this paper will appreciate the importance of establishing a database that will define the frequency a dental characteristic, or group of dental characteristics, occurs in the general population. It is commonly assumed that the each individual's dentition is unique. However, a literature search on the individuality of the human dentition as it relates to human bite marks indicates only a few studies. None, using computer image analysis have been published. .Currently forensic Odontologists, in reporting on bite mark evidence are unable to quantify the frequency the pattern they have objectively observed in their analysis. Their expression of probability or improbability is subjective, lacking a scientific foundation.

This pilot study seeks to demonstrate that, by using computer imaging software and six measurements, the pattern of each of the 400 dental exemplars will be shown to be unique. The significance of this is that with the study of an additional sufficiently large number of dental exemplars, a database could be established that will provide the forensic Odontologist and the criminal justice system with a valuable tool, providing hard science for the objective statement of probability in either exculpating or incriminating a suspect in the analysis of a patterned injury from human teeth.

The sample size (n=400) was derived from power calculations using nQuery Advisor®. A total of 500 exemplars allow for as many as 100 dropouts or unsuitable registrations. Final analysis will be accomplished Statistical Analysis Software (SAS®). They will be collected from randomly selected volunteer dental clinic patients, representing a diverse population of Caucasians, Blacks, Asians and Hispanics that mirrors the general population. All exemplars and subject's history will be recorded using an alpha numeric designation to protect identity and preserve confidentiality. Approval for the project has been granted by the Institutional Review Board and the researchers have completed the Human Participants Protection Education for Research Teams course.

Six dental students have been selected and trained to assist in registering the exemplars and obtaining limited, anonymous histories of any orthodontic treatment, jaw fractures or surgery. The ethnic background of the volunteer is also recorded for use in a study of differences in dental characteristics in ethnic groups.

Since a dental characteristic is not always a random event, each characteristic must be evaluated in relation to its frequency in the population. Some dental characteristics are more likely to occur than others and some are interrelated.

Two imaging specialists from the Wisconsin Department of Justice, State Crime Laboratory have been assigned to the project as consultants and will function to assure that the digital imaging techniques will be in conformity with the standards of the Federal Bureau of Investigation's Scientific Working Group on Imaging Technology (SWGIT). A Professor of Evidence from Marquette University's Law School will serve as a consultant to assure that the information derived from this study will have practical use in the courtroom. Considering also that a Professor of Mathematics and Computer Science and Biostatistician are also serving as consultants, this truly a multidisciplinary team

Currently this project has been awarded "acorn" grants from both the American Board of Forensic Odontology and the California Forensic Dental Association. We are in the process of seeking larger research grants to be able to complete the study, which is anticipated to take two years.

The significance of this pilot research and its impact on forensic science and the criminal justice system is the reduction and eventually through the continued expansion of the numbers of exemplars analyzed, the elimination of the subjective assessment of the linkage of dental characteristics found in bite marks with a suspect.

Database, Quantification, Bite Marks

F45 The Use of the Forensic Dentist at the Crime Scene by the FBI

Kevin Landon, DDS, Monterey Peninsula Dental Group, 333 El Dorado Street, Monterey, CA 93940*

This presentation will impact the forensic community and/or humanity by demonstrating a unique use of the forensic odontologist at the crime scene to decide whether the FBI should continue to investigate the case as the possible victim of a kidnapping or if it was just another homicide case that should be handled by the local authorities.

On June 12, 1998, Christina Williams, 13 years old, disappeared while walking her dog in Ft. Ord, California. The dog later returned to the family home causing investigators to believe that she had been abducted. The fact that this was an apparent kidnapping on federal property was cause for the FBI to become involved in this case at a very early stage in the investigation.

Over the next seven months, the FBI and the Presidio of Monterey Police searched the former military base numerous times. More than 1500 abandoned buildings were searched using teams with search and rescue dogs, volunteers, local police, and FBI agents. Composite sketches were made of two possible suspects from a witness who saw two men in the area where Christina had been abducted.

There was a tremendous amount of media attention on her disappearance. For the next two to three months, every day there was an article on the front page of the local newspapers. This media attention was not just of a local nature. Her parents were guests on "Larry King Live" and the "Today Show." Her story was broadcast on both "Unsolved Mysteries" and "America's Most Wanted" shows.

Needless to say, when human skeletal remains were found in a remote wooded area of Ft. Ord on January 12, 1999, there was speculation that Christina had finally been found. Dr. Landon was contacted at approximately 1730 hours by one of the investigators of the Monterey County Sheriff-Coroner's Office. He asked Dr. Landon if he would be available to come to the scene that evening, examine the remains at the site, and render an opinion regarding the possible identification. Dr. Landon informed the investigator that he would make himself available at anytime to expedite the case.

At approximately 1930 hours, Dr. Landon was again called and asked to come to the scene. He proceeded to the site, which was secured by officers of the Presidio Police. Even at this early stage in the investigation, there were numerous news media vehicles present at the area where the blockade was set up. Once inside the secured area he drove about a half a mile down a dirt road to an area where he met the investigator from the Coroner's Office, and numerous other law enforcement officers. They waited for about thirty minutes in this staging area, which was about three or four hundred yards away from the actual site where the remains had been found. The FBI agent in charge of the investigation had the antemortem dental records of Christina Williams in his possession. Dr. Landon reviewed the records there for the first time with the illumination of a flashlight.

They were taken in a small group to the site where the remains had been found. Until they got there no one had touched the remains. Along with Dr. Landon and his assistant, there were three FBI personnel and the Coroner's investigator. At several points along the way to the site they passed law enforcement personnel who where maintaining the security of the area. About ten yards away from the remains they were stopped while the FBI pho-

tographer documented the scene. When they were allowed to actually approach then remains, Dr. Landon saw that the skull was not present at this site; only a portion of the torso was present, presumably due to animal activity. They left the area and it was secured for the night by law enforcement officials. The investigation was then scheduled to begin at 0700 hours. Dr. Landon was again called to the scene at about 1030 hours on the next day after the rest of the remains were found. They were again led to the site by the same team of investigators, but were also accompanied by Allison Galloway, PhD, a forensic anthropologist and her assistant.

The skull was found upside down, such that Dr. Landon could see into the foramen magnum. The mandible was not readily visible but they found it a few inches away, partially covered by leaves and soil. After the scene was well documented by photographers, he picked up the skull and mandible and performed a preliminary dental charting. It appeared that there were no dental restorations present and that there were numerous (nineteen) missing teeth that had been present antemortem.

At this point Dr. Landon informed the investigators that he found nothing inconsistent in the comparison of the antemortem dental records of Christina Williams and the dental remains. Also, Christina's records indicated a severely crowded lower right second bicuspid, and the mandible exhibited this similar peculiarity.

Dr. Landon then returned to his office, and the investigators finished the examination of the crime scene. The remains were removed the morgue at about 1700 hours. The autopsy was scheduled to begin early the next morning, January 14, 1999. At about 1100 hours the mandible and skull were brought to his office for purposes of examination, radiography, and comparison.

After preparing a postmortem dental chart, photography, and radiography, he was able to make a positive identification in this case. He phoned the coroner's office and advised them of the positive ID and within forty-five minutes a press conference was held announcing the positive identification of the remains as those of Christina Williams.

Dr. Landon was initially told that the FBI wanted the on site "tentative" ID to let the family know that these remains were probably those of their daughter. It turns out the family was not notified about his "tentative" ID, and was not told anything until he had informed the coroner's office of the positive ID.

After learning that the family was never told of the "tentative" ID, he wondered why they had asked him to come to the site. In retrospect, he feels that if he had ruled out a possible match at the site, the FBI would have exited the investigation and left the rest of the investigation up to the local law enforcement agencies.

This case exhibits a unique use of the forensic odontologist at the crime scene to decide whether the FBI should continue to investigate the case as the possible victim of a kidnapping or if it was just another homicide case that should be handled by the local authorities.

Skeletal Remains, FBI, Homicide

F46 Bulimia vs. Starvation: Natural Death vs. Homicide

Kevin Landon, DDS, Montery Peninsula Dental Group, 333 El Dorado Street, Monterey, CA 93940*

After attending this presentation, attendees will have an understanding of the effects of bulimia on dental enamel, and will have an appreciation for another way that the forensic odontologist can aid in the investigation and prosecution of a homicide case.

This presentation will impact the forensic community by demonstrating This presentation will review an interesting homicide case involving claims of bulimia and starvation, and how the forensic odontologist can play an integral part in the prosecution of the caregivers of disabled persons.

Prior to January, 2000, 33-year-old, developmentally delayed, Junji Grubbs resided with his mother, Yukie Grubbs, in a mobile home in Soledad, CA. In December 1999, Yukie's Alzheimer's condition deteriorated. She and Junji moved into her other son, Shinji's, apartment, where Shinji resided with his then fiancé, Angela (Perez).

In March 2000, Shinji obtained approximately $80,000 from his mother Yuki. He used $65,000 of Yuki's money as a down payment on a four bedroom home in Prunedale, CA. Shinji placed title in his and Yuki's name. When Shinji and Angela first began to care for Yuki she weighed 93 lbs. Yuki's driver's license indicated her previous weight at 123 lbs..

At the time of Yuki's death, in October, 2001, she had dropped another 18 lbs., to 75 lbs.. Shinji said she choked while eating. Her stomach contained 600 cc of relatively undigested food material, including large amounts of rice, vegetables, and spaghetti noodles. The Medical Examiner's report states that Yuki died "as a result of atherosclerotic cardiovascular disease."

Sixteen months after Yuki's death, her son Junji died, while under the care and supervision of his brother Shinji, and Shinji's wife, Angela Grubbs. Again Shinji asserts that his relative died suddenly while choking on his food. The Medical Examiner's report states that the cause of death was "Acute Bronchopneumonia, with malnutrition as a contributing factor". Junji was emaciated. At the time of his mother's funeral, Junji had already lost a noticeable amount of weight. He was approximately 150 lbs. Sixteen months later, Junji had lost 65% of his body weight! He weighed only 68 lbs. at the time of his death. The postmortem report concluded with observations that there was "no evidence of significant underlying natural disease, intoxication, or recent trauma." Junji had failed to receive adequate caloric intake to sustain life!

After Junji's death was ruled a homicide, his mother, Yuki's case was re-investigated as a homicide also. Charges were filed against both Shinji and Angela Grubbs for felony abuse in the deaths of both Yuki and Junji Grubbs. Prior to their trial in March, 2005, prosecutor dropped all charges related to Yuki's death, due to lack of evidence.

The forensic odontologist had been called to the morgue in March 2003. At that time coroner's investigators asked if there were any signs of bulimia evident in the decedent's oral cavity. There were no signs of the typical enamel erosion on the lingual surfaces of the maxillary anterior teeth, or any of his teeth. There also was no evidence of abrasions, or ecchymosis, in the posterior of the soft palate, or orophayrnx. The oral examination was completely unremarkable, within normal limits. During the trial, the testimony of the forensic odontologist contradicted Shinji and Angela's claim that they fed Junji regularly, but that he suffered from bulimia, and constantly vomited after eating.

Angela and Shinji Grubbs were acquitted of felony abuse charges in April, 2005, after a jury deliberated for eight days. They did convict Angela of a lesser misdemeanor charge of negligence, but were unable to come to agreement on the same charge against Shinji. Angela was sentenced to four months in county jail, and three years probation. As the District Attorney's Office was preparing to re-try Shinji for the misdemeanor negligence charge, he pleaded 'no-contest' and was sentenced to 90 days in jail.

This case illustrates a unique use of the forensic odontologist in the criminal justice system. Too often it is assumed that a forensic odontologist can only assist in the identification of human remains, or in bite mark comparisons.

Bulimia, Starvation, Homicide

G1 Otologic Injury as a Consequence of Blast Trauma; Evaluated by Postmortem Otoscopic and Computed Tomography Examination

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After attending this presentation, attendees will recognize the pattern of middle ear injury from blast trauma and it's correlation with postmortem otoscopic findings and computed tomography results.

This presentation will impact the forensic community and/or humanity by providing a systematic evaluation of middle ear structures injured as a result of primary blast trauma. Techniques evaluated are intended to augment the routine gross and microscopic examination of victims of blast injury. The results of these studies will aid in the evaluation of patients status post injury and possibly assist in preventive measures in the appropriate setting.

The ear is one of the most frequently injured organs affected in an explosion. Otologic injury is a far more prevalent problem then has been previously reported. A more thorough evaluation of victims combined with an increase in both the number of civilian and military blast injuries cause us to recognize the extent of the problem. The short and long term sequelae of this type of trauma may include findings such as hearing impairment, tinnitus, and vertigo and cholesteatoma formation. A clearer understanding of the pattern and etiology of injury should benefit survivors in the planning of treatment strategies to optimize outcome. The techniques utilized in this study have enabled us to evaluate the mechanism and extent of injury to otologic structures.

Evaluation of middle ear injuries, postmortem, has been a laborious process. The current study provides two techniques that will provide additional information in the assessment of blast trauma. These techniques are useful in the evaluation of tympanic membrane perforation, hemorrhage into the middle ear and ossicular damage.

A series of cases is presented demonstrating the application of postmortem otoscopic examination and computed tomography to evaluate middle ear structures. These findings are correlated with the results of the corresponding circumstances of death.

Blast Injury, Otologic, Computerized Tomography Scan

G2 Natural Central Nervous System (CNS) Causes of Death: A Ten Year Retrospective Review (1994-2003)

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The goal of this presentation is to explore the incidence and specific demographic information (age/sex) for natural CNS deaths in Pima County, AZ from 1994-2003.

This presentation will impact the forensic community and/or humanity by reviewing the incidence and demographics for natural CNS deaths in Pima County, AZ from 1994-2003. Forensic pathologists and other forensic scientists may find this information useful to compare with the incidence of natural CNS deaths in their own practice.

Sudden unexpected natural deaths of CNS etiology are not an uncommon finding in many medical examiners offices. The authors performed a retrospective review of 262 cases of natural deaths attributed to a CNS etiology over a 10-year time period to compare the cause, incidence, and demographic profiles of such cases. Natural deaths were sorted from 11,152 total autopsies performed at the Pima County Forensic Science Center between 1994 and 2003. These natural deaths were then screened for a primary CNS cause of death (COD) excluding systemic diseases with CNS manifestations if the CNS pathology could not be determined to be the primary mechanism of death. COD and demographic information on each case was then tabulated with particular attention to the top three causes of death by year. Primary CNS deaths accounted for an average of 7.2% of natural deaths in this ten-year review. The majority of these (28% of CNS totals) were attributed to unexpected death in patients with a clinically documented seizure disorder with a slight male predominance (1.6:1 male: female ratio) and an average age of 38 years. The second most common cause of death (27% of CNS totals) was hypertensive stroke. The average age of this population was older as compared to the patients with seizure disorders and with a slight male predominance (average age 59 with a 1.4:1 male: female ratio). Ruptured aneurysms in various CNS anatomic locations were the third most common cause of death (16% of CNS totals) occurring in middle age with a male predominance (average age 48 with a 1.5:1 male: female ratio). Infectious meningitis, most commonly of bacterial or viral etiology, was also a frequent cause of CNS death (14% of CNS totals with average age 35 years with a 1.3:1 male: female ratio). Infectious etiologies were the most age variable COD ranging from 4 months to 69 years of age. Other, less frequent, COD, in order of descending frequency, included primary brain neoplasm, idiopathic intracerebral hemorrhage, congenital anomalies, progressive neurodegenerative dementias, and idiopathic encephalopathies. These findings are felt to be representative of a typical forensic autopsy population with an over representation of sudden death (seizure disorder, stroke, and aneurysm) and under representation of chronic CNS pathology (neurodegenerative dementias, neoplasm) than what would be expected in the general population.

Central Nervous System, Natural Death, Review

G3 Frequency of Cases of Fatal Gunshot Wound Victims With Retained "Old" Projectiles From Previous Penetrating Gunshot Wounds

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After attending this presentation, attendees will learn the importance of considering "old" projectiles in assessing a gunshot wound homicide.

This presentation will impact the forensic community and/or humanity by increasing awareness of the "old" projectile as a possible pitfall in the multiple/complex gunshot wound case.

When considering multiple gunshot wound cases, the simple equation of number of entrance wounds equals the number of exit wounds plus the number of bullets lodged in the victim is always an excellent starting point in the forensic examination. However, when there are intermediate targets, atypical entrance wounds or fragmented projectiles the situation can be more complex. The equation can be further complicated by individuals

who have sustained a penetrating gunshot wound in the past, survived the injury, and for medical or personal reasons elected not to have the projectile removed. These "old" projectiles can be easily distinguished from acute projectile injuries based on their gross appearance with lack of acute hemorrhage and usual encasement within an area of fibrosis, but when plain film radiographs are used in the original accounting process, this old retained projectile can complicate the equation.

A review of all of the victims of fatal gunshot wounds at the Arkansas State Medical Examiner's office from January 1, 2000-December 31, 2004 was performed to determine the frequency of cases in which an "old" bullet was discovered in addition to the acute, fatal, gunshot wound or wounds. A total of 703 gunshot wound homicides were reviewed; twenty-five of which had evidence of remote gunshot injury and retained projectiles or fragments identified on radiologic exam and internal examination. Individuals with evidence of remote gunshot injury were further classified based on anatomic location of the remote projectile, bullet caliber (large or small), or bird-shot pellets. This classification allows a discussion of possible reasons for leaving the "old" bullet in the patient; either for difficulty/futility of retrieval or the patient's desire to retain the bullet for show as a "souvenir" bullet.

In this retrospective study, four percent (4%) of the cases of gunshot wound homicides at the Arkansas State Crime Laboratory had retained projectiles from previous gunshot wounds. The frequency of these cases points out the importance of considering the possibility of old bullets when approaching complex gunshot wound cases. One should always remember that every projectile on the x-ray may not be from acute injury.

Gunshot Wound, Homicide, Old retained Projectiles

G4 Small Cell Carcinoma of the Lung Contributing to Pulmonary Barotrauma With Air Embolism in a Recreational Diver: A Case Report

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The goal of this presentation is to review the pathophysiology of pulmonary barotrauma in the setting of SCUBA diving fatalities and to discuss the potential contribution of local bronchial obstruction to the development of pulmonary barotrauma.

This presentation will impact the forensic community and/or humanity by demonstrating how divers would benefit from consulting a qualified medical professional about the risks of diving with an intrinsic lung disease prior to engaging in this sport.

SCUBA diving is a popular sport in the United States and approximately 90 deaths are reported each year, mostly from coastal states. Drowning is the leading cause of death in diving related fatalities but a host of injuries unique to diving may contribute. This presentation will impact the forensic community and/or humanity by increasing awareness of the potential danger of recreational SCUBA diving in those with obstructive pulmonary processes.

A 45-year-old man was SCUBA diving with a partner in seawater at a spot familiar to both of them. He was an experienced rescue-certified diver with over 450 dives. The dive lasted approximately 29 minutes with a maximum depth of 84 feet of seawater. During the decompression stop the divers became separated in murky water. The partner surfaced then resubmerged and recovered the decedent from the bottom approximately 25 feet below the surface. The decedent was removed from the water and resuscitation was attempted in the field prior to the pronouncement of death. No central lines or other procedures invasive to the central vascular bed or chest were attempted.

The SCUBA gear was examined by a Diving Safety Officer. All components were in good condition and in working order with adequate unadulterated air in the tank. The diving computer was interrogated and a depth/time histogram was produced. At approximately 23 minutes into the dive the histogram has a spike-like irregularity after which the depth remains steadily at approximately 25 feet until the data terminates.

Prior to autopsy an anterior-posterior radiograph of the chest in the left lateral decubitus position was obtained. Air fluid levels in the right and left sides of the heart, gas in the central vascular structures of the chest and neck, and pneumomediastinum were observed. Opening the myocardium under water produced a gush of bubbles. No gas emboli were grossly apparent in the coronary or cerebral arteries. There was no substantial heart disease.

A 3.0 centimeter white subcarinal mass, histologically confirmed as small cell carcinoma, extended into the hilum of the left lung. It caused subtotal obstruction of the left upper lobe bronchus and encased the pulmonary artery. The pulmonary parenchyma distal to the obstruction was hemorrhagic and atelectatic. Metastases were present in the mediastinal lymph nodes and liver.

Medical records revealed that the decedent had been diagnosed with metastatic lung cancer approximately six months before his death. He underwent chemotherapy with shrinkage of his metastatic lesions. Chronic cough caused him to undergo bronchoscopy approximately one month prior to his death, which revealed partial obstruction of the left upper lobe bronchus by the neoplasm. He received two fractions of palliative radiation to that area, the last on the morning of the fatal dive.

We hypothesize that 1) the presence of a carcinoma obstructing a bronchus resulted in fatal barotrauma in an experienced diver, and 2) filling of the central vascular bed by gas resulted in unconsciousness while submerged, in the absence of cerebral and coronary artery gas emboli.

Divers would benefit from consulting a qualified medical professional about the risks of diving with an intrinsic lung disease prior to engaging in this sport.

Scuba Diving, Air Embolism, Postmortem Radiograph

G5 Serum Levels of Pulmonary Surfactant Associated Proteins A and D (SP-A & SP-D) in Some Causes of Death

M. Essam E. El-Sheikh, MD, PhD, and Taisseur M. Mostafa, MD, PhD, Farwania, PO Box 1747, Kuwait, 1747, Kuwait*

After attending this presentation, attendees will recognize the potential benefits of testing for pulmonary surfactant proteins in certain types of sudden deaths, especially those occurring with an asphyxial or intoxication mechanism.

This presentation will impact the forensic community and/or humanity by demonstrating research that may be considered as a step in determining the potential diagnostic role of surfactant proteins in postmortem settings.

It has been suggested that surfactant proteins A and D (SP-A, SP-D) may be useful markers of lung injury in the clinical setting. In this present study, cadaveric serum samples were analyzed by specific enzyme linked immunoassays for the levels of SP-A and SP-D in certain causes of death, such as mechanical asphyxia, drowning, fire, sudden unexplained deaths, carbon monoxide intoxication, narcotics abuse, and organophosphate poisoning. Results in these types of cases were compared to the serum levels in a group of healthy volunteers, which served as the control group. No significant differences were observed in the median serum SP-A and SP-D concentrations among the groups of volunteers, sudden unexplained death, mechanical asphyxia, and carbon monoxide intoxication groups. Significantly increased SP-A levels compared to controls were found in deaths caused by fire, drowning, narcotic abuse, and organophosphate poi-

soning. Similarly, increased SP-D levels were observed in fire, drowning, organophosphate poisoning, and narcotic related deaths, when compared to controls and cases of natural sudden death. A positive correlation was found between the levels of SP-A and SP-D. These results suggest that analysis of serum surfactant proteins may be useful in estimating the intensity of alveolar functional damage at autopsy.

Cause of Death, Autopsy, Surfactant Proteins

G6 Gliomatosis Cerebri as a Cause of Sudden Death in a Young Woman

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After attending this presentation, attendees will be made aware of gliomatosis cerebri as a rare yet potential cause of sudden natural death.

This presentation will impact the forensic community and/or humanity by providing a well-illustrated example of an uncommon disease entity that can be a cause of sudden death that has not heretofore been well described in the forensic science case literature.

This central nervous system (CNS) neoplasm is briefly reviewed, which follows a typical premortem course, demonstrated in this case. The report is richly illustrated with premortem neuroradiographic images, postmortem images of whole and cut brain, and photomicrographs. In particular, the gross and microscopic postmortem findings provide an excellent example of the kind of subtle changes one may encounter in the postmortem neuropathologic evaluation of cases of gliomatosis cerebri. The pathogenesis of sudden death in the context of gliomatosis cerebri is discussed vis-à-vis changes in the permeability of the blood-brain barrier.

Sudden death due to undiagnosed primary intracranial neoplasm is uncommonly encountered by the forensic pathologist. In a recent review [1] of nearly 55,000 autopsies performed over a twenty year period at the Chief Medical Examiner of Maryland, undiagnosed primary CNS tumors comprised 0.02-0.05% of sudden deaths. Glial tumors, particularly astrocytomas and glioblastoma multiforme, were the most frequent tumor types in these cases, and mechanisms of death included seizure, acute hemorrhage, and herniation. In all of the reviewed cases, discrete CNS tumor masses were identified at the time of autopsy.

Gliomatosis cerebri is a rare brain neoplasm characterized macroscopically by enlargement, often subtle, of affected brain regions with preservation of native CNS architecture and absence of a discrete tumor mass. Microscopically, the tumor consists of proliferating malignant glial cells which diffusely infiltrate large areas of the CNS, involving more than two lobes [2], and often involving both supratentorial and infratentorial brain regions. The majority of patients diagnosed with gliomatosis cerebri are relatively young (median age 44 [3]), and experience insidiously progressive symptoms, which can include headaches, alteration of mental status and cognition, dysphasia, visual deficits, hemiparesis, and seizures. Often these cases present significant diagnostic challenges to clinicians, and final diagnoses are not made until postmortem examination. Invariably the mechanism of death in cases of gliomatosis cerebri is compressive sequelae from expanding intracranial mass.

This presentation describes a case of sudden death in a young woman due to previously undiagnosed gliomatosis cerebri. The patient, 40 years old, had a several month history of intermittent headaches that were gradually increasing in frequency and severity. Over this period the patient underwent multiple clinical evaluations, which were unremarkable, apart from nonspecific white matter enhancement and mass effects by magnetic resonance brain imaging. The patient's headaches were effectively controlled with mild analgesia and she remained fully active up until her death. This witnessed event occurred suddenly, shortly after the characteristic onset of episodic headache. General autopsy was unremarkable. Neuropathologic examination showed changes consistent with acute transtentorial herniation as a mechanism of death. Subtle mass effects and white matter expansion were noted on gross and cut brain examinations. Histologic evaluation revealed malignant glial infiltration diagnostic of gliomatosis cerebri. Immunohistochemical staining of lesion tissue suggests the pathogenesis of sudden death in cases of gliomatosis cerebri may be related to catastrophic failure of the blood-brain barrier vis-à-vis its permeability regulatory function.

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Gliomatosis Cerebri, Tumor, Death

G7 Death in a Confined Space

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After attending this presentation, attendees will understand the pathogenesis of confined-space asphyxia through the study of three forensic cases. Confined-space asphyxia is a quite rare event, caused by a lack of environmental oxygen that becomes inadequate to sustain life. This occurs when individuals find themselves trapped in airtight or relatively airtight enclosure, causing depletion of the oxygen supply and they asphyxiate.

This presentation will impact the forensic community and/or humanity by demonstrating the forensic approach in investigating cases of death due to confined-space asphyxia, thereby avoiding confusing this entity for a natural death.

Asphyxia due to a confined space is a quite rare event, caused by a lack of oxygen that becomes insufficient to allow normal respiration. This happens when a person is trapped in airtight space without exchange of air, as breathing exhausts the available oxygen, beginning the asphyxiation process.

The Department of Health, Education, and Welfare defines a confined space as "a space, which, by design, has limited openings for entry and exit combined with unfavorable natural ventilation." Examples of confined space are caves, refrigerators, tunnels, pipelines, sewers, silos, tanks, pits, mines, trenches, holds, vaults, excavations, manholes, and chimneys. In the past, this kind of accident usually involved people working in building, shipyard, and other manufacturing and service industries. As society changes, the causes and modalities of confined space deaths are different. In fact, the illegal immigration phenomenon and the search of new ways to reach Europe have become one of the main causes of these accidents in these last years. People try to enter a country travelling hidden among the cargo of trucks. If the trip is long and the space is very narrow, the deficiency of oxygen could become serious and fatal for the illegal passengers.

This paper presents two cases, occurring in two different Italian regions, describing the deaths of three men by confined space asphyxia during the travel to reach Italy illegally.

The first report concerns the death of two Kurdish men. They were found in the refrigerator van of a truck, completely loaded with watermelons, coming from Greece by a motor-ship and arrived to the port of Brindisi. The autopsies of the two deceased's did not show any remarkable pathology, and histological and toxicological tests were negative. The most

significant anatomic-pathological findings of the autopsy were cyanosis of the face and fingernails, copious and deep reddish-purple postmortem hypostasis, visceral congestion, brain and lung oedema, conjunctival petechiae (in one of the two corpses) and fragmentation of myocardial fibres. All these findings were compatible with the diagnosis of death by asphyxia and the discovery of the two bodies in the truck trailer. The circumstances of the deaths confirmed that they were due to confined space asphyxia.

The second report regards a stowaway found in a truck trailer near Trieste. When he arrived to the local hospital he was in coma, with cutaneous temperature at 43°C and completely dehydrated. He died after few hours because of progressive deterioration of general health conditions and massive bleeding from his stomach and bronchi.

On basis of all the clinical symptomatology, the results of laboratory tests and review of the medical records, and the external examination, it was established that the death was due to a "heatstroke". This diagnosis was confirmed by the circumstances of the discovery of the body, and the high environmental temperature (about 40°C). Also in this case, the confined space where victim had been in hiding for prolonged time, without any ventilation, had a key role in causing the death. The lack of oxygen in this confined space, and the overheating within the van of the truck became a lethal combination for this man.

These two reports bring to attention the serious problems of clandestine immigration occurring within a confined space. Confined space asphyxia has caused trouble in the past with occupational deaths, and now seems to come back under a different aspect.

The contribution of the medical examiner to these investigations should be to identify the correct cause of death due to confined space asphyxia. As the few and non-specific anatomic-pathological findings of this kind of diagnosis is difficult to determine without history, it is very important to carry out a careful analysis of the circumstances of the death. A correct diagnosis in these types of cases requires scene information coming from an "on-the-spot investigation."

Confined Space Asphyxia, Death Investigation

G8 Primary Hyperoxaluria: A Case Report and Review of the Literature

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The goal of this presentation is to discuss a case of the rare metabolic syndrome primary hyperoxaluria (PH), with a literature review. The attendees will learn about the inherited form of the disease, its systemic manifestations, genetic alterations and the potential mechanisms of death. PH is relevant and important to the medico-legal and public health fields to identify such cases, especially because it can lead to sudden death in affected patients, who are mostly children and young adults.

The presentation will impact the forensic community and/or humanity by identifying and discussing the etiologies of the disease, its renal and extra-renal manifestations, current therapeutic approaches, i.e. combined liver-kidney transplantation, and the common causes of death in these individuals. The entity is a surgical and anatomic/forensic curiosity, with remarkable gross and histological findings.

Primary hyperoxaluria is a rare autosomal recessive metabolic disorder, caused by the deficiency of the liver-specific peroxisomal enzyme, alanine: glyoxalate aminotransferase (AGT). AGT normally converts glyoxalate to glycine, but when absent, results in an increase of the glyoxalate pool, which is converted to oxalate.

This presentation will discuss the clinico-pathologic features, postmortem gross and microscopic findings of a fatal case of primary hyperoxaluria.

Case Report: The patient MS, a 24-year-old female with end-stage renal disease, presented to *Beth Israel* Deaconess Medical Center institution with gross hematuria of one month duration. She was eight months old when diagnosed with a rare metabolic disorder, Primary Hyperoxaluria (PH). The patient had two failed renal transplants (one in 1981 at eight months of age, and another in 1991). She began hemodialysis in 2000 and continued the treatment until presenting in January 2005, with gross hematuria. A CT scan also revealed a mass in the left renal allograft. Therefore, a nephrectomy was performed, and pathology ruled out post-transplant lymphoproliferative disorder, and revealed chronic allograft nephropathy, with extensive deposition of calcium oxalate crystals. The patient was discharged, with no complications, and returned to the institution one month later for a combined left kidney/liver transplant. Shortly after the procedure, the patient suffered thrombosis of the hepatic artery-aorta conduit, which was repaired the following day. During repair, it was noted that the liver allograft was necrotic in vivo, and a liver biopsy showed massive necrosis consistent with ischemic-type injury (left lobe). The patient quickly became hemodynamically unstable, developed supra-ventricular tachycardia, and after attempts at resuscitation had failed, was pronounced dead.

At autopsy, the body was that of a jaundiced female of small build with kyphosis, and a large abdominal surgical wound, covered by mesh. There were many adhesions throughout the peritoneum. The transplanted liver was partially necrotic (40%), and a hemorrhagic infarct was found in the left lower lobe of the lung. The left, newly-allografted kidney was anteriorly placed, and had a dusky hue. The right, previously (1991) transplanted kidney, was significantly atrophic, and could not be identified. The heart (280 gms) revealed no acute or remote infarcts. The abdominal aorta had an intact stent in place.

Histologic findings of the liver revealed necrosis in the majority of the left lobe, and marked bile stasis in the remaining tissue. The heart had abundant polarizeable oxalate crystals in the myocardium, with associated fibrosis. The kidney showed pigmented tubular casts, and focal calcium oxalate deposition. The final autopsy diagnosis was death due to thrombosis of the hepatic artery and aortic conduit that led to massive liver necrosis/failure, and hemodynamic instability. Pre-mortem cardiac conduction defects were most likely due to the diffuse deposition of calcium oxalate crystals within the myocardium.

Primary hyperoxaluria (PH) is a rare metabolic disorder due to a functional deficiency of the enzyme alanine:glyoxalate aminotransferase (AGT). There are at least 20 documented mutations in the gene encoding AGT (AGXT), but two mutations are associated with about 30% of the disease alleles in PH. More specifically, these mutations are associated with mitochondrial mistargeting and defective peroxisomal uptake of the AGT protein. Symptoms develop in 15% of children less than one year of age, and by five, 50% of patients are symptomatic. Infants may suffer from chronic renal failure and parenchymal oxalosis, and older children may have symptoms of urolithiasis, or complete ureteral obstruction. The kidney is the primary organ of involvement, since one of its functions is to excrete oxalate. Renal failure ultimately occurs, and subsequently, the oxalate crystals deposit in other organs, such as the heart, bone marrow, and soft tissues (systemic oxalosis). Chronic renal failure (uremia) leads to secondary hyperparathyroidism, which in a growing individual can cause marked skeletal abnormalities. Possible causes of death are end stage renal failure, cardiac conduction deficits, or a multitude of complications from surgical intervention. Combined liver-kidney transplant is the recommended treatment for these patients, along with hemodialysis, maintaining a high urine output, and thiazide diuresis.

In conclusion, in the presented case, the clinical picture and autopsy findings demonstrate a case of primary hyperoxaluria. The disease entity has numerous clinical manifestations, including renal failure and cardiac conduction defects, and has a high-risk management, (combined liver-kidney transplant); all of which can lead to early, sudden death in these mostly young patients.

Primary Hyperoxaluria, Calcium-oxalate Deposition, Combined Liver-Kidney Transplantation

G9 Planned Complex Suicide: Report of Two Cases

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Planned complex suicides usually present a challenge to the forensic pathologist and the police in determining the manner and mechanism of death. After attending this presentation, attendees will learn the importance of a careful evaluation of all elements to reconstruct the lethal chain of events.

This presentation will impact the forensic community and/or humanity by improving knowledge of planned complex suicide in the forensic practice.

Case report: Two cases of planned complex suicide are reported. In the first case (ingestion of sodium hypochlorite bleach with associated razor blade wounds), a 27-year-old unemployed female was found dying in the early hours of the day in the bedroom of her apartment, lying in a pool of blood. Her forearms had been incised at wrist level. A blood stained razor blade was found near the body. Traces of blood were evident on the floor in the hall between bathroom and bedroom. She also presented clinical signs of caustic substance ingestion: the lips were burnt, the interior of the mouth was eroded, and the tongue was swollen. A bleach bottle (hypochlorite bleach, 5.25% sodium hypochlorite, pH 11,4) was found in the bathtub. Upon external examination, numerous recent incised wounds were found on the left forearm, most probably inflicted by the razor blade found near the body. These wounds were parallel and superficial, with deeper wounds appearing on both wrists, which had lead to significant blood loss. Autopsy revealed oral, pharyngeal, esophageal, and gastric mucosal erosions. Stomach contents contained blood and had the smell of bleach. All the internal organs were pale. Toxicologic analysis revealed sodium hypochlorite in gastric contents. Death was ascribed to razor blade wounds followed by ingestion of sodium hypochlorite bleach. In the second case, an 86-year-old man was found dead in the bedroom of his apartment. A blood stained razor blade was found on the bed, next to the left arm. A nylon cord, similar to that used for a clothesline, was found bound tightly around the neck several times. The left arm and chest showed multiple superficial incised wounds. There was marked facial congestion and numerous petechial hemorrhages in the skin of the face. Petechial hemorrhages were also prominent in the conjunctivae and oral mucosa. Numerous, recent cuts were found on the chest. These cuts were superficial and parallel to each other, indicating tentative or hesitation cuts. Numerous (68) recent cuts were found on the left forearm, inflicted by the razor found near the body. Most of them were superficial cuts of sizes ranging from 2.5 to 3 cm. Upon autopsy, recent hecatomb was noted to the muscles of the neck, especially the stern mastoid muscles. The tongue showed a recent hemorrhage. Fresh blood was found in the larynx and trachea. The lung showed mild congestion. Toxicological analysis did not detect any drugs or alcohol. Death was ascribed to asphyxia due to strangulation by ligature with associated razor blade wounds.

Complex Suicide, Razor Wounds

G10 Effect of Toilet Detergent on Morphological Change of Spermatozoa

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After attending this presentation, attendees will be able to identify and appreciate the morphological changes that occur to spermatozoa when exposed to toilet detergent.

This presentation will impact the forensic community and/or humanity by showing how toilet detergent can affect changes in spermatozoa, helping the criminalist determine the length of spermatozoa exposure to the detergent, and providing further assistance in identifying perpetrators of sexual assault.

Human semen is an important specimen in forensic casework. A girl was killed at her own home and found approximately ten days after death. Five persons were suspected as the killer. A condom containing human semen and filled with toilet detergent was found in the toilet chamber pot. Results of DNA identification matched the specimen to one of the suspects. However, the problem was to determine the time when the semen was discarded. For this reason, the following experiment was designed and performed. Human semen samples were collected from fifteen healthy volunteers, and the samples were confirmed to be normal by routine semen examination. The semen samples were mixed in two concentrations of the toilet detergent (0.2 mg/ml and 0.02 mg/ml), or in water as control. All preparations were kept at room temperature and were examined periodically under a microscope. The Oppitz method was used for spermatozoa staining. In the first five days, no definite change in shape of spermatozoa was observed in all the samples. The major change of spermatozoa was separation of the tail and the head, which was clearly observed after ten days under 400 × magnifications. In samples mixed with 0.2 mg/ml solution of toilet detergent, dissociation of the tail and head was observed in approximately 40% of the spermatozoa by ten days, 80% by twenty days, and 98% by thirty days. When mixed with 0.02 mg/ml of toilet detergent, the corresponding proportions were approximately 40%, 70% and 95%, respectively. In the water control, only 25% showed separation by 10 days, and the percentage by 20 and 30 days was similar to 0.02 mg/ml detergent. Increase in bacteria was observed after 20 days. However, when magnification was increased from 400 to 800, approximately 70% of the spermatozoa in toilet detergent solution were found to possess a tail up to 30 days, whereas very few spermatozoa in the water control maintained a tail. The authors find is that after immersed in toilet detergent for a long time, many spermatozoa maintain the head and tail, but the tail becomes thinner and shorter.

Spermatozoa, Toilet Detergent, Morphological Change

G11 An Unusual Death of a Child at the Obstetrician's Office

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After attending this presentation, attendees will be presented with a case of a 13-month-old child who died after his pregnant mother accidentally fell on him while she was at her obstetrician's office. The goal of this presentation is to illustrate the severity of injuries that may result from such a seemingly innocuous event.

This presentation will impact the forensic community and/or humanity by increasing awareness of the potential for fatal injuries in a case where the severity of injuries was in excess of what might have been expected given the history and, had the event not been witnessed, might have been mistaken for child abuse.

A witnessed case of a 13-month-old child whose mother fell on top of him at her obstetrician's office is presented, resulting in severe head injuries that, under different circumstances, might be mistaken for abuse.

A 31-year-old, 5-foot 8inch, 180-pound woman in her 8th month of pregnancy was at her obstetrician's office with her two children, a 3-year-old girl, and a 13-month-old boy. While the woman was being weighed on a scale, the 13-month-old boy walked behind her. Not noticing her child behind her, the woman stepped backward off the scale and onto her child, losing her balance and falling on top of the boy. According to a statement to police, her "tailbone hit her son's head." The height of the scale was 4 inches from the carpeted floor. The event was witnessed by the doctor's nurse; whose statement corroborated that of the mother's and further indicated that the left side of the boy's face was down against the carpet when his mother landed on him.

The boy, who immediately became unresponsive, was taken to the hospital where his Glasgow coma scale on arrival was 4-5 and he was exhibiting decerebrate posturing. Computed tomography scans of the head showed a depressed frontal skull fracture, bilateral subarachnoid hemorrhage (left greater than right), left subdural hematoma (without midline shift), and elevated intracranial pressure. No funduscopic examination was performed. Despite medical intervention, he died the next day and was brought to the Harris County Medical Examiner's Office for autopsy.

At autopsy, external examination revealed diffuse, right-sided scalp hemorrhage and right periorbital ecchymosis. Internally, a gaping 7-1/4" linear skull fracture involved the parietal skull bilaterally, anteriorly extending to and involving the coronal suture. Dura and brain matter herniated through the fracture. Approximately 20 milliliters of subdural hemorrhage were present bilaterally (right greater than left). Bilateral parasagittal subarachnoid hemorrhage and bilateral tonsillar herniation were also present. Coronal sections revealed contusions of the right frontal and parasagittal contusions. No other injuries were noted.

In the United States, an estimated 1,400 deaths due to child neglect and abuse occurred in 2002; of these, 30% were due purely to physical abuse. The majority of pediatric homicides occur within the first two years of life, and the cause of death most commonly involves blunt force injuries to the head or abdomen. Typically, fatal injuries in children do not occur as a result of minor mishaps during ordinary activities of daily living. The discrepancy between the history provided by the caregiver and the severity of the injuries themselves is often the initial indication of abuse. Such stories may describe the decedent rolling off of a bed, falling from the arms of the caregiver, or the caregiver falling while carrying the child. Had the events described in the case above not taken place at the doctor's office and been witnessed, the "discrepancy" between the story and the severity of the injuries sustained by the decedent would likely have raised serious suspicions of child abuse.

Fall, Head Injuries, Child Abuse

G12 Methadone Treatment and Drug Overdose in Geneva, Switzerland, From 1994 to 2003

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After attending this presentation, attendees will learn how lethal methadone intoxications while on methadone treatment are very rare and probably due to a lack of strict medical oversight.

This presentation will impact the forensic community and/or humanity by demonstrating why it is important to collect good information regarding drug and clinical history when considering lethal methadone intoxications. In this study, most of the decedents were not enrolled in methadone programs. Wide access to methadone treatment with good medical oversight does not lead to an increase of lethal methadone intoxications and may be responsible for a large decrease of overall drug intoxication deaths.

This presentation will show that methadone treatment is safe when well controlled medically and that methadone overdoses are in most cases due to diverted methadone. It will extend an earlier study reported in 2000, covering the years 1994 to 1998, showing that in Geneva, the wide access to methadone treatment did not lead to an increase of lethal methadone intoxication and may be responsible for a large decrease of overall drug intoxication deaths.

It is hypothesized that the decrease in the number of lethal drug intoxications that started in 1995 had continued through 2004 because of the wide access to methadone treatment, which provides treatment to most of the heroin addicts in Geneva. In 2000, the estimated number of addicted drug users in Geneva, including users of heroin, cocaine, cannabis, and benzodiazepines was 2500. The number of methadone treated patients in 2005 is 1356 and the new heroin users asking for methadone treatment is dropping steadily.From 1 January 1994 to 31 December 2003, the authors studied systemically all toxicological data from all cases in which methadone and/or morphine was found. Cases were selected on the basis that the only cause of death was a potentially lethal drug concentration in the postmortem blood sample. For each case in which methadone was found, information regarding drug and clinical history was collected from police sources and from the Health Authority for each registered methadone-treated patient.

It was discovered that the drop of lethal drug intoxications starting in 1995 continued until 2003. Methadone lethal intoxications remain stable and low - around five cases per year. Most of them are due to illegally diverted methadone used by a person not in treatment. Cocaine overdoses have increased since 2002. Most of the lethal overdoses have other drugs present in the blood, the commonest being benzodiazepines and alcohol.

In conclusion, methadone treatment has been very successfully implemented in Geneva since the 1970s and has been widely available since the 1990's, with a dramatic decrease of heroin overdoses. This can be explained by the fact that almost all heroin addicts have easy access to treatment. The wide access to methadone treatment has not lead to an increase of lethal methadone intoxications. The lethal methadone intoxications while on methadone treatment are very rare and probably due to a lack of strict medical oversight. It is important to note that most of the decedents were not enrolled in methadone programs.

Methadone, Addiction, Overdose

G13 Pathological Changes Associated With Aortic Valve Stenosis

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After attending this presentation, attendees will understand the pathology of aortic valve stenosis (AVS). Aortic valve stenosis is a cause of sudden cardiac death in older individuals and young athletes.

As such, this poster will impact the forensic community by highlighting major pathological features of degenerative and bicuspid aortic stenosis as well as the underlying pathogenesis of these diseases.

An analysis of the morphological features and pathogenesis of this common heart valve disease will aid pathologists and researchers in understanding its role in sudden death. As the incidence of aortic stenosis increases, the rate of sudden death due to this disease does as well. This presentation will impact the forensic community and/or humanity by assisting in the understanding of the environmental and genetic determinants of its pathogenesis, which will aid those conducting pathological examinations to better understand the underlying features of the morphological changes seen at autopsy.

Aortic valve stenosis is the most common valvular heart disease among adults in the western world, and continues to increase in prevalence as the average lifespan of the population increases. As such, AVS has become a focus of intense investigation at the James Hogg iCAPTURE Centre in Vancouver, British Columbia, Canada.

Aortic valve stenosis may be due to congenital malformation of the valve, rheumatic fusion of commissures, secondary calcification of a congenital bicuspid valve, or primary degenerative calcification of an otherwise normal three cuspid valve. While the exact pathogenesis of AVS is unknown, several genetic and environmental determinants are most likely responsible.

AVS is characterized by narrowing of the aortic valve due to scarring and calcification, changes which create an obstruction to blood flow out of the main pumping chamber of the heart into one's circulation. Symptoms can include chest pain, fainting, or heart failure. If left untreated, the outcome of patients with AVS is poor. Once treated, however, mainly by valve replacement, the patient survival rates and well being greatly improve.

This poster will demonstrate some of the pathological changes associated with aortic valve stenosis with a discussion of its possible pathogenesis.

Aortic Stenosis, Cardiovascular Pathology, Sudden Death

G14 Fatal CO2 Suicidal Poisoning

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The goal of this presentation is to recognize that the cause and manner of death requires deliberate consideration, even when the circumstances may lead to an initial obvious, but misleading, direction. It is important to consider the case, the crime scene, and the autopsy findings, especially if the death is non-natural.

This presentation will impact the forensic community and/or humanity by demonstrating an interesting case for the forensic pathologist and forensic toxicologist. It is important that these two disciplines work together and to share the findings to go to the truth.

Introduction: The authors describe a case of suicide in a workplace. A 45-year-old man who worked in a vegetable and fruits packaging business was found dead in his workplace. Because of the scene circumstances, analysis of an arterial blood sample taken with an airtight syringe at the scene revealed absence of carbon monoxide but high levels of carbon dioxide (CO2). Autopsy found no significant injury and police investigators found a handwritten note of intent, describing a recent personal crisis. Therefore the authors concluded that the cause of death in this case was a suicide by carbon dioxide intoxication. This means of suicide is rare, with cases previously described in the literature as accidental carbon dioxide intoxications. This is the first case of suicide by CO2 intoxication within a closed-space tank in which the atmosphere is modified for the package of fruits and vegetables.

Case report: A 45-year-old male who worked as a packager of vegetables was found dead on the floor in his workplace. The location of the death was a confined room used for packaging vegetables, fruits, and apples. External examination showed no sign of struggle and the victim had no history of psychiatric disorders. The rescue team thought that cause of death could be carbon monoxide intoxication. In the residence of the deceased, police investigators found a handwritten note of self-destructive intent, describing a recent personal crisis.

Autopsy findings: An autopsy was performed by a board-certified forensic pathologist. The external examination of the body was significant for an absence of cherry red lividity, which is normally a good indicator of CO intoxication. Autopsy found no significant injury and no traumatic lesion.

Toxicology: Toxicological analysis was carried out, including blood ethanol levels and screening for common drugs and illegal substances. Surprisingly, carboxyhemoglobin was positive only at 2% saturation. The cause of death was unclear. The forensic pathologists had the idea to perform the quantification of PCO2 and PO2 in the arterial blood. An analysis of the airtight arterial peripheral blood sample found an oxygen saturation of 34.1%. The partial arterial CO2 level was 204 mmHg and the O2 38.6 mmHg. The normal range of partial arterial CO2 extends from 40 to 60 mmHg; the normal range of partial arterial O2 extends from 95 to 60 mmHg.

The cause of the death was attributed to asphyxiation caused by CO2 intoxication and especially the depletion of oxygen in the room. The manner of death was determined to be suicide. In spite of a suspected rapid postmortem increase in PCO2 and because of the context of death, assessment of the PCO2 level was performed in this case. The results of the PCO2 were elevated to such a degree, that it was possible to conclude that the cause of death was CO2 intoxication.

Discussion: the mechanisms of toxicity of CO2 are discussed. Carbon dioxide is produced when organic material decomposes or ferments. Asphyxiation from CO2 exposure has occurred in workers entering grain elevators (cereal stocking), the holds of cargo ships, and brewery vats. It occurs accidentally when these spaces are not aerated or ventilated, or when the ventilation system dysfunctions. Sub acute toxicity may be caused by the body's failure to eliminate endogenous CO2, as it occurs in hypoalveolar ventilation resulting from chronic obstructive pulmonary disease, opioid poisoning, or other causes of respiratory failure. Clinical signs of CO2 intoxication are presented and compared with the concentration in mmHg found in this case. Other sources of CO2 exposure are detailed. The most frequently encountered causes of CO2 intoxications are accidental and occur in the occupational setting. Examples of these types of cases are also presented. Deaths by intentional carbon dioxide intoxication are rare. Generally, such cases are suicide by intentional inhalation of automobile exhaust gases with low carbon monoxide emissions within an enclosed garage.

CO2, Occupational Suicide, Asphyxiation

G15 Case Report – Sudden Death Due to Cystic Tumor of the Atrioventricular Node

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The goal of this presentation is to show the importance of including cystic tumors of the atrioventricular node as one of the main differential diagnoses in cases of sudden death, especially in the context of congenital heart block with the adjunct of performing a thorough examination of the cardiac conduction system.

This presentation will impact the forensic community and/or humanity by demonstrating how this type of tumor will be missed if routine sections of the AV node are not submitted in cases of sudden death, especially those involving young, healthy individuals, and it should always be considered in cases of sudden death in the context of congenital heart block.

Cystic tumor of the atrioventricular (AV) node is a benign, congenital, cystic mass located at the base of the atria septum in the region of the AV node. Although cystic tumor of the AV node is the most common intracranial tumor causing sudden death it is considered a rare neoplasm with less than 100 cases reported in the literature to date.

A case of a woman in her 30's who was diagnosed as an infant with complete heart block is reported. A permanent pacemaker with epicardial leads was subsequently placed. She functioned normally with the exception of exercise related shortness of breath. She underwent several pacemaker changes throughout her life. She had a very active lifestyle. She was in her usual state of good health when she experienced a sudden witnessed collapse at her workplace. Her initial cardiac rhythm at the scene was pulseless electric activity with appropriate pacemaker discharge. She was pronounced dead at the hospital after unsuccessful resuscitative measures.

At autopsy, examination of the cardiovascular system disclosed a 550-gram heart. The coronary arteries had a normal distribution and were free of atherosclerosis. The pacemaker leads were appropriately positioned. No gross lesions were visible on examination of the cardiac conduction system.

Microscopic examination of the myocardium showed hypertrophic myocytes, focal interstitial fibrosis, and focal contraction band necrosis. Sections from the region of the AV node showed a proliferation of cells forming nests, cysts, and glands of variable size and shape measuring a minimum of one centimeter. The cell population ranged from those resembling transitional cells and those with squamous differentiation to cuboidal cells and clear, sebaceous-appearing cells.

Cystic Tumor of the Atrioventricular (AV) node has been called one of the "smallest tumors causing sudden death." When symptomatic the majority of patients present with complete heart block. The diagnosis of heart block in patients with AV nodal tumors may be made at birth or as late as the ninth decade of life. It has a female predominance. The majority of known cases are diagnosed at autopsy although a few reported cases have been diagnosed during life and treated. Pacemaker is the first line of therapy; however they are not always effective, as seen in this case. Although rare and histologically benign, cystic tumors of the AV node are the most common intracardiac neoplasms causing sudden death. They are located in the AV nodal region because this is an area of embryologic fusion and therefore prone to accidental incorporation of embryologic structures. The mechanism of death is related to its intracardiac location, which can precipitate conductive and hemodynamic abnormalities. Cystic tumors of the AV node are rarely seen grossly, but when visible it is seen as an elevated nodule above the septal leaflet of the tricuspid valve. Most of the time they are first identified microscopically. This lesion is characterized by multiple microcysts, gland like structures, and nests of epithelioid (occasionally squamoid) cells within a fibrous stroma. Previously thought of as a mesothelioma of the AV node, this lesion has since been shown convincingly to represent an endodermal heterotopia.

The tumor will be missed if routine sections of the AV node are not submitted in cases of sudden death, especially those involving young, healthy individuals. It should always be considered in cases of sudden death in the context of congenital heart block and congenital fibrosis of the AV node.

Cystic Tumor of the AV Node, Sudden Death, Heart Block

G16 Sudden Death in a Healthy 37-Year-Old Man While Driving: Spontaneous Dissection of the Posterior Segment of the Right Coronary Artery

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After attending this presentation, attendees will recognize spontaneous coronary artery dissection as a cause of sudden death, and as a discrimination between auto accident injury and natural cause of death. Review of the epidemiologic, gross, and histologic features and characteristics of this rare disorder will be presented to forensic pathologists

This presentation will impact the forensic community and/or humanity by increasing the awareness of the existence, characteristics, gross presentation, and histology of a rare natural disorder which frequently presents with sudden death, and which may complicate deaths in motor vehicle accidents.

A 37-year-old man with no history of heart disease, including no family history, was driving down a state highway when his car ran off the left side of the road, struck a sign, veered across the median across the oncoming traffic lane, and struck a utility pole. There was no attempt to brake, according to witnesses, and no skid marks. No other cars were involved in the accident. The victim was wearing his seat belt and shoulder belt, and the airbag deployed. A witness said the victim showed signs of life after the car came to rest. Emergency medical personnel who reached the scene noted there was no visible injury, but the victim was unresponsive and asystolic, and they believed him dead. Attempted cardiopulmonary resuscitation at the scene and in a local emergency room was unavailing.

At autopsy, the victim measured 68" tall and weighed 198, with a muscular body habitus with no evidence of obesity. External signs of injury were limited to several small bruises on the left side of the shoulder at the base of the neck, consistent with a shoulder harness. There were no xanthomata of the eyelids or elbows. The heart weighed 375 grams, less than five percent of estimated lean body weight; there were no signs of hypertrophy. The renal cortices were smooth. The coronary arteries had normal takeoffs, without atherosclerosis other than proximal fatty streaks. There were no coronary anomalies or previous infarcts. There were no significant internal injuries.

On sectioning of the ventricles, a "red dot" was noted in the epicardial fat over the posterior septum. Examination with a hand-held magnifying glass confirmed hemorrhage both inside and around the posterior septal segment of the right coronary artery. A delicate layer of coronary wall could be seen creating an S-shape between foci of hemorrhage.

On histology, the coronary artery had dissected through the outer plane, and a mixed inflammatory infiltrate including eosinophils surrounded the adventitia, and infiltrated the wall. No other area of the heart or coronaries showed eosinophils. There were no foci of lymphocytic myocarditis. No myocardial scarring, myocyte hypertrophy, or small vessel disease was present.

Dissection of the coronary arteries as a spontaneous event has been well reported in the literature, with an undetermined but possibly

autoimmune etiology. More than two thirds of patients present at autopsy; the remaining third often recover with stenting or thrombolysis. Coronary artery dissection accounts for approximately 0.5% of sudden deaths in patients 30-40 years old. The typical victim is female, of childbearing age, frequently in her thirties, occasionally postpartum. The victims do not have a history of hypertension (or hypertension is present as an unrelated factor). Over 90% of cases that come to autopsy involve the left anterior descending coronary artery. Under the microscope, the dissection plane is in the outer media, unlike the dissection of atherosclerotic arteries. There is a striking infiltrate of eosinophils, lymphocytes, neutrophils, and macrophages in the adventitia. Some believe that the inflammatory infiltrate is secondary to the dissection, and not a vasculitis. There is no time of day, drug, or activity, which is correlated with initiation of the dissection.

Spontaneous or eosinophil-associated dissection of the coronary arteries in males is rare. Men comprise about 15% of the victims of this unusual disorder. The posterior segment of the right coronary artery is the most frequently reported site in men. Researchers were unable to find information that would answer the family's questions as to risks for other family members. The etiology and genetics of spontaneous coronary dissection are unknown. The case is discussed in conjunction with a review of the literature and the sparse information that is available on this rare disorder.

Spontaneous Coronary Artery Dissection, Males, Motor Vehicle Accident

G17 Fibrosis of the Cardiac Conduction System as a Possible Cause of Death in Chronic Cocaine Addicts

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The goal of this presentation is to present a study of the fibrosis of the cardiac conduction system in chronic cocaine addicts.

This presentation will impact the forensic community and/or humanity by demonstrating and emphasizing that the early onset of fibrosis in the cardiac conduction system may explain sudden death in chronic cocaine users and especially whose measured drug levels are relatively low

It is well known that the results of toxicological analyses can be difficult to interpret in drug addicts because of their increased drug tolerance. Thus, the forensic pathologist is occasionally faced with death cases in chronic drug addicts that demonstrate relatively low drug concentrations in their blood. In some cases, autopsy does reveal the anatomic/pathological cause of death, but in other cases no lesion can be found at the macroscopic or microscopic levels.

The goal of the present work is to study fibrosis of the cardiac conduction system in chronic cocaine addicts. Myocardial fibrosis may provide the morphological substrate in certain arrhythmias and may even explain a sudden death. At the same time, a review of the literature shows that the cardiac conduction system is rarely examined in drug addicts, including individuals whose drug consumption is chronic, as revealed by hair analysis.

Materials: The group of cocaine addicts was comprised of 33 cases all known by the police to involve chronic substance abusers. In each case, cocaine was detected in the hair. Hair analysis also revealed that for all cases, cocaine was associated with other illicit drugs, such as opiates, methadone, and amphetamines. In the majority of cases (27), the cause of death was attributed to an overdose. The control group was comprised of 31 cases where death was attributed to trauma, hanging, or a natural cause. No illicit substance was detected in the blood, urine, or hair of the control cases. The age ranged from 21 to 45 years in the drug addict group (average of 31.6 years) and from 21 to 50 years in the control group (average of 31.7 years).

Methods: Samples were collected at the level of the atrioventricular junction. Slides were stained with haematoxylin-eosin and Masson's trichrome. The extent of fibrosis was determined using a 4-point semi-quantitative scale. Fibrosis assessment was carried out in the following regions of the atrioventricular junction: the atrioventricular node, the penetrating part of the node, the branching bundle and the left and the right bundle branches. In addition, the superior septum was also analysed.

Results: The mean values obtained from the different structures of the conduction system and the superior septum were higher for the group of drug addicts than for the control group.

Statistical analysis: The pair wise comparison population test showed significant differences ($p<0.01$) in the atrioventricular node, in the left bundle branch and in the myocardium of the superior septum.

Conclusion: Fibrosis of the different structures of the conduction system and of the superior septum is a degenerative lesion whose severity increases with age. Early occurrence of fibrosis in drug addicts appears to be linked primarily to chronic cocaine consumption. This is not surprising, as cocaine cardiotoxicity has been known for a number of years. At the same time, the hair analyses conducted in this study show that repetitive cocaine consumption is almost always associated with chronic abuse of other illicit drugs. Thus, one cannot exclude the role played by these other substances in the appearance of fibrosis in the studied cases.

Myocardial fibrosis may cause problems in the cardiac rhythm and even lead to sudden death. Thus, in the context of this study, the early onset of fibrosis in the cardiac conduction system and the superior septum may explain sudden death in chronic drug users whose measured drug levels in the bloodstream are relatively low.

Conduction System, Hair Analysis, Drug Abuse

G18 Fatal Venous Air Embolism in a Postmenopausal Female During Consensual Sexual Intercourse: A Case Report and Review of the Literature

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After attending this presentation, attendees should have an understanding of the varied setting in which venous air embolism can occur and can cause sudden death.

This presentation will impact the forensic community and/or humanity by presenting a case with an unusual cause of sudden death and to review the relevant literature for future reference.

Case Report: A sixty-year-old female had recently begun an infrequent sexual relationship with a younger man. Following sexual intercourse on the day of her death, her partner noted blood on his penis. She denied pain, but stated that she did not feel well and was having some shortness of breath. She then collapsed and expired despite resuscitative measures, which were delayed, as her partner dressed her prior to summoning help.

Autopsy revealed an atrophic vaginal mucosa with a laceration of the right lateral sidewall. Intravenous air was present in the pelvic veins and there was also interstitial emphysema. Aspiration of blood from the coronary sinus revealed frothy blood and air bubbles were present in her epicardial veins.

Methods: Autopsy protocol and investigative findings for this patient are reviewed. The medical literature was searched using the keywords *air embolism*, *venous air embolism, sudden death,* and *vaginal laceration* for citations relating to venous air embolism. References from citations found were further reviewed for relevant literature.

Results: Venous air embolism is a well-described phenomenon, associated with neurosurgical procedures in both the seated and prone position, as well as in pelvic procedures ranging from transurethral prostate resection to hysteroscopy. It has also been reported to occur in the pregnant women following vaginal insufflation and intercourse, in non-pregnant women following intercourse and autoerotic manipulation. Cranial blunt injuries may result in air embolism. Cases related to central venous catheter use, percutaneous lithotripsy, endoscopy and intraoperative hydrogen peroxide irrigation have also been reported.

Conclusions: Venous air embolism is an unusual cause of sudden and unexpected death and this report documents the first case of this phenomenon occurring in the setting of a vaginal laceration resulting from consensual sexual intercourse in a post-menopausal woman.

Air Embolism, Vaginal Laceration, Sudden Death

G19 Incidence of Laryngeal and Hyoid Fractures in Hangings and Strangulations Using Enhanced Examination Procedures

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After attending this presentation, attendees will understand that enhanced examination of the larynx and hyoid will reveal subtle injuries of bony and cartilaginous structures that might otherwise not be found

The rate of injury of the larynx and hyoid is significantly higher when examination of these structures is enhanced by high-resolution radiography and maceration and removal of soft tissues followed by macroscopic examination. This presentation will impact the forensic community and/or humanity by demonstrating how these simple and inexpensive procedures can reveal subtle injuries of bone and cartilage that otherwise might not be seen and complete the forensic examination of the neck in cases of known or suspected strangulation, hanging or other neck injury.

Between 1996 and 2005 the examination of the larynx and hyoid in cases of suspected or known neck injury was enhanced by the following methodologies:

1. Visual inspection and palpation of the larynx and hyoid at autopsy, in situ and after en bloc resection and limited dissection of soft tissues

2. High-resolution radiography of the fresh en bloc specimen utilizing mammography film

3. Maceration of soft tissue in water with removal of residual tissue and macroscopic visual inspection of laryngeal and hyoid bone and cartilage

The sample consists of 105 individuals who died of hanging or strangulation or suspected strangulation between 1996 and 2005. The sample population contains 52 males and 53 females with an age range of 8 to 81 years (mean of 36.32 years). For analytical purposes the ages were divided into decades: the first decade and the ninth decade each represented by one individual; the second through eighth decades ranged from four individuals (eighth decade) to 31 individuals (third decade). The ancestry of the sample was 62% European, 18% African, 18% Hispanic, and 2% Asian.

Examined were 62 hangings, 20 manual strangulations, 10 ligature strangulations and 13 strangulations not otherwise specified (mechanism unknown or evidence of arm lock or combination of manual and ligature). Sixty-one hangings were ruled suicide or consistent with suicide, one 15-year-old was ruled accidental and was consistent with autoerotic asphyxiation - this was the only hanging where padding was included with the ligature. The strangulations cases were all ruled homicide.

Of the hanging cases (N=62), 19.4% had hyoid fracture and 48.4% had thyroid fracture. Of cases of ligature strangulation (N=10), 20% had hyoid fracture and 40% had thyroid fracture. Of cases of manual strangulation (N=20), 45% had hyoid fracture and 50% had thyroid fracture. In cases of strangulation, not otherwise specified (N=13), 7.7% had hyoid fracture and 46.2% had thyroid fracture.

The most commonly fractured sites in the hyoid were the midshaft of the greater cornu either unilaterally (18.5% for left side, 25.9% right side) or bilaterally, 18.5%. This agrees with findings on a much smaller sample by Pollanen et al (1995). The most commonly fractured sites in the thyroid cartilage were bilateral fractures of the left and right superior cornua (32%), left superior cornu unilaterally (24%) or right superior cornu unilaterally (30%). The most common location for the superior cornu fracture was at its juncture with the lamina (18% left; 16% right). Ubelaker's review of the literature (1992) cites a cohesive fracture rate of 8% hyoid fractures and 15% thyroid fractures in hangings, 11% fractures hyoid and 32% fractures thyroid in ligature strangulations, and 34% hyoid and thyroid fractures in manual strangulations.

The data of the group support earlier contention that the supple nature of these structures in children and young adults does not lend them to easy fracture (O'Halloran & Lundy, 1987; Pollanen & Chiasson, 1996). The earliest age of hyoid fracture in this series occurs in the third decade with 19% fractured, all in the mid-portion of the greater cornua. The fourth through seventh decades show fracture rates varying between 14 to 26%. In the eighth and ninth decades the fracture rates are 100%; however this number is based on a total of five individuals. The earliest age of thyroid cartilage fracture is the second decade with one 18-year-old individual with a fracture of the left superior cornu at the base. Fracture rates of the thyroid cartilage range from 32% to 70% in the third through seventh decades and are at 80% in combined eighth and ninth decades.

In cases where ligature type is known for hangings and ligature strangulations, the frequency of fracture type with ligature type was detailed. Cord type ligatures, which included ropes, electrical cords, telephone cords, shoelaces, and other small diameter strings, resulted in 22% hyoid and 44% thyroid fractures. Strap type ligatures, which included cargo straps and belts, resulted in 12% hyoid fractures and 53% thyroid fractures. Fabric type ligatures, which included clothing such as t-shirts, sheets, curtains and neckties, resulted in 18% hyoid fractures and 45% thyroid fractures. In three cases where the ligature was not recovered at the scene, all had hyoid fractures and 2 out of 3 had thyroid fractures.

References:

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Larynx, Hyoid, Examinations

G20 Agonal Sequences in a Filmed Suicidal Hanging: Analysis of Respiratory and Movement Responses to Asphyxia by Hanging

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After attending this presentation, attendees will gain a better understanding of the physiological responses of asphyxia by hanging.

This presentation will impact the forensic community and/or humanity by demonstrating a unique case that will allow a better understanding of the respiratory and movement responses of asphyxia by hanging.

The goal of this presentation is to first review the literature of physiological responses to asphyxia by hanging in humans and animals, and to compare such data to a unique case of suicide by hanging that was recorded by a video-camera.

There is just one report in the literature of an analysis of agonal movement sequences in hanging, published in 1989 in German. In this case, a man recorded his autoerotic hanging with a video camera and died accidentally. Except for this foreign language case, there is very few data on human hanging. A few experimental studies have been conducted on dogs, but the application of those results to human hanging is limited. Of course, there are witnessed reports of judicial execution hangings, but those are very different in nature from typical hanging, since death is caused mostly by fracture-dislocation of the upper cervical vertebrae with transaction of the spinal cord, rather than asphyxia by neck structure compression.

A case of a 37-year-old man who filmed his hanging suicide is presented. The man tied a padded rope to his neck and fixed the other end on the rail system of an electric garage door. He used the remote control to close the door, therefore hanging himself. His feet were fixed in ski boots, tied with chains to a metal platform. A camera was previously set to film his suicide. This film allows a unique analysis of agonal movement sequences.

Before the final hanging, the man first hesitated for 23 seconds, testing the door by moving it up and down with the remote control. Then, he finally closed the door and hanged himself.

Considering the time of hanging to be time 0, the agonal sequences consisted of the following: loss of consciousness (thirteen seconds), convulsions (fifteen seconds), decortication rigidity (twenty-one seconds), decerebration rigidity (forty-six seconds), second decortication rigidity (one minute eleven seconds), loss of muscle tone with a few isolated muscle movements (one minute thirty-eight seconds) and last isolated muscle movement (four minutes ten seconds).

Twenty-one seconds after hanging, the body presented decortication rigidity, with extension of trunk and lower limbs combined with upper-limb flexion. This pattern of rigidity is caused by cerebral cortex impairment. Twenty-five seconds later, the body suddenly moved from this pattern of rigidity to decerebrate rigidity, with full extension of both upper and lower limbs. Mesencephalon impairment causes this rigidity pattern and is generally accompanied by irreversible coma and unstable vital signs.

The amplitude of movement during the initial convulsions, as well as during the rigidity pattern changes, explains the minor traumatic lesions often seen in hanging in closed areas, such as a wardrobe.

The hanging in the present case does not seem to completely occlude the airway and respiratory movements are well seen in the film. Twenty-seconds after the hanging, very deep respiratory attempts with rhythmic respiratory chest and abdominal muscle contraction started. The respiration was loud and wheezing. At one minute eleven seconds, abundant saliva freely flowed from the mouth. Respiratory movements progressively decreased and completely stopped at two minutes.

This case confirmed the well-known occurrence of rapid loss of consciousness within seconds. Moreover, it gives a unique opportunity to study the agonal movement sequences in hanging.

Asphyxia, Hanging, Forensic Pathology

G21 Visual Misidentifications of Human Remains: Lessons Learned

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After attending this presentation, attendees will learn of two visual misidentifications made by parents after the death of their sons.

This presentation will impact the forensic community and/or humanity byexamining the procedures followed after one of the parents alerted officials of the possible misidentification and suggests (1) methods to avoid visual misidentifications, and (2) measures to routinely follow to respond to claims of bodies being "mixed-up" in the morgue.

Misidentifications are often reported by the general media and rarely presented formally in the forensic science literature. This presentation will impact the forensic community and/or humanity by assisting the forensic community by pointing out the situations that most commonly result in misidentifications, the steps needed to prevent the misidentifications, and other measures to take to address where the misidentification occurred.

An automobile driven by a drunk driver, struck two 14-year-old white males, Child A and Child B, as they walked home from a skateboarding park. The mother of one of the boys (Mother A) "claimed" Child A as her son at the scene and rode to the hospital in the ambulance with the child. A second ambulance transported Child B. Child B died in the emergency department; "Mother B" and her husband arrived at the emergency department after Child B died and claimed him as their son. Child A died hours later in the pediatric intensive care unit with his parents and many others in attendance at his bed. An autopsy performed the following day on both of the boys showed the cause of both deaths to be multiple injuries due to pedestrian struck by a motor vehicle. Both children had severe head injuries. Photographs and fingerprints were obtained during the autopsy. Close family members viewed the body of Child A at the funeral home and then had him buried at a local cemetery. The family who claimed Child B had him cremated after an open-casket visitation and funeral. During the open-casket visitation, many students from the school the boys attended strongly voiced their opinion that the boy in the casket was Child A and not Child B. The parents denied the claims of the visiting children and the funeral directors believed the parents.

About one year later, Mother A reported that she believed she had claimed the wrong child; her opinion developed after reading the autopsy reports and recognizing the report with her son's name described the other child and vice versa. Mother A had antemortem fingerprints available for comparison with the two sets of postmortem fingerprints obtained at the autopsy; the prints matched the postmortem prints of Child B. Child A was exhumed and antemortem dental records were obtained for both children. The forensic odontologist compared the two sets of antemortem dental records to the exhumed remains of Child A; the odontologist was blinded as to the identity of the antemortem records. The antemortem records provided by Mother B matched the postmortem dental features of Child A. By both fingerprint and dental record comparison it was determined that Child A was the child of Mother B and Child B was the child of Mother A. In one photograph of Child B, the name of the child is clearly visible on the hospital identification band with the associated autopsy case number indicating the bodies were not mixed up in the morgue after being banded in the hospital. The parents visually misidentified the children.

Lessons learned from this case are multiple and include: (1) Visual identifications are not always accurate – even parents can claim the wrong individual as their child. (2) Incidents involving victims of the same sex, race, and approximately the same age, should be identified using a biological method such as fingerprints, dental record comparison, medical X-ray comparison, or DNA. (3) Photographs of all identifying tags with the autopsy case number clearly visible should be routinely obtained.

Human Identification, Forensic Science, Exhumation

G22 Identifying Corpses of Foreigners in the State of Advanced Decomposition: Sri Lanka After the Tsunami 2004

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After attending this presentation, attendees will gain an understanding of disaster victim identification under difficult conditions.

This presentation will impact the forensic community and/or humanity by assisting the forensic community in understanding the necessity of cooperation of different nations and individual specialists concerning mass disaster victim identification under difficult conditions (e. g. foreign country, different mentality, and multinational victims advanced decomposition)

After the tsunami numerous tourists were reported missing in Sri Lanka. Main objectives of the German disaster victim identification (DVI)-team were sustaining a general survey of the circumstances and to achieve actual dates concerning foreign victims, German citizens in particular, and to proceed with their identification. Exceptional conditions consisted in a relatively small percentage of multinational foreigners among a vast amount of local disaster victims and in the enormous area where the deceased were disseminated. Extensive search operations revealed that dead bodies of presumptive foreigners were located in hospitals, funeral parlours, swamps, or provisional graves. Lead-managed by local authorities, exhumations could be performed. Major challenges consisted of advanced decomposition, and some of the bodies were almost skeletonized by feeding defects. Moreover several bodies had been embalmed with formaldehyde. Pre-screening for an assumable foreign nationality was performed on the grounds of clothing, items carried along by the victims and dental work. The final identifications by multinational DVI-teams were mainly based on dental findings and results of DNA-examination performed in Austria. Targeted police investigations also revealed that numerous people were alive either in Germany or still in Sri Lanka.

At February 25th, 2005, the mission was completed successfully and no more German citizen was reported missing in Sri Lanka. It has to be emphasized that the complaisant support of the local authorities and the notable obligation of each individual specialist appointed by different nations, comparably contributed to the successful and effective completion of this complex and exceptional task.

Identification, Mass Disaster, Tsunami

G23 Mass Disaster Victim Identification: The Tsunami Disaster

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After attending this presentation, the attendee will understand how to organize, implement, and utilize the Interpol Disaster Victim Identification Protocol in mass disaster. Attendees will learn the various identification techniques used in the tsunami disaster in Thailand.

This presentation will impact the forensic community and/or humanity by demonstrating the importance of an organized approach to victim identification in mass disasters.

The Interpol Disaster Victim Identification Protocol has frequently been utilized in mass disasters like earthquakes, fires, and hurricanes however, never in a tsunami. The victim identification process in Thailand was challenging due to multiple factors including, rapid decomposition of bodies due to heat, significant number of foreigners, unprecedented number of victims, and lack of prior fingerprint and dental records. The death toll in Thailand included over 5,395 persons (1,953 foreigners) dead and 2,932 (909 foreigners) missing.

Three sites were established in Southern Thailand for the processing of victims, two in Khao Lak, Thailand, and one in Krabi, Thailand. Victims were then identified as either Thai or foreigner. All foreigners were processed by the International Disaster Victim Identification (DVI) Team while all Thais were processed by the Thai Victim Identification Team. Utilizing the Interpol Disaster Victim Identification Protocol, bodies were numbered and photographed. Forensic pathologists examined victims noting birthmarks, tattoos, scars, jewelry, clothing, height, weight, and other distinguishing characteristics. Due to the tropical environment and lack of initial refrigeration, many bodies rapidly decomposed before a forensic pathologist could examine the victim. Dentition was photographed and documented by forensic dentists for comparison to prior dental records. If possible, fingerprints were obtained from victims and recorded in the Automated Fingerprint Identification System (AFIS). In a few countries, fingerprints are part of the national ID card however, in most cases, anti-mortem fingerprints were difficult to obtain. Molar teeth and femur DNA samples were obtained for DNA profiling. According to the Interpol protocol, victims can be identified utilizing four methods: 1) Dental Records 2) Fingerprints 3) DNA 4) Property. All post-mortem information was forwarded to the Thai Tsunami Victim Identification Information Management Center (TTVI-IMC) and entered into a database.

Concurrently, embassy officials were obtaining anti-mortem records such as DNA, fingerprint, dental, clothing, and victim characteristics from victim's families around the world. The international scope of the disaster initially limited victim identification due to the logistics involved in obtaining dental and fingerprint records.

All anti-mortem information is entered into a database and cross-matched with postmortem information utilizing PLASDATA, a software database program. Of the 721 victims at the Krabi site, 560 (77.6%) were identified. 357 (63.8%) were of Thai nationality and 203 (36.3%) were foreign citizens. Utilizing property, location, and distinguishing physical characteristics identified 511 victims (91.3%). Dental records identified 49 victims (8.8%), primarily foreign citizens. DNA and fingerprints did not identify any of the victims.

At the Krabi site, identification of Thai nationals proved more successful than foreign citizens for multiple reasons. Family members physically identified Thai victims through clothing, property, and tattoos prior to body decomposition. Dental records, fingerprints, and DNA were rarely used for Thai victims. Foreign citizens were identified through property, clothing, and dental records. To date, DNA has not proven effective for Thai victim identification.

The Interpol Disaster Victim Identification System can be utilized in tsunami disasters where resources, technology, and personnel may be limited and multiple nationalities are involved.

Mass Disaster, Victim Identification, Tsunami

G24 Victim Trauma as an Identification Tool in Mass Disasters

Maurice G. Rogev, MD, MBChB, 11/1 Zamenhof Street, Tel-Aviv-Jaffo, 64373, Israel*

After attending this presentation, attendees will learn that it is important to consider the victim's injuries in relation to his location at the time of a Mass Disaster. This relationship is the basis of further identification procedures.

This presentation will impact the forensic community and/or humanity by demonstrating the need to reinforce its commitment to finance full identification procedures. There is a need to employ Forensic Science officers capable of implementing a full identification program.

Ipso facto, "Mass Disasters" involve large numbers of victims. In the Medical Legal field, dealing with such disasters includes the identification of victims of trauma in a very wide variety of circumstances. In addition to enabling families of the victims to learn the fate of their loved ones, results of identification procedures are made available for use by law enforcement agencies.

The final identification of the victim is usually confirmed by his/her DNA profile, and /or by examination of the dentition of the victim after experiencing the trauma. This identification process is greatly simplified if the victim's pre-trauma identification characteristics can be located in existing database of DNA or dental records for comparison purposes.

Difficulties are encountered when no such pre-trauma records of a particular victim can be located and the identification procedure needs to start ab initio. The aim is to attempt to determine the probable identity of a particular individual by a compilation of data such as details of where the individual was found, the trauma suffered and anthropological features, [gender, age, height and race], for comparison with DNA profiles and/or dental records of known missing persons. The DNA profile of a particular individual can be determined from the DNA profiles of parents or children. The dental history of an individual obtained from dental records kept by dentists can also be used in identification. Other indications may be obtained from tattoo marks or moles and in some cases implants such as pacemakers (with serial numbers), artificial joints, and the like.

Victims may be found in collapsed buildings following natural disasters such as tidal waves, severe flooding, hurricanes or earthquakes as well as due to human action. Human action can include direct injury as well as building collapse due to defective building design or construction or terror explosions.

Accidents involving road transport, aircraft and maritime vessels can cause large numbers of victims. The injury to each victim is largely determined by his location in relation to the area of the damage caused by the disaster. Traumatic injuries inflicted on a group of individuals, who were in close proximity to one another at the time of the disaster, will cause similar pathological changes in each member of the group. Different types of injury may often be associated with different locations at the scene of the incident e.g. injuries to passengers in the rear of an aircraft are likely to be different than those in front seats which are closer to burning fuel. Consequently, careful examination of the nature of the traumatic injury may in some cases enable the investigator to establish where an individual victim had been located at the time the incident occurred and therefore narrow the possible identities to persons who were known to be in that particular locality, e.g. from passenger seating lists or lists of occupants of rooms in a hotel.

If the identities of individual members of the group are known from records compiled before the disaster, the DNA profile comparison search is limited to a much smaller number of individuals and the identities of individual members of the group can be established more readily. (e.g. aircraft passenger lists or wedding invitation lists). The identification procedure is obviously much more complex when diverse crowds in public places are involved.

Injuries can be due to crushing, fire, gas or smoke inhalation, blast effects in explosions, penetration of primary or secondary missiles, laceration of soft tissue and the effects of bio-chemical agents. Examples will be shown to illustrate the various injuries and their relevance.

Victim, Location, Identification

G25 Differential Diagnosis: Antemortem vs. Postmortem Bone Trauma

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The goal of this presentation is to evaluate the difficulties in differentiation between antemortem and postmortem bone trauma in human skeletal remains

This presentation will impact the forensic community and/or humanity by demonstrating how antemortem - postmortem bone trauma is always challenging for the forensic pathologists who have to deal with predominantly skeletonised remains. This presentation will have an impact on forensic sciences by demonstrating a way of judging bone trauma on skeletonised remains.

Four years of the war in Bosnia and Herzegovina from 1992 to 1995 has left more then 30,000 missing persons, most of whom are presumed dead. Until now, between 14,000 and 16,000 sets of human remains have been exhumed from numerous single or mass graves in burials, wells, septic tanks and caverns, or as bodies simply left unburied in fields, meadows and forests. The majority of the remains were completely skeletonized, but occasionally they were saponified or mummified.

Variable burial conditions and variable decomposition of the remains caused deterioration and injuries to the bones. Also, the transfer of the remains from primary to secondary, or even tertiary, mass graves, and the different techniques used during the exhumation process, caused postmortem injuries to the bones.

Postmortem examination of the remains to determinate antemortem injuries revealed a considerable amount of additional postmortem damage.

Assessment of antemortem injuries is not only important in the legal process in order to determine cause and manner of death, but it is also helpful in the identification process, when considering antemortem information obtained from family members or witnesses about injuries sustained.

Cases from the authors' work on exhumed skeletal remains, discuss the injuries seen, and consider potential causes will be presented (in particular, consideration will be given to):

- cases with clear signs of antemortem trauma to the bones
- cases with clear signs of postmortem trauma to the bones
- cases with postmortem injury possibly due to the influence of the saponification process during the decomposition
- cases in which it is not possible to determinate whether the trauma is antemortem or postmortem

Forensic Pathology, Skeletal Remains, Bone Trauma

G26 Personal Identification by Morphometric Analyses of Retinal Vascular Pattern

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The goal of this presentation is to report the results of a biometric personal identification study conducted by comparing retinography samples obtained from different subjects

This presentation will impact the forensic community and/or humanity by demonstrating an interesting approach for personal identification for security environments

MATERIALS AND METHOD: A new method for personal identification by morphometric analysis of the retinal vascular pattern is presented.

In collaboration with the Ophthalmology Clinic of Bari University Hospital, two sets of color images of the right retinal fundus were acquired at two different times in 68 subjects, after instillation of mydriatic and using computerized fluorangiography. The system consists of a scanning laser camera connected to a computer, color monitor and operative software. This system enables acquisition of Megaplus 1.6 resolution images with 1534x1024 pixels that are immediately digitalized and stored on hard disk.

After making a quality selection of the images, they were submitted to morphometric analysis at the Electrotechnical and Electronics Department of Bari Polytechnic, using dedicated software.

Following the operative protocol, 5 reference points of the retinal vascular tree were identified: the origin of the superior temporal artery, the first bifurcation of the superior temporal artery, the origin of the superior temporal vein, the first bifurcation of the inferior temporal artery and the origin of the inferior temporal vein. These points were individuated and marked by the software on each image of the retinal tree. The program then automatically supplies the values for the absolute distances, the relative distances excluding reciprocals, the perimeter values and the areas of the triangles obtained by joining the points, as well as the independent variable consisting of the differences, albeit minimal, between similar irregular figures. Five numerical sets were thus obtained for each image.
Statistical comparison was made of the sets by linear regression, determining the correlation coefficient. Cross-analysis was made of each of the five numerical sets obtained from the 136 images (68 patients x 2), yielding 23120 comparisons (5 X 68 X 68) for heterologous correlations and 340 comparisons for homologous correlations (5 x 68).

RESULTS: Analyses showed that the *independent variable* and the *areas of the triangles* did not serve for identification purposes due to overlapping, the maximum values for the correlation coefficient in the heterologous comparisons being in the same range as those for the homologous comparisons in over 60% of the samples.

Instead, cross comparison of the correlation coefficients for the sets of *absolute distances, relative distances* and the *perimeters of the triangles* showed that they could potentially be useful, possibly in association with other analyses, for identification purposes.

There was no overlapping between the coefficients for the *absolute distances,* which yielded separate, distant dispersion curves for homologous and heterologous comparisons. Similarly, there was no overlapping for the triangle perimeters, which provided separate, albeit close clusters, for the correlation coefficients. There was only 1% overlap for the correlation coefficients for the *relative distances* (46 false positives/4620 comparisons).

The numerical results were:

- The correlation coefficient for autocorrelations for the *absolute distances* was between 0.999 and 0.992
- The correlation coefficient for heterocorrelations for the *absolute distances* was between 0.991 and 0.566
- The correlation coefficient for autocorrelations for the *triangle perimeters* was between 0.999 and 0.99299
- The correlation coefficient for heterocorrelations for the *triangle perimeters* was between 0.99293 and 0.56651
- The correlation coefficient for autocorrelations for the *relative distances* was between 0.99995 and 0.97876
- The correlation coefficient for heterocorrelations for the *relative distances* was between 0.99248 and 0.92452

Our results indicate that:

- The section point for the output of comparison of the *absolute distances* is 0.992; higher correlation coefficients indicate certain identification and lower values certain exclusion.
- The section point for the output of comparison of the *triangle perimeters* is 0.99299; higher correlation coefficients indicate certain identification and lower values certain exclusion.
- The section point for the output of comparison of the *relative distances* is 0.97876; higher correlation coefficients indicate positive identification, with a 1% risk of false positives.

Finally, it should be noted that the cases yielding false positives for comparison of the *relative distances* presented very negative values for the correlation coefficients of the *absolute distances* and the *triangle perimeters*. Thus, interpolating the results, it can be concluded that if comparison of the two retinal maps yields a higher correlation coefficient than the minimum threshold for autocorrelation of the absolute distances, relative distances and triangle perimeters, there is certain identification.

The method is currently being patented.

Biometric, Personal Identification, Retinal Vascular Pattern

G27 Laryngeal Nerve Iatrogenic Lesions

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After attending this presentation, attendees will deepen their understanding of the surgical practices most likely responsible for damage concerning the lower laryngeal nerve. For this reason, the authors examined the surgical operating procedures that more frequently involve this nerve. Therefore, thanks to the study of the specific international bibliography, procedures have been highlighted which must be carried out, in order to avoid this complication.

This presentation will impact the forensic community and/or humanity by studying the circumstances surrounding medical malpractice concerning laryngeal nerve lesions.

The aim of this work is to highlight the surgical practices mostly responsible for damages concerning the lower laryngeal nerve. Iatrogenic lesions of the recurrent laryngeal nerve have always been one of the most serious and frequent complications in the field of the thyroid surgery. During a thyroid operation, according to the medical literature, the complication rate ranges from 0.3 to 4%, but can range up to 17% with an operation concerning a thyroid neoplasia relapse. The lower laryngeal nerve iatrogenic lesions are supported by documentary literature in the field of the thoracic surgery, especially in the surgical literature on heart surgery.

Studying the most specific reliable and recent bibliographical sources, one can learn of the different factors which cause the onset of lower laryngeal nerve lesions, so they can be identified in a timely manner, in order to prove any possible medical mistake that has occurred.

An essential role is played in this case by the fundamental features of the main pathology of recurrent laryngeal nerve damage. In particular, it depends on whether the pathology concerns primarily the nerve itself (traumatic, toxinfectious, auto-immune, etc) or is the nerve just secondly involved by another pathological process (thyroid and laryngeal pathologies, aortic and carotid aneurysm, pulmonary neoplasia, dilatation

of the left atrium in the mitrals, mediastinum lymph node disease, cervical adenopathy, etc). Other factors that need to be considered in a case of alleged medical responsibility are the different surgical operating procedures carried out, especially the nerve isolation techniques, which is the main step during an operation concerning frames adjoining the nerve itself.

With regard to this study, the authors found a greater number of recurrent nerve lesions occurring during a surgical operation due to thyroid pathologies and malignant neoplasia behind the breastbone that are particularly widespread. In fact, statistical data shows a higher risk of iatrogenic damage during more drastic operations, such as with a total or subtotal thyroidectomy or after a second operation in the same location. By observing and analyzing six cases of recurrent nerve paralysis, and after a review of the pertinent literature, this study attempts to underscore the medico-legal difficulty in assessing the nerve damage, or identifying the professional responsibility in causing the damage. The examination of these cases showed a sharp preponderance of mistakes made by the surgeon. Among the above-mentioned cases under examination, four cases out of six concerned people undergoing an operation for thyroidectomy (total or subtotal), one case of laryngectomy, and one of aortic replacement in a patient affected by an aortic dissecting aneurysm. The second step of the analysis of the medical practice showed a relevant number of mistakes concerning a non-isolation of the lower laryngeal nerve during the surgical operation, even though there are many intraoperating techniques able to highlight the nerve frames at issue, and preserve them properly. Medico-legal experts consider this negligent practice, able to identify these mistakes made by doctors implicated in a similar situation, as a result of not keeping to the therapeutic protocols in the specific literature.

Among six cases of phonatory deficiency under examination, four cases have been closed with the admission of the surgeon's responsibility, while in the other two cases any responsibility has been excluded. One case involved the surgical repair of an aortic aneurysm, and it was considered more important to save the patient's life than preserve his nerve. In the other case, the damage was linked to the post-operative behavior of the patient himself.

Laryngeal Nerve, Medical Malpractice, Medical Liability

G28 Electrocution by Arcing: A Non Fatal Case Study

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The goal of this presentation is to report an unusual case of electrocution by "arcing" from overhead high-voltage power lines.

This presentation will impact the forensic community and humanity in general, as it provides information about a case of accidental electrocution during working activities that occurred due to dielectric breakdown, so that the current from a high-tension overhead cable (30000V) ran down an aluminium pole grasped by a farmer who was thrashing an olive tree.

An ancient rural tradition is called "battitura", whereby farmers in South Italy thrash the branches of the olive trees with a pole or stick, causing the olives to drop into sheets placed under the trees. This is a case of a 25-year-old Caucasian male, who suddenly collapsed while he was thrashing an olive tree in front of him, using an aluminium pole 2 metres long. The olive tree was dangerously situated underneath (but at no less than 7 meters distance) a high-voltage power cable. These cables transmit very high voltages (30000-60000V) and in Italy they are built at least 10 metres above ground level, thus it should not be possible to come in contact with the power lines. The patient underwent loss of consciousness and bleeding from the mouth. He was taken to the ER where, on examination for injuries, he was found to have "electrical burns" with peculiar pits on the hands and on the soles of the feet. He developed cardiac arrhythmia with high levels of CPK and CK, requiring electrical defibrillation. Dental radiography and CT scan demonstrated fractures of the mandibular symphysis and condyles, along with the left tubercle of the upper jaw, with no evidence of external wounds. Many teeth were injured, with avulsion of the first and second incisors of the upper right jaw (11, 12), the first incisor of the upper left jaw (21), the second pre-molar of the lower right jaw (45), coronal fractures of the first pre-molar of the upper right jaw (14), the second molar of the lower left jaw (37), and the first pre-molar of the lower right jaw (44). At the moment of electrocution, the worker was wearing shoes that were sold as safety footwear, and inspection revealed characteristic burn defects on the sole, which corresponded to the electrical burns of the feet. Therefore, the safety shoes did not prove effective.

A review of the literature reveals few data or case reports specifically addressing the issue of electrocution by arcing, with no direct contact with the wire, especially at so great a distance between the energy source and the victim. In this case the farmer was standing vertically below the power lines in front of the olive tree, grasping the aluminium pole. There was a gap of about 6-7 metres from the upper end of the pole to the high-voltage power lines. It has been reported that a sparking gap larger than 50 cm is sufficient to transmit a voltage of about 30-40000V. However, in the reported case there were behavioral and environmental factors, equally distributed, that can explain the near fatal accident. Firstly, in high voltage accidents it is known that direct contact with the wire is not necessary because when the body is near the voltage lines an electric arc may jump from the lines to the body. Moreover, the resistance opposed by the skin and the air has an important role in electrical conduction. In particular, the humid weather present at the time of the farmer's electrocution, a cloudy and drizzling morning at the end of November, boosted the electric current discharge. Another important environmental factor is the part played by the tree, known to be an excellent energy conductor, which in this case was growing just beneath the cable. This situation allowed the accumulation of energy on every branch, thus representing a potential risk of electrocution in itself. In addition, there were some behavioral aspects to be considered. The tool used by the victim for thrashing is ideal for the conduction of electric power. Aluminium or graphite, used in staff or pole manufacture, both have superconductor qualities. The current flowing from the metal staff through the hands would probably not have been able to electrocute the farmer if he had been wearing good quality safety shoes. Finally, the great human error was that of working under a tree situated so close beneath the high voltage power lines. This is commonly a great hazard for workers, especially those in industrial fields, as this is one of the most common reasons for accidents at the workplace in Italy. Each one of the above described factors likely contributed to dielectric breakdown and conduction of the current from the high voltage power lines to the end of the metal staff and then through the farmer's body. Identification of all behavioral and environmental causative factors may lead to future adjustments in design, to reduce the risk of electrocution in working environments. Photographic documentation illustrates the results of the case investigation.

Electrocution, Arcing, Accident at Work

G29 Abrasion or Gunshot Wound? The Primary Role of Forensic Pathologist

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After attending this presentation, attendees will learn about two cases of gunshot injuries that were undiagnosed by the physicians in the ER, posing a great risk of compromising both the victims' health and the Police investigations.

This presentation will impact the forensic community and/or humanity by illustrating the primary role of the forensic pathologist even in the ER, to prevent misdiagnosis of atypical lesions, especially when caused by unconventional firearms.

Although the effects of firearms on the human body are well known, in some circumstances the objective picture of the lesions may be so modest and lead to an incorrect diagnosis, unless there is a forensic expert present. The present work describes two cases in which the correct diagnosis of a shotgun entrance wound was formulated only thanks to the help of a forensic pathologist, who was called in to give an opinion of the unusual lesions observed in the patients. On 13 December 2004, at 09.00 a.m., a 35-year-old male subject, of robust build and about 180 cm tall, was brought by ambulance to the Emergency Room at Bari Hospital (S. Italy). He stated that two robbers had attacked him near his home, and one had grasped him around the neck to immobilize him. The patient was admitted to Intensive Care due to the presence of subcutaneous emphysema of the neck and superior mediastinum, causing severe breathing difficulties. He showed digitiform ecchymoses on the face, neck and upper portion of the chest. The Intensive Care specialist on duty called in the forensic pathologist for a consultation to confirm the traumatic picture and the compatibility of the lesions with the dynamics of the events referred by the patient. The forensic pathologist confirmed the presence of ecchymotic-excoriated areas in the referred sites and pointed out scratches and bruising caused by the robber's hands. An oval-shaped area appearing to be an abrasion was seen, with distinct, slightly retracted margins, 0.6 cm in diameter, with a small eschar in the lower right semicircle. The lesion was localized in the chin region, 2 cm to the left of the anterior median line. After photographing the lesion, the forensic pathologist decided to explore it in depth, introducing a needle cannula for use as a probe, which revealed the presence of an entrance into the body. X-rays of the chest and neck were performed, which demonstrated a foreign body found to be a bullet fragment, retained in the soft tissues of the anterior region of the neck just in front of the spine. After two weeks the patient underwent surgical treatment to remove the fragment, a deformed lead bullet core that was delivered into the hands of the Police. On the basis of the investigations, it was possible to conclude that the victim had been struck in the chin by a slow-moving bullet, which was partly fragmented by impact with the bone. The bullet had been fired from a small calibre firearm, likely a modified toy gun, which still had not been found at the time of this contribution.

On 5 March 2004, a 17-year-old boy accompanied his parents to a small hospital in the province of Bari. He complained of pain in the mandible, stating that he had fallen down the stairs in his home. Orthopantomography demonstrated a fracture of the mandible and avulsion of the lower incisors. Transfer to a clinic with facilities for maxillo-facial surgery was advised and the patient was taken to Bari Polyclinic for necessary care. On arrival, the forensic pathologist was called in to give an expert opinion. HA circular wound, approximately 0.7 cm in diameter, was observed in the chin region with inverted margins and a slight, ecchymotic, excoriated border. The wound was surrounded by powder tattooing and some soot, and these findings, together with the characteristics of the perforation, suggested a gunshot entrance wound. The available X-rays were reviewed and a foreign body was noted, which had not been referred to in the radiological diagnosis. The bullet, localized in the submandibular region, and surgically removed, was a 7.65 mm caliber (FMJ), deformed at the apex and with no markings (class characteristics). These elements led the investigators to conclude that, far from falling down the stairs, the victim had been hit in the face by a bullet from a modified toy gun, shot at intermediate range.

Failure to diagnose a gunshot wound is an exceptional event. Clinical medicine relies more and more on sophisticated diagnostic techniques, and procedures for quality control. However, the previous histories show that when non-conventional firearms are used, and the patient history is not suggestive of their use, clinicians may be unfamiliar with the type of wound they produce, because these events are rarely seen. In these circumstances, consultation with the forensic expert is needed to make a correct diagnosis of the wounds. This is very important to further judicial investigation procedures related to the case. In accordance with the Italian penal law code (penal procedure code, art. 331), health workers (physicians, nurses, etc) treating a wounded patient in a hospital facility are obliged to communicate the event to the Judicial Authorities without delay, if the lesions were obviously voluntarily inflicted (criminal assault) and recovery will take longer than 20 days (penal code, art. 582-583). This obligation applies even for shorter recovery times if firearms or other potentially lethal weapons were used (penal code, art. 585). Failure to notify the Authorities lays the health workers themselves open to criminal charges (penal code, art. 361 and 362). Photographic documentation of each of the above described cases will be shown during the presentation.

Forensic Pathologist, Gunshot Wound, Modified Toy Gun

G30 Sudden Death in Toddlers Due To Influenza B Infection: A Report of Two Cases and a Review of the Literature

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After attending this presentation, attendees will better appreciate the importance of viral testing in pediatric autopsy cases. Attendees will have better understanding that influenza may present with atypical symptoms such as abdominal pain, vomiting and shock and have a very short duration between onset of symptoms and death.

This presentation will impact the forensic community and/or humanity by bringing attention to the need for specialized testing in pediatric autopsy cases, more specifically the need for viral testing, especially for influenza. Cases of sudden death among children, especially with atypical symptoms for influenza, usually do not get viral studies collected at the time of autopsy and if viral infections are not considered the cause of death may remain elusive. The authors recommend viral screening for cases of sudden death among infants and children in addition to the more standard specialized testing such as bacterial cultures.

Influenza has historically been a cause of considerable mortality world-wide during pandemics as well as small outbreaks, and continues to be a significant cause of death today. The very young and very old are especially vulnerable. Influenza typically appears during the winter months and classic symptoms include fever, sore throat, sweating, nasal obstruction, and cough and maligns. In severe attacks bronchiolitis and pneumonia may be caused directly by the virus or may result from secondary bacterial invasion of the lungs. Influenza is caused by myxovirus influenzae and there are three distinct serotypes (A, B, and C), each containing antigenic strains. Virus A causes pandemics as well as local outbreaks. It affects all age groups and is associated with a high mortality in the elderly, the very young, and those with pre-existing cardiac and pulmonary disease. Virus B causes sporadic cases and limited epidemics, especially among institutionalized young people. It tends to cause a milder disease with a lower mortality rate. Virus C is occasionally detected in local outbreaks.

Two cases of relatively sudden deaths with atypical symptoms due to influenza type B infection in a 4-year-old girl and a 2-year-old boy with no past medical history or predisposing risk factors are described. Both children presented with mild abdominal symptoms of vomiting and abdominal pain starting within two days of death, and were found dead in their beds by their parents. Scene investigation, medical history, autopsy, metabolic screening, toxicology, bacterial cultures, and toxicology were all negative. Histology of the lungs showed a viral type pattern with a chronic inflammatory infiltrate involving the bronchioles, bronchi, and trachea. The girl also had small patchy areas of intra-alveolar mixed inflammation including macrophages and neutrophils consistent with bronchopneumonia. Viral testing on the lungs of both cases was strongly positive for influenza B (by immunohistochemistry in the girl, and RT-PCR in the boy).

These cases illustrate two atypical cases of influenza B infection that would not have been suspected based on the presenting symptoms and rapidly fatal outcomes. Influenza may be found to be the cause of death if viral cultures are done in similar types of cases.

In the literature there are reported cases in adults of influenza A infection with shock like symptoms and high morbidity and mortality. There is ongoing research into the possible role that cytokines play in causing additional injury in a number of infections including influenza associated encephalopathy, streptococcal toxic shock syndrome and RSV respiratory infections. Immune mediated injury may result from the cytokine storm triggered by the initial infection and may spill over into the systemic circulation and cause devastating consequences in a relatively short period of time. There are some studies that suggest that RNA viruses like influenza may be particularly prone to inducing cytokine and chemokine up regulation including numerous interleukins (including IL-1, IL-6, IL-8, IL-11, IL-16) and tumor necrosis factor. It has been suggested that immunomodulators be used as part of the medical treatment of influenza to help prevent cytokine storm.

Influenza, Sudden Death, Toddlers

G31 Neuropathology of Pre-Teen Homicides in the State of Maryland: 1994-2004

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After attending this presentation, attendees will appreciate that pre-teen homicides differ from that of other age groups. Brain pathology is a common finding in childhood homicide, especially in cases with a blunt force component. The majority of pre-teen homicides are due to blunt force injuries of the head or head and torso. Detailed, systematic study and documentation of the central nervous system and ophthalmic injuries is essential in determining the nature and timing of the injuries and ruling out natural diseases or accidental injuries.

This presentation will impact the forensic community and/or humanity by demonstrating; (1) a better understanding of the epidemiology of pre-teen homicides; (2) the necessary role of neuropathologic studies in childhood homicides; and (3) an understanding of the pattern of injuries in blunt force head trauma in children

Background: The State of Maryland (population below 6 million, half rural) has a unified medical examiner system that investigates suspicious deaths following standard protocols. Homicides in pre-teens differ from those in the general population in victim's characteristics (e.g. gender distribution), causes of death (e.g. firearm use), environment of death (e.g. home) and patterns of injuries.

Method: Cases were reviewed and tabulated for demographic characteristics, cause of death, post-injury survival, systemic and brain injuries. Cases with a significant central nervous system component were examined by a single neuropathology's (JCT). The majority of the cases included examination of the spinal cord and eyes. Cases were stored in a centralized database. Data was retrieved and analyzed by nonparametric statistical methods.

Results: From 1994 to 2005 one hundred and eighty five children younger than 13 years of age suffered homicidal deaths in the State of Maryland (7.5 % of all deaths reported to the office for that age group). Blunt force injuries were the most common cause of death (95 cases, 51.1%) followed by firearms (16.7%) and asphyxia (16.2%), each preferentially affecting children of specific ages. Most children with blunt force injuries had significant neuropathology, and this is the focus of the following study.

There was overrepresentation of cases in the Baltimore metro area (60% of the cases; 12% of the State wide population). Girls were slightly more prevalent than boys (52 vs. 48%) and African-Americans represented 64.5% of the total. Median age was 1.1 years. Brain weight ratio (brain weight obtained at autopsy divided by standard brain weight for individual's age) was 1.1. The neuropathologic findings depended on age, survival after injury and mechanism of force. The majority of the cases had external (73.7%) signs of blunt force head injuries, either alone (50%) or in combination with torso injuries (50%), with an average of 4.7 (median 4) head contusions/abrasions identified at autopsy. Injuries included intracranial subarachnoid hemorrhage (61.5%), intracranial subdural hemorrhage (55%), hypoxic injuries (35%), cortical contusions (38.5%), brain swelling (21%), intracranial epidural hemorrhage (17%), and gliding (intermediate) contusions (15.4%). White matter tears and diffuse axonal injuries were rare. Spinal cord was obtained and studied in 70 of 95 cases (73.7%). Intraspinal hemorrhage was seen in 31% (subarachnoid 24.3%, subdural 23% and epidural 17%). Eye pathology was found in 44 of 60 cases studied (73%), and was bilateral in 95% of them.

Summary and conclusions: Brain pathology is a common finding in childhood homicide, especially in cases with a blunt force component. The majority of pre-teen homicides are due to blunt force injuries of the head or head and torso. Age, gender, and race influence specific neuropathologic findings. Brain weight ratio correlates with survival and is influenced by neuropathology. Detailed, systematic study and documentation of the central nervous system and ophthalmic injuries is essential in determining the nature and timing of the injuries and ruling out natural diseases or accidental injuries.

Blunt Force Head Injuries, Pre-Teen Children, Homicides

G32 Transplacental Intrauterine Herpes Simplex Virus Infection Resulting in Cutaneous Calcifications in an Infant

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After attending this presentation, attendees will learn about a unique pathologic presentation of transplacental neonatal herpes infection, which may aid in future clinical diagnoses.

This presentation will impact the forensic community and/or humanity by highlighting a distinctive but rare presentation of Herpes Simplex Virus (HSV). By augmenting the relatively scant literature on transplacental HSV infection, this case may expand the differential diagnoses for infant autopsies with similar gross findings, and possibly aid in earlier detection and treatment of intrauterine HSV infection.

Neonatal HSV infection is often associated with liver necrosis, microcephaly, intracranial calcifications, and brain necrosis, and clinical signs may not be apparent until several days after birth. In many of these cases, transmission occurs during birth. More rarely, transplacental intrauterine HSV infection can occur, with life-threatening effects due to earlier onset in the pregnancy. A literature search reveals some isolated case reports of similar cases, most of which demonstrate unique gross presentations. The authors describe the autopsy case of an infant born at 25 weeks gestation with diffuse cutaneous calcifications. There was microscopic evidence of acute chorioamnionitis and acute funisitis. HSV immunostaining was positive on the tissue sections of placental membranes and umbilical cord. Polymerase chain reaction analysis (PCR) on the same paraffin-embedded tissues was positive for HSV. No viral inclusions were identified in any of the tissue sections.

A pregnant 20-year-old female (G1P0) presented to her obstetrician with spontaneous rupture of membranes at 25 weeks gestation. The patient was transferred to a tertiary care center for probable chorioamnionitis, where she was noted to be febrile with uterine tenderness and an elevated

white blood cell count. The fetus began to show signs of distress with decelerations in heart rate, and a caesarean section was planned. However, the infant was delivered vaginally in the operating room, approximately 18 hours after the membranes ruptured. The infant failed to breathe spontaneously and had no heart rate, so resuscitation efforts began, including intubation and 3 doses of epinephrine per endotracheal tube. Resuscitation was discontinued after 15 minutes since the infant could not sustain a heart rate. Apgar scores were 0 @ 1 minute, 1 @ 5 minutes, and 0 @ 10 minutes.

Maternal past medical history was significant for two urinary tract infections during pregnancy, with urine cultures positive for *Escherischia coli*. She was also briefly hospitalized for pyelonephritis one week prior to delivery, with urine cultures again positive for *E. coli*. She was treated with Macrobid and Keflex, and was still taking these medications along with prenatal vitamins at the time of delivery. Prenatal labs were negative for chlamydia, gonorrhea, HIV, and Group B Strep. She denied any history of sexually transmitted diseases. There was no documentation of prenatal HSV testing.

At autopsy, the infant's skin was light tan with extensive areas of dark red discoloration on the back, chest, and head. Additionally, there were irregular, white patchy lesions on the posterior head, back, shoulders, chest, inguinal areas, and over the coccyx. These lesions appeared to be intradermal, were not palpable, and did not scrape off. The remainder of the gross examination was unremarkable. The body was that of a normally formed male infant, consistent with a 25-week gestational age. No other dysmorphic features were noted, and the internal organs were located in their normal anatomic positions. The placenta was significant for a white area on the maternal surface, grossly consistent with an infarct, and encompassing less than ten percent of the maternal surface area.

Microscopically, the skin demonstrated multiple areas of intradermal calcifications, consistent with the white, patchy lesions seen grossly. Hyperkeratosis was present, with amorphous debris visible on the skin surface. However, only minimal inflammation was observed around the calcified areas. The lungs contained multiple areas of lymphocytic infiltration with debris-laden macrophages. The infarcted area on the maternal side of the placenta showed acute inflammation with neutrophilic extravasation and fibrin deposition. The umbilical cord demonstrated funisitis, with neutrophils visible in the walls of the cord vessels, and chorioamnionitis of the placental membranes. Of note, no herpetic viral inclusions were identified in any of the tissue sections.

Sections containing the intradermal calcifications and sections of placental membranes and umbilical cord were sent for special staining. GMS, gram stain, Steiner stain (for spirochetes) and Toxoplasmosis stain were all negative on these sections. However, HSV immunostaining was positive on the placental membranes and umbilical cord. HSV infection was confirmed by PCR at an outside laboratory (ARUP Laboratories, Salt Lake City, Utah). The tissue submitted for HSV PCR was from the formalin-fixed and paraffin-embedded sections of placental membranes and umbilical cord.

Herpes (HSV, Herpes Simplex Virus), Transplacental, Cutaneous

G33 Killer Hairdryer

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After attending this presentation, attendees will learn about the silent and invisible nature of electric current injury that requires a thorough investigation of the death scene, to aid in accurately determining the cause of death. In a suspected electrocution in water, if the autopsy fails to reveal indications for an electrocution, a check of the bathtub or pool's electrical system is still in order.

This presentation will impact the forensic community and/or humanity by assisting the forensic community in understanding the important reasons for vigorous investigations of these deaths in bathtub to prevent further injury.

This case consists of the tragic death of a perfectly healthy 9-year-old girl (Proc. N. 2172 / 2004 Court of Trani), with no history of illnesses, congenital or otherwise, who was found dead by her mother, in the bathtub filled of water. The parents reported to the Judicial Authority that it was an unexpected death, excluding the possibility of an electrocution. The findings of the following forensic investigations were unprecedented, both from a legal perspective, as well as from the point of view of the postmortem and histological data gathered.

The external examination of the child's body revealed no traces of traumatic or violent wounds, although two small unusual areas of skin were detected in the lumbar region, which, when substantially enlarged, appeared to be pale and irregular compared with the surrounding skin. The internal examination revealed only a small myocardial dyschromic area under pericardium, a small area of haemorrhage at the level of the lower part of the uterus and a reddish area in region of the vagina.

The histological examinations excluded acute or chronic pathology, revealing indications for an electrocution on the lumbar skin specimens where a palisade-type appearance of the malpighian layer was noted. Furthermore, in the myocardium specimen's bands of contractions and fragmentation and coagulative haemorrhagic intramyocardial necrosis were observed.

This suspicion of an electrocution was not related with the historical and circumstantial facts of the case. The authors suggested that the Judicial Authority obtain a specialist in electrical engineering to perform an examination of the child's home.

The survey of the bathroom revealed the presence of a glazed metal bath and a hairdryer. The examination of the hairdryer revealed that some of internal parts oxidized. The electrical plant of the house was protected only by a thermomagnetic circuit breaker and there was no differential circuit breaker.

In addition to these findings, suspicion for an electrocution was supported by the results obtained by a finite element method simulation, aiming at determining the electric current distribution inside a human body immersed in a bathtub when an electrically connected hairdryer came into contact with the bath water. The simulation showed that when the water came in contact with the electrical part of the hairdryer, the current lines permeate the bath water and go across the human body. The current flows until the thermomagnetic circuit breaker intervenes (i.e. when the total current reaches about 90 A). On the basis of this study, the authors suggest that a lethal fraction of this current went across the little girl body, and therefore across her heart, resulting in a fatal ventricular fibrillation.

Our investigation having been completed, the judicial authority summoned the parents of the child. The parents withdrew their previous statements, and replaced them with a circumstantial and specific reconstruction of the sequence of events immediately preceding the death, which revealed strong indications of fault. Indeed, the parents of the little girl confessed that her one-year-old brother, who had been left alone with his sister in the bathroom, had thrown the hairdryer into the bath in which his sister was immersed.

The JA therefore asked us to establish the cause or the contributory cause of the lack of differential circuit breaker in the electrical plant. The computer simulation allowed us to confirm that the presence of a differential circuit breaker (i.e. when the electrical plant is in compliance with the law) would not have prevented the death of the little girl, since she was immersed in a highly conductive medium.

In conclusion, the case established a grave 'negligence in supervision' by the parents. The fact that the electrical plant did not meet the Standard requirements did not account either for the cause and / or contributory cause of death. In similar cases the use of hairdryers having a full immersion protection plug against contact with water (either in the "on" or "off" position) should be mandatory. The authors also recommend that hairdryers which are not provided with a full immersion protection device be recalled.

Electrocution, Death in Bathtub, Electric Mark

G34 Pyelonephritis—Sudden and Unexpected Death in Infancy

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The goal of the presentation of these two separate cases is to demonstrate that acute pyelonephritis, which may not be detected clinically, is an unusual cause of sudden and unexpected death in infants.

This presentation will impact the forensic community and/or humanity by informing all of the role acute pyelonephritis plays in sudden, unexpected death in infancy, and providing a discussion of the differential diagnosis. This potentially lethal condition can be misdiagnosed clinically or masked by other co-morbid infections such as otitis media and viral illnesses.

This poster presents two cases of infants dying suddenly and unexpectedly from acute pyelonephritis. In the first case the infant had no known risk factors, in contrast to the second infant who had significant risk for the development of pyelonephritis. The authors review the pathogenesis, incidence, and differential diagnosis of pyelonephritis in infants dying suddenly and unexpectedly.

The first case is that of a previously healthy 7-month-old white female with medical history of asthmatic bronchitis. The infant appeared to be in her normal state of health, playing before she went to sleep the night before her death. She was fed a bottle around 3:00 AM and placed on top of her mother's chest, which was the infant's usual sleeping position at night. At around 6:00 AM the mother noted the infant to lifelessly fall limp from her chest onto the couch. The Coroner's investigation disclosed no evidence of maternal intoxication. No wedging or overlay was suspected. The mother stated the infant had a low-grade fever over the preceding 2-3 days. Despite emergency care and ACLS protocol, the infant could not be resuscitated. Gross autopsy findings revealed no evidence of accidental asphyxia or trauma. All other findings were negative except for an enlarged left kidney demonstrating wedge-shaped foci of pink, soft expanded renal cortex and medulla. No stigmata of sepsis were present. No congenital anomalies of the urogenital tract were grossly evident. Microscopic examination of the kidneys revealed acute pyelonephritis of the left kidney characterized by acute inflammatory cell infiltrates involving the renal tubules and interstitium. Tubular abscesses were present. Death in this case was attributed to acute pyelonephritis.

The second case involved a 10-month-old white male infant diagnosed with Ectrodactyly-Ectodermal Dysplasia-Clefting Syndrome complicated by extrophy of the urinary bladder with subsequent hydronephrosis. The infant had undergone multiple corrective surgical procedures for extrophy, epispadias, anteriorly placed imperforate anus, and cleft palate. His course was complicated by bilateral hydroureter and hydronephrosis. Prophylactic Cephalexin was prescribed throughout the last months of his life. On the day before death the infant developed recent onset of fussiness and low-grade fever, and was diagnosed in the local pediatric clinic with otitis media. He was prescribed Amoxicillin clavulanate and discharged to home. The next evening the infant was placed in an infant swing to calm his fussiness. He was found unresponsive in the swing 2 hours later. The body was positioned sitting in the seat with his head extended over the backrest of the seat. Coroner's investigation revealed no evidence of swing malfunction or positional compromise of respiratory excursion. At autopsy, gross examination revealed the facial and appendicular stigmata of Ectrodactyly-Ectodermal Dysplasia-Clefting Syndrome with postnatal operative corrections. The repaired urinary bladder contained numerous stones, and the mucosa was significant grossly and microscopically for chronic cystitis. Bilateral hydroureter and hydronephrosis were present. A perinephric acute inflammatory exudate was present around the right kidney and adjacent right liver lobe. Histopathologically, both kidneys demonstrated chronic interstitial nephritis, and the right kidney contained acute and chronic inflammatory cell infiltrates within the renal interstitium associated with focal tubular abscesses. Postmortem blood cultures yielded *Proteus mirabilis, Citrobacter freundii,* and *Enterococcus faecalis*. Death was attributed to acute pyelonephritis with perinephric abscess and urosepsis. The significant contributing cause of death was Ectrodactyly-Ectodermal Dysplasia-Clefting Syndrome complicated by extrophy of the urinary bladder.

Acute pyelonephritis is an acute suppurative inflammation of the kidney usually caused by a bacterial infection. Routes of bacterial spread to the kidney can be either hematogenous or due to retrograde ascension from the infected lower urinary tract. Risk factors for pyelonephritis include the following: hematogenous septic spread; congenital obstruction of the urinary tract; vesicoureteral reflux; pregnancy; instrumentation; age and sex; renal lesions with scar; or immunodeficiency. Papillary necrosis, pyonephrosis, perinephric abscess, and urosepsis represent complications of acute pyelonephritis. Both cases involve ascending route of infection. Although the first infant had no gross anomalies of the urogenital tract, functional vesicoureteral reflux cannot be excluded. An incompetent vesicoureteral orifice, which is not detectable on visual inspection, could have allowed the reflux of urine and bacteria into the ureter and kidney. The hematogenous route was not deemed likely in either case. The second case involved a physical anomaly of the urinary tract with subsequent chronic traction and obstruction of the ureters.

The clinical diagnosis of pyelonephritis in infancy may be difficult for several reasons. A diagnostic index of suspicion was blunted by the mild febrile presentation in the first case. Clinical focus on otitis media masked the more serious infection in the second case. This poster presents two cases of pyelonephritis, which were neither suspected by parental caregivers nor diagnosed clinically in the presence of a less serious infection. Pyelonephritis constitutes a rare cause of sudden and unexpected death in infancy.

Pyelonephritis, Sudden and Unexpected Death in Infancy, Autopsy

G35 Necrotizing Fasciitis: Manifestations, Microbiology and Connection With Black Tar Heroin

Nancy M. Dunbar, BA, Carl Wigren, MD, and Richard C. Harruff, MD, PhD, King County Medical Examiner's Office, HMC Box 359792, 325 Ninth Avenue, Seattle, WA 98104*

After attending this presentation, attendees will gain knowledge regarding the manifestations and microbiology of necrotizing fasciitis and how it is related to injection of black tar heroin. The hypothesis is that necrotizing fasciitis caused by drug injection differs substantially from the same disease due to other causes.

This presentation will impact the forensic community and/or humanity by showing the relationship of necrotizing fasciitis to injection of black tar heroin and the importance of understanding the manifestations, microbiology, and causes of this infectious disease.

Introduction: Black tar heroin use is pervasive in the Seattle area. When intravenous (IV) drug users exhaust their IV sites, they resort to subcutaneous (SC) and intramuscular (IM) routes. Unfortunately, SC and IM injection promotes infection by introducing contaminated material into the tissue. Infections are common in heroin users, who often believe that the drug rather than the injection method is responsible. From what is known about black tar heroin, it is likely that either the raw drug or diluents contain clostridial spores, which are difficult to kill by the brief heating drug users employ. It is not uncommon for clusters of infections to be associated with a single batch of heroin. Because necrotizing fasciitis is often fatal, this study was initiated to delineate factors responsible for the disease.

Methods: King County Medical Examiner's Office assumes jurisdiction in all reported cases of necrotizing fasciitis, deaths related to drug abuse, and all infections that may represent a public health hazard. For this study, a records review over 7 years yielded 87 total deaths due to necro-

tizing fasciitis. Eliminating those that lacked identification of the infecting microorganisms left 65 cases in the present study. For these 65 cases, disease manifestations were correlated with the source of infection and the microorganism(s) identified.

Results: Of 32 cases due to drug injection, 17 grew cultures isolating a single organism; the remaining 15 were polymicrobial. Of the 17 single isolates, 13 were clostridia (4 *C. sordellii* and 2 *C. perfringens*). Of the 15 polymicrobial cultures, clostridia were present in 11, with *C. sordellii* representing 4 cases. Overall, clostridia accounted for 24 of 32 cases of necrotizing fasciitis due to black tar heroin injection.

All of 13 cases of necrotizing fasciitis developing after other types of trauma grew cultures containing at least one species of streptococci; 7 grew a single isolate, 4 of which were *S. pyogenes*. The remaining 6 cases were polymicrobial with various streptococci predominating.

In 14 cases developing apparently spontaneously, with no known trauma but several with comorbid conditions, 3 had single isolates of clostridia identified, 2 of which were *C. septicum*. Another 7 grew single isolates of streptococci, 5 of which were *S. pyogenes*. Two additional infections were due to *Staphylococcus aureus*, and the remaining 2 were polymicrobial.

In 6 cases complicating integument breakdown, such as ulcers and percutaneous feeding tube sites, all were infected by streptococci; 2 had single isolates of *S. pyogenes* and 4 were polymicrobial.

Conclusions: This study shows convincingly that necrotizing fasciitis due to clostridial infections is a potential consequence of IM or SC injection of black tar heroin. This disease has a high mortality rate. Although black tar heroin is the likely source, clostridia are unlikely to cause infection unless mechanically introduced into an anaerobic environment. Thus, the injection method rather than the drug is primarily responsible for the disease. There is insufficient evidence from this study to say whether clostridial spores came from the raw black tar heroin, from diluents, or from contaminated needles. The microbiology of cases of necrotizing fasciitis originating from other sources of infection differs from those due to drug injection; in these, streptococcal infections predominate. Compared to clostridia, group A streptococci (*S. Pyogenes*) are virulent and can cause fatal disease spontaneously or following superficial trauma. Accordingly, the organism itself is often primarily responsible for disease.

This study supports the conclusion that necrotizing fasciitis caused by injection of black tar heroin is substantially different from the same disease resulting from other causes. Cases associated with heroin injection are predominantly clostridial infections while the others are predominantly streptococcal infections. While all cases of necrotizing fasciitis are potentially fatal, this conclusion indicates that different prevention and treatment strategies are necessary depending on the underlying cause.

Necrotizing Fasciitis, Clostridial Bacterial Infections, Black Tar Heroin

G36 Was the Shawnee War Chief Blue Jacket a Caucasian?

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After attending this presentation, attendees will gain an appreciation for the mutation rate of the paternally inherited Y chromosome with regards to inquiries of male lineage.

This presentation will impact the forensic community and/or humanity by demonstrating the confidence by which male line descent can be ascertained by performing a direct comparison of the Y-STR haplotypes back eight generations.

The paternally inherited Y chromosome contains the largest nonrecombining block of nucleotides in the human genome (approximately 50 million base pairs) and has much lower levels of polymorphism than any other region of the human genome (International SNP Map Working Group 2001). It has become an extremely important tool in a variety of areas including forensics (Jobling et al. 1997), genealogical reconstruction (Jobling 2001), molecular archaeology (Stone et al. 1996), nonhuman primate genetics (Stone et al. 2002) and human evolutionary studies (Hammer and Zegura 1996; Underhill et al. 2000, 2001; Hammer et al. 2001). As a direct result of the relatively low mutation rate, 0.23%/STR locus/generation in human pedigrees, concordance of male-line relation can be deduced via direct comparison Y-STRs. This direct comparison of paternally inherited Y-STRs was utilized to explore a centuries old controversial legend that contends that the legendary Shawnee War Chief, Blue Jacket, was not of American Indian descent, however, was a white man of Dutch descent, known as Marmaduke Swearingen. The comparison of twelve Y-chromosome polymorphic markers in six purported male-line descendants of Chief Blue Jacket and four purported male-line descendants of Marmaduke Swearingen, eight generations removed in both families, revealed that male line descendants in each of the families shared the same 12 locus Y-STR haplotype. However, the Swearingen haplotype was distinctly different from that of the Blue Jacket male-line descendants, with consistency at only five of the 12 tested loci therefore, excluding them from an ancestry linked to Chief Blue Jacket.

Y-STRs, Genealogical Reconstruction, Mutation Rates

G37 Using Multiplexed Microsatellite Markers of Cannabis sativa to Determine Genetic Diversity

Maria Angelica Mendoza, MS, Heather Erek, BS*, and José R. Almirall, PhD, 11200 SW 8th Street, CP194, Miami, FL 33199*

After attending this presentation, attendees will understand previously described microsatellite markers known to discriminate between individual plants were multiplexed into a single reaction and validated in 2 separate laboratories with over 30 plant individuals.

This presentation will impact the forensic community and/or humanity by providing the forensic community with a genetic test, which they can use to track origin in order to connect samples to each other to associate distributors.

Cannabis sativa L. (marijuana) plants can be easily identified through morphological examination and chemical analysis; however there is a need for a DNA test for use as a means of association between individual plants and even as a method to track distribution networks.

Cannabis sativa L. is the most frequently used illegal drug in the United States. *Cannabis* has been used throughout history for its stems in the production of hempen fiber for rope and fabric, for its seed for oil and food and for its flowers and leaves as a psychoactive drug. Microsatellite markers have been chosen for a DNA test because these markers have distinct advantages over other genetic methods. STRs have multiple alleles at a single locus, can be standardized such that reproducibility between laboratories can be easily achieved, have a high discrimination power and can be multiplexed.

In this project, seven *Cannabis* primers selected from a set of primers previously described by the group [1] and four *Cannabis* primers from a set previously described by Gilmore's group [2] were multiplexed into a single reaction. The multiplex reactions were independently analyzed in two separate labs for 30 different cannabis plants. Both an ABI 3100 and an ABI 310 were used for the analysis. Trinucleotide repeats were chosen to reduce the incidence of artifacts that may affect interpretation. The forward primers in some of the primer sets were fluorescently tagged with 6-FAM

dye and some of forward primer sets were tagged with HEX dye. Hemp DNA extracts were provided by Tariq Mahmood of the Alberta Research Council in Alberta, Canada. The hemp samples were amplified in a single optimized reaction to determine base pair size for each allele. The primers were then combined into a single multiplexed reaction. The samples were amplified on a 9700 Thermal cycler with the following parameters: a 5-minute incubation at 94°C then twenty-five cycles of 94°C for 30 seconds, 54°C for 30 seconds and 72°C for 30 seconds, eight cycles of 94°C for 30 seconds, 52°C for 30 seconds and 72°C for 30 seconds, a 60 minute extension time at 60°C and a final 4°C chill. The samples were prepared and electrokinetically injected for capillary electrophoresis on the ABI Prism 3100. The data generated was imported into GeneScan 3.7 and the base pair size analysis performed using Genotyper 3.7.

Previous studies using these microsatellite markers were able to distinguish clones from non-clones. Efforts to construct a comprehensive genomic map of *Cannabis sativa*, where the positions of these microsatellite loci on various chromosomes/linkage groups could be defined are presented. Efforts to determine the level of polymorphism and to measure the genetic relationships between different *Cannabis* plants are also presented. There were a total of 30 individual *Cannabis sativa* plants analyzed, 15 with a low Δ^9 tetrahydrocannabinol (THC) content and 15 with a high THC content.

This study determined the practicality of multiplexing primers sets to differentiate individual plants within the Cannabis sativa species. Using previously described primer sets the authors were able to produce a working multiplex, which could differentiate fourteen individual Cannabis samples of unique origin. During testing, the authors determined that there was no significant difference in base pair size between alleles typed using the single locus amplification and the multiplexed amplification. Each cannabis sample gave a unique profile showing clear differences between the generated genotypes.

References:

1. H. AlGhanim and J.R. Almirall, Development of Microsatellite Markers in *Cannabis sativa* for DNA Typing and Genetic Relatedness Analyses, *J. of Analytical and Bioanalytical Chem.,* **2003**, 376: 1225-1233.

2. S. Gilmore and R. Peakall, Isolation of microsatellite markers in *Cannabis sativa* L. (marijuana). *Molecular Ecology Notes* **2003,** 3: 105-107.

Cannabis, STRs, Multiplex

G38 Co-Amplification of Cytochrome B and D-loop mtDNA Fragments for More Reliable Species Identifications

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After attending this presentation, attendees will learn a new method for the analysis of degraded DNA samples in wildlife forensics, food inspection, conservation biology and ancient faunal remains analysis.

This presentation will impact the forensic community and/or humanity by demonstrating the co-amplification method, which is a simple, cost-efficient and genomic DNA-saving approach for species identifications from minute and degraded DNA samples.

This study proposed the simultaneous co-amplification of both cytochrome b and D-loop fragments for more reliable animal species identifications. This method uses a conserved cytochrome b sequence to obtain a less ambiguous species indication and a hyper-variable D-loop DNA sequence to obtain other specific information concerning species, population, and even individual specificities. Tests on ancient whale and salmon DNA samples have demonstrated that the co-amplification is a simple, cost-efficient and genomic DNA-saving approach for species identifications from minute and degraded DNA samples. It is suitable for the analysis of degraded DNA samples in wildlife forensics, food inspection, conservation biology and ancient faunal remains analysis.

Species Identification, PCR Amplification, mtDNA

G39 Sternal Shard From Bystander Bullet: A Rare Mechanism of Homicide

Wendy M. Gunther, MD, Office of the Chief Medical Examiner, Tidewater District, 830 Southampton Avenue, Suite 100, Norfolk, VA 23510*

After attending this presentation, attendees will become aware of unusual locations a bullet may reach in the in body, and understand how a gunshot wound can cause death without the bullet penetrating into the chest cavity, or injuring any vital organ.

This presentation will impact the forensic community and/or humanity by making the attendee aware of fractured sternal fragments as possible injuring substances in a death in which a bullet does not penetrate into the chest cavity, and achieve agreement on whether a death in such a circumstance can be considered accidental, or whether the manner is more appropriately to be deemed a homicide.

An 18-year-old senior high school student, who was captain of the local track team, exited an all-night pancake restaurant after two o'clock on a Saturday morning. He passed through the restaurant parking lot at the time that a gun battle was going on between adversaries on the opposite side of a busy six-lane surface street. The adversaries, who were exchanging shots after exchanging words at a nightclub, were unknown to the victim. It is likely that he was not aware of the gun battle on exiting the restaurant.

A bullet from the exchanged fire crossed the highway, and struck the young man in the chest. He collapsed in the parking lot. Emergency medical services both en route and at the local trauma center provided resuscitative efforts for more than an hour, without avail. Emergency thoracotomy revealed a large amount of blood in the chest.

At autopsy, the gunshot wound had a slightly atypical appearance, in that it consisted of a ½" oval, with a broader than usual central perforation. There were 250 cc of blood remaining in the chest after bilateral thoracotomy; all viscera were markedly pale, and the vascular tree was depleted of blood. In situ thoracic organ dissection revealed the presence of a partially transected right anterior pulmonary vein, with injury to the right atrial appendage. However, despite this clear evidence of an injury path, no bullet could be located for the initial hour of the autopsy.

During the prolonged search for the bullet, a physician, who was observing the autopsy, identified the projectile in the chest plate, which had been set to one side during the dissection, with its undersurface exposed to view. The bullet was clearly visible, impacted in the inner sternum, although it was partially covered by a disrupted shard of fractured bone from the inner cortex of the sternum. This shard of bone, with a triangular shape like a knife blade, projecting at close to a right angle from the inner cortex, had lacerated the pulmonary vein and right atrium. The bullet which caused death had done so without entering the thoracic cavity, and without perforating any vital structures, because it dislocated a sternal shard from the inner cortex of the sternum, at an unfortunate angle which was responsible for death.

The shooter claimed self-defense, in that he was returning fire on a person who, he stated, was firing at him from within a car across the parking lot. The mechanism of death supported his contention that he did not intend to fire at the victim. Three months later, free on bail, he was arrested with three other men after a drug-surveillance related gun battle with police.

The mechanism of this unusual chain of events leading to death will be discussed, utilizing autopsy photographs, with consideration of the appropriate manner of death.

Sternal Shard, Gunshot Wound, Bystander

G40 False Positive Diagnosis of Subarachnoid Hemorrhage and Subdural Hemorrhage by Computerized Tomography

Sangeeta Sandhu, MD, St. Luke's-Roosevelt Hospital, 515 West 59 Street, #4K, New York, NY 10019; Stephen deRoux, MD, and Beverly Leffers, MD, Office of Chief Medical Examiner (Brooklyn), 520 First Avenue, New York, NY 10016-6402; and Thomas Gilson, MD, Office of Chief Medical Examiner (Manhattan), 520 First Avenue, New York, NY 10016-6402*

The goal of this presentation seeks to raise awareness of the potential misdiagnosis of subarachnoid hemorrhage and subdural hemorrhage by computerized tomography. Attendees should understand possible reasons for misdiagnosis as well as their medicolegal and clinical implications.

This presentation will impact the forensic community and/or humanity by presenting three cases of misdiagnosed subarachnoid hemorrhage and one of subdural hemorrhage.
Death investigators should be aware of potential discrepancies between radiologic and autopsy findings.

Subarachnoid hemorrhage (SAH) involves bleeding into the space between the pia and arachnoid membranes and subdural hemorrhage (SDH) is characterized by bleeding into the space between the dura and arachnoid membranes. SDH is generally associated with trauma while SAH has well-recognized traumatic and non-traumatic (e.g. ruptured cerebral aneurysm) etiologies. Computerized tomography (CT) is frequently used in the evaluation of cases of suspected head trauma and has a high sensitivity in the diagnosis of SAH and SDH. Misdiagnosis by CT of SAH has been infrequently reported but may have significant clinical and medicolegal consequences. Potential sources of misdiagnosis include hypoxic encephalopathy, meningitis and reviewer inexperience. This report addresses three adult cases where CT misdiagnosis of SAH occurred as well as a pediatric case where CT misdiagnosed a SDH.

The **first case** involved a 25-year-old man who presented to the emergency department with vomiting and abdominal pain following an alcohol binge. He had altered mental status and went into cardiorespiratory arrest shortly after presentation. He was resuscitated but remained comatose and succumbed to multisystem organ failure three days after admission. A head CT after resuscitation was interpreted as showing diffuse SAH. No SAH was identified at autopsy. Neuropathologic examination revealed changes consistent with hypoxic encephalopathy with cerebral edema. Cause of death was acute liver failure due to acute and chronic alcoholism.

The **second case** involved a 49-year-old man who presented in cardiorespiratory arrest to the emergency department after being found unresponsive at home. Past medical history was notable for a high cervical spine injury approximately one and half years prior to death. Because of the injury the decedent was ventilator dependent. After resuscitation he remained comatose and died one day later. A CT scan of the head after resuscitation was interpreted as showing diffuse SAH but no SAH was identified at autopsy. Neuropathologic evaluation demonstrated hypoxic encephalopathy with cerebral edema. The cause of the decedent's initial cardiopulmonary arrest was related to complications of his remote neck injury and this was listed as the proximate cause of death.

The **final adult case** involved a 33-year-old man with a history of substance abuse who collapsed at a fast food restaurant and was taken unresponsive to the hospital where he was resuscitated. He regained vital signs but had sustained a hypoxic brain insult and never regained consciousness before expiring 14 hours later. A head CT after resuscitation was interpreted as showing diffuse SAH. This was not present at autopsy and neuropathologic examination again showed only signs of hypoxic encephalopathy with cerebral edema. Cause of death was related to acute drug intoxication.

The **pediatric case** involved a 5 week-old infant who was brought to the hospital in extremis by her father after she developed labored breathing. She had been previously healthy but over the preceding hours was described as progressively lethargic. She was intubated in the emergency department but became profoundly bradycardic during a head CT. She received inotropic support but expired four hours after presentation. Head CT was interpreted as showing a small right frontal SDH with blood at the posterior aspect of the interhemispheric fissure. No SDH was identified at autopsy, which revealed bacterial leptomeningitis and this was given as the cause of death. The father was released from police custody following autopsy as he had been arrested on suspicion of child abuse (shaken baby syndrome).

Forensic Science, Subarachnoid Hemorrhage, Subdural Hemorrhage

G41 TASER-Related Fatalities: Case Report and Review of the Literature

Amy T. Sheil, MD, and Kim A. Collins, MD, Medical University of South Carolina, Department of Medical and Forensic Autopsy, 165 Ashley Avenue, Suite 309, Charleston, SC 29425*

After attending this presentation, attendees will be aware of TASER-related fatalities, understand the pathophysiological effects of TASER stunning, know common comorbid conditions identified in deaths resulting in conjunction with TASER use, and identify important clinical and pathologic information in the assessment of a TASER-related death.

This presentation will impact the forensic community and/or humanity by demonstrating a compilation of information regarding TASER-related deaths and will educate the forensic community (police, coroners, medical examiners, and investigators) regarding use and pathophysiological effects of the TASER. Identification of comorbid conditions and risk factors for poor outcomes associated with TASER stunning may lead to additional studies concerning guidelines for use. Recommendations may inspire the implementation of clinical and histopathological standards in evaluation of future TASER-associated deaths. Finally, understanding the need for cautious use may limit the number of TASER-associated fatalities, and therefore support continued utilization of this non-lethal weapon.

A recent rash of TASER-related fatalities has inspired controversy regarding the use of the touted non-lethal weapon, as well as the exact role the TASER (an acronym for "Thomas A. Swift's Electric Rifle") has played in the deaths of over 100 people since 2001. Most reports have been prominently featured by the media. TASER International, Inc. asserts that the TASER has not been directly responsible for these deaths.

The TASER is an electric stun gun designed to cause incapacitation upon delivery of approximately 50,000 volts of electricity by means of two metal darts. A cartridge containing two barbed darts is loaded in the gun. The darts are attached to the cartridge by means of thin wire (some with ranges up to 21 feet), and are deployed from the cartridge by pressing a trigger button. One press of the trigger causes a five-second delivery of electricity. A longer duration of delivery may be obtained by continuing to press the trigger. Following deployment of the darts, the gun may be used to deliver electricity by direct contact. Delivery of such an electrical stimulus causes intense, immediate, and painful muscle contraction. Many law enforcement agencies throughout the U.S. employ TASER guns; the TASER is also commercially available to civilians. While the TASER likely has been useful in preventing lethal use of force in some situations, a concern is that few standards are in place governing the use of the TASER. Fatalities have occurred during or following TASER stunning. Many perpetrators on whom the TASER has been deployed have been acutely intoxicated by various drugs, including cocaine, methamphetamine, and phencyclidine (PCP). Acute intoxication has generally been ruled as the cause of death in these cases, and TASER use indirectly implicated. In the absence of any evidence of illicit substances, other causes of death have included positional asphyxia, excited delirium, or underlying cardiac disease.

A case of a 29-year-old schizophrenic inmate who died immediately after being tased approximately six times, subsequent to his attack on cor-

rections officers is reported. He collapsed in a supine position, and his hands were cuffed in front of his body. Postmortem examination revealed an anatomically normal heart, normal postmortem vitreous chemistries, and a negative urine drug screen. No obvious cause of death was revealed by autopsy. Focal interventricular cardiac septum subendocardial myocardial contraction bands were identified by light microscopy. The authors concluded that the inmate died of a fatal cardiac arrhythmia, and in light of the temporal relationship to delivery of TASER electrical stimulus, the manner of death was deemed homicide.

The pathology findings in this case are reported, with a review of the existing literature concerning TASER-related deaths.

TASER, Forensic Medicine, Death

G42 A Demographic Analysis of Youth and Teen Suicide in Maryland (1994-2003)

Melissa A. Brassell, MD, Carol H. Allan, MD, Mary G. Ripple, MD, and David R. Fowler, MD, Office of the Chief Medical Examiner, 111 Penn Street, Baltimore, MD 21201*

After attending this presentation, attendees will be briefed on the analysis of trends regarding youth and teen suicide, which will assist in properly developing, placing and implementing suicide prevention strategies.

This presentation will impact the forensic community and/or humanity by demonstrating the trends regarding age, gender, race and methods of suicide among youth and teen age groups (age 10-19) in Maryland, which may assist in the application of suicide prevention strategies.

Learning Objectives: This is a retrospective epidemiologic survey of youth and teen suicide, ages 10-19, in the state of Maryland. Analysis of trends regarding age, gender, race and methods of suicide within this population may assist in the application of prevention strategies.

Suicide is the 11th leading cause of death in the United States, comprising 7% of all deaths. Adolescent suicide rates have continued to increase over the last several decades. There have been an increasing number of articles focusing on the epidemiology of suicide, showing the majority of suicide victims to be Caucasian males, followed by African American males, Caucasian females and African American females, in decreasing order of frequency. Fewer studies have focused on the trends of suicide in childhood. This report is a retrospective analysis of suicide in youth (age 10-14) and teen (age 15-19) age groups.

Suicide is the third leading cause of death between the ages of 10-19 years, comprising nearly 8% of all deaths, following only unintentional injury and homicide. In the state of Maryland, during the years of 1994-2003, there were 262 deaths between the ages of 10 and 19 in which the manner of death was determined to be suicide. The average age was 16.7 years. Youth suicide (age 10-14) accounted for 19.5% of these deaths.

In this population, 68% of suicide victims were Caucasian and 28% were African American, a ratio of approximately 2.5:1. This ratio is lower than that typically seen in the general population. This may be explained by the larger African American population seen in the state of Maryland when compared to the United States as a whole. Other races comprised 4% of suicide victims. As in prior studies on suicide, the majority of suicide victims were male (81%). The order, in decreasing frequency, remains Caucasian males (55.3%), African American males (24.4%), Caucasian females (14.1%) and African American females (4.6%).

Gunshot wounds and hangings, which steadily increased in frequency over the ten-year period, comprised the majority of methods of suicide (83%), consistent with that seen in the general population. A majority of fatal self-inflicted gunshot wounds occurred in the male population (41.6%), with 71.6% of these deaths resulting from contact gunshot wounds to the head or intra-oral gunshot wounds. 5.7% of female suicides resulted from gunshot wounds, approximately half of these due to contact or intra-oral gunshot wounds. Females were significantly more likely to commit suicide by drug intoxication than were males, though hanging was the most common method used. While the availability of firearms has significantly increased over the last decade, there did not seem to be a significant upward trend in the use of firearms to commit suicide in the youth and teen population. There did appear to be an upward trend in hangings. Drug intoxication and multiple injuries, falls from a height, accounted for an additional 10%, with carbon monoxide intoxication and drowning making up the remainder.

Regional evaluation of youth and teen suicide occurrence in the state showed a preponderance of cases in Baltimore County (16%) and Baltimore City (15%). Montgomery County and Prince George's County comprised an additional 23% of cases. The remaining 20 more rural Maryland counties had suicide rates ranging from 1-4%. While there has not been a significant increase in the overall number of youth and teen suicide over the last decade, it may be useful to more closely evaluate those counties, which have had a steady rise in suicides in this age group. Knowledge of risk factors and demographics for suicide in this population, and how they differ according to socioeconomic status will assist in appropriately placing and developing prevention strategies.

Teen Suicide, Suicide Methods, Suicide Prevention

G43 Effectiveness of Death Investigation in Cases of Potential Elder Abuse

Diane C. Peterson, MD, and Richard E. Powers, MD, P220 West Pavilion, Department of Pathology, 619 19th Street South, Birmingham, AL 35233; James N. Robinson, BA, University of Alabama at Birmingham Medical School, VH P-100, 1530 3rd Avenue South, Birmingham, AL 35294; and Gregory G. Davis, MD, Jefferson County Coroner/Medical Examiner Office, 1515 Sixth Avenue South, Room 611, Birmingham, AL 35233-1601*

After attending this presentation, attendees will learn a means to examine the effectiveness of a medical examiner system at detecting cases of elder abuse.

This presentation will impact the forensic community and/or humanity by showing a means for evaluating the effectiveness of a medical examiner office at investigating cases of elder abuse.

RATIONALE: A primary means of detecting foul play is the examination by the medical examiner of the bodies of all individuals who die unexpectedly. Death in the elderly, however, is not necessarily unexpected, and it is possible that foul play is more easily hidden in the elderly by a claim that death was expected, thus bypassing the jurisdiction of the medical examiner. The rate of referral to the medical examiner's office of suspected lethal abuse or neglect in the elderly by all reporters or first responders is unknown. Reasonable conservative estimates exist, however, of claims of elder abuse substantiated upon investigation. Researches wished to assess the effectiveness of the existing medical examiner system in Jefferson County, Alabama at capturing all cases of physical abuse in the elderly. The authors compared the number of cases of suspected elder abuse investigated by the medical examiner office to the number of cases of elder abuse expected to occur in order to determine whether present reporting network and investigative guidelines are sufficient for recognizing cases involving physical abuse in the elderly.

METHODS: The authors conducted a retrospective study of deaths investigated by the Jefferson County Coroner/Medical Examiner Office, Alabama from January 1, 2003 to December 31, 2004 and reviewed the deaths that occurred in decedents 65 years of age or older, looking for evidence of assault or physical abuse. During this time criteria for accepting cases remained unchanged. The findings were compared with an estimate based on the estimated number of cases of physical abuse that should have occurred during this time span. The estimate was made using data from the Adult Protective Services Division of the Alabama Department of Human

Resources, the United States Census estimates for the state and county populations, and the mortality statistics for Jefferson County. During fiscal year 2004 Adult Protective Services conducted 4,754 investigations into allegations of abuse, of which 16% included allegations of physical abuse. Half of these allegations were substantiated upon investigation. Given a random distribution of cases, use of population and mortality data indicate that the Jefferson County Office should expect to investigate about six cases with allegations of physical abuse and three cases of substantiated physical abuse in the elderly per year.

RESULTS: From 2003-2004 the Jefferson County Coroner/Medical Examiner Office examined 198 individuals age 65 years or older, and suspicion of abuse was reported or found in eight cases. In three cases the abuse was not substantiated at postmortem examination, and in five cases the death was a homicide. Based on the estimates given above, the expected number of cases for two years was 12 cases of suspected abuse and 6 cases of substantiated abuse, so the office investigated roughly the number of cases that might have been expected over the course of this study. Because a case more or fewer would make such a large difference when dealing with such small numbers, e looked at the number of homicides in individuals 65 years of age or older by year during the past decade (1995-2004), during which criteria for accepting jurisdiction were identical to the criteria used for the years of review. It was found that the number of homicides in individuals 65 years of age or older per year ranged from a high of 12 (in 1997) to a low of 0 (2004), with a mean of six cases per year.

CONCLUSION: Using published reports of the incidence of substantiated investigations of physical abuse in the elderly, the authors investigated about the number of cases of physical abuse that were predicted by a model. The number of deaths suspicious for elder abuse investigated by the medical examiner is in keeping with the number of allegations and substantiations for elder abuse in Alabama. The authors' approach to case selection and assumption of jurisdiction appears to be adequate for the investigation of physical abuse in the elderly.

Elder, Abuse, Homicide

G44 Use of CT as an Aid in the Recovery of Metallic Foreign Bodies at Autopsy

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After attending this presentation, attendees will learn the practical application of a well-established technology to aid in the recovery of evidence.

This presentation will impact the forensic community and/or humanity by demonstrating the possible introduction of an existing radiology method into the forensic autopsy.

The recovery of metallic projectiles at autopsy can be difficult if the fragments are small, deeply embedded, very few in number or if the entrance wound or wound tract is obscured by burns or tissue loss. The recovery of projectiles is essential for evidentiary purposes. Plain radiographs frequently prove difficult to interpret, and recovery of metallic foreign objects often requires multiple views. The use of CT at autopsy to locate metallic objects is not a new concept, but is impractical when there are large numbers of foreign bodies to be recovered. Software algorithms now provide a means for the subtraction of tissue densities, allowing for: the determination of size, shape, density, and location of metallic foreign bodies in relation to anatomical structures. CT was utilized at the time of autopsy to identify and recover metallic foreign bodies as evidence.

CT, Radiology, Metallic

G45 Antemortem and Postmortem Toxicological Findings in Motor Vehicle Accidents, Maryland (2003-2004): Does Impairment Equal Death?

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After attending this presentation, attendees will understand the potential utility of adding toxicological screening for drugs to the routine testing of alcohol levels in individuals involved in motor vehicle accidents. Furthermore, attendees will better understand the individual, situational and regional factors associated with motor vehicle related fatalities.

This presentation will impact the forensic community and/or humanity by demonstrating a method to assist state officials in setting policy for the testing of substances of impairment involved in serious motor vehicle accidents. In addition, the presentation will impact the design of public alcohol and drug prevention programs by identifying at risk populations and consumption trends, assist law enforcement in the development of improved interdiction programs, and serve as a guide for future research among the forensics community.

In the state of Maryland, law enforcement personnel perform alcohol testing of individuals involved in motor vehicle accidents. The purpose of this research is to determine whether alcohol testing alone is a reasonable marker of impairment in motor vehicle accidents or whether full toxicological screening should also be required. In addition, this research identifies factors associated with use of alcohol and/or drugs in the driving fatality population with the goal of improving public policies and decreasing driving fatalities.

This presentation will assist state officials in setting policy for the testing of substances of impairment involved in serious motor vehicle accidents. In addition, the presentation will impact the design of public alcohol and drug prevention programs by identifying at risk populations and consumption trends, will assist law enforcement in the development of improved interdiction programs, and will serve as a guide for future research among the forensics community.

The research methodology is based on a retrospective study of the motor vehicle accident fatalities that presented to the State of Maryland Office of the Chief Medical Examiner (OCME) and the motor vehicle accident injured population that presented to the University of Maryland Shock Trauma Center (UMSTC) between July 2003 and June 2004. The study sample included motor vehicle operators, passengers, pedestrians, motorcyclists and bicyclists. Outcome variables include the presence of alcohol alone, drugs alone, and both alcohol and drugs. In the fatalities, drugs included are those routinely tested for at autopsy at the OCME and include illicit drugs, prescription medications and over the counter medications. In the injured sample, drugs included the 18 drugs tested for at UMSTC.

Predictor variables include individual factors (e.g., decedent age, race, and gender), situations factors (e.g., vehicle type, single vs. multiple vehicles, driver vs. passenger, at fault vs. not at fault, safety equipment, and road conditions), and regional/geographic factors (e.g., access to trauma care). This approach is similar to that used in public health research, focusing on primary (before event), secondary (during event) and tertiary (after event) factors, as they pertain to injury-causing events.

Using various descriptive and inferential statistical techniques, the following results were derived (for fatalities n=251; for injured n=2,880). The fatality sample was predominately male (n=186), constituting 74%. Caucasians (n=147) and African-Americans (n=78) comprised approxi-

mately 90%. Decedent ages in both populations ranged from 13 to 65 years. Of the fatality sample, 50.6% tested positive for alcohol and/or drugs, 39.4% tested positive for alcohol alone, 12.4% tested positive for alcohol and drugs, and 11.2% tested positive for drugs alone. Of the injured sample, 22.3% tested positive for alcohol and/or drugs, 16.5% tested positive for alcohol alone, 2.6% were positive for both alcohol and drugs, and 5.8% were positive for drugs alone.

The results suggest that alcohol is a good indicator of driving impairment, as approximately 40% of the fatality sample and 16.5% of the injured sample tested positive for its presence. However, nearly half of the fatality sample and 69% of the injured sample that tested positive for drugs would have been missed by alcohol screening only. Therefore, the ability to determine impairment following motor vehicle accidents may be improved by expanded toxicological studies.

Toxicology, Alcohol, Motor Vehicle Accidents

G46 Descriptive Study on the Causes of Death of Residents of Boarding Homes

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After attending this presentation, attendees will gain a better understanding of the circumstances surrounding death and the causes of death for disabled residents of boarding homes.

This presentation will impact the forensic community and/or humanity by demonstrating how boarding homes will become an increasingly common source of cases as disabled individuals are moved from institutional care to community housing in compliance with the federal Olmstead Decree.

RATIONALE: In 1999 the Supreme Court issued the Olmstead Decree, which requires that states offer community-based living for individuals with disabilities rather than house these individuals in institutions. Several options are available to states to satisfy the requirements of the Olmstead Decree. Nursing homes, for example, often house individuals disabled by dementia. Boarding homes also play a critical role in providing housing for disabled individuals, and boarding homes have proliferated in response to the increased demand for such housing since the beginning of the movement to deinstitutionalize individuals with disabilities. The quality of care given by nursing homes has been a subject of great interest recently, both in the medical and legal communities. The nursing home industry is tightly regulated by the federal government, and the causes of death for nursing home patients are recorded as a matter of course. Boarding homes, in contrast, are under no regulation, and virtually nothing is known of the outcomes of disabled patients living in boarding homes, including the circumstances in which these individuals die.

METHODS: The authors conducted a retrospective study of deaths investigated by the Jefferson County Coroner/Medical Examiner Office, Alabama from January 1, 2000 to December 31, 2004. Review of the case files revealed 35 deaths during that time that occurred in a boarding or group home. Each case was reviewed, recording the circumstances surrounding death and the cause and manner of death.

RESULTS: Researchers found 35 deaths investigated by the office which occurred in a boarding or group home. The mean age of the decedents was 59 years, with a standard deviation of 15 years (minimum age 25 years, maximum age 91 years). Twenty-one decedents were black and fourteen were white. Twenty-two decedents were male and thirteen were female. The reasons for living in a boarding home were divided between two broad categories – a history of substance abuse (12 cases) or a history of debilitating illness (17 cases, with 7 cases of schizophrenia or other psychiatric disorder, 2 cases of mental retardation, and 8 cases due to chronic illness such as diabetes mellitus, loss of mobility due to gunshot wounds, etc). In six cases the cause for living in a boarding home was unclear from the chart. The manners of death were distributed as shown in Table 1.

Table 1. Distribution of deaths by manner in decedents from boarding homes.

Manner of Death	No.	(%)	(Overall % of office)
Natural	20	(57)	(34)
Accident	3	(9)	(31)
Suicide	5	(14)	(12)
Homicide	0	(0)	(20)
Undetermined	7	(20)	(3)

The natural deaths were due to ischemic heart disease (7 cases), hypertension (3 cases), and one case each of pneumonia, cardiomyopathy, and alcoholism. The remaining seven natural deaths were due to undetermined natural causes, a situation that most often arises when a physician refuses to sign a death certificate after the body has already been buried or cremated. The three accidental deaths were due to intoxication related to substance abuse. Two suicides were a gunshot wound of the head, two a hanging, and one an overdose. In the seven cases where the cause of death was undetermined, four were undetermined in part because the office received the case after a physician refused to sign the death certificate, and three were undetermined following an autopsy. Decedents with a history of substance abuse tended to be intoxicated at the time of death; toxicology testing revealed an intoxicating substance in nine of the 11 decedents with a history of substance abuse who were tested. Thirty-two of the decedents were not married, whether because of death of their spouse, divorce, or never having married. The factors that led to the assumption of jurisdiction of a case were lack of a physician to sign the death certificate, history or scene evidence to suggest substance abuse, or concern on the part of the decedent's family about foul play or poor care. No evidence of physical abuse was found in any of these cases.

CONCLUSION: Federal law requires that states offer community-based living for individuals with disabilities rather than house these individuals in institutions. Boarding homes are the community-based housing available to these disabled persons. Residents of boarding homes are likely to be disabled by substance abuse or by a mental disorder. Research indicates that abuse of the elderly is more likely in individuals with short-term memory problems, any psychiatric diagnosis, substance abuse, or poor social support. Most residents of boarding homes in this study were socially isolated and either mentally disabled or prone to substance abuse, leading us to conclude that deaths that occur in boarding homes merit forensic investigation.

Group Home, Boarding Home, Disabled

G47 The Death of an Italian Soldier in Iraq: Murder or Fatality?

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The death of an Italian soldier in Iraq is presented. The goal of this study is to present a relatively quick and easy method for evaluation of gunshot residues, useful for interpreting gunshot wounds in cases where the circumstances of death are not clear. A specific histochemical stain with sodium rhodizonate and an analysis using a confocal type laser profile microscope was performed in order to clarify the exact death scenario.

This presentation will impact the forensic community and/or humanity by providing a relatively quick and easy method for evaluation of gunshot residues, using sodium rhodizonate staining on histological

samples, that may help determine range of fire in cases of death caused by firearm, and in this particular case, in order to clarify whether it is an accident, homicide or a suicide case. This histochemical data may be supported by the use of a confocal microscope.

A young Italian soldier in Iraq, at 01:00 p.m. was discovered wounded in a shooting range, where he was training with his rifle, a **"MINIMI" cal. 5.56 mm. The rifle was found near the man and was seized. He was quickly taken by helicopter to the nearest military hospital in serious clinical condition, but he** continued getting worse, so was transferred and hospitalized to Kuwait City, and died **at 4:27 p.m. The body was transferred to Italy to the Department of Forensic Pathology of Foggia. A Military Prosecutor arranged the autopsy on the body because the circumstances of the wound suggested that the death could be an accident or, alternatively, a murder.**

A complete autopsy was performed. The head injury was massive with partial evisceration of the brain. A large gaping tear of the scalp was present. The exact sites of the entrance and the exit of the bullet were not apparent. Careful re – approximation of the scalp and the examination of the tear showed an irregularly circular wound with irregular margins, surrounded by a wide zone of raw abraded skin in the forehead. A large, V – shaped scalp laceration (18 x15 centimetres) radiated from this circular area up to the parietal and occipital bones. Gross identification of the entrance site was not possible. The brain was edematous, and the bilateral frontal and right parietal regions were lacerated with lost brain parenchyma.

The brain was sectioned with coronal cuts according to the Adams technique and showed right to left shift of the midline structure.

In the bilateral frontal region a small foci of hemorrhage was present and characteristic petechial hemorrhages continued throughout coronal cuts and affected the corpus callosum. Furthermore, in the right hemisphere, superficial subcortical hematomas extended into the parenchyma and the right lateral ventricle.

The cerebellum the subarachnoid space was affected by moderate hemorrhage, and the brainstem showed characteristic petechial hemorrhages.

The examination of the other organs was unremarkable. Routine histological investigation of skin specimens applying hematoxilin and eosin staining revealed a detachment of the upper epidermal areas mainly extending through the basal cell layers with flattened and stretched epidermis. The deeper parts of stratum papillare and underlying upper layers of the corium were homogenized. In these areas wide erythrocyte accumulation was present in the dermis and sub-epidermic adipose tissue. In superficial and deep layers of skin and dura mater were black foreign bodies. Brain sections showed intraparenchymal diffuse haemorrhages.

Frontal wound skin and dura mater samples were also stained with Rhodizonate dye technique. Rhodizonic acid exists as needle-shaped crystals of a dark orange colour and forms a sodium salt, which reacts with heavy metal ions (barium, antimony, lead, tin) contained in gunshot residues (GSR) with a red precipitate. On histological tissue sections, Rhodizonate reacts with heavy metal particles from the primer by generating a finely granular scarlet red pattern. The specimens were examined with a light microscope, in transmitted brightfield illumination and phase contrast mode.

In the samples collected from skin of the frontal region the Na-Rhodizonate reaction was positive for the presence of gunshot residues (GSR), showing dotted, non–contiguous, coarsely granulated deposits of rhodizonate, positive not only on the surface of skin, but also appearing within the gaps between connective tissue fibers. The same findings were observed in the dura mater specimens.

The GSR-positive samples were examined with confocal microscope using fluorescence emission of skin and antimony, a heavy metal contained in gunshot residues. A three-dimensional reconstruction was performed that confirmed the presence of GRS – positive granules on skin and dura mater surface.

Gunshot residue findings, their morphological aspects, and their location were indicative for a shooting distance less 40 centimetres.

In this reported case, the careful histological investigation of the wound skin through specific staining made the circumstances of the death clear, leading to the assessment of entrance site and firing distance.
Furthermore the circumstantial data confirmed the hypothesized death scenario, that it was an accidental self–inflicted gunshot while the soldier was trying to unblock his rifle.

Soldier Death, Gunshot Wound, Shooting Range

G48 Prevention of Accidental Strangulation of Children in Their Sleeping Bags: Development of a New Sleeping Bag

Kathrin Gerlach, MD, Department of Legal Medicine, Pestalozzistrasse 22, Basel, 4056, Switzerland; Beat Horisberger, MD, Department of Legal Medicine, Rue du Bugnon 2, CH-1005 Lausanne, Switzerland, Walter Bar, MD, Department of Legal Medicine, Winterthurerstrasse 190, CH-8091 Zürich, Switzerland; and Volker Dittmann, MD, and Daniel Wyler, MD, Department of Legal Medicine, Pestalozzistrasse 22, CH-4056 Basel, Switzerland*

The goal of this presentation is to draw your attention to the dangers of accidental strangulation of children in their sleeping bags. Dr. Gerlach will also introduce a newly developed model of a sleeping bag, which prevents fatal incidents of that kind.

This presentation will impact the forensic community and/or humanity by aiming to sensitize the audience to the problem, to critically discuss the prototype as well as to show how to avoid such fatalities, which should also be accomplished by marketing the new sleeping bag.

In the last few years, researchers analysed several fatalities of children who had strangled themselves at the neckline of their sleeping bag due to their own movements while sleeping. Those sleeping bags can be purchased on the market and should be suitable to fix children.
Types of sleeping bags currently available on the market with their safety advantages and disadvantages are presented.
After this analysis, these fatal incidents appear to be avoidable, and it is possible to adopt measures to prevent these deaths. A simple means to resolve the problem would be a revision of the cut patterns in the current sleeping bags, which fixes the main hazard of these sleeping bags.

A prototype was developed with a cut to prevent these fatal incidents. This prototype sleeping bag is being tested for its functionality and handling and is registered for marketing. This prototype will be presented to an audience of experts.

Sleeping Bag, Strangulation, Prevention

G49 VIRTOPSY (Virtual Autopsy) - Past, Present, and Future

Michael J. Thali, MD, University of Berne, Institut Forensic Science, Buehlstrasse 20, Bern, Switzerland; Peter Vock, MD, University of Berne, Radiology Department, Berne, 3005, Switzerland; and Richard Dirnhofer, MD, University of Berne, Institut of Forensic Medicine, Berne, Berne 3012, Switzerland*

After attending this presentation the attendee will get an upgrade of the cutting edge technologies in forensic imaging/radiology.

This presentation will impact the forensic community and/or humanity by providing an actual overview of upcoming imaging technologies in forensic medicine.

The aim of the VIRTOPSY project (www.virtopsy.com) is utilizing 3D body-surface documentation and minimal-invasive, image-guided virtual autopsy utilizing optical and radiological scanning to push low-tech

documentation and autopsy procedures in a world of high-tech medicine in order to improve scientific value, to increase significance and quality in the forensic field. The Institute of Forensic Medicine, University of Berne is, in collaboration with a well selected national and international research team, evaluating and validating several cutting-edge technologies such as 3D optical and photogrammetric surface scanning, computed tomography (CT), magnetic resonance imaging (MRI), magnetic resonance (MR) spectroscopy, micro-CT, micro-MR, postmortem biopsy, postmortem angiography and synthetic body models. The term VIRTOPSY was created from the terms virtual and autopsy: Virtual is derived from the Latin word 'virtus', which means 'useful, efficient, and good'. Autopsy is a combination of the old Greek terms 'autos' (=self) and 'opsomei' (= I will see). Thus autopsy means 'to see with ones own eyes'. Because the goal was to eliminate the subjectivity of "autos", the two terms virtual and autopsy were merged - deleting "autos" - to create VIRTOPSY. Today the project VIRTOPSY combining all the research topics under one scientific umbrella, is characterized by a trans-disciplinary research approach that combines Forensic Medicine, Pathology, Radiology, Image Processing, Physics and Biomechanics to an international scientific network. The paper will give an overview of the Virtopsy change process in forensic medicine.

Virtopsy, Virtual Autopsy, Forensic Radiology

G50 Professional Quality in a Forensic Medical Setting: The Singapore Experience

Paul P.S. Chui, MBBS, DMJ, MBA, and Clarence T. Tan, MBBS, Health Sciences Authority, 11 Outram Road, Singapore, 169078, Singapore*

After attending this presentation, attendees will 1. Understand the need for Professional Quality in a forensic medical setting; 2. Gain an insight in how CFM, HSA has approached the subject of Professional Quality; and 3. See the need to implement quality systems suitable to their own operating environment.

This presentation will impact the forensic community and/or humanity by encouraging implementation of quality systems and promoting more emphasis on assuring quality of services of the forensic medicine community; and encouraging dialogue between practitioners as to best practices that would engender the above.

In many different industries, including the healthcare sector, the pursuit of quality has become an essential element in both assuring consumers a consistency of standards in the products and services delivered as well as delivering a competitive marketing advantage. Indeed, this also applies to many public agencies around the world.

Forensic medical practices/consultancies are typically small "enterprises" with limited budgets and they operate within a limited legal/geographical jurisdiction, in a typical single seller (the forensic practice) and single buyer/payer (State/Law Enforcement agency) environment. Some of these "enterprises" are one-man-operations (OMO).

Professional accountability is mostly limited to challenge within a courtroom environment or is non-existent outside of the courtroom in some instances. Peer review is not a norm. The weight placed on personal professional independence, expertise and experience creates an milieu amenable to development of a prima donna culture where forensic opinion is no longer largely a question of science but of the weight of persona and charisma in court and the public eye, where the risk of errant practices and practitioners may remain undetected for a long time. Failure to deliver good quality results can pervert the course of natural justice and damage public confidence in the law enforcement and judicial systems.

Considering the impact of the professional work in influencing judicial outcomes, it is important, in the authors' view that while one cannot wholesale adopt practices from the industry, efforts nonetheless need to be made to identify relevant and appropriate measures for adoption, to assure the stakeholders (the Prosecution, the Courts, Law Enforcement, the Public, the Politicians, the funders) that high standards in professional forensic practice are delivered consistently with accountability. The paper will discuss the experience of the Centre for Forensic Medicine, Health Sciences Authority Singapore, in its journey towards assuring professional quality.

Quality, Forensic Medicine, Accreditation

G51 Insects of the Grave: A Cold Case History Involving Insects 27 Years After Death

Richard W. Merritt, PhD, Michigan State University, Department of Entomology, 243 National Science Building, East Lansing, MI 48824; Mark E. Benbow, PhD, Department of Biology, DePauw University, Greencastle, IN 46135; Ryan K. Kimbirauskas, MS, Michigan State University, Department of Entomology, East Lansing, MI 48824; Joyce L. deJong, DO, Sparrow Hospital, 1215 East Michigan Avenue, Lansing, MI 48909; and Richard Snider, PhD, Michigan State University, Department of Zoology, East Lansing, MI 48824*

After attending the presentation, attendees will understand the biology of a relatively small group of insects (Collembola) rarely mentioned as an insect frequenting decomposing remains, especially following exhumation 27 years after death. They also will be exposed to the environmental factors that may have led to this occurrence.

This presentation will impact the forensic community and/or humanity by presenting case that provides important information to entomologists and biologists on the biology of Collembolan as it relates to human decomposition. The case also will add to the biological information of this insect group as to their movement in the soil and apparent niche at this soil depth. This is information that will rarely ever be collected in normal crime scene investigations, and it is a rare occurrence in nature to find insects inhabiting a cadaver 27 years after death.

This presentation will make forensic entomologists and other biologists aware of insects and other arthropods associated with decomposing bodies far beyond the normal postmortem interval. It also will make forensic pathologists aware of what types of arthropods may be encountered during investigations when bodies have been exhumed after several years.

The cadaver of a 28-year-old female was exhumed in January 2005 from a cemetery in Battle Creek, Michigan. She had sustained a gunshot wound to the head and was found dead in her home on November 15, 1977. An autopsy was performed and the manner of death was termed as a homicide. The body of the victim was subsequently embalmed and then buried at a depth of 6 feet in an unsealed casket that was placed inside an unsealed cement vault. Information leading to the perpetrator of the crime became known in 2004 and the investigating agency was unable to locate an autopsy report. Therefore, law enforcement officials requested the body be exhumed and a second examination be performed.

The current exhumation yielded thousands of live specimens of a single species of Collembola or spring tails, Sinella *(Coecobrya) tenebricosa*. This species is considered to be a "tramp" species, cosmopolitan in the United States and Canada. It is usually collected in protected areas such as caves, wood piles, and greenhouses. Based on their occurrence in soils, small size, and given the damp conditions present in the casket, this species probably made use of soil pores and tunnels made by worms and other burrowing arthropods in searching for food. Over time, some individuals moved down further into the soil into the moist vault and eventually the casket where cadaver tissues and clothing provided a suitable substrate for fungal/yeast/mold growth as a food source. At this site the species had ideal conditions and the population exploded. Collected with the Collembola were large numbers of Acarina (mites) of the Family Glycyphagidae, and phorid fly puparia, known as coffin flies.

Insects, Burial, Collembola

G52 Seasonal Effects on Blow Fly Species Composition and Behavior

Jennifer Y. Rosati, BSc, and Sherah L. VanLaerhoven, PhD, University of Windsor, Rm 119 Bio, 401 Sunset Avenue, Windsor, Ontario N9B 3P4, Canada*

After attending this presentation, attendees will learn about blowfly species and behavior and how it relates to decomposition and PMI determination.

This presentation will impact the forensic community and/or humanity by recognizing the importance regarding the effects of habitat and season on blowfly species composition and behavior.

Blowfly species composition is an important aspect to consider in the determination of the postmortem interval (PMI). Presented here are some preliminary results from the first year of a 2-year decomposition study. The effect of habitat (sun and shade) and season (spring, summer, and fall) on the successional patterns of carrion insects were investigated using the domestic pig. Each season, 2 freshly killed pigs (approximately 23kg) were placed in each habitat type in 6 test sites located throughout Windsor/Essex County, Ontario (n=12 pigs/season). Insects were sampled using a combination of pitfall and malaise traps as well as direct sampling. Internal carcass temperatures and ambient temperatures were recorded for each pig using Smartbutton data loggers and biomass loss was determined through weekly weighing. The effect of habitat and season can play a significant role in determining the species composition and successional patterns of the blowfly community. Observations and differences concerning maggot feeding and wandering behavior for each habitat and season were recorded. The research is currently on going with the second year beginning in April 2006.

Blowfly Species Composition, Blowfly Behavior, Habitat and Seasonal Effects

G53 Improving Postmortem Interval Estimates in Forensic Entomology: Blowfly Gene Expression and Development

Aaron M. Tarone, BS, Department of Zoology, 203 Natural Sciences Building, Michigan State University, East Lansing, MI 48824; and Kimberly C. Jennings, BS, and David R. Foran, PhD, School of Criminal Justice, 560 Baker Hall, Michigan State University, East Lansing, MI 48824*

After attending this presentation, attendees will learn about the use of gene expression information to assist in making entomology based PMI estimates.

This presentation will impact the forensic community and/or humanity by improving the precision of entomology based PMI estimates.

Investigators often use the presence and age of blowfly larva on a carcass to estimate the postmortem interval (PMI). Currently, morphological traits, including larval instar and length and weight are used to approximate larval age. Likewise, pupae can be dissected and morphological features observed. However, the precision of these estimates is always in question, particularly for the longer third instar and pupal stages.

The goal of this project was to produce a more objective, genetic-based assay of juvenile fly age, and thus PMI, focusing on the widely distributed and forensically useful blowfly, *Lucilia sericata.* The foundation for this assay was the wealth of developmental data already available from the model fly system *Drosophila melanogaster,* as well as from a *sericata* sister species, *L. cuprina,* a sheep parasite that has been studied in Australia and New Zealand. In both systems, a variety of developmentally important genes have been shown to undergo changes in expression levels throughout the immature stages (egg, larva, and pupa). Using known sequence from *D. melanogaster* and *L. cuprina*, a suite of genes (white, scalloped wings, resistance to organophosphate 1, acetylcholine esterase, ultraspiracle, ecdysone receptor, wingless, slalom, aminopeptidase 1, bicoid, chitin synthase, and heat shock proteins 60 and 90) was isolated and sequenced in *L. sericata*. The expression levels of these genes were profiled throughout the juvenile life cycle at two temperatures. They were also assayed in larvae that failed to pupate.

Gene expression profiles were obtained for replicate time series, as were the distributions of gene expression levels. Examples of informative transcripts at a specific stage include resistance to organophosphate-1, which became the most common transcript in mid pupal samples, and scalloped wings, which decreased dramatically at the same time. Through replicate analysis of many individuals from each developmental stage, a confidence interval could be assigned to the expression level of each gene throughout the life cycle. Further, by analyzing the expression levels of a number of genes, confidence levels could be assigned to the estimate of developmental stage of the flies. Finally, expression profiles of larvae that failed to pupate were examined, which indicated aberrant gene expression lay at the root of this phenotype.

Current research in forensic entomology includes investigation of error rates for PMI estimates, as well as improved use of environmental information, in an attempt to increase the accuracy of PMIs generated in this way. The developmental gene expression research presented here addresses the biological side of the same issue. The method allows for a quantitative analysis of age using many different traits, and represents a promising approach for improving entomology based PMI estimations.

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Forensic Entomology, DNA Expression Levels, Postmortem Interval

G54 The Developmental Studies of The Green Bottle Fly, *Phaenicia coeruleiviridis* (Diptera: Calliphoridae)

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After attending this presentation, attendees will learn the developmental growth times of Phaenicia coeruleiviridis in this preliminary study of this species.

Insects collected at crime scenes are often used to estimate PMI (Postmortem Interval). Developmental growth curves of individual species are used in these estimations. To date, there is very little information on the species Phaenicia coeruleiviridis. This presentation will impact the forensic community and/or humanity by helping in creating a more accurate PMI estimate when Phaenicia coeruleiviridis is used.

Despite its obvious presence and abundance in the south and southeastern parts of the United States, there is little information on the growth and development of the green bottle fly, *Phaenicia coeruleiviridis* (Macquart). Growth curves were determined for the egg, larva, and pupa stage of this species under constant temperatures of 21.1, 23.8, and 26.6°C. Development from egg to adult under all temperatures ranged from 608 to 844h. Length and mass measurements for each development stage at each temperature regime were reported, giving investigators an option for analysis of age and postmortem interval estimations using *P. coeruleiviridis*. Although the genus *Phaenicia* (=*Lucilia*) is small and the species appear similar, developmental data varies greatly within this genus, indicating a need for further study.

Developmental Growth Curve, Forensic Entomology, *Phaenicia coeruleiviridis*

G55 Effects of Fluctuating Temperature and Larval Density on *Calliphora dubia* (Diptera: Calliphoridae) Implications for Postmortem Interval Estimation

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After attending this presentation, attendees will be briefed on this part of a series of research papers, which revisits fly life histories and examines them in the environment lived in, rather than the constancy of the laboratory. Entomologists involved in case-work need to understand developmental rates of insects.

This presentation will impact the forensic community and/or humanity by reminding forensic entomologists to be careful in their assessment of fly life histories and their application in case work.

The accuracy of any entomological estimation of postmortem interval (PMI) depends on the thermal history of the larval samples investigated and the availability of comparative developmental reference data. At present, there is a paucity of data relating to larval development under geographic-specific climatic conditions and the influence of micro-environmental temperature produced by larval aggregations on development.

Most entomological PMI estimates are based on reference data compiled from larvae reared at constant temperatures. These estimations have the potential to be erroneous where ambient temperatures at the crime scene fluctuate over time, or where larval aggregations are present on the cadaver during development. High larval density can alter the temperature of the microenvironment experienced by the larvae above that of the ambient temperature used in the PMI estimation.

In this study, the rate of larval development of the forensically significant blowfly, *C. dubia,* was investigated under both constant and fluctuating temperature regimes. Temperatures investigated approximated the summer (24ºC; 19/30ºC) and autumn (19ºC; 13/25ºC) seasonal temperatures of southern Western Australia. The influence of larval aggregation on the development rate of *C. dubia* was also investigated using larval densities of between 50 and 5000 larvae. This presentation will discuss the influence of larval aggregation size and fluctuating temperatures on the development rate of *C. dubia* and the implications of this for PMI estimation

Development, Flies, PMI

G56 The Composition and Succession of Soil Microbial Communities Following Cadaver (*Rattus rattus* L.) Burial

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After attending this presentation, attendees will understand fundamental principles concerning the composition and population dynamics of soil microbial communities associated with cadaver decomposition in soil.

This presentation will impact the forensic community and/or humanity by demonstrating the potential for microbial succession as a basis for estimating postmortem interval.

Recent research has shown that the soil microbial biomass can respond positively to the burial of a juvenile rat (*Rattus rattus*) cadaver. However, it is unknown what components (bacteria, fungi) of the soil microbial biomass are associated with this increase in microbial abundance. It is well understood that the amendment of soil with an organic resource (such as a cadaver) can result in a shift in the composition of the soil microbial community. Furthermore, the composition of microbial communities can also change as a resource decomposes and these successional changes may provide a basis to estimate postmortem interval.

The current experiment aims to demonstrate the concentration and succession of Gram-positive bacteria, Gram-negative bacteria, and fungi associated with cadaver breakdown. In order to investigate this, a field experiment was conducted at two disparate field sites during the dry season (March 2003). Site 1 comprised a loamy sand soil (84% sand, 11.1% silt, 4.9% clay) and was located in Yabulu, Queensland, Australia. Site 1 receives an average rainfall of 140 mm during the dry season (March-October) and average maximum/minimum temperature equals 22.9 C/16.7 C. Site 2 comprised a sand soil (97.7% sand, 1.3% silt, 1% clay) and was located in Pallarenda, Queensland, Australia. On average, site 2 receives 120 mm of rainfall during the dry season and the average maximum/minimum temperature is 26.9 C/16.4 °C. The resulting vegetation at the two sites was dominated by grasses with scattered trees. These characteristics are typical of a tropical savanna ecosystem.

Juvenile rat (*Rattus rattus*: ~18 g) cadavers were buried (2.5 cm) in the center of a 2 m^2 plot. Cadaver mass loss and phospholipid fatty acid (PLFA) concentration of soil directly surrounding each cadaver were measured at 7, 14, and 28 days following burial. To measure PLFA concentration soil was amended with a chloroform:methanol:phosphate buffer, shaken and centrifuged. Supernatant was removed, placed in a clean glass culture tube, and dried under nitrogen (N_2). Dried lipids were resuspended in chloroform and phospholipids were eluted with methanol through a silicic acid column and dried under N_2. Dried phospholipids were amended with acidified methanol, incubated for 12 hours at 60 °C, and amended with purified water and petroleum ether. The ether layer was transferred to a clean culture tube and dried under N_2. Standard (19:0) and hexane were added to the dried ether layer and PLFAs were separated by capillary gas chromatography using an automated procedure developed by MIDI (MIDI, Inc. Newark, DE). PLFAs were used as markers of Gram-positive bacteria (15:0, i15:0, i16:0, 17:0, i17:0, a17:0), Gram-negative bacteria (cy17:0, cy19:0, 16:17c, 16:17t) and fungi (18:26c). This experiment was replicated four times and controls (soil without cadaver) were used.

After one week's burial cadaver decomposition at Site 2 (1/3 mass loss) was greater than at Site 1 (1/4 mass loss). All cadavers lost approximately ¾ of mass after two weeks at which time the larger soil microbial community was found at Site 1. At this site, the microbial community was dominated by bacteria throughout, and Gram-positive and Gram-negative bacteria comprised equal fractions of the population. Fungal PLFA's were detected after two and four weeks only. The microbial community at Site 2 was also dominated by bacteria for the first two weeks after burial, and Gram-positive and Gram-negative bacteria also comprised equal fractions of the bacterial population. In contrast to site 1 however, the microbial community was dominated by fungi on day 28.

These findings are not surprising considering the introduction of a high-quality; complex resource (such as a juvenile rat cadaver) tends to result in the proliferation of bacteria. As these resources are depleted bacteria are commonly replaced by fungi, which are more tolerant to moisture stress and can be indicators of low soil nutrient status. The difference in succession between soils may be because cadavers buried at Site 2 reached skeletonization prior to cadavers buried at Site 2. These successional sequences may be used as a basis to estimate postmortem interval of cadavers that have progressed into the skeletonization stage of decomposition. The dynamics of specific PLFAs will be presented in relation to cadaver decomposition stage.

Taphonomy, Succession, Phospholipid Fatty Acid Analysis

G57 Nematode Community Dynamics Associated With Cadaver (*Sus scrofa* L.) Decomposition and Insect Activity on the Soil Surface

David O. Carter, PhD, Department of Plant Pathology, University of Nebraska-Lincoln, 406 Plant Sciences Hall, Lincoln, NE 68583-0722; Timothy E. Huntington, MSc, and Leon G. Higley, PhD, Department of Entomology, University of Nebraska-Lincoln, 202 Plant Industry, Lincoln, NE 68583-0816; and Thomas O. Powers, PhD, Department of Plant Pathology, University of Nebraska-Lincoln, 406 Plant Sciences Hall, Lincoln, NE 68583-0722*

After attending this presentation, attendees will understand the relationships between the composition of belowground nematode communities and cadaver decomposition as well as how these relationships are influenced by insect activity.

This presentation will impact the forensic community and/or humanity by demonstrating the potential for nematode succession as a basis for estimating postmortem interval.

Soil-dwelling nematodes are microscopic invertebrates that play a key functional role in soil processes of decomposition and nutrient cycling. Nematodes are generally the most abundant and diverse metazoans living in the soil and respond rapidly to disturbance, such as the decomposition of a body. The investigation of nematode community structure can reflect decomposition status because nematodes exhibit a sensitive relationship to their environment by responding to the spatial and temporal dynamics of resources. Thus, a localised succession of nematode trophic groups (bacterial-feeder, fungal-feeder, herbivore, omnivore, and predator) occurs as a resource decomposes. Nematodes are readily sorted into trophic groups because feeding behavior can be deduced from the structure of the mouth cavity and pharynx. This makes nematodes an efficient indicator of decomposition status. In addition, nematodes may be transported to a decomposition site by insects. This may have implications for forensic science because nematodes can establish phoretic relationships with many insects associated with cadaver decomposition (Calliphoridae, Coleoptera, and Silphidae).

This study was based on the understanding that (1) insects respond rapidly to the placement of a cadaver on the soil surface and (2) a proliferation of soil microorganisms is associated with cadaver decomposition in soil. This work aimed to test the hypothesis that nematode community composition is related to the stage of cadaver decomposition and insect activity.

Six 10-week-old pig (*Sus scrofa* L.) cadavers (~45 kg) were killed by trauma (gunshot) to the head and placed inside a 2 m^2 plot on the soil surface within 30 minutes of death. Three cadavers were exposed to insects, three were excluded from insects using Lumite (18 x 14 mesh) exclusion cages (6 ft^3), and controls (plots without cadavers) were used. Thus, four treatments were used: + cadaver + insects, + cadaver – insects, - cadaver + insects, - cadaver – insects. Cadaver decomposition was measured using a decomposition scoring system at intervals of 24 hours for the initial seven days and at intervals of seven days thereafter. Cadaver decomposition was designated as being in one of four stages: Fresh, Early Decomposition, Advanced Decomposition, and Skeletonization. Soil samples (0 cm -10 cm depth) were collected from soil adjacent to the cadavers at intervals of seven days using a soil probe (2.5 cm diameter). Following transportation to the laboratory nematodes were extracted from soils enumerated and identified morphologically. DNA sequencing was used for identification when nematodes could not be identified morphologically.

The exclusion of insects had a significant negative effect on cadaver decomposition. Cadavers exposed to insect activity reached Early Decomposition by day 2, Advanced Decomposition by day 4 and Skeletonization by day 21. In contrast, cadavers excluded from insect activity reached early decomposition by day 3, Advanced Decomposition by day 21 and had not reached Skeletonization by day 49. Insect activity also had an effect on belowground nematode abundance that was characterized in a delay in peak nematode abundance. In the presence of insects nematode abundance reached peak levels on day 14. Nematode abundance in the absence of insects reached peak levels on day 21 to day 28 and a second peak was observed on day 49. The nematode community in association with insect activity could be dominated by phoretic nematodes while the nematode community in exclusion cages could be dominated by native soil-dwelling species. Nematode species identification is currently underway and results will be presented.

Taphonomy, Nematode, Succession

G58 Characterization of Adipocere Formation in Animal Species

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After attending this presentation, attendees will understand the chemical process by which adipocere forms, the requirements for its formation, the types of animal species it has been observed on, and an example of a case study in which its identification was required.

This presentation will impact the forensic community and/or humanity by discussing the value of adipocere as evidence and the limits associated with confirming its human origin in cases of homicide or human rights issues.

The aim of this presentation is to demonstrate the importance of identifying the species origin of adipocere samples collected as evidence. After attending this presentation, attendees will understand the chemical process by which adipocere forms, the requirements for its formation, the types of animal species it has been observed on, and an example of a case study in which its identification was required.

Adipocere is a soft white substance formed postmortem from fatty tissue in a decomposing body. Its formation is characterized by the hydrolysis and hydrogenation of the neutral fats into a mixture of predominantly saturated fatty acids. Under suitable conditions adipocere may form on both human and animal remains. The majority of research investigating adipocere formation has focused on either human remains or porcine remains, as a model for human decomposition. However, no studies of the nature of adipocere formation in other animal species have been reported. This study was conducted as a result of two enquiries from independent forensic laboratories to assist with the identification of adipocere collected as evidence in homicide cases. In both instances, the species origin of the adipocere fragments was in question.

Adipocere was formed in a controlled soil environment by burial of fatty tissue samples of several different animal species. Infrared spectroscopy was used to provide a lipid profile of the fatty tissue and adipocere samples. Gas chromatography-mass spectrometry was employed as a method for the identification of fatty acids in the original tissue and adipocere. Of the six species investigated, adipocere did not form on two of the species due to their reduced fat content. The adipocere that formed from the other species' tissue could not be visually discriminated between species.

The chemical characterization demonstrated identifiable differences in the fatty acid content of the original adipose tissue. Characterization of the adipocere samples also demonstrated differences in fatty acid content however this was determined to be a result of the different rates of formation of each species. The results suggested that the fundamental composition of adipocere is similar regardless of the species on which it formed. There was no evidence to suggest that the chemical composition

of adipocere is species-dependent. This conclusion highlights the difficulty associated with determining the species origin of adipocere, whilst also demonstrating the caution, which must be taken when attempting to link adipocere fragments to human remains.

Further studies are presently on-going to determine the feasibility of extracting DNA from adipocere. Extraction of DNA may provide the necessary information for determining species origin, as well as providing further evidentiary value in human identification. This presentation will impact the forensic community and/or humanity by discussing the value of adipocere as evidence and the limits associated with confirming its human origin in cases of homicide or human rights issues.

Adipocere, Species Origin, Characterization

G59 Maggot Development During Morgue Storage and the Effects on Estimating the Postmortem Interval

Timothy E. Huntington, MS, Leon G. Higley, PhD, and Frederick P. Baxendale, PhD, University of Nebraska, Department of Entomology, 202 Plant Industry Building, Lincoln, NE 68583*

The goal of this presentation is to present to the forensic sciences community research which demonstrates the potential for insect development during pre-autopsy morgue storage which may in turn affect estimates of postmortem intervals by forensic entomologists.

This presentation will impact the forensic community and/or humanity by demonstrating the need to consider insect development during morgue storage.

Forensic (or medicocriminal) entomology, the use of arthropods in legal investigations, is most frequently employed to estimate the postmortem interval (PMI) of victims of violent crimes or suspicious deaths. The most commonly used method of PMI estimation employs temperature-dependent developmental rates of blow fly larvae (Diptera: Calliphoridae). Retrospective scene temperatures, those temperatures, which the insects experienced during development, are used in combination with known developmental rates of the species involved to estimate the age of the larvae, which often correspond closely with the time of death of the victim. When insect evidence is obtained during autopsy, forensic entomologists often need to make decisions regarding the effects of low temperature (-1°C to 4°C) storage of the body and associated insects when estimating the PMI. Some have argued that development ceases during refrigeration, while others suggest that maggot mass temperatures go unchanged.

During the course of a 2003 homicide investigation, temperatures experienced by the insects associated with the victim were recorded from the time the body was removed from the scene until autopsy using an Onset Hobo H8 data logger. During the intervening time the body was kept in a standard morgue cooler and the temperatures which were recorded showed that the insects were able to maintain high enough temperatures to be able to continue development despite the cold storage temperature. Consequently, subsequent experiments with decomposing pigs were conducted to confirm observations on maggot development in morgue coolers and to establish the magnitude of temperature differences.

Seven porcine cadavers were used: "small pigs" (approx. 11 kg) and "big pigs" (38 kg avg.). Pigs were placed in the field for up to 14 days to allow for insect colonization and maggot mass formation, which were defined as aggregations of feeding third stage blow fly larvae. Upon removal from the study site, each pig was wrapped in a clean sheet and placed in a medium-duty body bag, as is standard procedure for human remains. Thermocouples were attached to each replicate and temperatures inside and outside of body bags were measured during storage in a morgue cooler. Temperatures remained significantly higher ($P<.05$) inside of the body bags relative to the cooler, and remained at levels sufficient for maggot activity (feeding and development). Maggot development was slowed, but not enough to discount insect development between removal of the body from the scene and autopsy. If the assumption is made that no insect development takes place during pre-autopsy refrigeration, potential error rates in PMI estimation of 8.6 – 12.8% occur. The potential for blow fly larvae to undergo significant development, including stadia transitions, while being stored in the morgue is a real possibility. Forensic entomologists must consider this continuing development during the course of an investigation involving samples collected at autopsy.

Forensic Entomology, Postmortem Interval, Autopsy

G60 An Unusual Postmortem Change in a Child Homicide—Leaching

Paul P.S. Chui, MBBS, DMJ, MBA, Health Sciences Authority, 11 Outram Road, Singapore, 289160, Singapore*

After attending this presentation, attendees will learn about an unusual form of decomposition change through leaching (loss of fluid from the body).

This presentation will impact the forensic community and/or humanity by creating awareness of such a finding and discussion of mechanism by which such a change occurred.

A child came to Singapore with her mother to study in a primary school. Her mother went back to China and left her on her own. The child went missing and sparked off a nationwide search. In the local hot and humid climate, bodies outdoors decompose quickly and early putrefaction begins within two to three days leading to early skeletonization in a week when the body is left in the open. Police investigations led to the arrest of a friend of the mother's whom the child was familiar with. After 3 weeks, the child's body was finally recovered, packed in nine plastic bags within a cardboard box in the undergrowth of a local hill-park. The case attracted much media sensation as well as outpouring of public sentiment.

At autopsy, the body was found to be much better preserved than expected. Bruises were well-defined and internal organs were well preserved. The condition of the body permitted better recovery of evidence of injury for determination of injuries resulting from allegations of sexual assault. It was also noted that after the autopsy was completed, signs of mummification became evident very quickly.

The presentation will discuss the cause of death, an unusual form of decomposition change, which has not been previously described in the literature, and the mechanism for such a postmortem change.

Decomposition, Child-Homicide, Leaching

G61 Comparison Study of Various Protocols to Release Maximal Amounts of Amplifiable DNA From Decomposed Soft Tissue Exposed to Different Environmental Conditions

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After attending this presentation, attendees will understand what protocols are most suitable for certain decomposed tissue remains based on type of soft tissue and the environmental conditions from which it came.

This presentation will impact the forensic community and/or humanity by providing guidance to the pathologist and DNA analyst in

obtaining the maximum quantity and quality of DNA from decomposed soft tissue samples.

The protocols investigated were compared using five different tissue types (brain, heart, kidney, liver, lung) exposed to three different environmental conditions (fire, submersion in water, and bog/swamp).

This presentation will benefit the forensic community by providing guidance to the pathologist and DNA analyst in obtaining the maximum quantity and quality of DNA from decomposed soft tissue samples.

At autopsy, questions are often raised regarding what type of tissue to send off for DNA analysis when the body is in a state of decomposition. While the standard answer has routinely been deep muscle tissue, anecdotal evidence from the Delaware OCME DNA Unit and Armed Forces DNA Identification Laboratory (AFDIL) have suggested that this is not always the case and that in fact, organ tissue is often preferable. Historically, the research regarding decomposed tissue samples and associated DNA yields has been somewhat limited because the typical DNA laboratory does not have access to such samples. The fact that Delaware's forensic DNA laboratory is located at the Office of the Chief Medical Examiner and, therefore, has access to such samples, allowed for this much needed study to be performed. Decomposition is a cumulative consequence that naturally occurs over time once a body is no longer living. Decomposition originates from the activity of microorganisms/bacteria and internal biodegradative enzymes, including DNases that cause autolysis of the body. The concentration levels of bacteria and enzymes vary amongst organs during decomposition based on the organ's function and location within the body. This variation results in some organs degrading DNA at a faster rate than other organs. Additionally, decomposition can be altered by external stimuli associated with different environmental conditions because different conditions have different effects on factors such as temperature, moisture, pH, and partial pressure of O_2.

Four extraction protocols were investigated in a collaborative effort between Delaware OCME, AFDIL, and National Medical Services (NMS) to develop the most successful extraction procedure from various organ tissues exposed to different environmental conditions. The four different extraction protocols were an organic extraction using a non-ionic detergent based digestion buffer, an organic extraction using an ionic detergent based digestion buffer, a non-organic extraction using standard columns, and a non-organic extraction with paramagnetic beads. In addition, variations in reagent amount as well as variations in reagent amount plus sample amount were studied. The tissue sample extracts were then quantitated, amplified, and analyzed. Data and conclusions will be presented and discussed at the meeting.

DNA, Decomposition, Tissue

G62 Eagles Syndrome: Case of an Elongated and Ossified Stylohyoid Ligament in an Elderly Female

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After attending this presentation, attendees will be able to recognize cases involving Eagles Syndrome and have a basic understanding of the mechanisms, which may result in this bony anomaly, and associated symptoms.

This presentation will impact the forensic community and/or humanity by providing death investigators with information to ascertain the presence of the skeletal anomaly Eagle Syndrome and how it may or may not be involved in the death of the deceased.

The case presented is that of a 72-year-old Negroid Female whose badly decomposed and, partially skeletonized remains were recovered from her residence in Baltimore, Maryland. Local police were called to the residence of the deceased, by neighbors who reported a fowl smell. Investigation of the scene found the deceased lying in her bed clothed. Police found no evidence of forced entry into the residence, or other evidence indicative of foul play. Relatives of the deceased reported that she was last seen alive approximately one month prior, during the summer months. Examination of the body at the Office of the Chief Medical Examiner in Baltimore, Maryland, found it to be in an advanced state of decomposition with partial exposure of the skull and upper thoracic cavity. Inspection of the chest and abdominal cavity revealed the absence of the internal organs as a result of decomposition. No injuries or notable defects were observed on the remains with the exception of an extraordinarily long, and irregularly shaped left styloid process of the skull.

The extremely large and lengthy styloid process was recognized as "Eagle syndrome" which is described as the elongation of the styloid process and stylohyoid ligament calcification. Eagle syndrome has been named under several other synonyms including stylohyoid syndrome, hyoid syndrome, styloid elongation syndrome, styloid process syndrome, and carotid artery syndrome. The syndrome is well documented in the dental and otolaryngology literature however it has not been widely reported in radiological and general pathological literature. Multiple symptoms are associated with Eagle syndrome, which includes cough, dizziness, recurrent throat pain, voice alteration, dysphasia and /or facial pain, and sensation of a foreign body present in the throat. It has also been reported that that approximately 4% of the general population is thought to have elongation of the styloid process, and that only a small percentage of those individuals 4% to 10%, are thought to be symptomatic.

Anthropological studies have documented the prevalence of elongated styloid process, in particular the high frequency of occurrence among various Mongoloid populations. The average length of the styloid process in adult is approximately 2.5 cm, and in most individuals there is little variation in length between left and right process. Eagle syndrome has been documented as occurring unilaterally or bilaterally. Recognition of Eagle syndrome is rare among the forensic case population unless it is noted during detailed radiographic examination of lateral views of the head and neck, or during gross examination of skeletonized remains. Most cases are picked up by dentists or oral surgeons during routine panoramic radiographs, or by physical examination involving palpation of the elongated styloid process in the tonsillar fossa, of those individuals who are symptomatic.

In the case of the elderly Negroid female, the recognition of Eagle syndrome was made during removal mummified and decomposed tissues surrounding the skull. The left styloid process measured approximately 8 cm in length, and had an average circumference of approximately of approximately 2.5 cm. Not only did the left styloid process look extremely large, but it had the appearance as if three medial phalanges had been fused together. Examination of the right side of the skull found the right styloid process to be near non-existent, measuring less than 5 mm in length. Close inspection of the left carotid foramen revealed evidence of significant narrowing resulting from the enlargement of the base of the styloid process. A review of the deceased medical records obtained by investigators later in time, provided documentation of Eagle syndrome which had been noted during a dental panoramic exam in 2003 to access periodontal disease. According to the medical records, the elderly woman was asymptomatic at the time of the exam. Documentation of Eagle syndrome provided a means of positive identification of the deceased. In regards to cause and manner of death, the absence of trauma, and documented history of heart disease, and negative toxicology, the case was signed out as hypertensive atherosclerotic disease -natural.

The cause of the elongation of the styloid process is not well understood. Multiple theories have been forwarded including congenital elongation, growth of osseous tissue at the insertion of the stylohyoid ligament, and calcification of the stylohyoid ligament by an unknown process. Pathophysiological mechanisms of symptoms is also contested which include irritation of pharyngeal mucosa by post-tonsillectomy scarring or by direct compression, traumatic fracture of the styloid process resulting in

proliferation of granulation tissue, inflammatory or degenerative changes in the tendon, and impingement of the carotid vessels thus irritating the sympathetic nerves of the arterial sheath.

Eagle syndrome can be treated by surgical and no surgical intervention. No surgical treatment includes steroid injections and other anti-inflammatory medications. Surgical treatment involves removal of the elongated portion of the styloid process.

Anthropology, Eagles Syndrome, Skeletal Pathology

G63 Where is the Head? A Case of Homicidal Decapitation

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The goal of this presentation is to present the case of a complete homicidal decapitation. Investigation of the scene where the body was discovered, autopsy findings, and DNA analysis are described. In particular, the primary importance of histological and immunohistochemical study to evaluate the vitality of wounds is underlined.

Only a few cases of homicidal decapitation are reported in the forensic literature. Sometimes the forensic pathologist faces the particular case, which may be difficult to distinguish between a vital or a postmortem beheading, especially when the circumstantial data is insufficient. This presentation will impact the forensic community and/or humanity by showing how histological and immunohistochemical investigations play a decisive role in forensic medicine.

Cases of complete decapitation have been sporadically reported in the forensic literature. In spite of high suicide rates all over the world, this particular mode of death is a relatively rare finding in violent suicidal deaths. Suicides by self decapitation have been reported, like those where individuals deliberately put their neck onto the track while a train is approaching or those where subjects use a ligature tied between the neck and a stationary object while attempting to drive a vehicle away, or even cases where individuals use a guillotine. Also unintentional decapitations are possible in suicidal cases, as after hangings. Accidental decapitation may also occur, for example, in cases of train pedestrian fatalities, industrial accidents, and unusual injuries during road accidents regarding either cars or motorcycles. Even more rare is the homicidal decapitation. This manner of death has been used for centuries for execution all over the world, and today is still used in some countries to carry out a death penalty. In recent years beheadings have also been registered in those homicides perpetrated by satanic sects, serial killers, or even in hostage killings. The forensic pathologist may meet some difficulties in evaluating cases of decapitation. A relevant problem, which the forensic pathologist has to face, may be the differentiation between a real decapitation and postmortem mutilation of the body.

Here is presented the case of a 32-year-old Italian woman murdered by her Romanian partner and found dead under a bridge in a country of South Italy. The man himself, who in the meantime had escaped abroad, phoned the police indicating the place where he had left the lifeless body of the woman, and he also confessed to having strangled her. When the police officers arrived at the suggested place, they found the lifeless body of a woman, tidily dressed, with the upper regions of the body completely wrapped in her jacket. When they lifted it they discovered that the body was completely decapitated. Numerous locks and shards of the scalp were scattered all around the body, abundantly stained with dried blood. Some locks held her earrings and necklace. On the ground beneath the body there was only a small amount of blood. Notwithstanding the careful examination of the scene where the body was discovered and the adjacent countries, neither the severed head nor the injuring tool was found. Only a metal bar, 66 cm in length and 2 cm in diameter, was recovered near the body, showing on its surface some blood spots. The postmortem examination showed that the neck was completely cut 3 centimeters above the jugular fossa; the wound margins were clear-cut, which led the examiner to assume that the head had been cut off with a sharp tool. The vertebral column was disconnected on the level of the seventh cervical-first dorsal vertebra. Numerous superficial linear wounds, of different length, and many excoriation zones with soft tissue bleeding underneath were present on the cutis adjacent to the neck lesion. No relevant injuries were detected in the remaining body parts. The lack of the severed head didn't allow analysis to injuries in this site. Massive blood aspiration, soft tissue hemorrhage surrounding the neck lesion and the pallor of inner organs as signs of bleeding out, were present. Histological investigation applying hematoxilin and eosin staining revealed massive hemorrhages in the cutaneous and subcutaneous tissues. Immunohistochemical studies were performed on the cutis specimens collected from the neck lesion for the determination of the vitality of the neck wound. The expression of Fibronectin, α_1-antichimotripsin, antitriptase, CD 31, and collagen type IV was analyzed. The positive results lead us to conclude that the neck lesion was vital, identifying homicidal decapitation as cause of death. Two months later a countryman discovered the skeletal remains of a human head on the back of his homestead, about 200 m from the place where the body was discovered. The skull showed no fractures. DNA analysis established that those skeletal remains belonged to the same woman.

Homicidal Decapitation, Vitality, Immunohistochemical Study

G64 Simple Tissue Preservation Methods That Result in Reliable DNA Analyses

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The goal of this presentation is to inform attendees of several simple tissue preservation methods that are conducive to obtaining a quality DNA sample. The procedures outlined can be applied to many situations, since the methods examined were developed for use in situations where time, materials, and facilities are limited.

This presentation will impact the forensic community and/or humanity by demonstrating providing valuable information on how to successfully preserve tissue samples for subsequent DNA analysis. The methods examined for this study required minimal materials, storage space, and temperature considerations. For these reasons, the results of this research can be useful to many factions of the forensic community, from mass disaster response teams, to conservation officers, to crime scene technicians. By having a simple tissue preservation method available in the field, samples can be preserved immediately, which increases the potential for a successful DNA analysis in the laboratory.

This presentation provides an evaluation of on-site tissue preservation methods, examining the success of each in yielding high quality DNA. The research examined factors such as availability and portability of materials, tissue storage life at room temperature, ease of use, ease of subsequent DNA extraction, and the quantity and quality of DNA obtained from preserved samples. Attendees will gain an understanding of the range of tissue preservation methods available, as well as the efficacy of each method in preserving DNA. The goal of this study was to develop a rapid, reliable method for storing tissue samples that can be easily employed in the field.

In the event of a mass disaster, where a large number of victims must be located and identified, it becomes difficult to process the site in a timely and orderly manner. Due to extensive injury or decomposition, many victims may only be identified through DNA analysis; therefore, obtaining viable tissue samples is of great importance. Amidst the rush of locating survivors, making anthropological identifications, and gathering other information about the victims of the disaster, tissue collection for subsequent DNA testing is often delayed. Likewise, tissue preservation of remains discovered in very remote areas can also be hindered. The goal of

this study was to examine protocols for on-site tissue preservation that would undergo later DNA analysis. Through development of simple, portable, and readily available methods for preserving tissues in the field, robust DNA results are more likely to be obtained.

Testing was conducted on tissues taken from recently killed pig carcasses that had been placed in a field during the summer; samples were collected regularly over a one-month period. Six preservation methods were evaluated: storage of tissue in ethanol, isopropanol, RNAlater (Ambion, Inc.), and silica desiccant, as well as hot air drying and freezer storage. Muscle, skin, and brain samples were collected in triplicate from each animal, and ca. 0.25 g placed in each storage medium. DNA extractions were performed after two weeks and after three months for each storage method. DNA quality and quantity were assessed using quantitative PCR of three species-specific single-copy nuclear genes. Results were analyzed in order to determine which preservation methods were the most successful in yielding a viable DNA sample after a period of storage.

Although DNA quantity and quality were the most significant factors in the evaluation, many other issues were addressed. Tissue type and level of decomposition, portability of materials, toxicity of the preservative, shelf life of preserved samples, and ease of subsequent DNA extraction were also factored into the analysis. By considering all of these interdependent variables, an optimized, reliable procedure for preserving tissue samples when adequate storage and DNA processing facilities are not readily available can be developed and implemented.

DNA Extraction, Mass Disaster, Tissue Preservation

G65 Quantification and Amplification of MtDNA From Chemically Treated Hair

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After attending this presentation, attendees will learn of some of the techniques used to extract, quantify, and amplify mtDNA from telogen hair shafts that have been chemically treated. The attendee will also be aware of how these chemical treatments affect the quantity and quality of DNA amplified.

This presentation will impact the forensic community and/or humanity by providing knowledge of whether chemical processes cause degradation to DNA in hair shafts and to what extent that damage may be. This knowledge can help the forensic community to establish ways in which to overcome this difficulty so as to enhance mtDNA extraction and amplification from hair so that genetic profiles can be more sufficiently attainable, as hair forensics is becoming increasing significant in forensics and law.

Evidentiary collection at crime scenes and mass disaster typically include hair strands that later undergo DNA typing that can identify victims and assailants. This presentation will impact the forensic community and/or humanity by demonstrating the effect that various beautification processes have on the quantity and quality of amplifiable mtDNA extracted from hair shafts.

Millions of people, both men and women, subject their hair to different chemical treatments, such as bleaching, coloring, and perming. As such, it is reasonable to assume that hair recovered from a crime scene may have come from a person who utilizes one or more of these popular processes.

Nuclear DNA extraction is typically done on hair strands with growing root tissue. However telogen hairs, hair strands that are naturally shed, do not contain roots. The shafts of hair are not suitable for nuclear DNA due to the degradation that occurs because of the keratinization process. However, mitochondria are present in abundance in hair shaft. Therefore, mitochondrial DNA is typically extracted from the myriad of mitochondria that are still present in cells. There have been several studies on the efficiency of mtDNA extraction from hair. While the consensus among these studies is that adequate amounts of mtDNA can be extracted from hair and other types of degraded samples, the quality and quantity of the genetic material recovered has not been directly addressed. Within some of these same studies, researchers agreed that damage to hair caused by fire or environmental conditions can significantly affect the amount of DNA extracted. However, there has not been any published research that examines how normal chemical conditioning of hair affect DNA recovery. With the advent of real time PCR, this DNA can be quantified at the picogram level and by examining the effect of amplicon size, the level of degradation can be evaluated.

In this research project, DNA was extracted from telogen hairs from volunteers who used chemical treatments and those who did not. Ten to fifteen hairs, approximately 2-3 cm long, were extracted from each volunteer using the published phenol chloroform separation method and purification of the DNA. The recovered DNA was quantified with real time PCR. Amplification was done using published mtDNA primers and primers specifically designed for this research. The primers utilized amplified conserved areas of the coding region of mtDNA, as these areas have the least amount of variability. Sequencing was done on selected samples with non-coding, control region primers for the hypervariable 1 and 2 regions. The resulting electropherograms were compared to the known reference samples to determine if adequate amount of quality mtDNA was amplified in order to yield a genetic profile.

The amount of mtDNA recovered varied from person to person, but preliminary results revealed that the quantity and quality of mtDNA recovered from individuals without chemical hair treatments exceeds that which comes from treated hair. However, those hairs subjected to treatments can undergo successful mtDNA amplification and sequencing which can then be used to obtain a genetic profile.

Mitochondrial DNA, Real Time PCR, Telogen Hair

G66 What is Forensic Informatics?

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After attending this presentation, attendees will gain an understanding of the precise meaning of forensic informatics, knowledge of its many dimensions, its role in the progress of the forensic sciences, and the current challenges of the discipline.

This presentation will impact the forensic community and/or humanity by demystifying the boundaries and contents of the concept of forensic informatics and allow forensic scientists an understanding of the dimensions of forensic informatics.

Forensic Informatics is the systematic application of information and computer science and technology to forensic practice, research, development, and learning. It is a major discipline of the forensic sciences and encompasses many other scientific disciplines, which have reached maturity at a first generation level. As a major or covering discipline it has the responsibility for establishing performance standards and ideological goals for the component parts. The forensic responsibility entitles the application of sound computer engineering and scientific principles in an open, introspective, and universal manner applicable to the judicial system. The goal of utility in the solution of crimes, the search for the criminal act, the discovery of the criminal, and the analysis and retention of evidence is obvious; the boundaries of informatics extends into the civil affairs of government additionally and extends into property, taxation, public health, and inheritance; the detailed review of the fine details and codes of computers and computer software entitling long hours of study are not easily obtained, but required. Forensic informatics has practical utility in the solution of complex problems and the retention for review of the detailed data arising

from the solutions of the problems. Importantly, forensic informatics not only records the past in its archival function, and solves problems with its present capabilities, but necessarily provides a key to the future as vacancies in disciplinary content and theory are discovered and programs developed to encompass the missing details.

Current challenges in forensic informatics are immense and include the development of operational and proficiency standards for all forensic software and information systems including the error rate of the system, operator deficiency recording, output errors, logic error detection in software, security requirements for forensic systems, acceptable decay rates, the mathematics of the database, specialized forensic informational databases, data mining of criminal patterns, three dimensional forensic images, the schooling of new scientists in forensic informatics with the development of educational standards and professional employment opportunities, and dimensions in informatics. Guidance to the judiciary in forensic informatics seems of major operational import.

Involvement of the forensic sciences in these initial stages of the "computer revolution" is a major activity of the current membership of the American Academy of Forensic Sciences.

Formal models of forensic informatics and its dimensions are presented in relation to the other recognized disciplines of information and computer science, including medical informatics, pathology informatics, chemical informatics, public health informatics, digital evidence, and bioinformatics.

Forensic Informatics, Forensic Computer Science, Forensic Science Models

G67 Death in Custody: A Historical Analysis

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After attending this presentation, attendees will understand the historical evolution of death in custody, be familiar with the various types of and the agencies that experience death in custody, and recognize the need for conceptual specification of death in custody.

This presentation will impact the forensic community and/or humanity by delineating the historical evolution (both qualitative and quantitative) of death in custody. Few analyses have examined death in custody from a historical perspective. An understanding of the history of death in custody may provide insight that would enhance the development of intervention protocols.

A substantial amount of controversy generally surrounds deaths that occur in custody, especially in this era of instant media coverage and communication. Often, allegations of brutality are launched and community relations are notably compromised. Exacerbating the situation, medical examiners are often presented with minimal physical findings at autopsy. To understand the phenomenon and minimize its occurrence, the medical-legal community has conducted a considerable amount of research. However, few analyses have examined death in custody from a historical perspective. The purpose of this research is to delineate the historical evolution (both qualitative and quantitative) of death in custody. An understanding of the history of death in custody may provide insight that would enhance the development of intervention protocols.

To identify the frequency and type of deaths in custody occurring over time, a retrospective, exploratory analysis was conducted. Using data from Maryland's Office of the Chief Medical Examiner, a sample of approximately 15,000 cases, dating from 1939 to 2004, was examined. Employing a general definition of the phenomenon, all deaths that occurred in custody were included for analysis. Custodial agencies were operationalized to include law enforcement, correctional, psychiatric and emergency medical. Study variables include, incident location, decedent demographics, behavioral, medical and toxicological indicators, and the cause and manner of death.

Results indicate that death in custody is a multi-faceted phenomenon, subsuming a variety of qualitative types. All manners of death were identified; however natural deaths and suicides comprised the vast majority of cases. Similarly, while all custodial agencies experienced death in custody, most cases occurred in correctional and psychiatric facilities, respectively. Results also suggest that there have been substantive, qualitative changes in death in custody. For example, during the 1940s and 1950s a significant portion of deaths occurred during police transport. This finding reflects the unique role of law enforcement during those decades: prior to the establishment of a formalized emergency medical system, police transported the sick and injured to local hospitals. "Sudden unexpected death in custody," especially those occurring after a violent struggle with police, emerged during the 1980s and 1990s, concomitant with widespread, recreational stimulant drug abuse.

Generally defined, death in custody is an "umbrella" concept that subsumes a variety of unrelated manners of death and that occurs in disparate custodial agencies. To understand deaths that occur in custody, further conceptual specification is required. Such specification would allow for better methodological precision and improve theoretical/conceptual uniformity.

Death in Custody, Sudden Death, Law Enforcement

G68 Simultaneous Diabetic Ketoacidosis and Neuroleptic Malignant Syndrome in a Patient on Olanzapine

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After attending this presentation, attendees will understand how neuroleptic malignant syndrome and diabetic ketoacidosis are well-described phenomena in conjunction with the use of antipsychotic medications. They can independently cause sudden death and this case report documents their first simultaneous occurrence in a patient taking olanzapine.

This presentation will impact the forensic community and/or humanity by documenting and reporting the first simultaneous occurrence of DKA and NMS in the same patient taking olanzapine.

Learning Objectives: To present to the forensic and psychiatric communities the historical, clinical and laboratory findings in a patient who was diagnosed postmortem as having concomitant diabetic ketoacidosis (DKA) and neuroleptic malignant syndrome (NMS) as the cause of his sudden death.

Case Report: A 32-year-old black male taking olanzapine for a long history of psychiatric illness (variably diagnosed as schizophrenia and schizotypal personality disorder) was found unresponsive. On arrival at the hospital he was afebrile with symptoms and lab findings consistent with DKA. During his stay in the emergency room he developed a progressive decline in mental and clinical status and subsequently developed clinical and laboratory findings of NMS, which were diagnosed postmortem. His condition continued to deteriorate and he expired despite aggressive resuscitative measures approximately 6 hours after being found unresponsive. Body temperature at the time of death was 108 degrees Fahrenheit.

Methods: Medical records and autopsy protocol with laboratory studies were reviewed for this patient and are presented. The medical literature was searched using the keywords *olanzapine*, *diabetic ketoacidosis*, and *neuroleptic malignant syndrome* for citations relating to NMS and DKA in the setting of neuroleptic use and relevant citations are reviewed and discussed.

Results: Poor glycemic control is a well-described phenomenon in the setting of neuroleptic use and new-onset DKA has been reported in patients taking many different neuroleptics, including olanzapine. Neuroleptic malignant syndrome, which was reported with much greater frequency on older neuroleptics, has also been reported to occur with newer antipsychotic agents, including olanzapine. A single case of the simultaneous occurrence of NMS and DKA was previously reported in a hospitalized patient on Thorazine. This case report is the first reported case of the simultaneous occurrence of both conditions in a patient taking olanzapine.

Conclusions: While both NMS and DKA are well-known occurrences in patients on neuroleptics and equally well-known causes of death in forensic practice, their simultaneous occurrence has not been previously reported in the era of newer antipsychotics.

Diabetic Ketoacidosis, Neuroleptic Malignant Syndrome, Olanzapine

G69 An Unusual Case of Child Head Injury by Coat Hanger

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After attending this presentation, attendees will understand the value of a multidisciplinary team, composed of clinical forensic medicine specialists, and law enforcement, in the management of injured children.

This presentation will impact the forensic community and/or humanity by demonstrating the value of crime scene reconstruction coupled with the evaluation of physical evidence in determining the factors in equivocal child abuse and neglect investigations.

The question of natural disease process versus accidental injury versus inflicted injury is the central issue involved in a clinical forensic investigation. The physical findings in the infant or child must be correlated with the history provided by the caretaker, as well as milestones achieved by the infant or child. Injuries affecting specific frontal locations, such as the forehead, nose, chin, palms, and knees, are often the result of accidental events secondary to children playing or falling. For these kinds of injuries, the examiner must have an open mind that the injury could be the result of an unintentional event, instead of a horrible episode of domestic violence.

The Clinical Forensic Medicine team in Louisville Kentucky is routinely consulted in a variety of cases of presumed child abuse and neglect. The authors present a case of a 2-year-old female who was brought to the Emergency Department with a large stainless steel hanger embedded in her left frontal region, between the orbit and the bridge of the nose. She was conscious, alert and moved all extremities. A lateral radiograph of the head demonstrated a foreign body embedded in the frontal region of the skull for approximately 2cm. A CT scan of the head demonstrated a U shaped body entering the frontal bone with probable fractures of the cribriform plate and crista galli, a small interhemispheric subdural hemorrhage and a left frontal subdural pneumocephalus. There was no injury to the left globe or nasolacrimal duct.

She was taken to the operating room where the curved part of the hanger was removed and the injured brain was derided. The ethmoid bone and shredded galea were repaired. After a five-day admission, she was discharged to home with a CPS approved caretaker. After examination by the Clinical Forensic Medicine team, coupled with home inspection and interviews by the local police, it was possible to reconstruct the child's injury.

The parent's, who are not married, were reported to be arguing. The child's mother stated that when she had her back turned to the father, he is reported to have thrown a hanger, with the intention of hitting the mother. Instead, the hanger hit his daughter, who was playing on the floor.

The investigators were uncertain whether the hanger was thrown from several feet across the room or if it was directly applied to the child's skull. The tool was a large caliber, stainless steel hanger measuring approximately 4 by 4 millimeters in thickness, while the U-Shaped angle measured approximately 3 centimeters. Experiments conducted by the police using a similar hanger and double-up pieces of cardboard demonstrated the U-shaped portion of the hanger penetrated the cardboard six inches deep or more, when thrown from the same distance the father stated he was from the child. The crime scene investigation pointed out that there were other hangers on the floor, manufactured of plastic material, and the one used was the only stainless steel, large caliber hanger present in the room.

The findings of the physical examination, the scene investigation with interviews of the parents, and the reconstruction of the incident support the conclusion that the injury to the child was inflicted.

In conclusion, diagnosing child abuse is a complicated issue. When the injuries are uncommon and involve specific parts of the body, such as the frontal plane, the examiner has to eliminate the potential of an accident. The combined efforts of a multidisciplinary team serve a primary role in the management of domestic violence and child abuse cases.

The present case represents a very unusual case of domestic violence, with child head injury using a stainless steel hanger. Unfortunately, this is only another incredible report about how abusers carry out their harmful acts.

Coat Hanger, Child Abuse, Pediatric Head Injury

G70 Adolescent Suicide Trends in the Third Largest County in the United States

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After attending this presentation, attendees will gain knowledge and awareness of the epidemiology of suicide and suicidal trends in Harrs County, Texas, the third largest county in the United States.

This presentation will impact the forensic community and/or humanity by providing the audience with an understanding of the scope of the adolescent suicide problem and relevant risk characteristics of adolescents in a large urban setting.

Introduction: Harris County accounts for 17% of the adolescent population in Texas and has a growing adolescent suicide rate, ranking first in the number of youth suicides reported to the Texas Department of State Health Services. Harris County, the home of the fourth largest city in the nation (Houston), is also the third largest county with 3.6 million residents and an area of 1,778 square miles. The Houston/Harris County Child Fatality Review Team (HHCCFRT) recorded a rise in the suicide rate for children aged 10-17 from 2.1 per 100, 000-population size in 1999 to 3.3 in 2003. The Harris County Medical Examiners Office (HCMEO) has identified adolescent suicide as a public health problem, and has conducted a collaborative retrospective study to identify those most at risk for suicidal injury. The results of this study can be used to drive prevention and intervention programs in Harris County.

Purpose: This collaborative study between the HCMEO, Harris County Public Health and Environmental Services, the Houston-area Suicide Prevention Coalition, and the HHCCFRT was implemented to identify and describe the number and relevant characteristics of adolescents who died by suicide from 2000 through 2005.

Results: The Harris County Medical Examiners Office classified the manner of death as suicide for 154 adolescents aged 10-19 years who were autopsied in the HCMEO from January 2000-July 2005. The majority of

these adolescents (79%) were male. White teens comprised the majority of these cases at 52% but a notable 34% were of Hispanic ethnicity, followed by 13% Black and only 1% Asian teens. Gunshot wounds were the cause of death in 55% of the cases. Hanging (34%) was the second leading cause of death. The remaining 10% of the cases were comprised of overdose deaths, blunt force injuries, and carbon monoxide poisonings. The most recent HHCCFRT data from 2002-2003 (N=34) cases demonstrates that older teens (15-17 years) most often used a gun as the mechanism of injury but the majority of younger (10-14 years) adolescents used hanging as a mechanism. A suicide note was recovered in only 21% of the reviewed cases. The most common precipitating factors to the injury were prior attempts/suicidal ideation (37%), argument with a parent or girlfriend/boyfriend (19%), documented depression or mental illness (17%), substance abuse (10%).

Implications: The results of this study are an important foundation for establishing prevention and intervention efforts in Houston and Harris County. The rising suicide rate among adolescents makes it imperative that the HCMEO and HCPHES mobilize to reduce risk in the adolescent population. The scope of the adolescent suicide problem and the characteristics of at risk adolescents will be disseminated to area agencies and community organizations for use in obtaining funding for effective, best practice suicide programming.

Adolescent Suicide, Epidemiology, Trends

G71 Intraspecific Competition in the Blowfly *Chrysomya megacephala* (Diptera: Calliphoridae) Reared at Different Densities

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After attending this presentation, attendees will learn the effects of population densities on the rates of development and subsequent effects on the calculations of postmortem interval estimates using entomological techniques.

This presentation will impact the forensic community and/or humanity by demonstrating the calculation of an estimated minimum postmortem interval estimate using entomological techniques depends on correct developmental data for the species involved. Understanding the effects of density and intraspecies competition will serve to gradually increase the accuracy of these estimates.

Larvae of *Chrysomya megacephala* are major factors in the early decomposition of remains in tropical habitats. This study was undertaken to determine the effects of larval density on rate of development, larval and puparial mortality and adult size for this species under laboratory conditions. Larvae were collected from a pig (*Sus scrofa* L.) carcass in a mesophytic habitat on the Island of Oahu, Hawaii. Colonies were established with limited food resource (15 gms of beef liver) at densities of 1:1, 5:1,10:1, 15:1, and 20:1. All colonies were reared at a constant temperature of 24ºC, with light/dark cycles of 13/11 hours. In one section of the study, total lengths of 10 larvae per day were recorded to determine rate of development based on increase in size. In the other section of the study, colonies were left undisturbed for the duration of larval development. Larval mortality and puparial mortality and total mortality were recorded. Of the densities studied, the 10:1 ratio appeared most favorable for development. Larvae reared in these colonies were significantly larger than those in other colonies, reached the puparial stage 24 h ahead of other colonies and had the lowest larval mortality.

Entomology, Competition, Postmortem Interval Estimation

G72 Comparison of Early Decomposition Between Domestic Pig Carcasses Hanging and in Contact With the Ground on Oahu Island, Hawaii

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The goal of this presentation is to document the differences in early decompositional changes in carcasses that are in contact with the ground and hanging.

The patterns of decomposition observed in hangings are quite different from those observed for bodies in contact with the ground. This presentation will impact the forensic community and/or humanity by demonstrating how the accurate estimation of the postmortem interval is dependent on an understanding of these differences in insect invasions, temperature generation, and biomass removal.

This study was conducted on the campus of Chaminade University on the island of Oahu, Hawaii. Carcasses of two domestic pigs, Sus scrofa L., were used. One carcass was placed in contact the ground on a wire mesh platform and the other suspended from a tree, not in contact with the ground. Carcasses were observed twice daily for a period of two weeks. Weights were recorded daily using a hand-held scale to determine rate of biomass removal. Internal temperatures were recorded using telethermometer probes of the mouth, abdomen, and anus. Ambient temperatures were recorded at each visit. During the study period, both carcasses passed through four of the five stages of decomposition established by Goff (1993): Fresh, Bloated, Decay, and Post decay. The skeletal stage was not reached during this study. Differences in decomposition patterns were noted between the two carcasses. The hanging carcass demonstrated an initial rate of biomass loss greater than the carcass on the ground. After the first week, the rate became more equal. Internal mouth temperatures for the pig on the ground were uniformly higher than for the hanging carcasses, probably due to the mediating effect of the air. Abdominal temperatures, as well as anal temperatures were more similar, although still higher for the carcass on the ground.

Decomposition, Temperature, Biomass Removal

G73 A Preliminary and Pilot Study About Mitochondrial DNA Deletion in Sudden Infant Death Syndrome: An Endemic Study in Taiwan

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After attending this presentation, attendees will gain an understanding whether there is a relationship between mitochondrial DNA deletion and sudden infant death syndrome. This presentation will impact the forensic community and/or humanity by demonstrating how although some change of genetic markers in mitochondrial DNA may not be the real etiological cause of death in SIDS cases; it could be a contributing factor to an infant's death within a critical medical condition or situation.

Sudden infant death syndrome (SIDS) is a leading cause of postneonatal infant mortality and a serious and challenging issue confronting the medical and legal professions. Many hypotheses have been proposed

and studied, however, a consensus on the causes of SIDS is still lacking. Although a number of coding region mitochondrial DNA (mtDNA) mutations involving SIDS have been reported, the role of mtDNA deletion or depletion in SIDS victims is still unknown. This study was designed to investigate whether mtDNA deletions exert any effect on the etiology of SIDS. Statistical data have shown that infants dying from SIDS score lower in activity tests and appear to be sleepier and less reactive than control subjects. These behavioral characteristics may have been the result of ATP depletion attributable to mutations or deletion in mtDNA.

Seven SIDS and 19 non-SIDS fatalities were included in this study to determine the relative amount of mtDNA copy number and the occurrence of mtDNA deletion in blood, skeletal muscle, and cardiac muscle specimens. Analytical approaches included real-time quantitative PCR, primer-shift PCR analysis and DNA sequencing. Breakpoints of the three types of mtDNA deletions (4977, 5335, and 7599 bp deletions) observed in the population were identified by sequencing methods.

Only one specimen (cardiac muscle) from a congenital heart malformation subject was found to have 4977 bp mtDNA deletion. Fisher's exact probability test and Spearman's correlation coefficient were applied to the analysis of the observed data on 5335 bp and 7599 bp mtDNA deletions and found no statistically significant difference on the occurrence frequencies of 5335 bp and 7599 bp mtDNA deletions between SIDS and non-SIDS victims. However, the observed data indicate: (a) for blood specimens, the occurrence frequencies of 5335 and 7599 bp mtDNA deletion observed in the SIDS were 4- and 2-fold, respectively, higher than the non-SIDS victims; (b) for skeletal muscle specimens, the occurrence frequencies of 5335 bp mtDNA deletion in SIDS victims was 1.8-fold of the non-SIDS victims. No significant correlation was observed on the relative amount of mtDNA copy number and the occurrence frequencies of mtDNA deletions between the SIDS and non-SIDS groups; however, the occurrence frequencies of 5335 bp and 7599 bp deletions and the relative amount of mtDNA copy number in the skeletal and cardiac muscle specimens from the SIDS group were much higher than that from the non-SIDS group.

The increase in mtDNA content in mtDNA deletion cases correlates with mitochondrial proliferation that might have been a compensatory mechanism of defective mitochondria. These defects in mtDNA may result in impaired production of ATP and bioenergetic crisis. mtDNA deletions in themselves do not cause SIDS but may cause energy deficiency or hypoxia in stressful situation during a vulnerable developmental stage. These preliminary results show that mitochondrial DNA deletion might predispose an infant to death in a critical medical situation.

Sudden Infant Death Syndrome, SIDS, Mitochondrial DNA Deletion

G74 Expression of Heat Shock Protein (hsp) 70 in Tissue of Different Human Organs After Burn Fatalities

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After attending this presentation, attendees will gain some understanding of the regulation of the early inflammatory response in humans, specifically regarding the initial response of heat shock proteins (hsp).

This presentation will impact the forensic community and/or humanity by providing some understanding of the regulation of the early inflammatory response in the human organism after burning fatalities, and contributing to the clinical understanding of the development of the serious septic or sepsis-like processes in these cases.

Heat shock proteins play an important role in the early response to various physical or chemical alterations and contribute to the up-regulation of numerous other stress-related mediators such as cytokines. To enhance the knowledge regarding the complex regulation of these inflammatory mediators, 18 cases of burn fatalities were evaluated immunohistologically after autopsy. Paraffin embedded tissues were investigated for expression of hsp 70 on the protein level related to survival time and further complications, such as pneumonia or sepsis). A tendency toward the early expression of hsp 70 in respiratory epithelium, inflammatory cells, and in the epithelium of renal tubuli was revealed. In the cases with longer survival time, hsp was increasingly expressed in other organs.

Heat Shock Proteins, Burn Fatalities, Inflammatory Response

G75 "Coca-Cola Man": Sudden Death in a Jailed Mentally Retarded Man After an Altercation Involving Police

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After attending this presentation, attendees will have an increased index of suspicion for diabetes insipidus in unsuspected cases, familiarity with the four types of diabetes insipidus, and gain an understanding of the mechanism of diabetes insipidus in psychogenic polydipsia.

This presentation will impact the forensic community and/or humanity by providing recognition, postmortem diagnosis and classification of diabetes insipidus, and exploring the medical, legal, and media ramifications of death from dipsogenic diabetes insipidus in a mentally retarded inmate.

A 58-year-old inmate of an institution for the mentally retarded, who bore a number of additional psychiatric diagnoses including undifferentiated schizophrenia, violently assaulted a fellow resident, as well as two nursing home workers who attempted to restrain him. He was subdued with the assistance of police. He was arrested for the assault, and taken from the group home to jail, where he received a medical evaluation, and was noted to be in good health. He was jailed for ten days, during which he received ongoing medication with oxcarbazepine. At 0310 hours on the eleventh day, he was found dead on the floor of his cell.

At autopsy, the oral cavity was noted to be full of vomitus. When the vomitus was rinsed away, white foam appeared. An 11" x 8" fading green-brown bruise occupied most of the right side of the chest, extending across the midline. Two smaller, more recent-appearing bruises were noted on the chest and abdomen. Healing abrasions and almost completely faded bruises were noted on both sides of the upper back, and on the left side of the chest. Multiple bilateral rib fractures appeared, by their freshness, location, and lack of hemorrhage, to have been incurred during cardiopulmonary resuscitative efforts. Natural disease at gross autopsy was restricted to pulmonary emphysema, slight heart hypertrophy, and minor renal changes consistent with hypertension. There was no coronary artery disease, and no coronary thrombosis or pulmonary embolism. It was noted that the urine was root beer colored.

Vitreous electrolytes, analyzed the following day, exhibited a severe deviation from expected values. The BUN was 127 mg/dl, and the creatinine, 1.2 mg/dl. The sodium level was 180 mmol/L, and the chloride level, 150 mmol/L. Potassium, CO_2, and glucose showed a postmortem pattern.

Significant social history included moderate mental retardation, a variety of psychiatric diagnoses, and a noted addiction to soft drink products. At the hospital where he underwent occasional treatment for exacerbation of psychiatric symptoms, the inmate was referred to as "Coca-Cola man," due to his nonstop consumption of as much of this soft drink as he could obtain. Psychiatric treatment notes had documented a recommendation that he be switched from caffeinated and sugar-containing soda to decaffeinated and diet soda, to control some of his behavior problems.

Death was due to marked hemoconcentration. Consultation with a local endocrinologist suggested the disorder diabetes insipidus.

Diabetes insipidus is a disorder of excessive urination, which may be traced to four types of inciting cause. One type, gestagenic, occurs only in association with pregnancy. Another, neurogenic, is due to a pituitary lesion, which may be acquired or congenital. A third, nephrogenic, may be congenital, but may also be drug-associated. Certain commonly administered drugs are well known to be associated with diabetes insipidus, including lithium, foscarnet, and clozapine, as well as many cytostatic drugs and antimicrobials. No record of administration of any of these drugs could be found. Trileptal is not associated with diabetes insipidus.

The fourth category of diabetes insipidus is dipsogenic, or caused by psychogenic polydipsia. In this disorder, excessive drinking of any fluid, over a prolonged period of time, causes excessive urination, which may become independent of normal feedback mechanisms. What was originally a psychological compulsion then becomes an organic condition. This disorder could be produced by a protracted indulgence in very large quantities of soft drinks.

As diabetes insipidus was not suspected at autopsy, the opportunity to examine the pituitary was lost. So it cannot be definitively stated whether this was in origin a neurogenic diabetes insipidus, or dipsogenic. A mentally retarded and schizophrenic person with a strong drive to imbibe as much soft drinks as possible may not have recognized water available in his cell as a source of rehydration. Nor could he likely explain his symptoms in terms, which would convey his condition to corrections personnel.

The postmortem diagnosis and classification of diabetes insipidus, and the ramifications of dipsogenic diabetes insipidus in a mentally retarded inmate, will be discussed, along with a consideration of how to deal with newspaper interest in the cause and manner of death.

Diabetes Insipidus, Psychogenic Polydipsia, In-Custody Deaths

G76 Estimating Time-of-Death by Body Temperature Analyses - A New Mathematical Strategy

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After attending this presentation, attendees will learn of a revised curve-fitting method of postmortem estimation of time-of-death by body temperature.

This presentation will impact the forensic community and/or humanity by presenting a new way of analyzing temperature data without making a priori assumptions regarding postmortem cooling rates or involving measurement of complex heat transfer parameters

Accurate determination of a patient's time-of-death is routine in a hospital, nursing home, hospice, or other well-monitored setting. It is more difficult when death occurs alone at home, at an isolated hunting site, in a vehicle in a remote area, at a crime scene or at some other unsupervised site. Time-of-death (TOD) nonetheless provides crucial information required in many clinical and forensic investigations.

Numerous techniques have been used for the past fifty years to estimate TOD, including quantitative analysis of body tissue and fluids or qualitative staging of rigor mortis, postmortem lividity, putrefaction, or mummification of the decedent's remains (6). Sequential and precise measurements of the change in deep body temperature during the postmortem period have been also been employed by numerous investigators (3). The amount of postmortem temperature data collected is practically limited by the amount of time the medical examiner is allowed access to the body by police and the stability of the environment in which the body was found.

Previous investigators have developed equations (2, 4) or intricate finite-element computer simulations (5) to predict postmortem body cooling from analyses of empirical data collected from the recently deceased and from tests on manikins. In most cases these analyses use three or fewer postmortem data points and impose, a priori, a multi-exponential curve fit. Data presented here are a first-order attempt using a thermodynamic model and non-linear regression with at least ten postmortem data points.

We are developing mathematical and curve-fitting techniques to construct an analytical model for which body cooling rate is deduced and from which time-of-death is estimated. Data for this model require measurements of internal body temperature during postmortem cooling at matched clock times, although not necessarily at regular intervals. Inexpensive, portable temperature monitoring and logging devices facilitate making these measures are currently available. An estimate of the person's body temperature at death and ambient temperature are also required, as are data about body weight and the quality of clothing or other body covering. Data about the person's physical activity immediately prior to death, medication history, environmental conditions, and exposure circumstances provide useful ancillary, but not essential information. The analyses are equally valid for people whose bodies are found in water or in air. Data analyses are made either with programmable calculators or with standard spread sheet programs. Time-of-death is reported as a range depending on the strength of the correlation coefficient revealed by curve-fitting data for the fall in multiple postmortem body temperatures. Interpretations of preliminary analyses for people whose postmortem cooling rate is recorded in a monitored environment as well as bodies found at crime scenes are providing important information to amend the mathematical model, increase its validity and improve the precision for estimating time-of-death by temperature.

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Postmortem, Time-of-Death, Temperature

G77 Photography of Abuse: Is There a Best Method?

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The goal of this presentation is to discuss methods of recording photographically injuries both visible and invisible to the unaided eye.

This presentation will impact the forensic community and/or humanity by demonstrating how there is a need for further research in the development of a standardized protocol for photographing injuries that are not immediately visualized. A standardized protocol for documentation of old injury patterns would be useful in elder and child abuse cases.

Historically, documentation of bruising of abuse victims was accomplished using standard film cameras, recording injuries visible to the naked eye. Presently documentation of abuse has advanced to include both infrared and ultraviolet imagery using both fast black and white film and high-speed infrared film. This research will attempt to establish standardized parameters and techniques for optimum light source and filtration together with an ideal photographic protocol for documentation of fresh and older patterned injuries. When developing a photographic protocol for this research, specific attention is given to techniques appearing in past literature concerning UV and IR imaging of bite marks and bruising. Several methods appearing in the literature on the documentation of pattern injuries are explored and tested. In the research the authors are attempting to determine if any one of those selected protocols explored proves more beneficial than the others, ultimately determining a "best method" if one exists. Since this is a time of technological shift from film to digital media, both types of cameras are examined for compatibility, advantages, and limitations. Photographs were taken for six weeks at two-day intervals using numerous filters with both digital and film capabilities in an attempt to discern if the digital camera is comparable for this type of forensic work. Different alternate light sources are tested during ultraviolet and infrared digital photography. The digital camera has advantages and limitations when working with infrared and ultraviolet photography.

Abuse, Ultraviolet, Infrared

G78 The Cave Man in the 21st Century: Chronicle of an Announced Tragedy: Preventive Measures and Repeating Risk

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The goal of this presentation is to describe a building collapse with fatalities in a typical southern Italian location. According to the common definition of a disaster, the authors want to warn against complacency and the underestimation of the appropriateness of certain environmental structures, and underscore the social impact of such a dramatic event, that upon review was truly a predictable tragedy.

This presentation will impact the forensic community and/or humanity by demonstrating how in spite of the tragic event, people continue to live in "the caves", in a condition of absolute poverty and in contrast of every safety rule. In all likelihood, just a few precaution safety measures could have avoided the dramatic event and could prevent a repeat collapse of these types of buildings.

A human made, level I disaster, occurred with the collapse of a building in the historical center of Foggia, a city in the South of Italy. In this location, some families still live in small, tall, and rundown buildings of usually two floors tall. These buildings were built in the very early 20th century, usually above a basement, three meters underground, named by the town citizens as "the caves." These basements are composed of one or two rooms and a small bathroom, with poor lighting and even worse ventilation, with just a small window for an entrance, accessed by stairs. The "caves" were generally intended for storage, but have often hosted people, usually elderly.

During the night of the 20th of November 2004, at 3:15 a.m., a one-floor building over one a "cave" suddenly collapsed. Of the 14 people living in the building at the time, six were found alive within a few hours after the collapse and were immediately transported to the local hospital. Eight bodies were recovered lifeless from the building, and none were missing.

Soon after the disaster, the local legal authority engaged a team composed of forensic pathologists and engineers to investigate the causes of death and the cause of the building collapse. Engineers' investigations discovered that the cause of the collapse was due to the accidental explosion of a domestic gas cylinder originating from a cave. Scene investigations also revealed irregular gas network connections in spite of standard safety rules.

Three working areas were designated early as medicolegal facilities. A provisional holding area was used to receive dead bodies coming from site of collapse prior to examination allowing family members to be able to identify the victim. A second private viewing area was designated to let family members and friends see photographs of the bodies, objects pertaining to the deceased (jewelry, clothing or identifiable objects found), and finally, the bodies themselves, carried from the holding area. An examination space was designated to conduct a more detailed exterior assessment of the body to provide a careful external examination, and to perform a complete autopsy in order to determine the cause of death, documenting injuries sustained, and determining activities at the time of the collapse.

According to the most advanced disaster preparation guidelines, injuries were coded using the Abbreviated Injury Severity Scale and its derivative Injury Severity Score (ISS). The AIS is a comprehensive taxonomy of individual injuries, which denoted body region, type of anatomic structure and severity of injury. The severity index ranged from 0 (no injury) to 6 (unsurvivable injury), the ISS estimated overall body trauma and was calculated by squaring and summing the single highest AIS score in each of the three most severely injured body regions. An ISS score of 76 was indicative of unsurvivable injury. A complete radiographic study of each body was performed.

Cranio-facial injuries, cranial fractures, sternum and multiple ribs fractures, upper and lower limbs fractures, spine fractures and vertebral subluxations, multiple diaphragm lacerations, multiple lacerations and contusion of internal organs (heart, lungs, kidneys, liver and spleen) were detected in a first group of persons represented from the "cave man" group, and the family living immediately above the cave. The second group was composed of three persons in the family living very close to the source of explosion, and presented with only mild to no traumatic injury. People belonging to the first group died quickly, due to the severity of their injuries. The people in the second group died from mechanical asphyxia.

Cave, Building Collapse, Injury Severity Score

G79 Hypothermia-Related Deaths in Cook County, Illinois From November 2000 to February 2005

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The goal of this presentation is to identify common risk factors in cases of hypothermia death.

This presentation will impact the forensic community and/or humanity by presenting epidemiological data on deaths due to hypothermia in Cook County, Illinois, including scene investigation, medical history, and toxicological studies.

Deaths due to hypothermia are a significant public health problem in cold climates in the United States. Cook County, IL, has a population of over 5 million people, and includes Chicago and 120 surrounding suburbs. Winter month temperatures in Illinois can reach below zero degrees Fahrenheit.

Risk factors for death during cold exposure are infancy, advanced age (? 65 years), inadequate shelter, mental impairment, substance abuse, and serious medical conditions. Cold-related deaths have received increased media attention in recent years in Cook County, Illinois, aimed in part at increasing public awareness of the deaths in order to decrease future deaths from hypothermia.

This retrospective study examined 129 cases of death related to hypothermia from the Office of the Medical Examiner in Cook County from November 2000 through February 2005, encompassing five winter seasons. Data examined included age, race and sex of decedents, location found, concomitant medical conditions, outdoor low temperature when found, the presence of paradoxical undressing, the presence of alcohol or other drugs, body temperature (when available), whether or not the decedent was homeless, and any other significant conditions that contributed to the death.

Three of the 129 cases were excluded from the study. In these three cases, the decedent suffered low body temperature due to sepsis during prolonged hospitalization; none were exposed to low ambient temperatures.

Of the 126 remaining cases, 34 occurred in the winter season of 2000-01, 27 from 2001-02, 26 from 2002-03, 20 from 2003-04, and 19 from 2004-05. Eighty-three cases (66%) listed hypothermia or cold exposure as the primary cause of death, and the remaining cases listed hypothermia or cold exposure as a contributing factor to death. Manners of death were listed as accident in 123 cases, suicide in two cases, and undetermined in one case, which involved an unwitnessed drowning with a high postmortem alcohol level. The group consisted of 65 white males (52%), 26 white females (21%), 25 black males (20%), 9 black females (7%), and 1 Asian male (<1%). In 52 cases (41%), the decedent was of advanced age. In 31 cases (25%), the decedent was homeless. The youngest decedent was 28 years old. Forty-seven cases (37%) involved alcohol, and 12 cases (10%) involved other drugs. In 67 cases (53%), the decedent had one or more significant medical problems, including heart disease, diabetes mellitus, dementia, or a seizure disorder. In six cases (5%), a significant injury contributed to the death. Body temperature was taken in 26 cases (21%), and ranged from less than 70°F to 94.5°F. Outdoor temperatures ranged from -9°F to 49°F on the evening before or day found. Mean temperatures per winter season were: 11°F in 2000-01, 21°F in 2001-02, 18°F in 2002-03, 20°F in 2003-04, and 25°F in 2004-05. Seventy three decedents (58%) were found outdoors, 39 (31%) were found indoors with no heat, 13 (10%) were found in various unheated areas, including motor vehicles, porches, and garages, and one was dropped off at the hospital with a high alcohol level and low body temperature by an unknown person. Paradoxical undressing, often cited as a hallmark of hypothermia, was observed in only seven cases (6%).

Autopsy findings in cases of death due to hypothermia may be absent or nonspecific. Correlation with the circumstances surrounding the death and the medical and social history of the subject is important in order to determine the correct cause of death.

Deaths due to hypothermia have decreased in Cook County over the last five years, possibly due to milder winters, but still remain a significant public health problem. The forensic community needs to be aware of the possibility of a cold-related contribution to cause of death.

Forensic Sciences, Hypothermia, Cold Exposure

G80 Analysis of Gene Expression Patterns to Identify Tissue and Body Fluid Specific mRNA Species Using Real Time PCR Assays

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After attending this presentation, attendees will learn that it is possible to test for specific mRNAs that serve as markers for tissue and body fluid identification. Attendees will be informed about pre-amplification protocols that can be employed to simultaneously amplify and detect multiple targets when the amount of material available is limiting.

This presentation will impact the forensic community and/or humanity by teaching the forensic community that gene expression profiles and specific mRNA can be used to identify a large number of body parts and fluids. Attendees will understand that this can be done with very small amounts of material and therefore useful in forensic investigations when sample available is limiting.

This presentation proposes that by screening microarray and SAGE based tissue expression data in multiple databases, both public and internal, it is possible to identify candidate mRNA species that would show tissue specific expression. Additionally, this would select highly expressed messages for use in forensic applications.

In this presentation, and from the screening of human tissue and body fluids, it is possible to define specific markers that can be used for identification. Identification of tissue parts and body fluids is frequently required in crime scene investigations. Conventional methods are often labor-intensive, not confirmatory and employ a diverse range of methodologies. Several forensic laboratories have pioneered the selection of specific protein or mRNA markers for identification of tissues and body fluids. Some laboratories have designed and tested real-time PCR based assays that target the detection of mRNAs encoded by > 20,000 genes in identified in the human genome. The presented methods employ proprietary methods to design assays specific to a target transcript avoiding amplification of related gene transcripts. It also allowed for the development of methods for pre-amplification of hundreds of targets present in a single sample preserving relative quantification information. These methods will be useful when dealing with heterogeneous mixtures.

In this study, the performance of assays targeting saliva specific markers was analyzed such as Statherin, Histatin Ge3, PRB1, PRB2, PRB3, menstrual blood markers like metalloproteinases, and semen specific markers like protamines. These were targets selected based on literature reports. A total of 480 genes from the analysis of microarray data from specific tissues were selected. TData was used to further limit this to a set of 130 genes. Next, RNA from 48 tissues was selected and converted to cDNA by reverse transcription reaction using random primers and commercially available kits. Initially, cDNA was tested using six endogenous controls (GAPDH, GUSB, 18S RNA and ACTB, HPRT and B2M) for normalization purposes. Next, assays targeting transcripts from these genes were used to analyze gene expression relative to endogenous controls across 48 tissues. HeatMap views of gene expression patterns were constructed to identify tissue specific patterns. Based on these expression profiles researchers identified ~20 genes, not reported in the literature as specific markers that are highly expressed in single tissues. Additionally, the authors identified some genes that were expressed in a few (2 to 3) tissues and could still serve as specific markers when used in specific combinations. This research also shows that pre-amplification protocols can be used to detect mRNA when the sample is limiting. Detection of saliva specific markers was demonstrated following pre-amplification.

This study demonstrates that, in many instances, single markers can be defined as specific for a given tissue. These include SEMG1, SEMG2, KLK3, and PRB4/HGNC that have not been reported in the literature as tissue specific markers. In some instances, using a combination of targets will provide identification. This research has shown that if the sample is limiting, pre-amplification of a large set of mRNAs in a single reaction is useful for identification.

Tissue Identification, Gene Expression, Real Time PCR

G81 Caveat Emptor: A Series of Deaths Related to Subcutaneous Silicone Injections in Transgender Males

Morna L. Gonsoulin, MD, Ashraf Mozayani, PhD, Terry Danielson, PhD, and Luis A Sanchez, MD, Harris County Medical Examiner's Office, 1885 Old Spanish Trail, Houston, TX 77054-2098*

After attending this presentation, attendees will learn about the history and consequences of the practice of illicit subcutaneous silicone injections as well as the circumstances, findings and available methods of testing in cases involving subcutaneous silicone injections in the forensic setting.

This presentation will impact the forensic community and/or humanity by alerting forensic professionals about the circumstances, findings and available methods of testing in cases involving subcutaneous silicone injections, as well as informing or increasing awareness of a largely underground, poorly documented and dangerous trend which may be gaining popularity despite the potentially significant morbid and lethal risks.

This presentation highlights a series of three deaths resulting from subcutaneous silicone injections obtained illegally outside the medical setting for cosmetic purposes. The goal of this presentation is to review the circumstances and findings of the cases in light of the general characteristics of the typically utilized silicone-containing compounds, their legal and illegal uses, the methods and procedures used during the injections and the complications of subcutaneous silicone injection as a result of inadvertent systemic siloxane exposure. The presentation will impact the forensic community and/or humanity by alerting forensic professionals about the circumstances, findings and available methods of testing in cases involving subcutaneous silicone injections, as well as informing or increasing awareness of a largely underground, poorly documented and dangerous trend which may be gaining popularity despite the potentially significant morbid and lethal risks.

In Houston, Texas, a series of three deaths within a three-month period in 2003 due to pulmonary silicosis were caused by the illegal practice of subcutaneous silicone injection for cosmetic enhancement of the hips and breasts among local transgender males. Gas chromatographic / mass spectrometric analysis indicated the presence of the cyclic siloxanes, hexamethylcyclotrisiloxane, octamethylcyclotetrasiloxane and decamethylcyclopentasiloxane, in fluids collected from hip and breast injection sites, and from syringes and containers of silicones seized during the investigations. These low molecular weight siloxanes may serve as chemical marker substances in the confirmation of siloxane injection.

This unusual cause of death occurred with alarming frequency over a relatively brief period of time due to a sporadic surge in popularity of the practice of subcutaneous siloxane injection among the local transgender community. The injections had been administered by two independently operating agents with no medical training who were soliciting in bars frequented by transgender males. Although ethnically diverse, the three individuals involved were young transgender males who had received several injections on at least one previous occasion, and their clinical presentations, hospital courses and autopsy findings were similar.

Siloxanes are used in preparations such as hair conditioners, skin care products, and industrial lubricants. While their topical use is common, siloxanes are not intended for internal use. Subcutaneous injection of siloxanes (silicone) presents the risk of direct introduction of silicone compounds into the systemic circulation, where they can accumulate in the pulmonary macrophages (pulmonary silicosis), resulting in hemorrhage, respiratory failure and death. Because of the potentially lethal consequence, injection of siloxanes into subcutaneous tissue is illegal in the United States.

Isolated case reports documenting the sequelae of subcutaneous silicone injections have been presented since the 1970's due to occasional trends, particularly in the transgender subculture, where silicone injections are sought as an easily accessible, non-surgical cosmetic procedure to create a more feminine appearance. The materials required for the injections are easily obtained through cosmetic supply companies (non-medical grade silicone), medical supply companies (medical grade syringe lubricants) or any supplier of viscous liquid silicone (including brake fluid), and the injections are commonly administered in large veterinary syringes. The substance is injected into the dermis and superficial subcutaneous fat, usually in a circular cluster of small punctures. There it accumulates as filler, distending the tissue with the objective of creating a more tense and rounded outline.

Multiple injections are usually required for contour enhancement of the hips and breasts, in particular. Most individuals require additional applications to maintain the enhanced appearance over time. No estimates are available for the number of individuals who have received such injections or for the effects of cumulative silicone exposure of a given individual who has been repeatedly injected. The clandestine nature of the practice and the pervasive social stigma associated with transgender community does not lend itself to obtaining accurate statistics. The persistence of the practice worldwide and anecdotal evidence would suggest, however, that the reported incidence of lethal sequelae of subcutaneous silicone injection is infrequent relative to the number of individuals who have received these injections.

Increased public awareness appears to have had a significant effect in the Houston area. After the local authorities began publicizing the dangers of subcutaneous silicone injections and prosecuting the individuals administering them, no more deaths related to the practice have been reported as of July 2005.

Pulmonary Silicosis, Silicone, Transgender

G82 Anogenital Anatomy: Colposcopy to Study the Appearance and Changes During the Postmortem Interval

Sharon R. Crowley, MN, RN, Forensic Clinical Nurse Specialist, 122 Emeline Avenue, Santa Cruz, CA 95060*

After attending this presentation, attendees will be able to describe the nature and appearance of the anogenital tissues at various postmortem intervals, and evaluate the efficacy of a previously described system of mobile technology for postmortem genital examinations.

This presentation will impact the forensic community and/or humanity by increasing the diagnostic acumen of forensic examiners, increasing the reliability and consistency of both examination techniques and documentation via improved methodology and an efficacious taxonomy, and to eventually allowing reliable comparisons between the anogenital findings in cases of sexual homicide to normative postmortem controls.

Text/background: A paucity of data exists on the "normal" appearance of the anogenital anatomy during the postmortem interval. Data from scrutiny and photodocumentation of these tissues are lacking. Detailed observations of the usual anatomic sites, which have been carefully studied in living sexual assault victims, are lacking in postmortem examples. Thus, the interpretation of genital findings in the deceased remains a vital and timely issue. In addition, techniques that are often employed by some examiners for the medical-legal examination of living sexual assault victims, such as the application of the nuclear stain, toluidine blue dye, have been insufficiently studied in the postmortem arena.

In order to accomplish this, postmortem cases presenting from various causes of death from natural, accidental, suicide, and homicide of non-sexual etiology, are the focus of the present discussion. These cases will comprise a normative, core group of baseline cases, and the first study of "normal" postmortem genital anatomy.

Materials and methods: Baseline examples of genital anatomy during the postmortem interval are selected based upon availability and accessibility. Female cases from the representative causes of death will be clinically evaluated, using the mobile system of technology described by Crowley (JFS, 2004).[1] Colposcopic technique includes inspection at 7.5X, 15X, or both, and photodocumentation via a 35 mm SLR camera. Colposcopy was chosen because it is a well-established technique for the evaluation of sexual assault in both child and adult victims. The range of postmortem interval categories are ≤ 24 hours (fresh), 48-72 hours, 73-96 hours, ≥ 5 days, and unknown. Reproductive status is categorized as prepubertal, reproductive age, perimenopausal, and post-menopausal. Some of the variables to be collected and entered into a sexual homicide database include age, ethnicity, race, date/time body found, date/time of examination, cause of death, past medical history, reproductive status, exam techniques, and any known past medical history, especially gynecological history. Routine inspection, visualization, and photodocumentation of the salient anatomic sites includes the labia majora, peri-clitoral area, peri-urethral area, labia minora, hymen, vagina, cervix, perineum, fossa navicularis, posterior fourchette, anus, and rectum. Any concomitant gynecological condition or benign lesions are noted. Examination techniques such as labial separation, labial traction, use of vaginal speculum, anoscopy, and the degree of fixed magnification (*e.g.*, 7.5X, 15X), used for colposcopic documentation, are also documented.

Discussion: The use of colposcopy is well documented in living sexual assault victims. The obvious benefits of improved visualization via magnification, photodocumentation, and the capacity for peer review are equally germane to the postmortem arena. For living victims, the sexual assault examiner is asked to determine if the physical examination is consistent or inconsistent with the history as provided by the victim. In the deceased, the lack of a history provided by the victim makes the need for reliability and accuracy paramount. The examiner must consider the usual benign factors, gynecological conditions, and concomitant anatomical variations often present in antemortem cases. The examiner of postmortem cases must have the ability to reliably and accurately assess the nature and appearance of anogenital tissues at all major anatomic sites and at various postmortem intervals, while the normal changes of decomposition are simultaneously superimposed on the anatomy. For both the normative, baseline controls and suspected cases of sexual homicide, it is vital that meticulous attention be paid to technique, taxonomy, and interpretation.

The most compelling argument for the use of the colposcope in this setting is the dearth of information available on what is "normal." In the field of postmortem sexual anatomy, the pivotal issue is that "normal" has never been defined. Postmortem changes that are routinely recognized by the adroit examiner of deceased victims such as mucosal autolysis, skin slippage, dilatation, and lividity, may be mistaken for traumatic changes by even experienced sexual assault examiners, whose prior experience is limited to antemortem cases. The entire perineum including the vagina and rectum can be removed en bloc for dissection and microscopic evaluation by the Forensic Pathologist. However, there may be valuable information gleaned by initial in situ examination via colposcopy of the anogenital site.

A high degree of photographic detail and careful analysis of related sample variables will also facilitate categorization of anogenital findings, using an expanded version of the taxonomy described by Crowley and Peterson (AAFS, Dallas, 2004). Continued study may require that the initial taxonomy be modified or expanded.

Reference:

1. Crowley, Sharon R. "A mobile system for postmortem genital examinations with colposcopy: SART-TO-GO," ***J. ForensicSci***. 2004 (Nov); Vol. 49(6):1299-1307.

Colposcopy, Forensic Nurse, Postmortem Anogenital Anatomy

G83 Unusual Suicide With Chain Saw: A Case Report

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After attending this presentation, attendees will learn the importance of a careful observation of the crime scene. This presentation will impact the forensic community and/or humanity by reminding the forensic pathologist that a careful analysis of both the death scene and the findings of the autopsy are essential in reaching the proper conclusion, especially in a very unusual death.

Only a few cases of suicide with a chain saw exist. The reports of these cases are never a complex system, such as presented in this case report. It is interesting to know of this type of a complex system.

A case of suicide using a chain saw is presented. A female suffering from schizophrenia committed suicide through an ingenious system leading to the sectioning of her upper cervical spine involving the cervical spinal cord. The findings of the resulting investigation are described and the mechanism of suicides with the use of a chainsaw is reviewed. The damages to organs and soft tissues are compared to the kinds of chainsaw used.

Case report: Death scene findings: A 32-year-old woman was found dead in her living room. The decedent was a female Asian engineer. She had a significant medical psychiatric past history. She was found dead by her family members ten days after her death. The head was disposed under a material of pulleys and bags filled with water bottles. The material and the appliance are detailed. The chain saw had a 1600 W, 220-240 V, 50-60 Hz engine, and weighted 3 kg. The length was 50 cm including the projecting rim of the chain. The chain's number of revolutions was 9.5 per second. The stains of blood were located on the floor without splatter on the walls.

Postmortem findings: The wound extended 7 cm deep into the neck and involved the posterior muscles and the posterior side of the third and fourth cervical vertebrae. A complete section of the spinal cord was noted.

A study of the cervical bones was performed to compare with the characteristics of the chain saw and to explain all wounds on the cervical vertebrae. Bone injuries were compatible with the use of a large width cutting edge instrument consistent with known chain saw toolmarks. The edges were regular and no hesitation lesion was seen. Because the cadaver was decomposed, the dentist performed identification. The dental comparison of antemortem records and postmortem examination confirmed her identity.

Discussion: Suicides or suicidal attempts with saws are rare but sensational, due to the unusual patterns of injury and sometimes, because of the unusual death scene. Cases reports exist in the forensic literature of this type of suicide. The injuries are almost always inflicted to the head or the neck but in some cases are visceral, and tissue damage occurs because of strong vibrations of the chain saw applied directly to the body. In this case, the young female had significant psychiatric disorders, conceived, and completed a complicate scene of suicide. The wounds inflicted to the neck confirmed the observation of other authors.

The findings of the scene of death were very important to understand the mechanism of the additional material used in the complex manner. No typical hesitation injuries were observed in the neck, and these findings were compatible with the situation of the cadaver and the device. The dry bone study confirmed the regular and sharp limits of the bones injuries.

The authors discuss and compare this case to the literature in consideration of her occupation with possible cultural influences to explain the invention of this efficient and complex deadly system.

Initial autopsy study of the decomposed body were not sufficient enough to characterize the chain saw wounds on her neck, and therefore a dry bone analysis was important and subsequently performed in order to objectively study and understand the mechanism and the physiopathology of her death.

The presentation will illustrate the complex deadly system at her scene of death, in addition to the autopsy findings and the dry bone study.

Chain Saw, Suicide, Complex System

G84 Suicidal Hangings: A Growing Trend in Northern Virginia

Erin E. Falconer, MFS, Danielle L. McLeod, MFS, and Todd M. Luckasevic, DO, Northern Virginia Office of the Chief Medical Examiner, 9797 Braddock Road, Suite 100, Fairfax, VA 22032*

The goal of this presentation is to identify trends present in suicidal hangings.

This presentation will impact the forensic community and/or humanity by providing information on the findings associated with suicidal hangings with emphasis on injuries to the neck, ligature device, presence of a suicide note, and history of mental illness/life event.

Introduction: Suicide is one of the most important public health issues in the United States. Suicide represents the eleventh leading cause of death in the United States. Nearly 20% of the caseload of the Northern Virginia Office of the Chief Medical Examiner in Fairfax, Virginia is suicide. Suicide rates for this country have been relatively stable over the past decade with approximately 10 suicide deaths per 100,000 people. The most common method of suicide in the United States for both males and females is the use of a firearm. The second most common method of suicide in males is hanging.

Materials and Methods: This is a retrospective review of case files from the Northern Virginia Office of the Chief Medical Examiner in Fairfax, Virginia. Inclusionary data for this pilot study included the cause of death from hanging and the manner of death ruled as suicide for autopsy cases from the years 2003 thru 2004. A total of 320 suicides were autopsied during this 2-year study period. Of these 320 suicides, 52 (16%) were due to hanging. These 52 cases were reviewed for the following information: injuries to the neck, type of ligature device, history of mental illness/life event, the presence of alcohol, the presence of a suicide note, past ideations/attempts, and the demographics of the decedent. The case information was organized into a spreadsheet and the data was analyzed for any trends or interesting correlations.

Results: Between the years 2003 and 2004, the Northern Virginia Office of the Chief Medical Examiner in Fairfax, Virginia investigated 320 suicides. Of these 320 suicides, 52 (16%) were reported as hanging. Males comprised 81% (42), while females accounted for the remaining 19% (10) of all suicidal hangings. Caucasians accounted for 71% (37) of the cases, followed by Asians with 13% (7). Case files will be reviewed for a history of depression, mental illness, or life event, and past suicide attempt(s). The presence of alcohol and/or suicide note will be reported.

Conclusions: This pilot study emphasized the increasing rate of suicidal hangings in Northern Virginia. Sixteen percent of the suicides in Northern Virginia are due to hanging. In 2003, 20 individuals died as the result of suicidal hanging. The rate of suicidal hangings increased to a total of 32 cases in the year 2004 and the rate continued to rise in the first half of 2005. This study will report the correlation between type of ligature used and pathologic trauma to the neck. A history of depression, mental illness, or life event, and/or past suicide attempt(s) by the decedent will be analyzed, and the presence of alcohol and/or suicide note will be reported.

Suicide, Hanging, Ligature

G85 DNA Done Right: Manner of Death Determination, Based on Evidence Obtained From a Belt at a Complex Scene Involving a Decomposed Body

Leah L. Bush, MD, and Wendy M. Gunther, MD, Office of the Chief Medical Examiner, Tidewater District, 830 Southampton Avenue, Suite 100, Norfolk, VA 23510*

After attending this presentation, attendees will learn the appropriate methods for handling of evidence at complex scenes; learn about the use of DNA analysis in cases where manner of death is not evident from forensic autopsy; and learn about the value of DNA analysis in cases involving decomposed bodies.

This presentation will impact the forensic community and/or humanity by demonstrating an expanding awareness of the usefulness of DNA touch preparation analysis on items such as ligatures in scenes involving decomposed bodies, and to influence the collection and handling of relevant items at scenes where the manner of death appears undetermined.

A 32-year-old man was found dead in his home at Christmastime, in a state of moderately advanced decomposition. His car was missing from his home, as it had been towed away after an interstate crash days before. The house was secure. There was no suicide note.

The body at the scene was face down on the bedroom floor, lying prone between the bed and a chest of drawers. He was clad only in bikini underwear and socks, with some clothes draped over his lower legs. He was partially suspended by a belt ligature tied to a drawer handle. The belt was looped twice around his neck, with one end of the belt pulled through the buckle behind his left ear. The opposite end of the belt was tied in an overhand knot to the brass drawer handle.

Significant social history included homosexuality, with a history of depression over his sexual orientation, as reported by his mother. There was no known history of autoerotic asphyxia. He had no significant medical history.

Scene investigation included leaving the ligature intact for the autopsy pathologist, bagging the hands in clean paper bags, leaving the clothing undisturbed to allow for a physical evidence recovery kit at autopsy, and wrapping the body in a clean white sheet prior to placing it in a body bag.

Autopsy procedures included photography and close examination of the hands, clipping of the fingernails for DNA analysis, physical evidence recovery kit for sexual activity, removal of the ligature by division away from the buckle, and complete visceral dissection. Autopsy findings included a ½" horizontal ligature furrow with no upslope, and the following pertinent negative findings of no internal neck injuries, significant blunt force or penetrating injuries, obvious sexual assault, or significant natural disease processes, as far as could be determined in his state of moderate decomposition. Postmortem toxicology on bloody purge fluid yielded only an ethanol level of 0.07 mg%, which most likely was due to postmortem bacterial production.

The cause of death was evident at autopsy as ligature strangulation. The manner of death was not evident. Manners considered included either suicide, supported by the Christmas season and history of depression, accident due to autoerotic asphyxia, or homicide by another person. Autopsy findings could not distinguish between these manners of death. After discussion of this fact with the responsible detective, he elected to submit the entire ligature for touch DNA determination of the tied belt ligature end.

This case report will discuss how the DNA evidence from the end of the belt determined the manner and solved the case, with examination of relevant procedures by forensic personnel at scene and forensic pathologists at autopsy, with recommendations for future similar scene investigations.

Touch Preparation DNA, Scene Investigation, Manner of Death Determination

G86 Guns That Fire Themselves: Report of Three Cases

Elizabeth L. Kinnison, MD, and Wendy M. Gunther, MD, Department of Legal Medicine, Virginia Commonwealth University, Medical College of Virginia, 1101 E Marshall Street, Richmond, VA 23298-0568*

After attending this presentation, attendees will be able to recognize characteristics of unusual gunshot wound fatalities that suggest accidental misfires from dropped guns.

This presentation will impact the forensic community and/or humanity by increasing awareness of gunshot wound fatalities due to accidental misfires from dropped guns, recognition of typical characteristics of such cases, and familiarity with pistol types which are associated with accidental misfires on dropping.

Most unwitnessed deaths due to distant gunshot wounds are homicides. Most unwitnessed deaths due to close range or hard contact gunshot wounds are suicides. This report discusses three cases in which dropped guns accidentally took the lives of their owners, in unwitnessed events which had to be pieced together by the examining forensic pathologist.

A 21-year-old man was found shot beside his bed, with a .44 caliber revolver beside him. He had no history of depression, strife, worries, or alcohol abuse. A trail of blood led to the body from the bathroom, where there was a narrow gouge in the vinyl flooring. There was no soot or stippling on the skin or the clothing. The bullet entered the right chest, and was retrieved from the soft tissues of the back, with an angled trajectory through all three lobes of the right lung. The gouge in the vinyl flooring was measured, and was found to correspond in size to the hammer of the gun.

A 30-year-old man was found shot inside a locked residence. Earlier in the evening, a 911 call had been placed from the residence, but operators only heard an open line, with no talking. Attempts to re-establish communication were unsuccessful. Police arrived to find him dead inside of his locked residence. A .22 caliber pistol, knife, and telephone were nearby. Autopsy revealed a single gunshot wound to the back of the right inner thigh. While it had minimal marginal darkening, there was no soot or stippling. Microscopic examination of the entrance showed evidence of a close range of fire. Firearms examination of the clothing revealed a range of fire estimated between 6 and 30 inches. The bullet had a steep upward trajectory through the body, ending its course anterior to the lumbar vertebrae, after lethal iliac artery injury. The gun had marks on the hammer spur, and could be fired without pulling the trigger if the hammer was resting against the firing pin.

A 22-year-old man, seated on his front porch with his friend, and in possession of an illegal gun, observed a police cruiser passing by. Deciding to return the gun to his house, he left the porch, and entered the small anteroom that led to his apartment, with an additional exit in the form of stairs to the upstairs apartment. His friend heard a single gunshot report. He was found dead in front of his door, with his keys beside him in a location that suggested he had been about to unlock the door. Autopsy showed a single distant (more than 3 feet) gunshot wound of the abdomen, with visceral injuries on a sharply rising course, exiting the back of his neck. Significant history included his involvement in an altercation five days previously, resulting in a fracture in his hand, which had been cast at a local emergency room. It proved to be important that the gun was a Takharov pistol.

Characteristics of these cases include unusual, sharply angled trajectories, no evidence of hard contact gunshot wounds in victims with any documented suicidal ideation, frequent absence of powder soot or stippling, and guns which may be known to misfire on impact. Case discussions highlight these and other useful findings in similar cases.

Gunshot Wounds, Dropped Guns, Accidental Misfires

G87 Handgun to the Head: Suicide Trends in Northern Virginia

Erin E. Falconer, MFS, Danielle L. McLeod, MFS, and Todd M. Luckasevic, DO, Northern Virginia Office of the Chief Medical Examiner, 9797 Braddock Road, Suite 100, Fairfax, VA 22032*

The goal of this presentation is to identify trends present in suicidal handgun wounds to the head.

This presentation will impact the forensic community and/or humanity by providing information on the findings associated with suicidal handgun wounds to the head. Emphasis will be focused on the location and characteristics of the wound, caliber of the handgun, result of gunshot residue (GSR) testing, presence of a suicide note, and history of mental illness/life event.

Introduction: Suicide is one of the most important public health issues in the United States. Suicide represents the eleventh leading cause of death in the United States. Nearly 20% of the cases autopsied at the Northern Virginia Office of the Chief Medical Examiner in Fairfax, Virginia are ruled suicide. Suicide rates for this country have been relatively stable over the past decade with approximately 10 suicide deaths per 100,000 people. The most common method of suicide in the United States is with the use of a firearm.

Materials and Methods: This is a retrospective review of case files from the Northern Virginia Office of the Chief Medical Examiner in Fairfax, Virginia. Inclusionary data for this pilot study included the cause of death as gunshot wound to the head with a handgun as the lethal device and the manner of death ruled as suicide for autopsy cases from the years 2003 thru 2004. A total of 320 suicides were autopsied during this 2-year study period. Of these 320 suicides, 113 (35%) were due to handgun wounds to the head. These 113 cases were reviewed for the following information: the location and characteristics of gunshot wounds, the caliber of weapon, underlying psychiatric illness/depression or life event, GSR results, the presence of alcohol, the presence of a suicide note or past ideations/attempts, and the demographics of the decedent. The case information was organized into a spread sheet and the data was analyzed for any trends or interesting correlations.

Results: Between the years 2003 and 2004, the Northern Virginia Office of the Chief Medical Examiner investigated 320 suicides. Of these 320 suicides, 113 (35%) were caused by shooting oneself in the head with a handgun. Males comprised 87% (98), while females accounted for the remaining 13% (15). Caucasians accounted for 87% of the cases. Ethanol (>.02% by weight by volume) was present in postmortem toxicology samples in a total of 39 (35%) of the decedents. Gunshot residue (GSR) was present in 61 (87%) out of 70 samples analyzed. Suicide notes were present in 44 (40%) cases. The location of the gunshot wound in decreasing frequency: right temple 61 (55%), intraoral 34 (31%), left temple 8 (7%), forehead 6 (5%), submandibular 4 (4%), and back of head 1 (<1%). Two cases involved multiple gunshot wounds to the head. A .38 caliber revolver was the most common handgun used. There was no known or documented history of depression, psychiatric illness or life event in only 7 (6%) of the decedents. Finally, 6 (5%) of the decedents had a previously documented suicide attempt.

Conclusions: This pilot study emphasized the role handguns play in suicide. In the years 2003 thru 2004, thirty-five percent of the suicides in Northern Virginia were due to handgun wounds to the head with the right temple region being the most common location. Interestingly, when handedness of the decedent was known and reported, only 3 gunshot wounds of entry were located on the opposite side of the decedent's dominant hand. Also, 2 cases involved multiple (2) gunshot wounds to the head. There was only 1 case where the gunshot wound of entry was located to the back of the head. GSR was positive in 87% and a suicide note was present in 40% of the cases. Finally, only 7% of the cases had no known/reported history of depression, psychiatric illness, or life event.

Handgun, Head, Suicide

G88 Evaluation of Less-Lethal Impact Munitions

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After attending this presentation, attendees will learn about the types of less-lethal munition systems available, their relative safety, and forensic considerations.

This presentation will impact the forensic community and/or humanity by providing a further understanding of the relative safety of less-lethal impact munitions that will assist forensics examiners in the study, analysis, and reconstruction of events associated with serious injury or death.

Law Enforcement is embracing the concept of less-lethal weaponry. Less lethal options are demonstrating their worth in reducing injury to officers, and often suspects while providing alternatives to higher force options. The function of these less lethal devices is often misunderstood. When a negative outcome or even death results from the use of a less lethal option, the forensic examiner is often called upon to analyze and reconstruct the incident.

There is currently a lack of independent data useful for the comparison of the various products available on the market. Police agencies and trainers often have to rely on manufacturer and marketing data to select munitions and tools for their agencies.

A study was devised in an attempt to develop a more objective standard.

Six basic types of specialty impact munitions were examined for this initial study; 12 Gauge bean bags, 40mm bean bags, 40mm sponge type rounds, 37mm ARWEN/Sage variants, FN303, and Pepperball products. The ordinance was fired at 10 feet and 35 feet into bare and covered ballistic gelatin. The ballistic gelatin was used to observe energy distribution and relative injury potential across the spectrum of munitions tested.

Less-Lethal, Impact, Bean Bag

G89 A First Time for Everything: Homicide Involving the Brenneke® Super Sabot Shotgun Slug

Amy Tharp, MD, and Donald Jason, MD, JD, Department of Pathology, Wake Forest University Baptist Medical Center, Medical Center Boulevard, Winston-Salem, NC 27157*

After attending this presentation, attendees will understand the physical characteristics of the Brenneke SuperSabot shotgun slug as it pertains to the practice of forensic pathology, including injury patterns and scene interpretation.

This presentation will impact the forensic community and/or humanity by introducing a novel projectile, including its physical characteristics that have never before been reported in a homicide.

Sabot shotgun slugs are not a new projectile, but the Brenneke® Super Sabot shotgun slug has never been reported in a homicide. The authors present the case of a 28-year-old man killed with multiple gunshot wounds during an alleged "drive-by" shooting. At autopsy, a 496.2 grain slightly deformed projectile with a base diameter of 5/8" (1.7 cm) was found within the decedent's clothing. Six distinct bullet tracks were identified. An entrance of the anterior right thigh was 3/4 x 5/8" and ovoid, having only passed through the decedent's jeans. This bullet track passed through the soft tissue of the right thigh, exiting out the medial aspect and partially transecting the right greater saphenous vein, re-entering the medial left thigh and re-exiting out the posterior left upper thigh. With the exception of an irregular entrance on the sole of the left foot, which passed through the decedent's shoe, all other entrances were less than 1/2" in greatest dimension. Investigating officers recovered an additional projectile of the same type, which had undergone more extensive deformation after striking and penetrating the tailgate of a truck. Further investigation identified the projectiles as the Brenneke® Super Sabot shotgun slugs.

Homicide, Shotgun, Sabot

G90 Death by a Radio-Controlled Helicopter

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The goal of this presentation is to report an unusual death by a radio-controlled helicopter and to discuss the safety issues concerning model helicopters with the forensic community.

This presentation will impact the forensic community and/or humanity by providing awareness of the dangers in the recreational use of radio-controlled aviation models by detailing the types of fatal injuries that can occur with these aircrafts.

This case involves a 41- year- old, white male who was instructing another man on how to operate a radio-controlled helicopter. The scene was a five-acre, grassy field, designated as an area for model aeronautic recreation. The instructor had five years of experience with flying radio-controlled helicopters, whereas his student had just three months of experience. The instructor demonstrated to his student how to hover the helicopter, an older model PHI Tornado radio-controlled, and then passed the controls to his student. The student hovered the helicopter for a few minutes and was attempting to land it, when it tilted and came straight toward them. The student immediately threw himself to the ground and was uninjured; however, the instructor was struck by the helicopter blades and died at the scene.

At autopsy, the decedent had a 7 by 2 inch, gaping chop wound of the right side of the neck and chin. The wound injured the sternocleidomastoid muscle, the strap muscles, the salivary gland, and the right jugular vein. The mandible was exposed, and the transverse processes of the 4th and 5th cervical vertebrae were palpable through the wound. He also had linear-patterned abrasions on the right shoulder, right upper arm, and right upper back. Toxicology for alcohol was negative. An examination of the helicopter showed fragmentation of the main rotor blades with blood spatter on the frame and on the rotor blades. The rotor blades were made of fiberglass composite and had an interior metal wire along the leading edge. The helicopter measured approximately four feet in length, two feet in height, and had a main rotor span of five feet.

Based on the circumstances of death and type of injury in this case, there seems to be an inherent danger in the design and rotational movement of the blades used in radio-controlled helicopters. The use of radio-controlled aircraft is restricted to designated flying fields, and a license is not required to operate them. Flying fields also have designated areas for the aircraft operator with separate areas for spectators.

The recreational use of model helicopters and airplanes is guided by the Academy of Model Aeronautics, which publishes an official national model aircraft safety code. In addition, there are many local model airplane clubs that establish their own rules and regulations about the use of radio-controlled aircraft, based on the official national code. Local clubs usually have their own posted safety guidelines at their flying fields. The Academy of Model Aeronautics recommends that qualified instructors should teach beginners how to use these aircrafts, as was the case in this situation. Instructors, however, are not required for beginners, who can instruct themselves on their use. It is also recommended that people learn to fly airplanes before flying helicopters.

This case illustrates an unfortunate accident where the recreational use of a radio-controlled helicopter by an inexperienced person led to the death of another individual.

Accidental Death, Radio-Controlled Helicopter, Safety Issues

G91 A Fatality Due to Atomoxetine - The First Known Case

Kathryn Haden-Pinneri, MD, 21827 Hollow Field Lane, Katy, TX 77450*

The goal of this presentation is to alert the forensic community to the first known fatality associated with Atomoxetine, a non-stimulant medication utilized for the treatment of Attention Deficit Hyperactivity Disorder (ADHD).

This presentation will impact the forensic community and/or humanity by alerting forensic scientists and the medical community of the potentially deadly combination of atomoxetine and paroxetine and to inform them of the first known fatality due to atomoxetine.

Attention Deficit Hyperactivity Disorder (ADHD) is a diagnosed condition in which a child exhibits symptoms of inattention, hyperactivity, and impulsivity. As these behaviors are part of most developing children at one time or another, the diagnosis requires that such behavior be demonstrated to a degree that is inappropriate for the person's age. Diagnostic guidelines exist to aid clinicians in determining if the symptoms displayed represent ADHD or are just part of normal development. This diagnosis can be quite controversial amongst physicians, with some feeling that the diagnosis is fictitious and over-used and others who feel that it is a medically justified disorder and have documented improvement in children with treatment. This paper serves to provide basic information on ADHD, without bias towards one view or the other.

Treatment for ADHD includes behavioral therapy and medication management. Stimulants are typically the class of medication used for ADHD treatment, and include amphetamine, methylphenidate, and dextroamphetamine. These medications work on the dopamine receptor. Atomoxetine is the first and only non-stimulant medication approved by the FDA for the treatment of ADHD in children, adolescents, and adults. Atomoxetine works differently than the stimulants in that it is a norepinephrine reuptake inhibitor. Evidence to date indicates that over 70 percent of children with ADHD who take Atomoxetine manifest significant improvement in their symptoms. Over 2 million prescriptions have been filled since the FDA approved it in 2002. It is not a controlled substance like the amphetamines; therefore refills may be phoned in, rather than having to pick up a refill prescription in person.

Because it is a relatively new medication, postmortem blood and tissue levels are not well established. Prior to this case, there have been no known fatalities associated with the use of the medication. There have been deaths due to other factors (motor vehicle accidents, hanging, etc) where atomoxetine has been identified, but in low levels. One factor in the lack of information regarding postmortem levels is that not all the toxicology laboratories have the atomoxetine standard to run the samples against.

This case is a 17-year-old male with a history of ADHD, depression and one prior suicide attempt with medications. His social history is negative for alcohol and tobacco use, but positive for prior recreational marijuana use. At the time of his death, he had not used marijuana in approximately one year. He presented to a psychiatrist in January 2004 with complaints of difficulty sleeping, indifference towards school, anxiety and depressed mood. At the time of that presentation, he was taking escitalopram, quetiapine, and lamotrigene. He was diagnosed with Bipolar disorder and ADHD and the plan was to begin a trial of atomoxetine and taper and stop the lamotrigene. He was also placed on zolpidem, 10 mg each evening. Several days later, he attempted suicide with the zolpidem after relationship problems. He had not shown any suicidal ideations prior to that. His atomoxetine dose was increased from 40 mg to 80 mg three weeks from the initial visit and he was instructed to stop the lamotrigene. Three weeks later, the depression was reportedly improved, his aggression reduced and overall affect seemed "more flexible." At the time of his death, his medications consisted of atomoxetine, paroxetine, quetiapine, lamotrigene, and zolpidem. He was found face down in a wooded area near his home, approximately 22 hours after last being seen alive.

Autopsy findings reveal a well-developed male with pulmonary edema and no evidence of natural disease. There were a few abrasions on the face that were consistent with the terminal fall and body position. Toxicologic examination of postmortem blood from the inferior vena cava, just above the iliac bifurcation, revealed an atomoxetine level of 16 mg/L and a small amount of paroxetine (less than 0.10 mg/L). The liver level of atomoxetine was 240 mg/kg and paroxetine of <5 mg/kg. These levels of atomoxetine are markedly higher than any levels published to date.

The presence of both the atomoxetine and paroxetine complicates the toxicologic picture, as they are both metabolized by the cytochrome P450 2D6 enzyme. It has been documented that co-administration of other 2D6 inhibitors with atomoxetine can increase serum atomoxetine levels three- to fourfold. In one documented non-fatal overdose of atomoxetine alone, the patient developed seizures and a prolonged QTc, but was medically managed and survived. Because of the co-administration of these two medications and the lack of suicidal ideations or suicide notes, the manner of death is undetermined. The cause of death is atomoxetine and paroxetine poisoning.

Atomoxetine, Attention Deficit Hyperactivity Disorder, Paroxetine

G92 Methadone Deaths are on the Increase in Maryland (1998-2004)

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After attending this presentation, attendees will learn the details about the increase in methadone related deaths in Maryland and they will realize the importance of cooperation between state drug research groups and the medical examiner's office.

This presentation will impact the forensic community and/or humanity by assisting the forensic community in recognizing local and national trends in methadone related deaths and the need to be diligent in checking the information that is given to research groups that share data with medical examiner's offices. They will also realize that the cooperative effort between these groups can result in the elucidation of causes for drug trends that can be of public benefit.

This presentation will review the increase in Methadone deaths in the State of Maryland from 1998-2004 and discuss the cooperative efforts of the Office of the Chief Medical Examiner (OCME) and the Maryland Drug Early Warning System (DEWS) at University of Maryland's Center for Substance Abuse Research (CESAR).

Methadone is a narcotic used in the treatment of addictive disorders and chronic pain. Nationally, methadone associated deaths increased rapidly in 2001 and 2002. A national report in 2004 showed that the recent increases in methadone use and associated mortality were related to its use as an analgesic and not to its use in opioid treatment programs. Maryland also showed a significant increase in methadone related deaths from 1998 to 2004.

The computerized files of the OCME were searched for all cases positive for methadone by toxicology. These cases were then individually reviewed to determine the number of cases in which methadone intoxication was the only cause of death and those in which methadone contributed to the cause of death in multiple drug intoxications. The concentration of methadone, cause and manner of death, and demographics were reviewed for those cases.

There was over an eight-fold increase in the number of methadone intoxication deaths from 1998 to 2004 with a peak 11-fold increase in 2003. There was over a five-fold increase in the total number of drug deaths

involving methadone, including methadone only and multiple drug deaths involving methadone. During this time the commercial distribution of methadone increased at a much faster rate than the admissions to methadone treatment programs. Most decedents were white males in their late 30s and early 40s. Over the years, the residents of Baltimore City made up a decreasing proportion of the deaths. Medical conditions contributing to death made up a small percentage of cases. In all cases, the most commonly found drugs were antidepressants. The most common other lethal drug was morphine in the multiple drug intoxication deaths. The most common manner of death was undetermined. There was no significant difference in the concentration of methadone in the methadone only vs. multiple drug intoxication deaths. The source of the methadone was unknown in over 50% of the cases and this spurned a pilot study in which OCME pathologists collected additional information from September 2004 to May 2005 about each decedent's source of methadone using a specially prepared CESAR form. Even using the form, information about the source of methadone was still unknown for over 50% of the cases.

Our review has findings similar to the national review, in that decedents most likely obtained methadone through means other than treatment programs. The increase in methadone deaths appears to be due to the procurement of legally prescribed drug for chronic pain or illegal diversion and street sales and does not appear to be from its use in treatment programs. Investigators were not asking specific enough questions about the source of methadone. If additional information was requested on the CESAR form and that information was not needed for the determination of cause and manner of death, then additional calls were not made and the information was listed as unknown. In the future, OCME investigators will be paid by funds from CESAR to collect the desired information for these forms. Thus, in the near future, an answer to this question shoul be available. Also, as a result of this review, the OCME adopted a new protocol in which each separate drug is now listed in the cause of death and this will facilitate statistical research.

Methadone, Research, Maryland

G93 Methadone-Related Deaths: A Review of Medical Examiner Cases in a Large Metropolitan Area

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The goals of this presentation are to (1) to present a review of methadone-related fatalities encompassing comprehensive medicolegal death investigations conducted at the Office of the Chief Medical Examiner in Kentucky between 2000 and 2004; (2) to offer guidance in the interpretation of toxicological data involving methadone, specifically in the context (a) of the victim's use of methadone prior to death and (b) of combinations with other drugs, particularly benzodiazepines, antidepressants, and other opiates.

The documented rapid rise in methadone-related deaths in Kentucky and nationally requires a better understanding of its pathophysiology and the ways it contributes to significantly increased morbidity and mortality. A thorough investigation into the practices of procurement and use/abuse of this drug is essential to arrive at the proper designation of the cause of death. The interpretation of blood methadone concentrations alone or in combination with other psychoactive drugs must include inquiry concerning the victim's potential chronic use and tolerance of the drug. Research shows that pharmacogenetics play an equally important role in an individual's metabolism of methadone and other opiates. This presentation will impact the forensic community and/or humanity by demonstrating why further forensic study should focus on the interplay of drug metabolism with potential genetic links in individuals who die from opiate drug intoxication.

Methadone, a synthetic opioid, received approval by the U.S. Food & Drug Administration (FDA) in 1947 for use as an analgesic. By 1950, physicians prescribed it for the treatment of withdrawal symptoms associated with heroin and other opioids. The majority of methadone-associated deaths in this study include at least one other drug, in most cases another opioid or central nervous system depressants such as benzodiazepines. The synergistic effects of methadone in combination with ethanol, benzodiazepines, or other opioids may be lethal. Methadone-associated deaths skyrocketed in the early 2000's: a greater number of these deaths were reported to MedWatch (FDA's Safety Information and Adverse Event Reporting Program) in 2001 alone than in the previous decade; the number doubled once again in 2002. The dramatic increase is likely due to a rise in consumption attributable to either (a) the rise in prescription of oral methadone to outpatients for chronic pain management, or (b) the greater availability of "street" methadone, which may account for overall increases in illicit drug diversion tactics and usage.

This study reviews 176 methadone-related deaths involving postmortem examination with toxicological analyses at the Office of the Chief Medical Examiner in Louisville, Kentucky between 2000 and 2004. Analysis by the Kentucky Office of Forensic Toxicology revealed that more than a ten-fold increase in methadone-related fatalities occurred, varying from 6 cases in 2000 to 68 cases in 2003. Sixty percent were males; all were Caucasian. Individuals ranged between 17 and 60 years (mean age: 38). The average body mass index (BMI) was 26.2. The Coroner's investigation reported methadone use in 95 (54.0%) cases. Of these, 46 (48.4%) involved prescription by private physician, 19 (20.0%) obtained the drug illegally, 9 (9.5%) received it through a methadone treatment clinic, and 21 (22.1%) acquired methadone by unknown means. Of the 46 individuals receiving physician-prescribed methadone, 23 (50.0%) either initiated or refilled their prescriptions < 10 days prior to death. One-third of these had been undergoing pain management, as supported by the Coroner's documented clinical history and, in some cases, in conjunction with a lumbar or other significant surgical scar.

In view of the broad overlap in blood methadone concentrations in cases of toxicity compared to tolerant individuals on maintenance, interpretation of the postmortem blood methadone concentration was uniquely individualized for each subject. Evaluation included consideration of the history of past exposure, including amount, frequency, and duration of consumption, in an effort to determine whether the subject developed tolerance to methadone. With application of this evaluative methodology, a total of 130 (73.9%) individuals had toxic or lethal blood concentrations of methadone. The blood alcohol concentration (BAC) was negative in 152 (86.4%) of cases, while 9.1% had a BAC ? 0.1%; 4.0% had a level between 0.1% - 0.2%; and one victim had a level between 0.2% - 0.3%. The following psychoactive medications were detected in the blood: benzodiazepines (33.0%), antidepressants (39.2%), and other opiates (27.8%). The P450 metabolizers, promethazine and diphenhydramine, were frequently observed in combination with methadone, at 14.2% and in 10.2%, respectively. Urine was collected in 88.1% of cases. In addition to blood concentrations of drugs noted above, the urine screen confirmed cannabinoids in 28.4% and cocaine or its metabolites in 21.9% of all cases.

Methadone, Opiates, Pain

G94 The Value of Expanded Postmortem Toxicology Testing Menu

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After attending this presentation, attendees will understand the value of retaining alternative tissues for postmortem toxicological analyses.

This presentation will impact the forensic community and/or humanity by demonstrating the utility of alternative postmortem tissue analysis in determining defensible cause of death.

The objective of this presentation is to relate experiences from the Harris County Medical Examiner's Office regarding use of brain tissue, as a supplement to blood, for the postmortem identification of cocaine and its metabolites.

First reported by Spiehler and Reed in 1985 (1), and then further clarified by Karch in 1998 (2), the concentrations of cocaine (COC) and benzoylecognine (BE) in brain parenchymal tissue are vital components to a defensible cause of death due to cocaine intoxication.

Over a 16-month period, in Harris County, there were 58 cases initially designated as undetermined but were suspected of being cocaine-associated deaths. Brain tissue from each of these cases had been obtained as part of the routine autopsy protocol at the time of necropsy. Due either to insufficient quantity, the complete lack or poor quality, of blood specimens taken from these cases, the traditional blood analyses did not identify COC or its metabolites and did not contribute to the determination of cause or manner of death. Subsequently, the brain tissue was analyzed for the presence of COC, BE, and/or cocaethylene (CE). Of the 58 cases analyzed, 35 (60%) COC, BE, and/or CE was found in the brain tissue. As a result, 35 cases that would potentially have been classified as undetermined could be closed and signed out as cocaine-associated deaths.

While the analysis of brain tissue should not be considered as a routine procedure, the collection of parenchymal tissue (e.g., brain) should be incorporated as part of the autopsy procedure. Even if not actually analyzed, this tissue may prove to be invaluable when more routine analyses prove to be non-contributory to the cause of death determination. Other solid tissues or alternative specimens such as hair, nail clippings, maggots, and other solid organs are proving to be useful in postmortem toxicological analyses.

In conclusion, the Harris County Medical Examiner's Office has observed the utility of alternative specimens, such as brain, in the determination of cause in cocaine-related, or suspected, deaths.

References:

1. Spiehler VR, Reed D, Brain Concentrations of Cocaine and Benzoylecognine in Fatal Cases, Jour Foren Sci, 1985, 30(4):1003-1001.
2. Karch SB, Hearn L, Mash D, and Ruttenber J, Postmortem Diagnosis of Cocaine Toxicity: The Utility of Brain Concentration Measurements, SOFT-TIAFT Meeting, October 1998, Albuquerque, NM.

Cocaine, Alternative Tissue Testing, Cause of Death

G95 Arteriovenous Malformation and its Implications in Forensic Pathology: A Case Report

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After attending this presentation, attendees will gain better knowledge and understanding of the four types of vascular malformations (morphology, usual location, outcome) and their implication in forensic pathology.

Sudden deaths from the rupture of an arteriovenous malformation (AVM) are rare in forensic pathology practice. This presentation will impact the forensic community and/or humanity by illustrating the importance of understanding this entity to avoid confusing an AVM with child abuse.

The goal of this presentation is first to differentiate the four major groups of vascular malformations of the brain, which are arteriovenous malformation (AVM), cavernous angioma, venous angioma and capillary telangiectasia, and secondly, to describe their implications in forensic pathology.

AVMs consist of tangled masses of tortuous arteries and veins devoid of intervening capillaries that frequently extend from brain parenchyma into the subarachnoid space. Cavernous angioma is a tightly packed collection of hyalinized vascular channels most commonly found in the cerebellum, pons and subcortical regions. Venous angioma is composed of varicose veins generally located in the cerebral white matter. Capillary telangiectasia appears as a collection of small-caliber, very-thin-walled channels most likely found in the pons. Cavernous hemangioma is the only malformation lacking intervening brain parenchyma. AVM and cavernous angioma often cause hemorrhages. On the other hand, venous angioma and capillary telangiectasia are typically asymptomatic.

AVM is a rare cause of sudden death. In forensic context, six cases of such deaths have been reported, in three different papers. In five of these reported cases, children aged 5 to 10 years old complained of headache and went to lay down, and later found dead from a ruptured AVM within the cerebellum. The other one is an 8-year-old boy found dead in a swimming pool after rupture of an unsuspected brain AVM.

Presented here is the case of a 14-year-old girl who died from a ruptured arteriovenous malformation of the brain. The girl was in good health except for asthma. The eldest of nine, she lived in a family that was part of a marginal community. Her parents were members of a group that allowed child beating and refused all vaccination and modern medicine.

The girl was found dead in the morning, lying on her bed, her legs hanging off the side. Child brutality was suspected at first sight because of a bluish coloration on the side of her face, which was later proven to be livor mortis. On the previous morning, she was feeling fine and went to school. At noon, she started to feel sick. She vomited twice and complained of headache and nausea. Her body temperature was normal. She went home and went to bed by 6 pm, and later found dead the next morning.

External examination of the 60-pound and 4-foot-5 girl revealed nothing worthy of note. At internal examination, the 1580-gram brain showed massive edema with intracerebral hemorrhage and secondary necrosis around the left lateral ventricle, extending to the ventricle with widening of the latter. Microscopically, the lesion was composed of different caliber thick-walled vascular channels surrounded by intervening reactive cerebral parenchyma, with gliosis and hemosiderin deposits. The abnormal vessels extended into the subarachnoid space in some areas. The rest of the autopsy was unremarkable except for mild lung congestion. Toxicological analysis reveals only a therapeutic dose of acetaminophen. The death was attributed to a rupture of a cerebral AVM and the manner of death was ruled natural.

The present case is a reminder that the forensic pathologist should be able to recognize an AVM and know how to differentiate it from the others types of cerebral vascular malformations. Although rare, it can be a cause of sudden death, and should be considered in the differential diagnosis of intracerebral hemorrhage, and not confused with trauma, especially in children.

Sudden Death, Arteriovenous Malformation, Forensic Pathology

G96 Sudden Death in the Young in Australia

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After attending this presentation, attendees will have a good understanding of the range of causes of sudden death in young persons, and be able to implement recommendations made from this analysis.

This presentation will impact the forensic community and/or humanity by providing a greater understanding of the range of diseases causing sudden death in the age range 5 to 35 years.

Objective: To determine the causes of sudden natural death in persons aged 5-35 years.

Method: A review of all autopsies conducted at a forensic medicine facility for the years 1995-2004 (inclusive). This facility serves over 2.5 million people in the eastern part of Sydney, Australia. Data collected included the subjects' age, height, weight, gender, circumstances of death and pathologic findings at autopsy. Deaths caused by trauma, accidental causes, drowning and drug toxicity were excluded from the analysis.

Results: There were 427 non-traumatic, sudden deaths in the 10-year period (70.7% male). Cardiac causes accounted for 56.4%, non-cardiac causes for 39.3% and the cause was not determined in 4.3%. The most common cardiac cause for sudden death was presumed arrhythmia in those with no or minimal structural heart disease (29.0%). Other causes were acute myocardial infarction (24.5%), myocarditis (11.6%), hypertrophic cardiomyopathy (5.8%), aortic dissection and dilated cardiomyopathy (5.4% each). Over two-thirds of deaths caused by acute myocardial infarction occurred in the 30-35 year age group. Sudden cardiac death occurred during physical activity in 10.8% of cases. Sudden cardiac death had been reported in a first-degree relative in 4.5% of decedents. The most common non-cardiac causes for sudden death were epilepsy (23.8%), intracerebral hemorrhage (23.8%), asthma (16.1%), and pulmonary embolism (12.5%).

Conclusion: Presumed cardiac arrhythmia is the most common cause of sudden natural death in the young. There was no reported history of sudden death among the relatives of most decedents.

Sudden Death, Arrhythmia, Autopsy

G97 Suicide Among 10 to 20 Year Olds in Cook County, Illinois: A Retrospective Review

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After attending this presentation, attendees will learn the risk factors and most common methods of suicide in this age group.

This presentation will impact the forensic community and/or humanity by identifying the following: the methods used to commit suicide among 10- to 20-year-olds in a large urban population, the frequency of drugs and alcohol in the study group, and the relationship of suicide to other factors studied. This information will further assist in the formation and implementation of prevention strategies.

The goal of this presentation is to present a review of the findings of a retrospective study of suicide deaths among 10- to 20-year-olds in Cook County, Illinois between 1994 and 2004. After attending this presentation the attendee will be able to recognize the risk factors and most common methods of suicide in this age group.

This presentation will impact the forensic community/and or humanity by identifying the following: the methods used to commit suicide among 10- to 20-year-olds in a large urban population, the frequency of drugs and alcohol in the study group, and the relationship of suicide to other factors studied. This information will further assist in the formation and implementation of prevention strategies.

After steadily increasing during the late 1970s through the early 1990s, the Centers for Disease Control and Prevention reported that between 1992 and 2001 the overall suicide rate for 10 to 19-year-olds in the United States decreased from 6.2 to 4.6 per 100,000 population. In 2001, suicide was the third leading manner of death behind accidents and homicides among 10 to 19-year-olds. In the United States, approximately 2000 adolescents commit suicide annually. Nationwide, 8.5% of students in grades nine through twelve report that they have attempted suicide. Of those attempts, 2.9% required medical attention for their injury or overdose. Several major risk factors for adolescent suicide have been identified. Although a history of a previous suicide attempt is a known risk factor, according to the American Psychiatric Association, many teen suicide completers have never made a prior attempt. Other identified risk factors include a history of a psychiatric disorder (most commonly a mood disorder either alone or in combination with a conduct disorder or substance abuse), a history of sexual abuse, and a history of parental psychiatric disorder. A family history of psychiatric disorder probably increases the risk of suicide in two ways: by bestowing genetic vulnerability and creating home and living conditions with decreased social support, which increases stress at home. Girls are three times more likely to attempt suicide when a psychiatric condition is present in association with alcohol use or a conduct disorder. Peer related violence also appears to increase the level of suicide risk for boys and girls. A recent study found that several of the known risk factors for completed suicide are constant across cultures and countries. The precipitating event, according to one study, occurred from within 24 hours of death up to one year prior to death. The most frequent precipitants within the week prior to death were difficulties in, or the end of, a relationship, and arguments with relatives and friends.

The most common method, identified in numerous studies, is firearms. This is followed by asphyxial deaths - most commonly caused by hanging. Beginning in 1997, however, among 10 to 14-year-olds, asphyxia became the most common method, exceeding deaths caused by firearms. The explanation for this change is unclear. It may in part be due to youth focused firearm laws which are intended to keep firearms away from teenagers - such as gun safe storage laws known as child access prevention laws. Many states have adopted laws, which establish a minimum age for legal possession and purchase of a firearm in response to studies that have consistently found that the presence of firearms in the home increases the risk of adolescent suicide. In 1994, a federal law established 18 years as the minimum legal age for purchasing and possessing handguns. Illinois has a minimum age of 21 years for the purchase and possession of a firearm. Interestingly, a study examining the association of these laws and suicides found that among 14 to 17-year-olds there was no statistically significant association between suicide rates and laws setting minimum ages for firearm purchase or possession. This study did find a modest reduction in suicide rates among the same age group associated with child access prevention laws. Their model estimates that in the absence of the law the expected suicide rate in this age group would be 6.51 per 100,000 rather than the observed 5.97 per 100,000.

This study examines suicides in children and adolescents who live in Cook County, Illinois, a large culturally and racially diverse, primarily urban setting. Cook County, which includes the city of Chicago, has a population of 5,376,741 according to the 2000 census. Caucasians comprise 56.3% of the population, including 19.9% that are of Hispanic ethnicity, African-Americans comprise 26.1 %, Asians 4.8%, and other racial backgrounds 12.8 %. The same census indicates that the city of Chicago has a population of 2,896,016, and a slightly higher African American population — 36.7% — than the county. In the city, Caucasians comprise 42% of the population, Asians 4.3% and other racial backgrounds 17%.

This study explores the demographics, seasons, methods, situational factors, presence of drugs, presence of notes, history of previous suicide

attempts and the identification of known risk factors/stressors when possible. With cases involving gunshot wounds, the location of the injury, the caliber, and ownership of the weapon, (when available), was noted.

In the time period examined there were 254 cases of suicides: 205 male (81%) and 49 females (19%). The majority involved Caucasians, 120 (47%), followed by African-Americans, 87 (34%). Hispanics accounted for 42 (17%) of the cases. Among Asians, there were 5 (2%) suicide deaths.

The majority of the cases occurred in the 16- to 19-year-old age range, accounting for 74%. Overall, the leading cause of death was from a firearm injury, 48%, followed by hanging, 38%. Among 10- to 14-year-olds, however, the leading cause of death was asphyxia (hanging), which accounted for 65.8%. This is similar to a national trend in this age group, reported by the Centers for Disease Control and Prevention in June 2004, in which asphyxial deaths surpassed firearm deaths. Three methods tied for third, each accounting for 3%. The three were pedestrians who stepped in front of vehicles, carbon monoxide deaths, and falls from heights. Drug overdoses accounted for 2%. Self-immolation, drowning, and incised/stab wounds, each accounted for 1%.

The number of suicides was fairly uniform throughout the year. There were slightly more deaths during the spring (29%), compared to autumn (27%), summer (24%), or winter (20%). A history of previous suicide attempts was identified in 11%. Depression and/or another psychiatric disorder were found in 23%. Suicide notes were left by 28%.

Toxicology studies revealed the presence of alcohol, and/or drugs (cocaine, benzoylecgonine, opiates, methadone and phencyclidine) in 19.3%. Blood alcohol levels ranged from 12 mg/dl to 350 mg/dl (mean: 109.6 mg/dl).

Although the data from retrospective studies cannot predict who will commit suicide, by identifying risk factors, strategies and intervention, and assistance programs can be implemented for those who may be at risk. Families, friends, school personnel and healthcare providers need to continue their vigilance because the complexity of childhood and adolescent suicide requires multiple strategies to identify and assist those at risk. Childhood and adolescent depression is more common than many adults believe. In this study, 23% had a psychiatric history, and/or a history of depression. It is estimated that for every completed suicide there are between 100 to 200 suicide attempts.

Depression in children and adolescents can be misinterpreted as anger or sullen behavior. The years between ages 10 to 20 can be a difficult time. Warning signs or behaviors can be subtle and may be mistaken as typical growing pains. Some signs of depression include: unhappiness, isolated behavior, drop in school performance, loss of interest in activities that were formally sources of enjoyment, increase in physical complaints, fatigue, lack of energy or motivation, changes in sleeping and eating habits, increase in drug and alcohol use, outbursts of temper, irritability, restlessness and reckless or dangerous behavior. It is important to remember that the traumatic events, which are the triggers or catalysts for suicide in this age group, may seem minor from an adult's perspective (such as failing a test/class, getting into an accident, breaking up or being rejected). There is no single theory, which explains why children and teenagers take their lives in great numbers. Strategies in the home may include restricting access to medications and firearms. Child firearm access prevention laws can only go so far because, ultimately, laws cannot protect those intent on harming themselves.

Suicide, Methods, Children & Adolescents

G98 Immunohistochemical Examination of α-Lactalbumin in SIDS (Sudden Infant Death Syndrome)

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After attending this presentation, attendees will understand the usefulness of semiquantitative comparison of á-lactalbumin immunohistochemical staining in evaluating cases of suspected SIDS (Sudden Infant Death Syndrome).

This presentation will impact the forensic community and/or humanity by demonstrating the use of alpha-lactalbumin in the diagnosis of SIDS. The aim of this study is to evaluate the presence or absence of milk's particles within pulmonary histologic sections of 10 infants whose cause of death was suspected to be asphyxia due to human breast milk aspiration.

α-Lactalbumin is a whey protein. Previous immunohistochemical research with this antibody in SIDS deaths has been useful in some cases where aspiration was suspected as a cause of death (Iwadate K. et al., 2001).

The authors selected 10 cases of SIDS from the archives of the Section of Legal Medicine and Pathological Anatomy of the University of Bari. All tissues were embedded in paraffin. In order to demonstrate aspirated milk within the lungs, histological sections stained with Hematoxylin-Eosin (H&E) were initially evaluated. In each case, and when the staining was positive or suspected by H&E, immunohistochemical staining using commercially available anti-human α-lactalbumin antibodies was performed.

The authors compared the results of the 10 infants with pulmonary sections from a control group of five infants in which the cause of death was due to a cardiac malformation. In the control group of five deaths, none were positive for the antibody, while in the studied group there were two kinds of results. In the experimental group, one pattern showed small quantity of protein suggestive for a gastroesophageal reflux or cardiopulmonary resuscitation, with both of these factors a cause of terminal inhalation. In the second pattern, there was clear positivity of immunohistochemical staining. This result was clearly interpreted to mean that aspiration was the cause of death.

This method allows the pathologist to evaluate in a semiquantitative manner for the possibility of milk aspiration (Iwadate K. et. al., 2001). Using this technique, the authors are able to evaluate in detail cases in which the circumstances, the autopsy, and the classical histological techniques alone do not allow for a definitive diagnosis. It is possible that a re-examination of cases of SIDS using this technique could be useful in evaluating for the possibility of breast milk aspiration.

Lactalbumin, Breast Milk Aspiration, Immunohistochemistry

G99 Forensic Approach in a Case of Simultaneous Sudden Infant Death Syndrome

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Simultaneous Sudden Infant Death Syndrome (SSIDS) has received limited attention in the medical forensic literature with only a few articles directly addressing this topic. The goal of this presentation is to present a rare case of simultaneous sudden infant deaths (SSIDS) in twin infants. The complete multidisciplinary approach from scene investigation, autopsy examinations, and performance of toxicological testing, satisfies the SIDS criteria and explains this simultaneous lethal event.

This presentation will impact the forensic community and/or humanity by reporting the simultaneous death of a pair of twins. The rarity of the event makes it peculiar and the described complete pathologic investigation (death scene investigation, autopsy examination, and toxicological screening) is strongly recommended in SIDS and is warranted in SSIDS cases.

The case of a simultaneous death in premature, identical male monozygotic, 138 days old twins who were found lifeless in their crib three or four hours after feeding is presented. In the history given by the mother, she stated that early in the morning she fed her sons and then put them at one end of their crib. A few hours later she found the babies in prone position, cyanotic and breathless. She immediately took each of them out of the crib, wet their faces, and alerted medical rescue, meanwhile trying to unsuccessfully resuscitate them. It was also noted that the babies suffered from a cough and respiratory difficulties with mucus production for the last few days, and were seen by a general practitioner who prescribed a cough syrup. The mother also stated that both babies refused feeding before their deaths. The extended family had no history of prior SIDS deaths. After death notification, the authority immediately alerted a forensic pathologist and a detailed scene investigation was performed. Upon the death scene investigation, the babies were found lying on the sofa in the restroom of a small and poorly furnished apartment situated on the ground floor. A domestic gas stove was connected to its fuel cylinder and was found cold to the touch in the same room. A technical assessment performed by fire fighters revealed that the gas supply system was functioning perfectly. The mother, except for cigarette abuse, denied risk factors for SIDS, such as maternal alcohol consumption and legal or illegal drug use during the pregnancy. Internal temperature of the infants measured by means of a bulbus thermometer was 29°C each, and external temperature was 10°C. Rigor mortis was present and livor mortis was represented by fixed reddish-purple coloration localized on anterior part of the body. External examination was unremarkable, showing no sign of traumatic injuries and/or signs of compression of the nose or mouth or upper airway obstruction. Only an intense cyanosis on lips and nails was observed. Complete autopsies two days later were performed. In both cases, cardiac sections showed a septum secundum atrial septal defect, the lungs were hypoexpanded and heavy with diffuse, firm, red boggy parenchyma, with the presence of white fluid in the upper respiratory tracts. Examination of other organs showed cerebral edema, epicardial petechiae, and intense vascular congestion. Histological examination of the hearts revealed the presence of multiple foci of myocardial contraction band necrosis, and myofiber break-up. Examination of the sinoatrial (SA) node and the bundle of His revealed no abnormalities. The lungs showed subpleural haemorrhages, alveolar septa mildly thickened by edema, capillary congestion, alveolar edema, and interstitial infiltrates with leukocytes. No other findings were found except for brain edema and generalized intraparenchymal acute hemostasis. A complete toxicological screening was performed to test for concentrations of bromexine in blood and urine, and for determination of HbCO in the blood. Results of the analysis excluded toxic values for drugs, including carbon monoxide. Data provided from the death scene investigation, medical history of the children before death, macroscopic and microscopic autopsy findings and the results of toxicological examination, exclude any traumatic injury, carbon monoxide or drug intoxication, and led us to conclude that acute respiratory failure from interstitial pneumonia was the cause of the deaths. The presence of environmental risk factors such as the ambient air temperature in the infants' room, number and position of covers, type of bed, prone sleeping position, cosleeping, mother's cigarettes abuse, and recent signs and symptoms of illness, acting at the same prolonged time on each baby, had to be considered relevant in justifying the simultaneity of the lethal event.

Simultaneous Sudden Infant Death Syndrome, Acute Respiratory Failure, Interstitial Pneumonia

G100 Infant Position and the Assessment of Risk Factors for Asphyxia: A Review of 209 Sudden Unexpected Infant Deaths

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After attending this presentation, attendees will understand the importance of a scene investigation, preferably with reenactment using a doll, in identifying the risk factors for asphyxia in a sudden, unexpected infant death.

This presentation will impact the forensic community and/or humanity by demonstrating how historically, the investigation of an infant death has focused predominately on autopsy and microscopic findings with little understanding or consideration of the risk factors for asphyxia at the scene. Since most infant autopsies are negative for significant disease or injury, many of these have traditionally been called sudden infant death syndrome (SIDS). Even in some cases where asphyxia was strongly suspected at the scene, such findings have been ignored in favor of a SIDS diagnosis or cause of death based on some evidence of natural disease at autopsy such as a respiratory tract infection. By ignoring risk factors for asphyxia in many cases, pathologists have missed emphasizing a major cause of sudden infant death through the years.

At the Wayne County Medical Examiner Office in Detroit, Michigan, from 2001 to 2004, scene investigations were performed on 209 sudden and unexpected infant deaths, ages 1 day to 12 months. This included a follow-up visit, usually performed by a public health nurse. A reenactment of the position of the infant's body when found using a doll took place in all except 7 scenes where parents refused or a doll was unavailable. The 209 cases were reviewed to assess the position of the infant at the time of discovery and identify the common risk factors for asphyxia including bed sharing, overlay, wedging, strangulation, and prone position, demonstrated obstruction of the nose and mouth and coverage of the head by bedding. Sixty (28.7%) of these infants died in their cribs, 110 (52.6%) died after being placed to sleep in adult beds, 25 (12.0%) died after being placed to sleep on couches, 5 (2.4%) died in car seats and 9 (4.3%) died in miscellaneous other locations. Conclusive evidence of asphyxiation including witnessed overlay, wedging, or strangulation was established in 27 cases (12.9%). Bed sharing occurred in 114 deaths (54.5%). An infant position with demonstrated complete obstruction of the nose and mouth upon discovery was shown in 64 cases (30.6%). Prone positions on soft bedding +/- partial obstruction of the airway, general prone position, and/or coverage of the head by bedding were documented in 30 cases (14.4%). Overall, one or more risk factors for asphyxia were identified in 178 out of 209 cases (85.2%). Nonspecific criteria which may complicate breathing in an infant with airway compromise were identified in 59 out of 178 infants with asphyxia risk factors (33.1%) and included symptoms of the flu or upper

respiratory infection, medication with sedating decongestants, known respiratory complications of prematurity and/or a previously diagnosed medical condition for which they were not exhibiting acute symptoms. Thirty-one of 209 infants (14.8%) had no discernible risk factors for asphyxia. The information gathered at the scene investigation regarding the infant's position at death was completely different from the initial death report in 26 of 209 cases (12.4%) and revealed additional information regarding asphyxia risk factors in 92 cases (44%). Of the 209 infants, the cause of death of 49 (23.4%) was determined to be position-related asphyxia, 35 (16.7%) were natural causes (with pneumonia/airway inflammation and congenital heart disease predominating), 67 (32.1%) were designated sudden infant death syndrome (SIDS), 57 (27.3%) died of indeterminate causes and 1 case was ruled accidental aspiration of food. The increasing awareness in risk factors for asphyxia at the scene has led to a reduction in the diagnosis of SIDS at the Wayne County Medical Examiner Office from 38 in 2000 to 2 in 2004 (94.7% decrease). In this same time period, the diagnosis of position-related accidental asphyxias in the 1-day to 12-month age group increased by 283% from 6 to 17 and indeterminate causes of death increased by 900% from 3 to 27. This study suggests that asphyxia plays a greater role in many sudden infant deaths than has been historically recognized, and a thorough scene investigation with doll reenactment is an effective way to identify the risk factors. A better understanding of the significance of these risk factors is needed so that the causes of many sudden infant deaths can be determined and appropriate preventive measures reinforced.

Sudden Infant Death, Infant Position, Asphyxia

G101 Hyperglycemic Hyperosmolar Nonketotic Syndrome in a Sixteen-Month Old Child With Rotaviral Diarrhea

Mary E. Carr, MD, and Andrew M. Baker, MD, Hennepin County Medical Examiner's Office, 530 Chicago Avenue, Minneapolis, MN 55415*

The goal of this case study is to present a child death due to severe dehydration from hyperglycemic, hyperosmolar, nonketotic syndrome (HHNS), with concomitant rotavirus diarrhea.

This presentation will impact the forensic community and/or humanity by reviewing the rare entity of HHNS in children; and discussing the differentiation between stress-induced hyperglycemia, diabetic ketoacidosis (DKA) and HHNS.

A sixteen-month-old male child, born at twenty- five weeks and five days gestation, had several congenital anomalies including serious mental and neurological deficiencies.

The initial five months of his life were spent in the hospital during which time he never demonstrated hyperglycemia or showed signs of being diabetic.

Three days prior to his death he developed episodic, profuse watery diarrhea. He was fed a banana, rice, applesauce, toast, (BRAT) diet, without toast. He was also treated with acetaminophen and bismuth subsalicylate. There were no visits to a physician.

On the third day of his illness, he was fussing at 0430. His mother tried to give him cough medicine but he refused. She changed his diaper, laid him prone, and rubbed his back. He was notably limp. When she checked on him approximately two hours later, he was unresponsive. Paramedics were called, but death was obvious and no resuscitation was attempted.

Postmortem examination revealed a slightly dysmorphic male, weighing 18 pounds and having a crown-heel length of 29.5 inches. The occipital frontal circumference was 16.8 inches. The eyes appeared sunken. The organs had dull surfaces and were tacky to touch. There was no physical or historical evidence of previous or recent abuse.

The stomach contained 300cc of light pink fluid without any food fragments. The intestinal contents were of a similar consistency to that of the stomach and light tan in color. The brain had markedly small cerebellar hemispheres and atrophic optic nerves. The hippocampi were atrophic and the lateral and fourth ventricles were mildly dilated. Microscopic sections from the pancreas, heart, lungs, liver, kidney, adrenals, thymus, and trachea were normal. Vitreous electrolytes included a glucose of598mg/dL, vitreous osmolality 430mOsm (285-305mOsm), sodium-158mEq/L, chloride-140 mEq/L, urea nitrogen-37mg/dL, and creatinine-1.0 mg/dL. Acetone was negative. Stool culture was positive for rotavirus. Toxicology was positive for liver acetaminophen with25mcg/gm, and liver salicylate of3.5mg/100gm.

Diarrhea illness, world wide, represents a leading or second cause of death for children less than five years old. In the United States only about 300 child deaths per year are due to diarrhea.

HHNS is almost always a disorder of Type II diabetes mellitus in elderly, neglected, or debilitated adults. In HHNS, glucose levels are elevated, often as high as 1000 mg/dL or more. Ketones are negative because lipolysis is inhibited. Serum osmolarity is high, with the measured level being higher than the calculated level. Acidosis may occur, and is usually due to lactate from hypoperfusion.

Fewer than 30 cases of HHNS have been reported in children since 1960. In most of these, the children are less than two years old and/or neurologically impaired. Mortality is as high as seventy five percent, and occurs from dehydration or from cerebral edema if rehydration occurs too rapidly.

HHNS in children represents either the initial presentation of diabetes mellitus, or it is associated with gastroenteritis, usually rotavirus, as was the case with this child. When HHNS is associated with gastroenteritis it is a transient condition and, if the child survives, they have no greater risk of developing diabetes mellitus than the rest of the population. The mean glucose level (634 mg/dL) is lower, and the sodium is higher (mean 135 mEq/L), when gastroenteritis is the cause of HHNS.

Suggested laboratory studies needed to make the diagnosis of HHNS, and to exclude diabetes mellitus, include glucose, osmolarity, HgA1C, plasma insulin levels, and islet cell antibodies.

Although samples to exclude diabetes mellitus did not remain in this case, this child, who had a severe neurologic disorder and no prior history of a hyperglycemic event, and who was hyperosmolar with rotavirus diarrhea, represents a rare case of HHNS.

Hyperglycemic, Hyperosmolar, Nonketotic

G102 Starvation – Interpretation of Morphological Findings and Pitfalls

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After attending this presentation, attendees will learn how to interpret the morphological findings in cases of starvation.

This presentation will impact the forensic community and/or humanity by helping to avoid the misinterpretation of the morphological findings in cases of starvation by demonstrating the classifications of malnutrition and potential pitfalls in its diagnosis.

Starvation is still a worldwide and every day problem. A high infant mortality exists in many Asian, African and some Central and South American states, which is directly explainable by hunger and its aftereffects. In European and North American countries cases of death from starvation are rare, but nonetheless, are not unknown in the forensic pathology literature. Actually, illness resulting from wealth and overfeeding are much more prevalent.

Nowadays, cases of death due to starvation originate, in general, from physical or psychical diseases, from food refusal or food deprivation. The latter cause of intentional food depravation of a child being in most cases a sign of child neglect punishable by the law.

Starvation due to consumptive illness resulting from serious natural disease, such as cancer, is always related to the original natural disease. Deaths caused by malnutrition are cases of unnatural death.

Under-nutrition can be classified in certain stages. According to the Gomez-Classification the body weight of a malnourished individual is compared to the expected weight of an individual of the same age. The categories mild, moderate and severe malnutrition is based on a body weight of 75 to 89%, 60 to 74% and <60%, respectively, of the expected body weight. With this classification it is difficult to interpret the correct bodyweight of children. Because of the different growth rates of children, in these cases of suspected starvation, the Waterlow classification (Table 1) should be used. The chronic growth retardation of a child can be assessed by comparing the measured height of the body with the expected height. Then the weight of the individual is compared with the expected weight of the body corresponding to the actual height to assess the actual state of under or malnutrition.

Growth Retardation (Chronic) Height (% of the expected height at a defined age)	0 normal > 95	1 mild 95 – 87	2 moderate 87 – 80	3 severe < 80
Protein-Energy-Malnutrition (Acute) Weight (% of the expected weight at a defined age dependent on the actual height)	0 normal > 90	1 mild 90 - 80	2 moderate 80 - 70	3 severe < 70

In this study, cases of starvation were evaluated to point out the difficulties in interpretation of body weight and weight of internal organs and to demonstrate potential pitfalls in this analysis.

The following conclusions can be drawn from this analysis:

- The suspicion of death through starvation becomes evident at first sight.
- The real cause of starvation has to be confirmed by numerous examinations (autopsy and histology and toxicology).
- The autopsy of the body includes the determination of all measurable parameters (height, body weight, organ weight), as well as photo documentation.
- Verification of the development of the child at an early age and from birth on is necessary.
- Investigation by the police of the responsible caretakers for the child, and their responsibility in the starvation, must be carried out.
- Under certain circumstances, such as suspicion of a rare chronic disease, a pediatrician can be consulted for their expert opinion.

Starvation, Waterlow Classification, Malnutrition

G103 Perimacular Circular Folds in the Eyes of Injured Children

M.G.F. Gillland, MD, Brody SOM at East Carolina University, Department of Pathology & Laboratory Medicine, Brody 7 South 10, Greenville, NC 27834*

After attending this presentation, attendees will gain an understanding of how to recognize perimacular folds, will know when to look for them, and know in what kinds of cases perimacular circular folds have been reported to be present.

This presentation will impact the forensic community and/or humanity by demonstrating an increasing ability of forensic pathologists to recognize perimacular circular folds and stimulate interest in looking for such folds in a wider variety of death investigations, although most perimacular circular folds have been seen in abusive head injury deaths.

Hypothesis: Examination of the retinas of a group of children would allow the identification of perimacular circular folds if present. Review of the clinical history, investigative information, and autopsy findings would help establish the significance of such circular folds.

Circular folds have been identified in the eyes of injured children. The initial reports described these findings in children described as battered babies and in children with head injuries attributed to shaking. Cases were selected to report the presence of circular folds. Another report described them in three of ten consecutive cases of child abuse. In all of these reports vitreous traction was the proposed mechanism in the development of circular folds. In the consecutive series report it was proposed that direct head trauma was sufficient to produce the acceleration deceleration traction. More recently, a report described circular folds in a child with crush head injuries occurring when a television fell from a stand, which was an accidental event.

Ocular examinations were a part of a prospective study of child deaths investigated at the Southwestern Institute of Forensic Sciences. Adequate material was available for a retrospective evaluation of 33 of the children's retinas for the presence of circular folds. This group consisted of 25 children with abusive injuries, 5 children with accidental head injuries, and one each of lethal trunk injuries, brain tumor and drowning. Perimacular circular folds were identified in 11 cases. Review of the clinical histories, investigations, and autopsy findings revealed that the circular folds were only found in children with abusive head injuries.

The mechanism of the head injury has previously been reported for a subgroup of head injured children from the entire series from the Southwestern Institute of Forensic Sciences. The mechanism of injury for the 30 head injured children in this group was established independent of information about the presence or absence of perimacular circular folds. Circular folds were seen in 3 of 15 deaths attributed to blunt force mechanisms, 7 of 12 deaths with combined shake and blunt force mechanisms, and 1 of 3 with the mechanism of injury attributed to shaking.

Conclusion: These observations confirm the association of perimacular circular folds with abusive head injuries in a larger group of child deaths than previously reported. The cases were not selected on the basis of circular folds or abusive head injury. The number of accidental head injuries and other causes is too small to clarify whether the perimacular circular folds could be found in other conditions. The mechanism of injury in 8 of the 11 children with circular folds included shaking which supports the proposed vitreous traction mechanism for the formation of perimacular circular folds. However, the presence of circular folds in 3 abusive head injury deaths attributed to blunt force injuries suggests more observations are needed to clarify this issue.

Perimacular Circular Folds, Abusive Head Injury, Vitreous Traction

G104 Postmortem Detection and Evaluation of Retinal Hemorrhages

Patrick E. Lantz, MD, and Constance A. Stanton, MD, Department of Pathology, Wake Forest University Health Sciences, Medical Center Boulevard, Winston-Salem, NC 27157-1072*

After attending this presentation, attendees will gain a better understanding of the variety of disease processes associated with retinal hemorrhages in neonates, infants, children, and adults.

This presentation will impact the forensic community and/or humanity by demonstrating how postmortem monocular indirect ophthalmoscopy permits visualization of the fundus after death and can identify retinal hemorrhages associated with a variety of conditions in children and adults.

Although occurring in about 25% of adults with subarachnoid hemorrhage, Terson syndrome has been considered rare in children and any retinal hemorrhages (RHs) not associated with inflicted childhood neurotrauma have been described as few in number and restricted to the posterior pole. A number of ophthalmologists, pediatricians, and forensic pathologists have asserted that RHs in conjunction with intracranial hemorrhages in children can be considered virtually pathognomonic for inflicted childhood neurotrauma or shaken baby syndrome based on the number, character, location, and distribution of RHs. Unfortunately but characteristically, most studies to date concerning hemorrhagic retinopathy in non-accidental head injury have lacked specific criteria for case definition, exhibited observational and selection bias or cases were selected by the presence or absence of RHs - the clinical or autopsy finding that was being sought as diagnostically valid.

Since June of 2004 the authors have used postmortem monocular indirect ophthalmoscopy to prospectively examine the eyes of 425 deceased individuals at the institution (medical examiner and non-medical examiner cases) ranging in age from birth to 96 years. The postmortem interval ranged from 1 hour to 3 days with 65.9% of examinations occurring less than 24 hours after death. Slightly over 17% exhibited retinal hemorrhages associated with a variety of diseases and conditions. The number of decedents with retinal hemorrhages by age group is listed in the accompanying Table.

Age Range of Decedents and Presence/Absence of Retinal Hemorrhages

	< 1 yr	1-4 yrs	5-9 yrs	10-14 yrs	> 15 yrs	Total
Cases in which fundi not visualized	6	0	2	1	5	14
Cases with no RHs	43	14	7	4	270	338
Cases with RHs	11	3	3	2	54	73
Total	60	17	12	7	329	425

Conditions or causes of death associated with the presence of RHs by age group and number of cases (noted in parenthesis) were:
< 1 yr: Birth-related (2), asphyxia/suffocation (2), Sudden Infant Death Syndrome (SIDS)/resuscitation (2), apnea/gastroesophageal reflux (1), in-utero intracranial hemorrhage (1), blunt trauma of head (1), prematurity/congenital heart disease (1), meningitis (1)
1-4 yrs: Blunt trauma of head (3)
5-9 yrs: Blunt trauma of head (3)
10-14 yrs: Intra-cranial hemorrhage/metastatic cancer (1), blunt trauma of head (1)
> 15 yrs: Blunt trauma of head (17), coagulopathy (10), gunshot wound of head (7), ruptured saccular aneurysm (7), intra-cerebral hemorrhage/hypertension (6), subarachnoid hemorrhage/vascular malformation (1), hypoxic-ischemic brain injury/drug toxicity (1), meningo-encephalitis/leukemia (1), intra-cerebral hemorrhage/amyloid angiopathy (1), hypertension (1), diabetes mellitus (1), pulmonary fibrosis/extra-corporeal membrane oxygenation (1).

The manner of death in children under the age of 14 years with RHs (by age group and number of cases) was:
< 1 yr: Natural (7), Accident (2), Homicide (1), Undetermined (1)
1-4 yrs: Homicide (2), Accident (1)
5-9 yrs: Accident (3)
10-14 yrs: Natural (1), Homicide (1)

Histological ocular examination of 28 neonates, infants, children and adults with retinal hemorrhages from this study demonstrated a variable pattern as to the number, character, location and distribution of retinal and optic nerve sheath hemorrhages. Of the 73 individuals with retinal hemorrhages, 75.3% died in the hospital; however, only four children and one adult had documented clinical fundal examinations. The four children had child abuse consults while the adult experienced a vitreous hemorrhage from thrombocytopenia during treatment for leukemia. Postmortem monocular indirect ophthalmoscopy is a valuable technique for identifying retinal hemorrhages associated with a variety of conditions and diseases in children and adults.

Retinal Hemorrhages, Postmortem Monocular Indirect Ophthalmoscopy, Shaken Baby Syndrome

G105 Examination of Sexually Abused Child: What is the Impact on Judgment?

Nathalie S. Jousset, MD, Department of Forensic Medicine, University Hospital, Angers, 49033, France; and Hubert C. Poirout, MD, Arnaud N. Gaudin, MD, Michel Penneau, MD, PhD, and Clotilde G. Rougé-Maillart, MD, Department of Forensic Medicine, 4 rue Larrey, Angers, 49033, France*

After attending this presentation, attendees will know how the assumption of the possibility of sexual abuse leads almost systematically to a forensic examination. This fact has implications on the health of the victim and the course of the judicial action. However, it is an examination often poor in clinical elements that is used as material proof of abuse. The goal of this study was to try to better understand the contribution of this examination in the legal process.

This presentation will impact the forensic community and/or humanity by attempting to better understand the contribution of the forensic examination when sexual abuse is suspected, and the expected judicial follow-up in sexually abused child affairs.

Assumption of the possibility of sexual abuse leads almost systematically to a forensic examination. This fact has implications on the health of the victim and the course of the judicial action. However it is an examination often poor in clinical elements that is used as material proof. The goal of this study was to try to better understand the contribution of this examination in the legal process.

A retrospective study on a sample of forensic examinations was carried out on requisition. It concerned 74 children of less than 18 years old, examined between June 1998 and June 2000. With the authorisation of the court of Angers city, the judicial files were consulted on site.

It concerned 58 girls for 16 boys. The average age of the victims at the time of the medical examination was nine and a half years old. In 15 cases there was a history of ill-treatment. For nine percent of the victims, the father had been the subject of a penal judgement with prison sentence.

Nine cases related to acts of sexual improprieties, 58 cases of sexual transgressions and 25 cases of rapes or rapes attempts. In 61 percent of the cases, the victim revealed the facts. In 70 percents of cases, time between the facts and revelations was longer than one month.

The forensic examination did not find any disorder for the great majority of the children. In four cases, it highlighted hymenal damage of which two were assigned to sexual abuse. Forty-two victims underwent a

psychological or psychiatric consultation. For two children, their remarks were not recognised credible by the experts.

The total number authors blamed for abuse was 58. Nineteen had already been condemned for sexual abuse. In 26 cases, the father was the abuser. In 43 percent of the files, the authors acknowledged the facts. The courts pronounced the culpability of the authors for 42 victims. It was more frequently pronounced for the female victims (63 %) than for male sex (21 %).

Young girls are mainly the victims. In many cases they are abused by their father or by members of the close family. Forensic examinations did not often reveal cutaneous or genital disorders. The lesions can be fleeting and are often healed. Without bringing material proof, anatomical description makes it possible to come to a conclusion about the feasibility or not of some denounced sexual abuse. Conclusions of forensic examinations, when they partly contradict denounced facts do not call into question the reality of the sexual abuse. In many cases, the author is condemned despite everything. That highlights the importance of investigation and of the child's words.

Sexual Abuse, Child, Forensic Examination

G106 Sensitivity of Autopsy and Radiological Examination in Detecting Bone Fractures in an Animal Model: Implications for the Assessment of Fatal Child Physical Abuse

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After attending this presentation, attendees will come to realize the limits of the radiological CT scan and autopsy assessment in the detection of antemortem bone fractures in cases of fatal child abuse, and that direct osteological assessment of certain anatomical areas (particularly the rib cage) is advisable.

This presentation will impact the forensic community and/or humanity by demonstrating how the osteological assessment of certain anatomic areas upon autopsy of infants is advisable, since radiology, autopsy, and CT scans may miss fractures.

Skeletal injuries are often strong indicators of child abuse and their detection is crucial. Regardless of whether one is referring to the living or the dead, bone fractures are perhaps the most important and problematic issue as far as detectability is concerned. According to some authors, skeletal injuries occur in 36-50% of abused children. Whereas external and internal soft tissue traumatic injuries will eventually show up at a thorough clinical examination or at the autopsy table, the presence of bone fractures whose distribution, number and age are crucial is not easy to detect, particularly if very recent or if inflicted in the circumstances of a lethal event and therefore just barely antemortem. In cases in which the child dies immediately after infliction of trauma, the signs may consist of very subtle soft tissue lesions and especially bone fractures – the latter being at times, particularly difficult to detect when healing processes (and therefore callus formation) have not taken place. Furthermore, hemorrhaging of soft tissues may be slight and barely visible upon autopsy, particularly in the paravertebral and posterior vertebral regions, or may be hidden by initial decomposition processes. Thus autopsy and radiological assessment are crucial.

However it is not really known how sensitive such procedures are. Although several studies have been performed, little research has been done on the actual sensitivity of radiology, CT scan, and autopsy on control cases. In order to do this in fact, it is necessary to verify, after radiological assessment and autopsy, all fractures, which are actually present on the bone by studying the cleaned skeleton.

The aim of this study was to compare the sensitivity of three diagnostic approaches of autopsy, traditional (conventional) radiology, and computed tomography on "battered" piglets, in order to verify the sensitivity of each method, with respect to the true number of bone fractures assessed once the piglet was skeletonized (osteological control).

Four newborn cadaver piglets that had died from natural causes were severely beaten postmortem in every district of the body. Traditional radiography, computed tomography (CT) and autopsy were performed. The piglet was then macerated until skeletonized and the number of all fractures present recorded (osteological control).

On the cranium, traditional radiology revealed only 35% circa of actual fractures, autopsy detected only 31 % ($P<0.01$ for both comparisons vs. osteological control), whereas CT imaging detected all fractures actually present. For ribs, radiology detected only 47% of all fractures present, and autopsy 65% circa ($P>0.05$ for both comparisons vs. osteological control), while CT scans detected 34% ($P<0.01$).

In suspected cases of fatal child abuse, the authors suggest that the bones of specific districts be directly analyzed either at autopsy or by collecting specific diagnostic sites, such as parts of the rib cage, and subjecting them to maceration. The removed areas could be replaced with artificial material for cosmetic purposes. These findings stress the importance of combined radiological, CT scan, autopsy, and osteological survey in the detection of perimortem bone fractures. This study confirms the possibly low sensitivity of autopsy and radiological analysis particularly in the detection of hairline fractures of head and thoracic osseous elements if fractures are perimortem and show no healing. According to the authors, in cases of suspected fatal child physical abuse, the bones of specific anatomic regions should be directly analyzed.

Child Physical Abuse, Bone Fractures, Radiology

G107 "Homicide by Heart Attack" - An Unusual Pediatric Death

Dwayne A. Wolf, MD, PhD, Harris County Medical Examiner Office, 1885 Old Spanish Trail, Houston, TX 77054*

The goals of this presentation are to illustrate and discuss applicability of previously published criteria for homicide by sudden cardiac death in pediatric cases. An unusual case of fatal child abuse will be presented as an example.

This presentation will impact the forensic community and/or humanity by demonstrating how the possibility of underlying potentially fatal natural disease must be considered in instances where multiple blunt trauma in a deceased child is unassociated with internal injuries of sufficient severity to explain the demise. Although the current example entails obvious natural disease, the presence of more subtle abnormalities should diligently sought in such cases. If a temporal correlation of abuse (with non-fatal injuries) with death can be documented by investigation, the manner of death may be properly classified as homicide.

This 17-month-old Hispanic female child had a history of various types of abuse, including blunt trauma as well as neglect. The mother was the reported perpetrator, and according to family members, this child was targeted because the mother had doubts as to her maternity (she speculated that the hospital had sent her home postpartum with somebody else's child).

On the date of death the mother phoned from home to her brother-in-law and initially indicated that this child had "fallen from the bed." Over the next several minutes she phoned her sister as well, made several other incriminating statements indicating that in fact she had "hit" the child, and even admitted to her sister "I killed the baby." The brother-in-law immediately rushed to her house, while simultaneously phoning emergency medical services. He arrived at the house at nearly the same time as ambulance personnel. Paramedics found the child unresponsive. Aggressive resuscitative efforts were unsuccessful and the child was pronounced dead upon arrival to the emergency room. As paramedics were entering the house the mother rushed out, drove to the local day care, retrieved her other children and fled to Mexico. The mother and siblings have not been returned to this country, despite multiple warrants.

The abusive nature of the child's injuries was undeniable. Contusions of various ages were distributed widely over all body surfaces, including the scalp, face, thorax, and extremities. Pressure type contusions were on the pinna. Multiple contusions were distributed across the mucosa of the lower lip, and a gaping laceration undermined the upper frenula separating the upper lip from the alveolar ridge. Internal findings were less impressive. In fact, no internal injuries were found. Furthermore, no natural disease was grossly evident. The microscopic appearance of the heart was strikingly abnormal; myocarditis was florid, with abundant lymphocytic inflammation, with intramyocyte edema and myocyte necrosis.

To paraphrase Davis's criteria for "homicide by heart attack," 1. the threat must be severe enough to be considered as a threat to the life of the victim; 2. the victim should perceive the incident as a threat to their life; 3. the threat must be an emotionally charged event; 4. death must occur within the emotional response period during or immediately following the threat; and 5. cardiac disease associated with predisposition to arrhythmia should be documented, although no acute cardiac change (ruptured plaque for example) need be found (J Forensic Sci 23:384; 1978). Although Davis's criteria have been applied primarily to instances of a threat without physical contact, more recent literature (J Forensic Sci 49:598; 2004) expands the criteria to include threats with actual physical contact, but the inflicted injuries are insufficient to explain death. Therefore, the investigative and autopsy findings in this case fit the published criteria for homicide by sudden cardiac death. Accordingly, the cause of death was classified as "sudden cardiac death (myocarditis) associated with multiple blunt force injuries." The manner of death was classified as homicide. Implications for similar types of pediatric cases will be described in the presentation.

Child Abuse, Myocarditis, Homicide by Heart Attack

H1 Estimating Time Since Injury From Healing Stages Observed in Radiographs

Kevin B. Hufnagl, MA, 601 Lindsay Place, Apartment B14, Knoxville, TN 37919*

After this presentation, attendees will understand some of the ideas and purposes behind dating fractures and the processes used in this research. They will understand the contribution that dating of fractures will bring to the forensic sciences and how this technique can be used to aid in the identification of unknown remains. This presentation will familiarize the attendees with some of the difficulties associated with dating of fractures. Furthermore, the attendees will be made aware of the necessity for cooperation between researchers from different fields in order to further explore the process of fracture healing.

This presentation will impact the forensic community and/or humanity by making the forensic community aware of the study of fracture healing, the need for cooperation in these studies, and the benefit of this work in the identification process.

This presentation will illustrate the benefits of being able to assign ages to partially healed fractures. Information on when a traumatic event occurred is valuable in the identification process of unknown remains. The number of possible identity matches can be reduced if the age of a healing fracture [is] known and [this can] narrow the search of medical records. The time since injury may also help to differentiate between similar remains in settings of mass graves, mass disasters, and war. Fractures do not heal at uniform speeds for all individuals. This project examines the effects of sex and age on the rate of bone repair after fracture in order to establish a method to predict the timing of fractures.

Successive x-rays taken during the period of fracture healing were collected from a private orthopaedic clinic. Based on bony change observable in these radiographs, six stages of bone healing were defined; fracture, granulation, mature callus, partial bridging, almost complete bridging, and complete bridging. Each x-ray was analyzed and identified as exhibiting characteristics of a particular stage. The date of injury was determined from the first radiograph. The six stages of fracture healing were defined as to the time they are expected to occur during healing in individuals of varying age and sex.

The six stages of fracture healing were shown to be influenced by age and sex. Females exhibited a slight delay in onset of the various stages in contrast to males. Age was found to display an inverse relationship with the rate of fracture healing. Furthermore, these findings indicate that age and healing may have a linear relationship. Alternatively, age groups may also be used to separate the rate of bone healing. However, the results of such a separation did not reveal one age at which healing is significantly effected. From these differences, a variation in the rate of fracture repair was inferred based on these factors.

With the ultimate goal of establishing timelines for the healing of fractures based on different stages, this project illustrates the first steps in this direction. The author anticipates that this presentation will spark interest in the establishment of healing timelines, leading to further studies focusing on individual factors showing influence over the rate of fracture healing.

Fracture, Healing, Radiograph

H2 The Human Petrous Temporal Bone: Potential for Forensic Individuation

Jason M. Wiersema, MA, Department of Anthropology, Texas A&M University, College Station, TX 77843-4352*

After attending this presentation, attendees will learn about the potential utility of the petrous temporal bone, as seen on computed tomography images, as a means to make individual forensic identifications of persons from highly fragmentary skeletal remains.

This presentation will impact the forensic community and/or humanity by demonstrating the utility of the petrous temporal bone, as seen on CT images, as a means to make individual identifications in cases in which human remains are heavily fragmented as is often the case in mass disaster investigations. The petrous bone is of particular utility because of its resistance to taphonomic influence and frequent availability, in the form of CT images, to investigators.

Personal identification is of primary importance in forensic investigations involving decomposed human remains. Frequent complications of the identification process can result from a vast number of taphonomic influences, particularly in mass disaster and human rights investigations. Remains are often heavily fragmented and commingled due either to myriad destructive circumstances in the case of mass disasters, or by intentional efforts to hinder identification efforts in the case of human rights related criminal activity.

The forensic scientist has at his/her disposal numerous techniques which yield more or less definitive identifications, but that are often vulnerable to taphonomic complications. DNA identification for example, which is generally preferred for individual identification, is on many occasions not possible because the DNA has been destroyed by taphonomic influence, most commonly fire, or because there is not an antemortem DNA sample to which comparisons can be made. The literature is also inundated with published attempts to find means of extracting diagnostic information directly from fragmentary skeletal remains themselves. Most of these efforts have focused on developing methods from areas of the skeleton which are of known diagnostic significance. Unfortunately, the most individually diagnostic portions of the skeleton, such as the midface are often those that are most susceptible to taphonomic destruction. Even dental remains are often not complete enough for identification due to destruction of the surrounding skeletal matrix. Thus, in spite of the efficacy of these techniques under ideal conditions, they are rarely of practical utility in mass disaster and human rights investigations. A different tact is proposed here. Rather than developing further techniques for identification based on portions of the skeleton that harbor known diagnostic value in spite of their low representation in mass disaster, human rights, and even archaeological settings, this investigation will focus on establishing the as yet undiscovered diagnostic value of a portion of the skeleton which most frequently survives taphonomic destruction.

The petrous portion of the temporal bone is widely considered to be the densest bony structure in the human skeleton (Swartz 1990). The consequent resistance of the petrous bone to taphonomic destruction is broadly appreciated in the forensic literature. However, little effort has been levied on extracting information of individually, sexually, or ancestrally diagnostic value from this portion of the skeleton, although recently some scholars have begun to explore it superficially.

This poster tests the following hypotheses: 1) as visualized in computed tomography imaging, the morphology of the petrous portion of the temporal bone is individually variable; 2) by means of comparing ante-and postmortem CT images, this variability can be used to make individual pos-

itive identifications; and/or 3) that the same variability will provide a reliable means to resolve issues of commingling of individual remains associated with exposure to the taphonomic processes associated with mass disasters, and archaeological excavations. More specific is the hypothesis that an antemortem CT image can be matched to a cranium from which the image is known to have been taken. Finally, it is hypothesized that an antemortem CT image can be correctly associated with the skull from which it was taken in cases in which the identity is not known, and there is more than one skull for comparison.

The head CT scans of 120 adults (60 males and 60 females) were assessed statistically in three dimensions. Coordinate data were collected from 3D reconstructions of the petrous portion of the temporal bone (along the x, y and z axes) as distance matrices. The landmark locations and the measurement distances between them were tested for repeatability, and variability. Coordinate data collected for 18 independent landmarks were included in this study. The poster will show which landmarks were diagnostic and in which combinations they were effective in their support of the above stated hypotheses. It will also discuss the statistical reliability with which ante and postmortem CT images could be matched using these data.

Mass Disaster, Personal Identification, Petrous Temporal Bone

H3 Results of Forensic Anthropological Examination in Daegu Subway Disaster (2003, Korea)

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The goal of this presentation is to demonstrate the results of forensic anthropological examination in the Daegu subway disaster in Korea (2003).

This presentation will impact the forensic community and/or humanity by presenting the methodologies and results used to reconstruct the biological profiles and separate the commingled bone fragments of the victims by forensic anthropologist in the Daegu subway disaster in Korea (2003).

Disaster victim identification normally consists of multidisciplinary procedures: recovery of victims, mortuary center operations, collection of ante-mortem data and identification methods. During the 1990's, recovery of victims of mass disaster in Korea were usually performed by non-medical personnel such as firefighters, soldiers, and police-officers. But, the Daegu subway disaster allowed for [challenged] a meticulous and careful investigative approach in the recovery and reconstruction of the victims because carbonized victims were left *in situ*, piled one over another within narrow aisles and seats inside the train.

After mapping the disaster area, two recovery teams composed of two medical examiners and one forensic anthropologist began the recovery of corpses from the train. At first, the surface debris was cleared from inside the trains. The area was searched for fragmented body part and scattered and fragmentary remains were recovered. During the recovery, attempts were made to locate all parts of one body and associate them. Commingled bone fragments were separated by anthropological examination considering typical bony landmarks such as external occipital protuberance, greater sciatic notch, pre-auricular groove, linea aspera, and so forth. Body parts without bony marks were separated based on surface color of burnt bones - gray, yellowish, white, and black, and anatomy-humerus, tibia, metacarpal. The separated commingled bone fragments were packed in zipper bags and tagged with the area number and comments on the contents, e.g., male's upper extremities, female's hip bone. After the recovery team determined that one victim's fragmented body parts and associated bones were present, the remains moved from the original location to a steel-tray for autopsy, dental investigation, and DNA-sampling.

After the results of DNA recovered from burnt fleshy were obtained, the recovery team began to reconstruct individuals. Cadavers from the same area were moved to the reconstruction room and commingled bone fragments were rearranged according to the DNA-results of associated body parts. Fragmented body parts and carbonized bones of victims were individually laid out in anatomical position. During the reconstruction of victims, the surfaces of body parts and bony fragments were brushed and the debris from each victim's body was collected and stored in another zipper bag. After the careful investigation, less than 30 zipper bags containing bone fragments remained unassociated with body parts. These were delivered to the committee of the bereaved and cremated in a joint funeral.

This presentation demonstrates the utility of forensic anthropological investigation to identify the disaster victim whose body is fragmented and burned. In the future, guidelines for recovery of bodies in mass disasters should be made on the basis of these experiences in Korea.

Forensic Anthropology, Body Recovery, Daegu Subway Disaster (2003, Korea)

H4 Population Variation in the Sacrum

Jaime L. Loichinger, BA, and Cynthia A. Wilczak, PhD, University of Maryland, College Park-Dept. of Anthropology, 1111 Woods Hall, College Park, MD 20742*

Upon the conclusion of this presentation, attendees will have a better understanding of population differences in the sacrum and the feasibility of using sacral morphology to identify the ancestry of human skeletal remains.

This presentation will impact the forensic community and/or humanity by expanding the available information characterizing population differences in post-cranial morphology, and also informing the forensic community on the limitations of using the sacrum in identifying the ancestry of skeletal remains. This research also serves as a case study on the effects of sample selection on classification accuracy relevant to all general research using osteometric determination of ancestry.

This study tested the hypothesis that individuals of African-American ancestry could be distinguished from other populations based on osteometric analysis of the sacrum. The study was initially prompted by casual observations of a distinct "pinching" at the level of the second sacral vertebra and a narrower overall breadth relative to length among African-Americans in comparison to Americans of European descent. Using 610 sacra from mature individuals in the skeletal collections of the National Museum of Natural History, Smithsonian Institution, three standard measurements were taken as defined by the Buikstra and Ubelaker standards: anterior length (AL), anterior superior breadth (APB), and the maximum transverse diameter of the base (TDB). Two additional measurements were added: the curved length of the sacrum at the midsagittal plane (CL), and the minimum breadth at the level of the second sacral vertebrae (MS2). The maximum height of curvature (HC) was obtained by subtracting the anterior length from the curved length. Two indices were calculated by dividing MS2 by either AL or APB and multiplying by 100.

Four hundred sacra sampled from the Terry skeletal collection were evenly distributed by ancestry (African-American, European-American) and by sex. The Native American sample included 84 males and 83 females from South Dakotan Arikara sites and the New Mexican sites of Hawikuh and Jemez. A sample of 43 individuals of Chinese ancestry from California included males only. Statistical procedures for univariate analysis included descriptive statistics and ANOVA procedures to assess among group differences with a Bonferroni adjustment applied to pair-wise comparisons. Direct discriminant function analysis with cross-validation used the five measured variables (AL, CL, APB, TDB, MS2) to assess the

overall effectiveness of multivariate ancestry determination. All statistical analyses were performed separately for males and females using Systat 11 software.

In males and females, the ANOVA analysis showed significant differences for all of the variables among African-Americans, European-Americans, and Native Americans. In pair-wise comparisons of males, African-American sacra were significantly shorter (AL and CL) narrower (APB) and more pinched (MS2) than either Native Americans or European-Americans. European-Americans had significantly greater curvature (HC), while Native Americans had significantly broader promontories (TDB) and higher indices. All trends were similar in females, and the only discrepancies in the results were that AL and CL differences were not significant between the African American and Native American samples for females. Discriminant function analysis correctly classified 70% of males and 74% of females when the three populations were included. While classificatory accuracy did increase to 79% for males when the categories were reduced to African American vs. non-African American, the hypothesis of a distinct morphology in the former population required some modification. Female accuracy did not change with the reduction to the two-category classification system. Correct classification was also highest for Native Americans at 81% for males and 88% for females versus only 66% and 71% respectively for African Americans. When the Chinese sample was included, correct classification decreased to 66% for males (63% for African Americans; 70% for Chinese; 70% for Native Americans, and 64% for European Americans). While the Chinese males did show some of the expected similarities to Native Americans, they are also similar to African Americans in the measurements of pinching (MS2) and overall narrowness (APB). These results suggest that some of the hypothesized "unique" characteristics of the African Americans initially observed are contingent on the populations included in the analysis. The phenomenon of convergence among populations with the addition of larger, more diverse samples has been noted in other studies, but its critical importance in the accuracy of ancestry determination can not be overemphasized.

The presentation of this research not only expands the available information characterizing population differences in post-cranial morphology, it also informs the forensic community on the limitations of using the sacrum in identifying the ancestry of skeletal remains. This research also serves as a case study of the effects of sample selection on classification accuracy relevant to all research and forensic applications that use osteometric determinations of ancestry.

Ancestry, Osteometrics, Sacrum

H5 Skull and Photo Superimposition Technique Used to Aid in the Identification Process

Audrey L. Meehan, BGS, and Robert W. Mann, PhD, Joint POW/MIA Accounting Command/Central Identification Laboratory, 310 Worchester Avenue, Hickam AFB, HI 96853*

After attending this presentation, attendees will learn the use of 3D cranial/photo superimposition as a useful tool.

This presentation will impact the forensic community and/or humanity by demonstrating an enhancement method useful for eliminating possible matches to narrow the search field for missing persons.

The mission of the Joint POW/MIA Accounting Command Central Identification Laboratory is to search for, recover, and identify missing U.S. service personnel from past wars. Difficulties present themselves when the skeletal remains are of like biological profiles, as seen routinely at the CIL, and when mtDNA testing is not possible due to preservation of the osseous remains or lack of comparative family reference samples. This poster presentation shows the Skull/Photo Superimposition procedure currently being developed as part of an ORISE Fellowship Research Project. In conjunction with tested identification methods, this procedure may be useful in creating a short list of possible individuals when used as a means of exclusion.

A line-up of photographs for blind analysis is set up with multiple views of each possible individual obtained from military records and families of the MIAs. Using an overlay program, the sagittal plane is aligned for each using the nasion and the base of the nasal spine as points of congruity between the photos and cranium. Adjustments are made by resizing the photo and tilting the skull to coincide with the subject's angle in the photo. Alignment criteria scoring is used to rate the congruity of eight additional features within the superimpositions. Each feature is scored as a +1 good fit, -1 lack of alignment, or 0 for areas not seen in the photo or trauma to the skeletal remains. This scoring process results in a final comparison sum with a maximum of ten points for each photo and skull comparison. Individuals represented by the photos are considered eliminated from the possible list when inconsistencies in congruity cannot be explained. When the photos and skull have no apparent inconsistencies, this analysis may also be a useful tool for confirmation of identifications made by anthropological analysis, dental record, and historical record comparisons.

Missing Persons, Superimposition, Skeletal Remains

H6 Selection of Variables for Discriminant Analysis of Human Crania for Determining Ancestry

Adam Kolatorowicz, MS, 4510 Marcy Lane, # 41, Indianapolis, IN 46205*

The goal of this presentation is to present to the forensic anthropological community the value of using non-standard instruments in the analysis of unidentified human crania.

This presentation will impact the forensic community and/or humanity by suggesting that biological anthropology laboratories purchase radiometers and coordinate calipers to record data that would be missed with spreading and sliding calipers. Standard measurements can be combined with non-standard measurements to produce more powerful discriminant function formulae for the prediction of ancestry.

Forensic anthropologists use the computer program FORDISC 2.0 (FD2) as an analytical tool for the determination of ancestry of unknown individuals. There are an almost endless number of measurements that can be taken on the human skeleton, yet FORDISC includes only 78 measurements for its analysis. In particular, the program will only utilize up to 24 measurements of the cranium. These 24 cranial variables are used because they require simple, relatively inexpensive instruments that most biological anthropology laboratories have (spreading and sliding calipers). Also, individuals with a basic knowledge of the anatomical landmarks can take the measurements with relative ease. Unconventional measurements of the cranium require unusual, costly instruments (such as the radiometer and coordinate caliper) and are more difficult to take. This poster will examine which measurements of the human cranium provide the greatest classificatory power when constructing discriminant function formulae for the determination of ancestry and will answer the question of whether the use of variables that require more time, training, and equipment are worth the effort.

Sixty seven cranial measurements were taken on 155 adult human crania from three different ancestral groups: (1) African American (n=50), (2) European American (n=50), and (3) Coyotero Apache (n=55). The 67 measurements were broken up into four subsets for statistical analysis: (1) FD2 (1996), (2) Howells (1973), (3) Gill (1984), and (4) All Measurements. A predictive discriminant analysis with a forward stepwise methodology of $p = 0.05$ to enter and $p = 0.15$ to remove was run using the computer software package SPSS 13.0. The analysis produced four sets of

discriminant function formulae. The classificatory power of each set of formulae was determined by comparing the hit-rate estimation (the percent correctly classified) of each of the subsets. First, the resubstitution rate was compared to the leave-one-out (LOO) rate for each subset and then both rates were compared across all subsets. The FD2 subset had a resubstitution rate of 91% and LOO rate of 85.8%. The Howells subset had a resubstitution rate of 96.8% and a LOO rate of 94.2%. The Gill subset had a resubstitution rate of 64.5% and a LOO rate of 62.6%. Finally, the All Measurements subset had a resubstitution rate of 94.8% and a LOO rate of 93.5%. The non-standard measurements of the Howells subset performed the best and the standard FD2 measurements performed third best. Non-standard measurements incorporated in the Howells formulae included frontal subtense, zygoorbitale radius, biasterionic breadth, occipital fraction, and prosthion radius.

The formulae provided the best separation of the Apache group from the other two groups. Stepwise analysis showed that the use of more variables is not necessarily better. Not all of the variables were included in the final formulae. Only 12 of the 24 FD2 measurements, 18 of the 61 Howells measurements, 4 of the 6 Gill measurements, and 14 of the 67 All Measurements were used. Results show that the non-standard measurements can be useful for determining the ancestry of unknown human crania. These measurements could be especially useful for incomplete crania. It is suggested that biological anthropology laboratories purchase radiometers and coordinate calipers to record data that would be missed with spreading and sliding calipers. Standard measurements can be combined with non-standard measurements to produce more powerful discriminant function formulae for the prediction of ancestry.

Ancestry Determination, Discriminant Analysis, Radiometer and Coordinate Calipers

H7 Age of Closure of the Spheno-Occipital Synchondrosis in the Arabian Gulf Region

M. Essam E. El-Sheikh, MD, PhD, and Salwa Ramadan, MD, PO Box 1747, Farwaina 1747, Kuwait*

After attending this presentation, attendees will be provided with age standards for fusion of the Spheno-occipital Synchondrosis based on an Arabian Gulf sample.

This presentation will impact the forensic community and/or humanity by establishing normative age identification standards for Arabian Gulf area populations.

The closure of the spheno-occipital synchondrosis may be regarded as a significant age marker when investigating incomplete human remains. However, the age at which the Spheno-occipital synchondrosis ossifies is still a matter of debate. Fusion has been described in individuals aged as early as ten years and as late as 25 years. The present study investigates the age of fusion of the spheno-occipital synchondrosis in a sample from the Arabian Gulf as a trial to establish a reference standard to be used locally. A total number of 207 subjects with known ages (between 9 and 23 years) were selected among those who had computed tomography (CT) examination for visualization of the base of skull. The state of closure of the spheno-occipital synchondrosis, as seen on high resolution thin-section CT scans, was recorded as closed or open. Partial closure was categorized as open. In males, complete closure of the spheno-occipital synchondrosis was observed as early as 12 years old, and all males past the age of 18 years exhibited closed synchondroses. In females, the corresponding ages were 11 years for earliest fusion and 16 years for the age in which all females demonstrated complete closure.

Arabian Gulf, Age of Closure, Spheno-Occipital Synchondrosis

H8 Sexual Dimorphism in the Subadult Mandible: Quantification Using Geometric Morphometrics

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The goal of this presentation is to outline how geometric morphometric methods can be applied to problems in forensic anthropology. It will illustrate how these methods can further knowledge about morphological differences in the subadult skeleton with increased sensitivity and objectivity compared to standard analytical methods.

This presentation will impact the forensic community and/or humanity by providing data, based on a quantitative, rather than subjective analysis of a reference skeletal sample, allowing a degree of sex determination in the subadult mandible. Further, geometric morphometric techniques have special relevance in forensic anthropology because they are a practical alternative to biomolecular methods, which are often unavailable due to either economic and/or biological constraints, and are unable to be readily applied in the field.

The determination of sex from human skeletal material is of fundamental importance for any forensic investigator. The most favored methods are selected in the hope of providing a high degree of accuracy, but also for suitability of assessment of material that is often damaged or fragmentary. Though these methods are suitable when the recovered material is adult, when applied to the subadult skeleton, the accuracy of sex determination falls markedly. Thus, the inability to reliably assign sex in the subadult age range is a significant problem facing even the most experienced forensic anthropologist.

There have been numerous attempts to differentiate males from females on the basis of the immature skeleton. Loth and Henneberg (2001) claimed that shape differences in the mandible can predict sex with an accuracy of 81%. Subsequent research, however, using different population samples did not achieve such high classification accuracy. Though sexual dimorphism exists in the subadult mandible, two key issues require further clarification: 1) whether this bone can discriminate immature individuals; 2) whether such differences, if they exist, characterize the sample population examined, rather than reflecting universal morphological differences. To investigate these issues, techniques derived from the growing discipline of geometric morphometrics are applied. Geometric morphometric methods utilize landmark data to visualize and quantify shape changes, allowing detailed assessment of differences among specimens.

The authors report here on new morphometric data examining sexual dimorphism in the subadult human mandible. The material was sourced primarily from dissection hall subjects of European and indigenous southern African origin, consequently the sex and a statement of age are known for each individual. Thirty eight bilateral three-dimensional landmarks were designed and acquired using a Microscribe G2X portable digitizer. Measurement error in landmark acquisition was assessed by digitizing six different specimens on six different occasions; the test demonstrated that errors of precision are small with respect to sample variability. The shape analysis software morphologika (www.york.ac.uk/res/fme) was used to analyze the three-dimensional coordinates of the landmarks. A principal components analysis (PCA) explored the relationships between samples of male and female mandibles. The shape differences were then visualized and explored using three-dimensional wireframe and rendered models, and further interpreted using thin plate splines.

This presentation will illustrate and reinforce the concept that population specific differences in sexual dimorphism must be considered in order to achieve optimal sex discrimination. This presentation will benefit the forensic community by providing data, based on a quantitative, rather than subjective analysis of a reference skeletal sample, allowing a degree of sex determination in the subadult mandible.

Sex Determination, Subadult, Mandible

H9 Forensic GPR: Using Ground-Penetrating Radar to Search for Buried Bodies

Johh J. Schultz, PhD, University of Central Florida, Department of Sociology and Anthropology, Orlando, FL 32816-1360*

After attending this presentation, attendees will learn how GPR is used to search for buried bodies in a forensic context and how to find a GPR consultant.

This presentation will impact the forensic community and/or humanity by providing a better understanding of how GPR can be used to search for buried bodies.

The use of ground-penetrating radar (GPR) as a search tool for buried bodies and evidence has become a valuable search option for forensic investigators. This equipment is not only important to locate forensic targets, but it is just as important to clear suspected areas where a body is thought to have been buried so investigations can be directed elsewhere. Ground-penetrating radar is a non-invasive or non-destructive search method that preserves the site during a survey. The equipment is used prior to excavating to identify target areas for invasive testing. Ground-penetrating radar is now routinely used in conjunction with other forensic search methods because the cost of the equipment has decreased and the equipment has become easier to operate. The purpose of this paper is to discuss GPR methodology while emphasizing how this equipment can be used to search for buried bodies by drawing from forensic case examples and research by the author.

Standard GPR systems consist of a control unit, an antenna containing a transmitter and a receiver, and a display monitor that can also be a laptop. Antenna frequencies ranging from 400- to 500-MHz are appropriate for most forensic and archeological applications because they provide an excellent compromise between depth of penetration and resolution of subsurface features. The equipment can be configured a number of ways such as hand pulling the antenna with the monitor secured to the body via a harness, or the monitor can be placed at a fixed location while the antenna is hand pulled. In addition, the newest option integrates all of the components into a cart that can be pushed while performing a survey.

When the equipment is used during a survey, the antenna is emitting electromagnetic waves into the ground as it is being pulled or pushed. As the waves encounter areas of contrasting properties, such as a grave or metallic object, the imagery is captured by the equipment as an anomaly; this is not an exact picture of the buried object in the ground but an indication that something is buried. Depending on the soil type and the burial scenario (e.g., wrapping the body and adding non-biologic items to the grave) an anomaly for a grave or buried body may appear as a distinct and localized hyperbolic shape or a localized soil disturbance. Once target areas are identified, invasive testing will be required to determine the identity of most features that produce anomalies.

The two most limiting factors of GPR surveys that are conducted for forensic contexts are site conditions and operator experience. The best conditions for GPR surveys include open areas that are comprised of dry and sandy soils that are relatively free of large pieces of debris and stone cobbles. False anomalies can be a problem in soil containing debris and stone cobbles and in areas that contain trees or brush. The roots and stumps can be detected as anomalies that are similar in size to anomalies produced by buried bodies. Before, a GPR operator is consulted for a forensic survey, it is important to inquire about their experience. They should have experience searching in forensic and archaeological contexts so they would be familiar with detecting and interpreting anomalies produced by small features such as a buried body or grave and not large geologic features. In addition, GPR can be the most valuable search option in a forensic context when a survey for a body needs to be conducted over a hard-packed surface such as cement or blacktop. For example, if the search for a body needed to be conducted over the cement slab of a residential home, the GPR survey could first be performed to identify the location of target areas that required further testing. There would then be limited damage to the concrete because invasive testing would only be limited to target areas.

Ground-Penetrating Radar (GPR), Search Methods, Forensic Anthropology

H10 A Case of Historical Homicide in Northern Nevada

Ryan W. Schmidt, BS, 1424 Santa Anita Drive, Apartment B, Las Vegas, NV 89119; and Jennifer L. Thompson, PhD, University of Nevada, Las Vegas, 4505 Maryland Parkway, Las Vegas, NV 89154*

The goal of this presentation is to provide the attendee with an introduction to aspects of cranial reconstruction, the difficulties of distinguishing traumatic from taphonomic effects on bone, and to provide a brief history of the Chinese population in northern Nevada in the latter part of the 19th century. In addition, this presentation will open a dialogue about the geo-political climate resonating among ethnic groups in the western United States at the turn of the 20th century, and the violence directed toward one of those groups, Chinese immigrants.

This presentation will impact the forensic community and/or humanity by demonstrating through its application of forensic techniques within a broader historical framework, by confirming attitudes of hostility directed against particular ethnic groups during the nation's diverse history.

On 10 April 2002, construction workers were operating a backhoe to expose an irrigation line on the east side of the events center in Winnemucca, Nevada and noticed several bones sticking out of the dirt that appeared to be human. The local police were notified and a case report issued (no. 02-0351). Photographs were taken of the immediate area and the exposed remains, which were then processed by the Washoe county crime lab. The bones appeared to have been deposited for some time and were determined to be of historic, rather than immediate forensic, relevance. They were then transported to the University of Nevada, Reno where Dr. S. Livingston verified the remains to be human, most likely male, and corroborated the historical nature of burial by identifying a porcelain button of a style manufactured between the years 1850 and 1880. Dr. Livingston also noted distinctive shoveling on the maxillary central incisors, a variable, yet quantifiable non-metric trait found among Sino-American populations (East and North Asia, Americas). The skeletal remains were transported to the Nevada State Museum, and then were subsequently turned over to the University of Nevada, Las Vegas for additional analyses.

Historical accounts of northern Nevada during the years 1860-1880 indicate a steady influx of Chinese immigrants to meet the labor-intensive needs of the trans-continental railroad (Chung *et al*. 1999). In the year 1868, the United States signed an agreement with China, called the Burlingame Treaty, to allow for free, unrestricted immigration and trade between the two nations. This brought numerous Chinese males seeking employment with the railroads or in various other occupations in many small towns across the west. This caused severe agitation among the local settlers who viewed the Chinese as competitors for jobs and as cheap-laborers brought in purposefully by the railroad companies and politicians to undercut their wages. A number of anti-Chinese acts were passed by Congress in the late 1800's, with particular impact upon the remaining Chinese found in towns such as Winnemucca. Newspaper articles and death records document many incidents of violence directed toward the Chinese workers, often resulting in death. The human remains from Winnemucca attest to this turbulent time.

This study presents a biological profile of an unknown individual of Chinese origin. Restoration of the skull allowed metric traits to be measured and used, along with non-metric traits, to assess ancestry. Cranial reconstruction was achieved using a mix of polyvinyl acetate and acetone, common substances often used to aid restoration of fragmentary remains. Adequate cranial elements were preserved to allow comparable anatomical restitution. Importantly, the cranial vault exhibits radiating fractures emanating from the right parietal and occipital. Restoration allowed a more accurate assessment of whether these fractures were due to blunt-force trauma perimortem or to taphonomic factors that occurred after internment. The results indicate that the ectocranial beveling was the result of trauma. This work supports a case of historical homicide and substantiates accounts of violence directed toward the Chinese during the late 19th Century.

A case study where forensic techniques were applied to human remains buried in an historical context is presented. Using forensic methods in such cases can help to chronicle and substantiate a lamentable time in history that should, nonetheless, not be forgotten.

Biological Profile, Trauma, History

H11 What Matters - Size or Shape? Three-Dimensional Analysis of Craniofacial Sexual Variation Among American Populations

Ann H. Ross, PhD, North Carolina State University, Department of Sociology and Anthropology, Campus Box 8107, Raleigh, NC 27695-8107; Erin H. Kimmerle, PhD, University of South Florida, Department of Anthropology, 4202 East Fowler Avenue, SOC 107, Tampa, FL 33620-8100; Dennis E. Slice, PhD, Institute for Anthropology, University of Vienna, Vienna, Austria; and Anthony B. Falsetti, PhD, University of Florida, CA Pound Human ID Laboratory, Department of Anthropology, Gainesville, FL 32611*

After attending this presentation, attendees will understand the sexual dimorphic variation among different American populations, the various effects of allometry in assessing sexual dimorphism, and the impact of allometry on sex estimation from skeletal cranio-facial remains.

This presentation will impact the forensic community and/or humanity by demonstrating that shape is as an important factor as size in the assessment of sex estimation. It is further demonstrated that 3D analysis of the cranio-facial region, through the use of Generalized Procrustes Analysis, may be an important tool in sex estimation. Finally, it is shown that population specific standards are needed for size and shape assessment in the estimation of sex.

One of the four pillars of the anthropological protocol is the estimation of biological sex. The estimation of sex along with the estimation of ancestry are critical first steps in a biological profile, as other elements in the analysis of human skeletal remains, such as age and stature, are sex and ancestry specific and cannot be adequately determined without this very basic assessment. The standard protocol used consists of visually assessing individual skeletal morphological features of the cranium and mandible and the *Os coxae* based on a scale of 1-5, ranging from "Male" to "Indeterminate" to "Female." These morphological traits are then interpolated or "averaged" by the investigator to estimate sex. However, visual assessments of these traits are subjective and the weight given to any particular trait varies among observers based on training and experience. Further problems may arise when applying these methods to different populations, who may innately differ in stature, physique, or general robustness. Consequently, a skeletally robust female may appear to be "male," particularly in light of cross-population comparisons.

A study presented by Rosas and Bastir (2002, Thin-Plate Spline of Allometry and Sexual Dimorphism in the Human Cranio-Facial Complex, AJPA 117(3): 236-245) investigating allometry and sexual dimorphism among a Portuguese population, demonstrated that size and sex had a significant influence on the shape of the cranio-facial complex. They found that both size and sex independently influenced shape, demonstrating that there is a greater amount of information to be obtained than from the visual methods used to assess cranio-facial morphology.

The purpose of this study is to further examine the effect of size and sex on cranio-facial shape in Americans to better understand the allometric foundation of the skeletal traits currently used for sex estimation from the skeleton and to investigate possible cross-population differences.

For this project, 3D coordinates of 17 standard craniofacial landmarks were collected using a Microscribe-3DX digitizer. Data were collected for 118 White and Black males and females from the W.M. Bass Donated Collection and the Forensic Data Bank, University of Tennessee - Knoxville.

Raw coordinate data are not directly comparable as shape variables to compare specimens since each set is collected in its own coordinate system. The data must be translated and rotated to a common coordinate system and scaled to a common size. To undertake these transformations a generalized Procrustes analysis (GPA) was used that minimizes the sum of squared distances between landmarks of each skull and those of an iteratively-computed mean. The resulting shape variables and Centroid Size were then used in the subsequent multivariate analyses. A principal component analysis (PCA) of the covariance matrix was conducted on the GPA transformed variables to reduce the dimensionality of the data to meet the requirements of the parametric test. A multivariate analysis of covariance (MANCOVA) was performed using the PCA scores to test whether size and sex have significant effects on the average shape of males and females.

Concurring with Rosas and Bastir's study, no difference in the influence of size on shape between males and females (no significant size*sex interaction) is found. Thus, the shape differences observed between males and females are not solely dependent on their respective sizes. In this study, sex, controlling for size, had a significant influence on shape in both American Whites ($F=2.90$; $df=39$; $Pr > F = 0.0024$) and Blacks ($F=2.81$; $df=37$; $Pr>F=0.0035$). Interestingly, the size effect did not have a significant influence on shape in either Whites ($F=1.69$; $df =39$; $Pr>F=0.08$) or Blacks ($F=1.09$; $df=37$; $Pr>F=0.40$). These results show that sexual dimorphism is based on underlying unique sex differences not simply a matter of size.

Geometric Morphometry, Sexual Dimorphism, Americans

H12 Estimation of Living Stature From Selected Anthropometric (Soft Tissue) Measurements: How do These Compare With Osteometric (Skeletal) Measurements?

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The goal of this presentation is to provide research results pertaining to the estimation of living stature from anthropometric measurements. The research compares the accuracy of models using soft tissue measurements to models using skeletal measurements. The use of soft tissue measurements would be of particular utility when working with dismembered bodies, but the results indicate that it is worth the added time and effort to use skeletal measurements when feasible.

This presentation will impact the forensic community and/or humanity by assisting forensic anthropologists working in mass fatality incidents and dismemberment cases.

Forensic anthropologists play an integral part in mass fatality resolution, especially in the triage and analysis of fragmentary human remains. Body dismemberment is a common occurrence in traumatic events such as aircraft crashes. Critical anthropological information will include body part identification (perhaps even determining human vs. non-human), recognition of commingling, documentation of trauma, and assessment of the biological profile (age, race/ancestry, sex, and stature).

Estimation of living stature has obvious utility in the identification process, especially when individuals are observed to be particularly tall or short in comparison to their associated population. Typically, anthropologists estimate stature from the measurement of long bone length. As emergency response to a mass fatality is generally immediate, the presence of soft tissue on the human remains necessitates dissection to expose skeletal landmarks for measurement. As part of this research, a test was performed to observe the accuracy of regression formulae derived from standard anthropometric (i.e., soft tissue) data compared to osteometric (i.e., skeletal) data. The goal was to determine whether anthropometric mea-

surements could be used in place of osteometric measurements, which would remove the added time and effort associated with dissection when working with dismembered remains.

Medical personnel have used anthropometric measurements to estimate stature of the living (particularly the elderly and disabled) who are not able to stand erect. High correlations are cited (e.g., Cheng et al 2001) but most regression equations use age as a variable in the formulae. Since one of the goals of a forensic analysis during a mass fatality is identification, age is unknown and most of the published equations from the health literature are not appropriate.

Using National Health and Nutrition Examination Survey (NHANES) data from 1998-2002 it was possible to construct anthropometric regression equations from a large sample of individuals. Regression formulae were derived from the NHANES data based on age, race/ancestry, and sex. The available anthropometric variables included Standing Height, Upper Arm Length, and Upper Leg Length. Values for the limb portions were recorded to the nearest 0.1 centimeter using a measuring tape. From this data set, a sample of White and Black males between the ages of 18 and 50 were selected (n=3353). The strength of correlation between these variables was compared with those presented by Trotter and Gleser (1958) for skeletal measurements of White and Black males using the Maximum Length of the Humerus and the Maximum Length of the Femur.

It was found that the correlation between stature and the selected *skeletal* measurements is higher than the correlation seen for the *soft tissue* measurements (Tables 1-3). It was hypothesized that the lower correlation between the anthropometric data and stature may be related to measurement bias. For example, there is certain to be individual variation of soft tissue thickness (e.g., excessive fat) that would not be related to height and may skew measurement accuracy. In order to test this assumption, Body Mass Index (BMI) was factored into the anthropometric equations. BMI proved to be a significant contributor to the regression equations. Individuals with a BMI value over 25 were removed from the sample and the correlations were re-calculated. The reduced BMI samples show slightly higher correlations as compared to the full samples (Tables 1 and 2). Correlations with standing height improved with the removal of individuals with high BMI scores (>25).

Table 1: Correlation of Upper Arm Length with Standing Height in 18-50 Year Old Males (NHANES data)

White		Black	
All (n=1076)	BMI<25 (n=425)	All (n=604)	BMI<25 (n=297)
0.671	0.723	0.668	0.677

Table 2: Correlation of Upper Leg Length with Standing Height in 18-50 Year Old Males (NHANES data)

White		Black	
All (n=1073)	BMI<25 (n=425)	All (n=600)	BMI<25 (n=297)
0.623	0.629	0.651	0.703

Table 3. Correlation of Humerus and Femur with Standing Height in 18-46 Year Old Males from the Korean War (Trotter and Gleser 1958)

	White	Black
Humerus*	0.733	0.705
Femur*	0.803	0.807

*Values represent the right side only

The regression formulae calculated from the NHANES data for anthropometric measurements are presented in Table 4. Although it was found that a reasonable correlation exists between standard anthropometric measurements and living stature, it is not to the same degree as with skeletal measurements. While an improvement in the anthropometric models was found when BMI was factored into the equation, BMI cannot be determined for isolated body segments and would not be viable in the forensic context.

Table 4. Regression Coefficients for Stature Estimation from Upper Arm and Leg Segment Measurements from the NHANES Data (1998-2002)

Arm			
	Intercept	Slope	Error
All (n=1680)	96.44	2.08	5.30
White (n=1076)	94.07	2.16	5.27
Black (n=604)	98.33	2.02	5.28
Leg			
	Intercept	Slope	Error
All (n= 1673)	113.26	1.47	5.63
White (n= 1073)	112.11	1.52	5.54
Black (n= 600)	103.52	1.65	5.40

The conclusion drawn from this research is that when estimating living stature from dismembered bodies, limb portions do provide reasonable estimates of living stature and the formulae provided as part of this research may be utilized. However, numerous factors influence these estimates (such as body weight) and it is worth the added effort to take skeletal measurements when feasible and use established regression formulae.

Stature, Mass Fatality, Identification

H13 Morphological, Metric, and Morphometric Variation in the Midface

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After attending this presentation, attendees will understand 1) Collecting data to answer current question can be used to answer other questions in the future 2) discriminant function analysis (DFA) is a powerful tool for estimating ancestry from skeletal remains, and 3) DFA using interlandmark distances (ILDs) can distinguish between Whites, Blacks, and American Indians very well.

This presentation will impact the forensic community and/or humanity by demonstrating the need to be more thoughtful when collecting and analyzing data.

Often, the forensic anthropologist trying to identify remains is faced with providing discrete answers: Male or Female, Black or White, or especially in possible NAGPRA cases, American Indian or White, and if Indian, which tribe. Data collection and analysis is often centered on answering specific questions, and morphological observations are more valuable when they can be quantified and analyzed in a statistical framework. Unfortunately, applicability of a method can be constrained by a limited approach.

Gill (1984) and Gill *et al.* (1988) proposed a metric method for determining American Indian vs. European ancestry. The authors calculated three ratios and "eyeballed" where the best sectioning points between groups would be in each; an unknown was classified into the group that was on the same side of the sectioning point in at least two of the ratios. Their method correctly classified 88% of large samples of Indians and Whites. However, Gill et al. (1988) also noted that the measurements of Blacks and Indians were similar enough that Blacks would classify as Indians using the method.

To test the Gill method, a three-dimensional digitizer was used to collect midfacial cranial landmark data from approximately 300 American Indians, Blacks, and Whites at the National Museum of Natural History, Smithsonian Institution. Twenty landmark coordinates were recorded on each cranium, primarily Type I landmarks, those located at the intersection of sutures, as well as the Gill landmarks. One of the challenges of the Gill

method is locating alpha. The Gill definition involves drawing a line from zygoorbitale to nasale inferius and eyeballing the deepest part of the concave contour. For this analysis, the digitizer pointer was traced from zygoorbitale to nasale inferius and the alpha point on each side was calculated directly as the point of maximum departure from the straight line from zygoorbitale to nasale inferius. Other challenging landmarks are the 'deepest point on the nasal bridge," the points used to calculate subtenses, which are also apparently eyeballed. The digitizer pointer was traced from nasion inferiorly along the midline and the smallest distance to each paired alpha, maxillofrontale, and zygoorbitale determined the subtense points. Statistics were performed using SAS and SYSTAT. Reported classification accuracies are cross-validated.

Results were somewhat in agreement with Gill *et al.* (1988) with some important differences. While 103 of 117 (88%) American Indians and 88 out of 95 (93%) Blacks classified as non-White, only 59 of 95 (62%) Whites classified correctly. A sample of 20 Eskimos was classified 100% correctly. An analysis of the Gill measurements revealed that there are sex differences in the alpha index ($p < .001$) and the zygoorbital index ($p < .05$). In looking at measurement and index distributions, it was also clear that certain measurements (even when standardized by sex) showed greater differences between American Indians and Whites than the indices in which they were used. Further, DFA uses different weights according to the contribution of each variable to separating groups and their correlations to the other variables. In the Gill method, each index receives equal weight. Analyzing the three Gill indices in DFA, 79% of the Indians and 74% of the Whites were correctly classified, but the alpha index did not significantly contribute to the discriminant function. Analyzing the six Gill measurements used to calculate the indices classified the American Indians and Whites 90% correctly, and the alpha cord was especially valuable. A three-way DFA of American Indians, Blacks, and Whites classified 72% correctly.

The advantages of more extensive data collection became apparent when the interlandmark distances from 20 landmarks were calculated. In the two-way DFA, American Indians and Whites were correctly classified 95% of the time using up to 25 ILDs including alpha landmarks, and 92% without the alpha landmarks. In a three-way DFA, American Indians, Blacks, and Whites were classified 85% correctly using 19 interlandmark distances, including alpha landmarks, and 82% correctly without them.

Gill *et al.* (1988) discovered important measurements that differ between American Indians and Whites and outlined specific measurements for discriminating between them. However, greater differences were found through collecting better-defined landmarks, and employing multivariate methods such as DFA. DFA also provides posterior probabilities and other statistics so one can know how strongly an individual classifies into a particular group. Also, a more comprehensive data collection routine captured more differences, some clearly less perceptible, between groups. As a result, the original problem of misclassification of Blacks as American Indians was greatly reduced.

Cranial Landmarks, Interlandmark Distances, Discriminant Function Analysis

H14 An Assessment of Non-Metric Traits of the Mandible Used in the Determination of Ancestry

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The goal of the current study is to present results of the analysis of non-metric traits of the mandible used in the determination of ancestry and to demonstrate the utility of ordinal regression in the examination of discrete skeletal characteristics.

This study is the first multivariate study conducted on discrete mandibular traits used for the determination of ancestry. Employing ordinal regression on a large sample of identified individuals, this study determines whether sex and age affect the incidence of each trait independently of ancestry. Additionally individuals from two separate continents are examined; therefore, the findings are applicable for worldwide use. While ancestry determination from the cranium has been established as reliable in the literature, a suite of characteristics derived from multiple bones is preferred. This presentation will impact the forensic community and/or humanity by demonstrating how the inclusion of mandibular traits builds on previous non-metric studies and helps to increase the reliability of ancestral determination from the skeleton.

In the field of forensic anthropology, the construction of a biological profile is of utmost importance in the identification of a decedent. The biological profile includes the age, sex, stature, and ancestry of the individual. Of these, ancestry is considered the most difficult and least precise.

The purpose of this study is to build on previous non-metric studies of the mandible to determine whether it may be used to differentiate between individuals of European and African ancestry. Several studies have shown that ancestry can be determined by looking at non-metric characteristics of the cranium. Unfortunately, few of these studies have included the mandible. Many relevant studies suffer from small sample sizes, did not control for age or sex, or were derived from collections whose ancestry was anatomically determined rather than known. Many of the traits commonly used for the determination of ancestry are found on the face. However, these facial bones are rather thin, are the most fragile part of the skull, and are usually the first to be destroyed by taphonomic forces. The mandible, however, is quite dense and is better able to survive in an archeological or forensic setting. This study looked at skeletal remains from the Hamann-Todd Collection, the Terry Collection, a forensic collection at the University of Florida, and the Pretoria Bone Collection in South Africa. A large sample of modern individuals ($n = 921$) from two continents is used, all having documented age, sex, and ancestry. Twelve non-metric traits were examined: ramus inversion, location of inversion, gonial eversion, mandibular border form, mandibular tori, robusticity of muscle attachment sites, mylohyoid bridging, accessory mandibular foramen, chin prominence, chin shape, number of mental foramina, and the position of the mental foramen. Europeans and Africans were analyzed to determine how traits differed from one broad ancestral group to the other. Additionally, the smaller subgroups were compared (e.g. European American vs. European African) to see if there was any difference in trait expression between the more closely related groups.

Wilcoxon Signed Ranks Test was used to determine if there was a relationship between trait frequency and side. This test was also used to see if there was a significant amount of intra-observer error between the first and second scorings of the Florida sample. Ordinal regression was utilized to determine the effect, if any, that age, sex, ancestry, and the interaction between sex and ancestry have on any given non-metric trait.

Six traits differed significantly between the left and right sides. Intra-observer error was relatively low, with two traits showing a significant difference between the first and second observations. Nine out of 12 traits were significantly affected by ancestry. However, due to the effects of sex, age, and the sensitivity of ordinal regression, some of these traits may be less useful than others in determining ancestry in unknown cases. Ramus inversion, gonial inversion, muscle attachment sites, chin shape, number of mental foramina, and position of the mental foramen are the most effective traits to use when determining ancestry. However, caution must be taken because all of them except the number of mental foramen are significantly affected by sex. The number of mental foramina may be the most reliable trait because it is statistically and practically significant and it is not affected by sex, age, or the interaction between sex and ancestry. However, multiple foramina are very rare in each population studied.

European individuals were found to most likely posses little to no ramus inversion, no gonial eversion (straight gonia), gracile muscle attachment sites, a round or square chin, one mental foramen, and a more anteriorly placed mental foramen. Individuals of African descent were more likely to display moderate to extreme ramus inversion, gonial inversion, a round chin, and multiple mental foramina.

Ancestry, Non-Metric Traits, Mandible

H15 Discriminant Function Analysis as Applied to Mandibular Morphology to Assess Population Affinity

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After attending this presentation, attendees will be able to use mandibular morphological data as a tool to potentially diagnosis the biological affinity of an unknown individual.

This presentation will impact the forensic community and/or humanity by informing the forensic community of another potential tool for use in the identification process.

Determination of population affinity using the mandible has been gaining attention. Researchers have commonly used mandibular metric data to classify American Whites and Blacks, but analyses using three or more populations (either mandibular metrics or morphology) are rarely undertaken. While mandibular morphological state frequencies can be found for three (or more) groups in the same study, complex statistical modeling of these frequencies is rarely encountered. This paper examines the ability to correctly classify an unknown individual using mandibular morphology through discriminant function analysis.

Seven morphological traits of the mandible are utilized. They include the lower border shape, chin shape, ascending ramus shape, ascending ramus profile, gonial angle flare, mandibular torus, and posterior ramus edge eversion. Categorical scoring of these traits has been previously described, though in the present study, a modification to the scoring of the lower border was made. Here, the border has been scored as either straight, undulating, partial rocker, or rocker. Categorical assessments were converted to an ordinal score for each trait. The ordinal scores were assigned in step-wise fashion based on a perceived complexity of each trait. For example, the mandibular border was scored as a one for straight to a four for rocker, assuming that a curved form is more complex than a straight form.

Some statisticians have argued that ordinal or binary variables can be used in linear discriminant functions instead of metric variables. Recently, several researchers have applied this type of analysis to cranial non-metric traits. Using linear discriminant functions, 90% classification rates were achieved between populations from just a few variables. In depth statistical analysis of their data did not yield substantial objections concerning the application of the generated discriminant functions.

The presented analysis concentrates on male individuals from approximately ten different populations that include American Whites and Blacks, Cambodians, Vietnamese, Central American Hispanics, and Native Americans. The sample size is in excess of 1000 individuals; all individuals are assumed to have from late 19th to 20th century birth years. Linear discriminant function analysis was undertaken not only using two group comparisons, but also three, four, and five group comparisons. Each analysis was cross-validated using a leave-one-out method for accuracy assessment. The only variable to continuously fall out of the analyses was the ascending ramus profile shape.

Five population comparisons yielded a 54% cross-validated accuracy rate, approximately three times better than the expected accuracy if based on chance alone. Two group comparisons fared better, some in excess of 83%, while three group comparisons approached 70% accuracy rates. Further, two group comparisons of closely related populations (Cambodian, Vietnamese) also appeared to function well, with a 74% accuracy rate. As a means of comparison, FORDISC 2.0 was used to determine classification rates for six or seven craniofacial/vault measurements, using three populations. In these analyses, classification rates of 62-87% were generated, depending on the populations and measurements selected. Vault measurements faired better than craniofacial measurements in these comparisons. Based on these results, the use of discriminant functions to assess population affinity via mandibular morphology is argued to be a valuable tool for the forensic anthropologist.

Mandibular Morphology, Population Affinity, Statistics

H16 Morphoscopic Traits and the Statistical Determination of Ancestry II

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The primary goal of the presentation is to provide the audience with a new statistical method for utilizing nonmetric traits in the determination of ancestry in unidentified human crania.

This presentation will impact the forensic community and/or humanity by enhancing both the process of identifying the ancestry of human remains and the courtroom presentation by attaching probabilities to the analysis.

Ancestry determination is generally regarded as the most difficult aspect of the biological profile, primarily because of the traditionally subjective, experienced-based emphasis that has been taught in the past. In addition to subjectivity, another weakness of the classic nonmetric approach is that it does not provide any posterior probabilities, which indicate how likely the individual comes from one group as opposed to the other groups. Nonmetric (categorical) trait analysis is often devoid of all but the most simplified statistical analysis (e.g., frequency distributions and chi-square tests). Nonetheless, Ousley and Hefner (2005) demonstrated that morphoscopic traits could be analyzed statistically with classification accuracy as high as 90% using kernel probability densities. In addition, several other methods (including logistic regression and linear discriminant functions), confirm the value of using various statistical methods in nonmetric trait analysis. The statistical techniques that utilize metric data provide posterior probabilities, usually because the data are normally distributed, but nonmetric data are not normally distributed, and quantifying nonmetric traits is not practical and may not provide additional significant information. A new multivariate statistical method recently introduced for use with categorical data is presented that not only addresses these concerns, but also addresses the *Daubert* issue using posterior probabilities, graphs, and cross-validated results.

In the present contribution, a total of thirteen separate distance measures were applied to 12 nonmetric variables recorded for American Whites (n = 89) and American Blacks (n = 105). The data were analyzed using a constrained ordination procedure (CAP) proposed by Anderson and Willis (2003) which relies on a canonical discriminant analysis (CDA) on the principal coordinates (PCO) of the dataset. The analysis can be performed using *any* calculated inter-individual distance matrix, and the distances need not follow any particular distribution or even be Euclidean. Numerous distance calculations can be used, so distance calculations can be fine tuned (i.e., each method highlights various aspects of the multivariate data), and judged by their classification accuracy. A "leave-one-out" resampling post hoc test of the CDA is then used to (1) calculate classification accuracy and (2) test the significance of additional PCO axes (m). This method is more applicable to ancestry determination than frequency distributions, as it accounts for correlation among variables, provides classification error rates, and allows for classification of a new observation**.** In these regards it is more consistent with traditional multivariate discriminant function analysis (DFA). An additional benefit of this method is that while conventional DFA can be applied to macromorphoscopic data (Ousley and Hefner 2005), the CAP approach is more appropriate for this type of data.

Several CAP analyses offered interesting results, demonstrating the flexibility of the technique. Multiple distance measures (e.g., chi-square, Euclidian), were selected for the analysis in order to determine the weaknesses and strengths of each one of them. Among these, chi-square distances appear to be the most appropriate measure for categorical, macromorphoscopic data. For example, the chi-square distance measure with $m = 10$ produced the lowest mis-classification error, and the first three PCOs alone explained over half of the total observed variation. In fact, a CAP analysis using the five best variables (INA, NBS, ANS, IOBW) and the chi-square distance measure with $m = 3$ has cross-validated accuracies of 86%.

These results indicate that the analysis of nonmetric traits through robust statistical models, particularly constrained ordination procedures like CAP, greatly enhances the process of identifying the ancestry of human remains. This method also addresses issues related to the *Daubert* decision by calculating classification accuracy and posterior probabilities of the classification, and enhances courtroom presentation through the obtained bivariate plot, an easily understood graphical representation.

Nonmetric Traits, Canonical Discriminant Analysis, Ancestry Determination

H17 Ontogeny of Femur Subtrochanteric Shape: Implications for Determining Ancestry Using the Platymeric Index

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The objectives of this study are to examine changes in proximal femur diaphyseal shape during growth and development, determine the proximate causes for the patterns of change, and evaluate the usefulness of proximal femur shape in discriminating between Native American and American Black/White subadult femora. Attendees will learn about changes in femur subtrochanteric shape during growth and development and the validity of the platymeric index in the estimation of ancestry from human subadult and adult skeletal remains.

This presentation will impact the forensic community and/or humanity by demonstrating how femur subtrochanteric shape develops and that the platymeric index can be successfully used to distinguish between Native Americans and American Blacks/Whites in subadult skeletal remains greater than six years of age.

Gill and colleagues have suggested that subtrochanteric shape may be established early in life, and therefore the platymeric index (PI) may be useful for assessing ancestry in subadults. In this paper, the author examines changes in proximal femur diaphyseal shape and size during growth and development, and discusses the implications of the results to the validity of estimating ancestry in subadult (immature) skeletal remains.

Femur subtrochanteric anteroposterior (AP) and mediolateral (ML) diameters and diaphyseal length were obtained for 74 Native American, 17 American Black, and 50 American White subadult femora. Individuals used in the study range in age from birth to 18 years. Left femora were preferentially used, but the right femur was used if the left was absent or damaged. Since sex is difficult to estimate from subadult skeletal remains, males and females were pooled. Previous studies have shown no significant differences in subtrochanteric shape between adult American Blacks and American Whites, so they were pooled as a single group.

Changes in femur subtrochanteric shape (PI) and diameters (AP and ML) were examined by age for each of the samples. The results show that the PI decreases or becomes more platymeric from birth to about five years of age and then generally levels off in both groups. Therefore, the author examined subadults less than five years old and subadults six years old and greater separately. This second analysis shows a significant negative correlation between PI and age in subadults five years and under in both groups, but the changes in the PI are more noticeable in Native Americans (slope = -0.03, $r^2 = 0.33$) than in American Blacks/Whites (slope = -0.02, $r^2 = 0.10$). The more noticeable change in Native Americans is expected since they are generally more platymeric as adults. After the age of five years there is little change in the PI, except for a possible increase associated with the adolescent growth spurt (slope = 0.001 and $r^2 = 0.005$ for Native Americans; slope = 0.002 and $r^2 = 0.009$ for American Blacks/Whites).

An examination of the subtrochanteric dimensions reveals the proximate causes for the differences between younger and older subadults and between Native Americans and American Blacks/Whites in proximal femur diaphyseal shape. Between birth and five years of age the ML dimension increases more rapidly than the AP dimension in both groups. However, the difference is again more dramatic in Native Americans. That is, differences in the rate of growth between AP and ML dimensions is greater in Native Americans (AP slope = 1.60, $r^2 = 0.74$; ML slope = 2.32, $r^2 = 0.81$) than in American Blacks/Whites (AP slope = 1.92, $r^2 = 0.88$; ML slope = 2.24, $r^2 = 0.81$). This same pattern continues after the age of five but at a greatly reduced rate. In individuals over five years of age, the AP and ML dimensions increase in size with age at approximately the same rate in Native Americans (AP slope = 0.72, $r^2 = 0.63$; ML slope = 0.59, $r^2 = 0.53$) and American Blacks and Whites (AP slope = 0.69, $r^2 = 0.46$; ML slope = 0.66, $r^2 = 0.44$).

The results of this study demonstrate that the adult shape of the proximal femur is established relatively early in life – probably shortly after the achievement of a mature gait pattern. The proximate cause for this early establishment of adult shape is that between birth and five years of age the proximal femur diaphysis grows more rapidly along the ML plane compared to the AP plane, especially in Native Americans. However, after the age of five, growth occurs more equally in the two planes. The results of this study also make evident that the PI can be used to distinguish between platymeric Native American femora and more eurymeric American Black/White femora in subadults over the age of six years. However, the results also show that subadults, like adults, exhibit great variation within groups, probably due to environmentally induced biomechanical stress placed on the femur. This variation should be considered when using only the PI to determine ancestry in medicolegal investigations.

Forensic Anthropology, Platymeric Index, Ancestry

H18 A New Method for Estimating Age-at-Death From the First Rib

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After attending this presentation, attendees will understand that the first rib can be used as an effective age-at-death indicator. In addition, attendees will learn that a Bayesian approach utilizing transition analysis can be used for developing robust aging methodologies.

This presentation will impact the forensic community and/or humanity by demonstrating that forensic anthropologists working in numerous contexts can improve their efforts by refining methods used to estimate age-at-death. Results from this research indicate that the first rib can be used to estimate age-at-death as an isolated element or as a component in a multifactorial approach.

Forensic anthropologists working both internationally and domestically are often faced with the problem of developing a biological profile from incomplete skeletal remains. Elements commonly used for establishing age-at-death are sometimes absent and frequently damaged. Such occurrences are unfortunate; however, they underscore the importance of developing aging methodologies from a broader range of skeletal elements. The purpose of this study was to determine whether a modification of the Kunos *et al.* (1999) method for estimating age-at-death from the first rib could be developed. While the fourth rib has been used for some time in age-at-death estimation, Kunos and coworkers (1999) indicate several limitations with the element. Oftentimes, the fourth rib is misidentified in unarticulated skeletons or damage to the sternal aspect precludes its use as an age indicator. Moreover, Kunos *et al.* indicate methods that rely solely on morphological changes of the costal face do not utilize other aspects of

the rib that change throughout life, particularly the head and tubercle. These authors argue that the first rib is unambiguously identifiable in addition to its prolonged span of remodeling into the eighth decade.

The purpose of this study was to determine whether the method devised by Kunos and co-workers can be reproduced and successfully applied as a workable model for the estimation of age-at-death. Data were collected on three aspects of the first rib (rib head, tubercle facet, and costal facet) for 549 known-aged males and for 74 known-aged females. The data come from Balkan materials collected as evidence during the investigation of violations to international humanitarian law conducted by the ICTY. The ages-at-death for this sample range from 15-90 years for males (with a mean age of 48.2 years) and 15-96 for females (with a mean age of 51.1).

First, a list of variables was extracted from the original study utilizing all three skeletal aspects of the first rib. This list was subsequently modified as preliminary tests based on serrations of the samples occurred during this investigation and resulted in a total of eleven possible variables. Morphological changes of costal face, rib head, and tubercle facet were coded with regard to numerous features that include shape, surface topography and texture, and marginal morphology. These variables were each scored using a coding system ranging from 1-4 to 1-7 depending on the variable in question. Second, two observers independently scored the three rib components using all eleven variables. The eleven variables were first analyzed separately. To calculate the mean, standard deviation, log-likelihood, and standard error of the ages-of-transition for each component, the *unrestrictive cumulative probit model* is performed. These statistics are further used to calculate the *highest posterior density region*s for estimating individual ages-at-death. Additionally, a multivariate analysis of the three components is performed. A principal component analysis (PCA) of the covariance matrix is conducted for the regions of the first rib to reduce variables with a high degree of correlation. The correlation matrix demonstrates that the inter-correlations of the eleven variables are low (0.496-0.768 for the costal facet, 0.181-0.444 for the rib head, and 0.146-0.521 for the tubercle facet). Findings are consistent with those of Kunos and co-workers, in that the morphological changes of all three components of the first rib are useful indicators of age-at-death.

Age-at-Death, First Rib, Transition Analysis

H19 Stature Estimation Based on Dimensions of the Bony Pelvis and Proximal Femur

Carolyn L. Giroux, BA, 6200 East Richland Road, Columbia, MO 65201; and Daniel J. Wescott, PhD, University of Missouri-Columbia, Department of Anthropology, 107 Swallow Hall, Columbia, MO 65211*

After attending this presentation, attendees will gain an awareness and appreciation for the advantages and limitations of using measurements of the pelvic region to estimate stature in mass disaster and burned remains cases where more commonly used bones are not preserved.

This presentation will impact the forensic community and/or humanity by providing ancestry and sex specific stature estimation formulae based on standardized dimensions of the pelvic region that can be applied to mass disaster and burned remains cases.

Inspired by a study that examined the use of sacral and coccygeal dimensions recorded from radiographs to predict living stature, this paper evaluates the validity of using sacral height (SH) measured on dry bone for estimating stature in mass disaster and burned remains cases. The authors also extend this examination to include hip height (HH) and femur head diameter (FHD) because these components are often preserved in mass disaster and burn cases. The affect of sex and ancestry on stature estimation using these dimensions are investigated and group specific regression equations for estimating living stature are provided.

Stature, SH, HH, and FHD were obtained from the Forensic Data Bank on over 260 Black and White males and females of known forensic or cadaver stature. All measures show a significant positive correlation with stature, except SH in White females. There were significant sex and ancestry differences in the variables, but no significant sex and stature or race and stature interactions exist for any of the variables. However, in general, pelvic region dimensions correlate better with stature in American Blacks than they do in Whites. The validity of the regression functions was evaluated using the squared correlation (r^2) and mean squared error (MSE). For males, HH is the best single variable for predicting stature (Blacks: $r^2 = 0.47$, MSE = 31.72; Whites: $r^2 = 0.26$, MSE = 46.99) and SH the worst (Blacks: $r^2 = 0.19$, MSE = 48.07; Whites $r^2 = 0.15$; MSE = 51.64). Among females, FHD is the best single variable (Blacks: $r^2 = 0.32$, MSE = 45.83; Whites: $r^2 = 0.18$, MSE = 45.18) followed by HH (Blacks: $r^2 = 0.35$, MSE = 31.72; Whites: $r^2 = 0.09$, MSE = 54.00) and then SH (Blacks: $r^2 = 0.16$, MSE = 50.58; Whites: $r^2 = -0.003$, MSE = 56.87).

In this study, multivariate equations out-preformed univariate models for all groups. A MAXR procedure was used to find the best two- and three-variable equations. The best two-variable models include HH and FHD for all groups, except White males. The best two-variable functions are 84.23 + 0.338*HH + 0.432*FHD ($r^2 = 0.53$, MSE = 29.42) for Black males, 99.46 + 0.166*SH + 0.267*HH ($r^2 = 0.28$, MSE = 43.95) for White males, 45.73 + 0.206*HH + 1.89*FHD ($r^2 = 0.58$, MSE = 27.44) for Black females, and 95.94 + 0.069*HH + 1.266*FHD ($r^2 = 0.17$, MSE = 50.88) for White females. The addition of the third variable does not increase the correlation except in Black females. The best three-variable equations for predicting stature for Black females is 44. 40 + 0.106*SH + 0.178*HH + 1.792*FHD (r = 0.60, MSE = 26.77).

The results demonstrate that dimensions of the pelvic region can be used to estimate stature with moderate accuracy. Dimensions of the pelvic region are a poorer predictor of stature than long bone lengths, but they perform as well as ankle bone, metacarpal, skull, or bone fragment dimensions previously examined for use in mass disasters. This study also shows that there are considerable differences in the accuracy based on ancestry, with HH, SH, and FHD predicting stature more reliably in American Blacks than for American Whites. Stature estimation in White females based on pelvic dimensions should be avoided due to the low correlation and high MSE. Sacral height alone is a fairly poor predictor of stature, especially in American Whites, with the error ranging from about 7.0 to 7.5 cm. However, the precision of using SH measured from dry bone to estimate stature in males is nearly equivalent to that using SH determined from radiographs.

Forensic Anthropology, Stature, Mass Disaster

H20 Evaluation of Three Methods of Age Estimation From Human Skeletal Remains (Suchey-Brooks, Lamendin, and Two-Step Strategy)

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The goal of this presentation is to evaluate the application of a comprehensive (combined) method of age estimation compared with two isolated, individual methods. The methods considered are the Two Step Strategy (comprehensive method), and Lamendin and Suchey-Brooks (individual methods).

This presentation will impact the forensic community and/or humanity by demonstrating appropriate times of use of comprehensive methods versus individual, isolated methods of age estimation.

Previous research suggests that a method which utilizes more than one anatomical part of the body will have higher accuracy in age estimation than a method which considers only one anatomical part. The Two Step Strategy (TSS) utilizes ages generated from the Suchey-Brooks (SB) method of evaluation of the pubic symphysis for younger adults and those generated by the Lamendin (L) method based on single rooted teeth for older adults. This presentation offers forensic anthropologists an assessment of the usefulness of these three methods of age determination when applied to the same individuals from the Terry Collection housed at the Smithsonian Institution's National Museum of Natural History.

This study compares the measure of reliability (how close a result comes to the true value) of those three methods when applied to the Terry collection. The sample consisted of 312 individuals (age 25 to 99 years, with a mean age of 52.97 years and a standard deviation of 14.87years): 78 black females (age 25 to 99 years, mean 52.75, SD 16.57), 63 white females (age 27 to 90 years, mean 58.63, SD 14.16), 90 black males (age 26 to 76 years, mean 47.66, SD 13.00), 81 white males (age 27 to 85 years, mean 54.58, SD 13.67). To ensure unbiased results the real ages were hidden from the observer, and each method was applied with complete independence.

The smaller the value of the mean error (ME) is the higher the method's reliability. The ME of the TSS method was 7.7 years while the ME for the SB and L methods were 8.6 years and 8.1 years respectively. Overall, all three methods underestimated ages.

Samples were sub-grouped according to sex and ethnicity, and interestingly within some groups TSS was less accurate than the individual methods (L and SB). For example, accuracy was equal for the TSS and L methods (8.7 years) in White females (which had the highest mean error values) where as the ME was 9.4 years for the SB method. The estimations obtained from the SB method were inaccurate enough to substantially decrease TSS's accuracy, since TSS takes SB method's estimates into account. Similarly in White males, the mean error values of the TSS and L methods were almost equal (8.1 years and 8.0 years respectively, and 9.1 years for SB). In Black males, which had the lowest mean error values (SB: 7.2 years, L: 7.1 years, TSS: 6.8) TSS had much higher accuracy than the other two methods. Estimates generated by all the methods for males were more accurate than those for females, and more accurate for Black samples than for White samples.

Overall, the comprehensive TSS method was more accurate than the other two individual, isolated methods (L and SB). This trend of the Two-Step Strategy having the most accuracy at estimating age supports previous research that strongly suggests comprehensive approaches, such as TSS, are superior to isolated ones, such as L and SBS methods (Prince and Ubelaker, 2002; Lamendin *et al.,* 1992; Brooks and Suchey, 1990; Helena *et al.,* 2003; Baccino *et al.,* 2003).

However, when different subgroups were taken into account, the notion that combined methods have more accuracy in age estimation than individual methods was not well supported. This study suggests that the L method can be used alone for White samples, but a more comprehensive approach is recommended for other groups if the relevant skeletal parts are available. The greater accuracy of the L method when applied to White samples can prove advantageous since teeth offer superior preservation over pubic bones. All parts of the skeleton should be considered if they are available.

MEAN ERROR VALUES (in years)

Sub-groups	SBS	Lamendin	TSS
WFemale	9.4	8.7	8.7
BFemale	9.27	8.8	7.7
Wmale	9.1	8.0	8.1
BMale	7.1	7.1	6.8
Black (F & M)	8.2	7.9	7.2
White (F & M)	9.3	8.4	8.4
Male (B & W)	8.1	7.6	7.4
Female (B & W)	9.3	8.8	8.2
Overall	8.6	8.1	7.7

Age Estimation, Lamendin, Suchey Brooks

H21 Evaluation of Purkait's Triangle Method for Determining Sexual Dimorphism

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After attending this presentation, attendees will be briefed on a method for determining sexual dimorphism using measurements from the proximal end of the femur and its comparison and combination with more traditional methods.

This presentation will impact the forensic community and/or humanity by evaluating a relatively new method for determining sexual dimorphism and its application to the Terry collection.

The ability to determine sex from isolated bones and bone fragments is a necessity in medicolegal investigations. Sexual dimorphism in the skeleton is generally based on two factors, size difference with males being generally larger than females, and function related differences, particularly in the pelvis. Differences between the sexes involve varying levels of stress and strain on the bones during development that lead to differences in size and morphology. Traditionally, when the proximal end of the femur is the only portion of bone available for analysis, the maximum vertical diameter of the head is utilized for determining sex. Purkait's (2005) triangle method includes the use of points of muscle insertion that develop and change based on muscle strain.

This study compares the accuracy of Purkait's method in comparison and combination with the maximum vertical diameter of the head when applied to the Terry collection housed at the Smithsonian Institution's National Museum of Natural History. The sample consists of 200 individuals with a balanced number of males and females, and black and white adult subjects. Additionally, another sample of 40 individuals equally balanced was measured. Purkait's method involves measuring a triangle that is projected on the posterior side of the proximal end of the femur. The point projecting most medially on the greater trochanter and the highest point on the lesser trochanter were labeled points 'B' and 'C', respectively. The point on the articular margin of the head dipping most laterally was labeled point 'A'. Measurements of the sides of this triangle (AB, AC, and BC) along with the vertical diameter of the head were taken from each femur.

The data were subjected to discriminant function analysis. The accuracies for determining sex using the single variables of AB and AC (69% and 70.5%, respectively) were much lower than those found in Purkait's study which is reflected in the higher standard deviations found in the Terry collection data. BC was shown to be the best indicator using Purkait's triangle method with an accuracy of 85.5%. The accuracy using the diameter alone was 89%. Combining the diameter and BC raised the accuracy to 90%. Additionally, a jackknife procedure was conducted on the data that reflected nearly identical results for accuracy. The threshold value for separating the larger male values from the smaller female values were 53.0 mm for BC and 45.7 mm for the diameter of the head. When individuals where BC and diameter measurements produced conflicting results using the threshold approach were excluded, the prediction accuracy increased to 94.5%. The 40 additional femora not included in the determination of the threshold values were tested against these threshold values. The accuracy using BC was 80%, diameter was 95%, and the two factors in combination (with exclusion of individuals with conflicting results) were 97.5%. There was no significant difference between the Terry collection white and black samples.

The value of the study is the evaluation of a relatively new sexual dimorphism method in order to determine the population variability between the Terry collection and Purkait's sample, which consisted of middle class Central Indian males. BC was determined to be a valuable

measurement in estimating sex using the proximal end of the femur, particularly in combination with the maximum vertical diameter of the head. The measured values in the Terry Collection taken in this study were found to be smaller than those from Purkait's study. More studies should be conducted on different populations using contemporary samples in order to determine proper threshold values based on population variability and to further document human variation in this aspect of the anatomy.

Forensic Anthropology, Sex Determination, Femur

H22 Sex Determination From the Hyoid Body

Jered B. Cornelison, MS, Michigan State University, Department of Anthropology, 204 Olds Hall, East Lansing, MI 48824; Wendy L. Lackey-Cornelison, MA, Michigan State University, Department of Anthropology, 426 East Fee Hall, East Lansing, MI 28824; and Brian C. Hunter, PhD, 1215 East Michigan Avenue, Lansing, MI 48912*

The goal of this presentation is to elucidate the utility of using measurements of the hyoid body to estimate sex.

This presentation will impact the forensic community and/or humanity by demonstrating how the hyoid bone can be used to estimate sex in situations where critical skeletal elements for estimating sex are not available or as additional data for sex estimation.

Previous studies have shown that the hyoid bone is sexually dimorphic and can be utilized for sex determination of unknown skeletal remains. These studies are based on numerous measurements taken from x-rays or digital photographs. The current study illustrates that sex can be readily determined from three measurements, which can be obtained from the hyoid body directly. The method presented here will offer a relatively simple and reliable procedure for sex determination, particularly in instances of fragmentary, commingled, and/ or sparse remains.

Skeletonized hyoid bodies of 203 individuals (N= 132 males and 71 females) from an autopsy sample were measured in this study. Twenty-nine individuals under the age of 20, however, were eliminated due to confounding issues associated with growth and developmental processes. Age ranged from birth to 92 years with a mean age of 43.5 years. After individuals under the age of 20 years were eliminated the sample was composed of 114 males and 60 females. Three measurements were obtained to the nearest tenth of a millimeter using sliding calipers including, midbody height, maximum body height, and maximum body breadth. While each measurement was analyzed separately to understand the strength of discrimination between the sexes, it was determined that composite measurements may better discriminate between the sexes. The measurements were analyzed using SPSS 12.0.

Using an Independent Samples T-test the significance ($p<0.05$ confidence interval) for midbody height, maximum height, maximum breadth, and composite scores for maximum height plus maximum breadth and maximum breadth plus maximum height and midbody height demonstrated that the hyoid body is sexually dimorphic. The sectioning point between males and females was calculated by determining the mean from the two averages of the male and female groups. Using the sectioning point, the predictability of each measurement and composite measurements are as follows (mean +/- standard deviation). Using a sectioning point of 10.7 mm. for midbody height, 72% of males (11.4 +/-1.1 mm) and 80% of females (9.9 +/-1.2 mm.) were correctly identified. Using a sectioning point of 23.3 mm. for maximum breadth, 84% of the males (25.4 +/-2.6 mm.) and 83% of the females (21.2 +/-2.4 mm.) were correctly identified. Using a sectioning point of 11.3 for maximum height, 80% of males (12.1 +/-1.1 mm.) and 83% of females were correctly identified. Using a sectioning point of 34.6 mm. for the composite score of maximum breadth plus maximum height, 82% of the males (31.7 +/-3.2 mm.) and 88 % of females were correctly identified. Using a sectioning point of 45.3 for the composite score of maximum breadth plus maximum height plus midbody height, 89% of males (49 +/-3.7 mm.) and 88% of females were correctly identified.

One important observation in this study is that there appears to be increased growth of the hyoid bone through the twenties and then stabilization of the hyoid dimensions after the age of thirty. This is especially apparent with the younger males who have a greater tendency to cluster with the females at a younger age. This may demonstrate a later cessation of hyoid bone growth for males.

In this study individual measurements discriminated between the sexes with great predictability values. When the composite of all three measurements were used sexual dimorphism increased for both males and females to almost 90% predictability. This easy, low technology and replicable method may be used to efficiently determine or confirm sex in cases where traditional skeletal elements to determine sex are absent or in commingling situations. However, caution should be used if it is suspected that the remains are from a subadult or young adult. In addition, data set limitations did not warrant comparison of different populations

Sexual Dimorphism, Hyoid Body, Forensic Anthropology

H23 Forensic Application of Epiphyseal Sequencing

Maureen C. Schaefer, MA, University of Dundee, Anatomy and Forensic Anthropology, Faculty of Life Sciences, University of Dundee, Dow Street, Dundee, DD1 5EH, Scotland*

The goal of this presentation is to revisit historic interest regarding the reported ontogenetic sequence of epiphyseal union. The accuracy of this information is tested in a forensic context and its applicability to assist in the re-association of commingled remains is evaluated.

This presentation will impact the forensic community and/or humanity by providing a test of the reliability of this method to aid the re-association of commingled juvenile remains. Analyzing the sequence in which the various epiphyses unite can help to identify outlying elements that do not match the predicted developmental pattern of the remaining skeleton, thus indicating that the element may not belong to that individual. Of equal importance, identifying sequential patterns can also facilitate prediction of the likely maturity status of missing elements, thus assisting in prioritization of disassociated bones.

Commingling of remains is a significant problem in the identification of the Srebrenica missing. In an effort to better conceal evidence, the perpetrators of this massacre buried, exhumed, and then re-buried individuals in secondary mass graves. This resulted in mass graves with a high frequency of partial and disarticulated bodies. Many of the bodies that have since been exhumed by archaeologists are incomplete and/or commingled.

This presentation proposes the application of an approach that utilizes prediction of epiphyseal union sequence to identify misplaced skeletal elements in addition to predicting the developmental status of missing elements. This approach is a powerful aid for the re-association of commingled juvenile remains.

A review of the literature displays that the sequence of union has been addressed by several authors in the past but is an issue that has largely been neglected in a forensic context. Stevenson (1924) was the first to consider and identify the order in which the various epiphyses unite. He concluded that, "the sequence of union among the various epiphyses is observed to be exactly the same in every individual." While Todd (1930) also reaffirmed this statement of exact order progression, (1934) was the first to suggest that ethnicity and perhaps socio-economic class may influence sequence. However he reported that within defined cohorts, order was consistent.

Despite these assurances, this study will show that sequence of union varies considerably. The research was undertaken utilizinga sample of 271 individuals, between the ages 13 to 30 from Srebrenica. Differences in ethnicity and economic status are unlikely to be major influences within this group as the town was reported to be largely ethnically homogenous with no marked socio-economic variation. Contrary to previous research, this presentation will show the value of including data on the sequence of

beginning union and not just the sequence of complete union. This is an important distinction as consistent commencement of union in one epiphysis does not ensure that it also completes union first. Establishing dual spectra patterns provides optimal application for use in the sorting and re-association of commingled remains by maximizing the variables available for assessment.

In conclusion, sequence of union should not be oversimplified if epiphyseal patterns are to be used in a forensic context. Full documentation of sequential variation must be examined for both the commencement and the completion of union if this information is to help with the re-association and identification of misplaced skeletal elements.

Epiphyseal Union, Commingled Remains, Bosnia

H24 Research Trends During the History of the Physical Anthropology Section at the AAFS Annual Meetings

Derek C. Benedix, PhD, JPAC-CIL, 310 Worchester Avenue, Building 45, Hickam AFB, HI 96853-5530; and William R. Belcher, PhD, JPAC-CIL, 310 Worchester Avenue, Building 45, Hickam AFB, HI 96853-5530*

The goals of this presentation are to discuss the research trends that have occurred during the more than 30-year history of the Physical Anthropology Section at the annual meetings of American Academy of Forensic Sciences as well as physical anthropological contributions to the *Journal of Forensic Sciences* (*JFS*) during the same time period.

This presentation will impact the forensic community and/or humanity by presenting trends in physical anthropological research seen through the American Academy of Forensic Sciences (AAFS) and *JFS* during the more than 30-year history of the Physical Anthropology Section. This poster will provide forensic and physical anthropologists with essential information for the interpretation of research importance and popularity of scientific research.

In 1972, a new section was established at the annual American Academy of Forensic Sciences (AAFS). Dr. Ellis Kerley was pivotal in the development of the Physical Anthropology Section at the AAFS meetings (Snow 1982; Stewart 1979; Ubelaker 2001). Since its inception, physical anthropologists and, specifically, forensic anthropologists have had a medium in which to share their research with others. This new section allowed forensic anthropologists a national meeting in which to communicate research and discuss problems and unique case situations.

In the past 33 years, both professional physical anthropologists and archaeologists as well as student participants have presented their research in both oral and written formats at various AAFS meetings; during the last decade, poster presentations have become a more important and integral alternative for presentation at the Meetings. In addition to presenting research at the national meeting, the *JFS* provides an important publication outlet for physical/forensic anthropologists and archaeologists.

Research trends, like anything else, wax and wane with popularity. This is particularly true in forensic sciences, because of the relationships with funding and grants for "new and unique research." Additionally, since most physical anthropologists are academically-based, research that is oriented along new trends has a higher likelihood of being chosen for presentation at the meetings and publications in the *JFS*. This poster examines the main trends, including case studies; major categories of study (osteometrics, biological profile determinations, various forms of trauma interpretation, taphonomy, forensic archaeology), and historical treatises of importance to forensic anthropologists.

The methodology categorizes abstracts and keywords from both *Proceedings of the American Academy of Forensic Sciences Annual Meeting* and the *JFS* since 1973 to 2004. These categories are then presented in graphic form in order to illustrate the major research trends in the field.

Trends in Physical Anthropology, Research, History

H25 Estimating the Postmortem Interval in Freshwater Environments

Billie L. Seet, MA, 16 Arcola Street #2, Jamaica Plain, MA, 02130*

After attending this presentation, attendees will understand the difficulty with which an estimation of the postmortem interval is in freshwater environments.

This presentation will impact the forensic community and/or humanity by attempting to gather and share more data on the process of decomposition in freshwater environments. This data is important because it is under-represented in the literature.

Forensic investigators often deal with human remains recovered from water. Estimating the time since death for bodies that have been submerged in water, however, can be quite difficult due to the lack of data on the subject and the vast number of different variables possible in watery environments. This preliminary study is intended to provide additional data concerning the estimation of time since death of submerged bodies through the use of record research. Seventy autopsy reports containing cases in which human remains were recovered from bodies of freshwater were used. Thirty-one variables were collected from each report in a present/absent context. Nine of the variables were then used in logistic regression analyses in order to measure their relationship to time in water. Some of the other variables that were collected, but not used in the analyses were body temperature, water temperature, ambient temperature, and invertebrate scavengers. These variables, although important, were omitted due to the inconsistency with which they were recorded in the police and autopsy reports.

The variables used were the postmortem interval, collected in hours, which ranged from two hours to 2,880 hours, or four months, and the presence or absence of the following: Clothing, cutis anserina, washerwoman skin, discoloration, marbling, skin slippage, hair slippage, and sub-cutaneous gas. Through the use of logistic analyses it was shown that clothing did not effect the postmortem changes collected for this analysis. This led to more statistical analyses using 70 cases total as one group rather than two smaller groups defined by the presence or absence of clothing. Two backward stepwise logistic regression analyses were then performed, splitting the postmortem time interval into two categories: (1) less than or equal to 24 hours and greater than 24 hours and (2) less than or equal to 48 hours and greater than 48 hours. These analyses aimed to predict the presence or absence of the postmortem changes based on the postmortem interval.

Results indicate that only three of the nine variables used in logistic regression analysis were significant. The time since death estimate can only be made in large time intervals. Purge can be used to predict a time since death of less than 48 hours while marbling and sub-cutaneous gas can be used to predict a time since death of greater than 48 hours. When estimating the postmortem interval as less than or equal to 24 hours and greater than 24 hours, purge was the only significant variable. This can be used to predict a time since death of less than 24 hours.

These preliminary results suggest that through the use of logistic regression and the presence and absence of these postmortem changes, a time since death can be estimated in large time intervals only, i.e. less than or equal to 48 hours or greater than 48 hours.

Postmortem Interval, Freshwater, Decomposition

H26 Missing, Present, and Left Behind

Julie M. Saul, BA, and Frank P. Saul, PhD, Lucas County (Toledo) Coroners Office and Wayne County (Detroit) Medical Examiners Office, 3518 East Lincolnshire Blvd, Toledo, OH 43606*

After attending this presentation, attendees should better understand the taphonomy (including origins and dispersal patterns) and investigative value of isolated bones and fragments often unexpectedly encountered by law enforcement.

This presentation will impact the forensic community and/or humanity by reminding the forensic community of the significance and probative potential of isolated (or missing) human bones or fragments.

Forensic anthropologists are well aware that there are bits and pieces of human skeletons to be found in all sorts of places. Law enforcement should be mindful of this possibility, and the bone or fragment brought to them by a conscientious citizen should be examined by a forensic anthropologist and not dismissed as "animal" – as occasionally happens.

Sometimes these remains are from the past - Native American, or forgotten cemeteries - and therefore not of forensic interest. The abundance of ancient and historic remains may also confuse investigators who, while searching for a specific missing individual, locate Native American/historic remains instead.

A knowledge of taphonomy (what happens to bodies after death) helps explain unexpected body parts. In addition to animal activity, water, wind and other natural forces, human activity may be involved – especially agriculture and construction. Remains may even be unknowingly transported by trains and other vehicles after an accident. Clandestine removal of murdered victims' remains may result in small bones and fragments in unexpected places. Medical specimens, ritual and fraternal activities also provide us with "abandoned" human parts. Anthropologists frequently receive remains that lack varying numbers of small bones or fragments. The explanation may be failure to recognize small bones (or fragments) as being human, or even as being bone at all. However, hungry scavengers do make off with hands, feet, or other bones that "protrude" from shallow graves or surface deposits.

The authors' proximity to several rivers, and especially Lake Erie, has made clear the importance of wind, currents, and aquatic scavengers in disappearing and dispersing body parts from both intact and dismembered bodies.

Occasionally, parts of bodies are apparently retained by the perpetrator, as was the case when a former husband severed his former wife's lower legs and feet to fit her into a too short homemade box in eastern Ohio in 1974. Body parts may also be deliberately dispersed to avoid identification.

The presence of bones can yield important information. The incomplete skeletonized remains of a young man were found on a Maumee River flood plain. He had disappeared three years earlier, some 30 miles upstream. Bones were scattered under leaves, tangled in weeds, with some partially buried by repeated flooding. Several bones were never recovered, but recovery of small bones of the hands and feet, as well as a few finger and toe nails, demonstrated that although he had traveled many miles and over a dam, his body had been relatively intact upon reaching the floodplain. Occasionally the refers is seen - situations where bones or fragments ranging from femoral heads to carpals, tarsals, phalanges and even partial maxillas and crania have been recovered as isolated finds.

The explanation for isolated finds may be more complicated, involving such aspects of taphonomy as the human and animal activity discussed above, erosion, agricultural or construction projects that involve removal and dispersal of soil. These processes are a frequent source of Native American and historic remains in many parts of the country, including Ohio and Michigan. It has also been noted in relation to the shallow burial of massacred Guatemalan peasants in recent times, whose remains were then dispersed by agricultural activity.

A variation on the non-recognition of small elements during recovery that actually serves the cause of justice involves attempts by perpetrators to cover up individual or mass clandestine deaths by returning to the original deposition site some time afterwards and "disappearing" remains by moving them elsewhere to avoid discovery and/or confound identification. During such procedures, the easily seen and recognized bones are more likely to be collected, while less easily located and recognized small bones, fragments and individual teeth may be left behind. In some cases, this "collection" seems to have been followed by disposal of remains in several different and widely separated locations. Fortunately, these small initially unrecognized bones and fragments are sometimes left behind to bear witness to the original crime. Such instances of exhumation, reburial, and dispersal of victims of genocide have been documented in several countries, including Bosnia-Herzegovina.

Forensic Anthropology, Taphonomy, Small Bones

H27 Gooney Birds and Rocky Clouds: Perimortem Trauma in World War II C-47 Crashes From Papua New Guinea

Alexander F. Christensen, PhD, Joint POW/MIA Accounting Command, Central Identification Laboratory, 310 Worchester Ave., Hickam AFB, HI 96853*

After attending this presentation, attendees will observe multiple cases of extreme perimortem skeletal trauma and understand possible explanations of why different individuals may suffer different patterns of trauma from the same type of aircraft crash.

This presentation will impact the forensic community and/or humanity by demonstrating detailed description of trauma patterns from one particular class of aircraft crashes which will allow a better understanding of the variability observed in current and historic aircraft incidents.

This paper will present several cases of extreme perimortem trauma observed in aircraft crashes. By focusing on one type of aircraft, the C-47 Dakota (also known as the Gooney Bird), and one type of crash, collisions with terrain in Papua New Guinea (P.N.G.) it will control for some of the variability that may underlie the different trauma patterns observed in different aircraft crashes. The primary incident considered occurred in P.N.G. in 1944. The aircraft involved was carrying four crewmembers and one passenger. One wing was torn off upon impact with a mountain peak, and the remainder of the airplane fell several hundred feet down slope. All five individuals were recovered by the Central Identification Laboratory-Hawaii (CILHI) and Joint POW/MIA Accounting Command (JPAC) over the course of three missions, in 1981, 1982, and 2004. The extensive perimortem trauma observed in these individuals was compared to the patterns seen in two other C-47 recoveries from P.N.G. Traumas were recorded by region; because of the fragmentary condition of many of the remains, midshaft fractures of the lower legs and arms were recorded by limb, rather than bone, treating the radius and ulna as one unit and the tibia and fibula as another. Most notable was the high incidence of complete, generally comminuted, fractures of the femoral shaft. As the largest and strongest long bone, the femur is also the most resistant to fracture, and femoral fractures generally result from high energy events, such as motor vehicle crashes. Of thirteen individuals with at least one observable femur, seven exhibited a perimortem midshaft fracture, and of 20 observable femora, 14 were fractured. The humerus exhibited a similar incidence of complete midshaft fractures, with seven of 13 individuals exhibiting such trauma, and nine of 18 bones fractured. Forearms and lower legs were also frequently broken. Eight of ten individuals exhibited complete forearm fractures, and four of ten complete lower leg fractures. Victims were divided into two groups by seating position, comparing pilots and copilots to all others. Although sample sizes were small, there was one statistically significant difference: Seven of ten humeri from pilots were fractured, while only two of eight from passengers and other crew were. Pilots also exhibited a slightly higher incidence of broken forearms, although this was not statistically significant. One possibility is that the higher incidence of arm fractures in pilots is a result of impact with the dashboard. Leg fractures occur at a similar frequency in both groups, as their legs were not subjected to different forces at impact.

Perimortem Trauma, Skeletal Pathology, Aircraft Crashes

H28 Of Butterflies and Spirals: Interpretation of Fractures in Motor Vehicle vs. Pedestrian Accidents

Laura C. Fulginiti, PhD, Kristen M. Hartnett, MA, Kevin D. Horn, MD, and Ruth E. Kohlmeier, MD, Forensic Science Center, 701 West Jefferson, Phoenix, AZ 85007*

After attending this presentation, attendees will gain an appreciation for improving the diagnostic process of fracture interpretation in pedestrian victims of motor vehicle accidents. The role of the forensic anthropologist in these cases will be discussed. Comminuted fractures and analysis of direction of force will be addressed.

This presentation will impact the forensic community and/or humanity by exposing the forensic community to the advantages of a multidisciplinary approach during the reconstruction of events around a pedestrian vs. motor vehicle accident. Fracture patterns can provide a more complete understanding of the dynamics of the blunt force and the interpretation of these fractures on bare bone can help to illuminate the direction of force and may assist in the resolution of cases where charges are pending.

At the Maricopa County Forensic Science Center in Phoenix, Arizona, a multidisciplinary approach to accident reconstruction is employed. The investigating officer, pathologist, and anthropologist each bring a unique perspective to the positive outcome of these cases. An area of particular interest in recent years is the interpretation of fracture patterns in order to determine direction of force to the bones of pedestrians impacted by motor vehicles. These fractures often involve the pelvis, lower vertebral column, and lower extremities. Maceration and reconstruction can aid in the interpretation of these fractures and in the evaluation of the sequence of events surrounding the fatal accident.

In the cases presented, three victims, all pedestrians, were impacted by a motor vehicle. The pathologist obtained full body radiographs, performed complete autopsies, and removed the lower limb bones for maceration by the anthropologist. The anthropologist was asked to reconstruct the fractured bones for analysis.

In the first case, a 16-year-old girl was struck while crossing the road in a rural setting. The driver of the vehicle was impaired and charges were brought. The pathologist removed portions of the left distal tibia and fibula which were macerated and reconstructed. Analysis revealed that the victim had been struck from the right side as the left foot was bearing weight.

In the second case, a male was found on the side of the roadway in a rural setting. There were no witnesses to suggest the sequence of events causing his death. Autopsy revealed a skull fracture and badly shattered right lower leg. Radiographic analysis by the anthropologist demonstrated a Duverny's fracture of the right ilium. Based on the autopsy and lack of avulsion pockets, the pathologist surmised that the victim had been thrown from, or jumped from a vehicle, striking his head. There was concern, however, because the fractures of the tibia and fibula did not appear to support this reconstruction. The pathologist removed the shaft of the right tibia and fibula and requested maceration to enhance the diagnosis. Anthropological analysis revealed that the victim was likely struck from the right by a vehicle.

In the final case, a male was struck by a moving vehicle as he attempted to cross a busy street. The vehicle did not stop and the accident was investigated as a hit and run. Witnesses claimed that the individual was struck as he was crossing by the vehicle in the curb lane after the cars in the left and middle lanes had stopped for him. The pathologist removed the shafts of the right and left tibia and right fibula which were macerated and reconstructed to facilitate interpretation of the accident. Anthropological analysis revealed that the victim's right leg was struck from an anterior and lateral direction while the left leg was struck from a medial and slightly posterior direction.

In each of the above described cases, the leg bones of the victims' exhibited combinations of complete, spiral and comminuted "butterfly" fractures. In all cases, some reconstruction was necessary to determine the direction of force. Butterfly fractures are wedge-shaped, produced by a combination of complete transverse forces, and typically occur when the limb is weight-bearing. Since bone fails first under tension, the point of impact in a butterfly fracture is at the bottom of the wedge opposite the apex of the triangle. In one of the cases, a spiral fracture was observed on the left fibula. Spiral fractures of the distal fibula are typically caused by pronation/external rotation of the ankle joint. This individual (#3) also exhibits "boot top" fractures which are typically caused by direct or rotational forces.

The direction of force in each of these cases was discerned based on interpretation of the types and locations of the limb fractures. Careful dissection, removal, maceration, and reconstruction allow for a more intensive analysis of the direction of force and the relative position of the pedestrians legs to the vehicle. The multidisciplinary approach results in a more complete and detailed accident reconstruction in these types of cases.

Fracture Interpretation, Forensic Anthropology, Accident Reconstruction

H29 Orthopedic Devices and the William M. Bass Donated Skeletal Collection: Implications for Forensic Anthropological Identification

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The goal of this presentation is to demonstrate a chronology of orthopedic devices used in hip, knee, and shoulder arthroscopic surgeries in relationship to the osseous healing process. In doing so, it will provide summary statistics on the demographic profile of those exhibiting orthopedic devices within the William M. Bass Donated Collection compared to National Inpatient Survey (NIS) data.

This presentation will impact the forensic community and/or humanity by augmenting attendees' existing knowledge of the varieties of orthopedic devices and their manufacturers, the demographic profile of those receiving these orthopedic devices, and to examine the degree to which healing can be used in the forensic investigation.

This paper stands to demonstrate a chronology of orthopedic devices used in hip, knee, and shoulder arthroscopic surgeries in relationship to the osseous healing process. In doing so, it will provide summary statistics on the demographic profile of those exhibiting orthopedic devices within the William M. Bass Donated Collection compared to National Inpatient Survey (NIS) data.

Hemiathroplastic or total arthroplastic surgery involves prostheses used to replace arthritic damage and relieve pain in a joint complex. Prostheses are typically manufactured from stainless steel, titanium, or a cobalt/chromium alloy and contain wear-resistant polyethylene plastics anchored by bone cement. The design of prostheses are usually trademarked by a particular manufacturer, such as the Gunston knee™ or the Exeter Hip™. Ubelaker and Jacobs (1995) provided information on the identification of orthopedic device manufacturers enabling identification using company logos. However, manufacturers were not required to place logos on their products prior to 1993 (Ubelaker and Jacobs 1995). Prosthetics manufactured before1993 may not have these identifying logos and if present the logo may be obscured by new bone growth. Therefore, understanding the chronology of particular designs could help identify possible manufacturers, as well as indicate the timing of the surgery. Furthermore, understanding the osseous response to orthopedic devices in conjunction with the timing of implantation will provide a better time of insult estimation for the forensic investigator.

According the National Impatient Survey (NIS) more than 557,000 total hip or knee replacement surgeries occurred in 2002. Knee replacements have become the leading arthroscopic surgery performed in the United States followed by total hip replacements. According to the NIS,

381,000 knee replacements occurred in 2002 with those 65 or older accounting for 241,000 of these replacements. NIS also noted that females (235,000) out numbered males (146,000) on a 2 to 1 margin. However, NIS did acknowledge a growing trend for total knee replacements within the 45-65 age group (131,000 individuals) which is a 6 percent increase from the previous survey.

Hip replacements are not as common as knee replacements with 193,000 total and 114,000 of these going to those 65 years or older. Like knee replacements, hip replacements are more common in females (112,000) than males (81,000). Data for partial replacements and shoulder replacements are yet to be available.

The William M. Bass Donated Collection (N=436) was surveyed for individuals demonstrating partial or total hip, knee, and shoulder joint replacements. Demographic information for individuals displaying evidence of arthroscopic surgery were obtained and compared to the NIS statistics. Each device was observed for the presence of a logo, the location of a logo, and specific design characteristics. This information was compared to manufacturer data to determine the specific manufacturer of the appliance and the years for which that appliance was made. Also, the amount of osseous healing was noted. The results from these were compared to a chronology of specific device designs established using reference samples from the major orthopedic device manufacturers.

Very few individuals demonstrated early varieties of hip or knee replacements and few individuals demonstrated a shoulder replacement (N=2). Knee replacements are more common than hip replacements in the collection, but not to the predicted NIS amounts. Females (N=107) demonstrated a higher percentage of replacements, particularly knee replacements, compared to males (N=329), which corresponded to that which was predicted. Appliance designs varied greatly between individuals. However, far fewer logos could be found on the appliances suggesting that these cannot be solely relied upon to identify the manufacturer of an orthopedic device.

It was estimated that most individuals displaying orthopedic devices at a joint complex had these devices implanted within 10 years of death if not sooner than 5. This is supported by the minimal amount of osseous response on affected bones. Conclusions are limited by the degree of healing observed on the individual bones. More studies must be completed to fully appreciate the use of the osseous response in the timing of an insult.

It is necessary to continually update references, especially those involving manufacturing companies, for use by the forensic anthropologist.

Human Identification, Orthopedic Devices, Osteoarthritis

H30 The Effects of Household Corrosive Substances on Human Bone and Teeth

Darcy J. Cope, and Tosha L. Dupras, PhD, University of Central Florida, Department of Sociology and Anthropology, Orlando, FL 32816*

After attending this presentation, attendees will gain an understanding of how various household corrosive products, chiefly those products used in masking the identity of a victim, effect human bone, and teeth. Application of this information can assist in the analysis of human remains and possibly provide an identification of the chemical.

At present, the forensic literature does not provide the needed information to determine how these household chemicals can affect the bone and teeth of the victim and how the identification process is hindered by the use of such chemicals. In an effort to provide such information, this presentation will impact the forensic community and/or humanity by assisting investigators in determining the affects of common household corrosive agents on bone and teeth.

Often times a murderer will attempt to destroy the body of their victim with the prospect of deterring the investigative process of determining the identity of the victim's remains. Forensic literature does address body disposal with the purpose of annihilating a victim's identification such as incineration or dismemberment of the limbs and head, but surprisingly there is a gap in the literature concerning the chemical effects that household products may produce on human bone and teeth. These highly corrosive household products are easily attainable by the general public and include such products like drain cleaners, toilet bowl cleaners, and muriatic (hydrochloric) acid.

A total of eight chemicals were utilized for this experiment. Of these chemicals, seven products were purchased at general stores and one chemical was prepared by dissolving sodium hydroxide pellets. Each product is categorized according to the pertinent amount of corrosive chemical found within the product. The corrosive acid/base categories include hydrochloric acid, sulfuric acid, phosphoric acid, and sodium hydroxide. Two products from each acid/base category were used to represent a higher and lower concentration of the corrosive acid/base found within the products.

Two human teeth, an incisor and molar, were allocated for experimentation in each chemical. To simulate the position of the teeth in the mandible/maxilla, a hole was drilled through the root of each tooth and a wire was fed through this hole. A wooden dowel was used to suspend the tooth, which allowed concentration of the chemical reaction to occur only on the occlusal surface of the molars and the incisal surface of the incisors. The teeth were suspended over a beaker holding 40ml of a chemical. Each sample was emerged in the chemical for 24 hours with documentation of changes after 1, 2, 3, 4, 5, 6, 12, and 24 hours.

For experimentation on human bone, a fresh human humerus was cut into eight segments, originating from the shaft of the bone. Only one segment was used for each chemical. The bone samples were submerged in a beaker holding 200ml of a chemical for a total duration of 24 hours. Documentation of changes was recorded after 1, 2, 3, 4, 5, 6, 12, and 24 hours.

Documentation of the chemical effects on the teeth and bone comprised of gathering quantitative and qualitative data. A fifteen minute interval was allotted for each measurement period. A spreading caliper was used to take measurements of the crown width and length of the tooth as well as the length and diameter of the bone segments. Weight measurements were taken with a digital scale. With the use of a digital camera microscope, pictures were shot of the teeth and bone during every measurement interval period.

The results of this experiment showed destruction of the teeth and bone with certain chemicals like hydrochloric acid, while other chemicals demonstrated an insignificant effect. In certain cases, within one hour the enamel portion of the teeth was completely obliterated while the bone segments demonstrated almost complete loss of tissue and afterwards a decrease in inorganic matter. Continuing changes of both the teeth and bone was witnessed in their basic morphology and quantitative aspects. The longer undisturbed exposure the samples had with the chemical, the greater the destructive effects.

Corrosive Agents, Human Bone, Human Teeth

H31 Artists Contribution to Facial Reconstruction

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The goal of this presentation is to understand whether the artists incorporate their own anatomy into their work and how this tendency may be counteracted.

This presentation will impact the forensic community and/or humanity by addressing an aspect of facial reconstruction that has previously only received anecdotal attention. Artists may incorporate their own features into reconstructions by referring to their own faces for guidance. However, attention to instruction in facial anatomy appears to provide a way of avoiding this situation.

Facial reconstruction or approximation is a delicate balance between scientific analysis and artistic interpretation. If either exists without the other, the reconstruction appears both lifeless and vague or is a poor match to the individual. The question of accuracy in facial reconstruction is debated with claims of 10-60%. One fundamental aspect of these tests has been neglected, however, and this is the experience and talent of the artist.

In the present study, the authors assess whether or not beginning facial reconstruction artists unconsciously put their own facial anatomy in their work. The study attempts to find out if observers can identify which artist did which facial reconstruction when all the artists used the same skull and technique. Human subjects' approval from SFSU and UCSC was obtained for all participants.

Students enrolled in a scientific illustration course were asked to complete a half reconstruction based on identical model skulls as part of their regular assignment. Instruction in the technique was provided by an experienced reconstruction artist (GN). Photographs were taken of the reconstructions and the artists. Images were constructed of a "full face" by flipping the half reconstruction using Adobe® Photoshop® 6.0 and cropped to limit the image to the facial region. Photographs of the artists were similarly cropped to the facial region.

Groups of individuals with varying levels of skill were then asked to compare a selection of four skull reconstructions and six artist faces. Some were experienced anthropologists or graduate students; others work in identification of remains while others are undergraduate students with no exposure to forensic identification.

The four reconstructions selected showed differences in morphology, particularly in the midface. The associated artists also showed a range of facial features although all were young adult females. Preliminary results of the matching exercise show that there are clear preferences to associate particular facial reconstructions with artist faces. However, there is no clear pattern in which the correct match is made.

This study suggests that, with proper training, the tendency to rely on the artist's own anatomy may be minimized. Such training should include information on facial anatomy and the principles by which the soft tissue can be interpreted and individualized from the skeletal data.

Facial Reconstruction, Facial Approximation, Facial Anatomy

H32 Superficial Ancestral Characteristics of the Nose

Stephanie M. Crider, BA, 4525 North Leata Lane, La Canada, CA 91011*

After attending this presentation, attendees will learn, retain, and implement the newest additions to Olivier and Thomas nasal characteristics. Attendees will also find a new understanding of the nose and root superficial characteristics, as well as the characteristics that are common among different ancestral groups.

This presentation will impact the forensic community and/or humanity by being a catalyst for further research into the genetic work on the varying aspects of what composes the superficial ancestral characteristics of the nose. Also, this presentation serves as the beginning of a catalogue of varying nose and root types, including images and text explaining in detail the differences between nose and root types. All of these would be extremely crucial for Forensic Facial Reconstruction.

Facial reconstruction or approximation depends on the ability of the artist to utilize the landmarks on the skull to build a replica of the soft tissue. The primary features of the face (the eyes, nose, and mouth) useful for facial recognition are the areas most concern for the artist. A closer understanding of the relationship of bone to soft tissue and of the variation present in contemporary human populations is essential.

Classification systems for the nose are relatively limited and are often based on broad divisions of ancestral groups into 3-4 main clusters. These categories do not recognize the diversity represented in the contemporary American population nor do they recognize the amount of admixture of ancestral lineages. This study explores the variation of nose proportions, nasal bridge and root shapes, and nasal angles.

Sixty-seven individuals from five ancestral backgrounds (Mongoloid, Hispanic, African, Caucasoid, and Mixed Ancestry) were selected. Frontal and lateral photographs were taken of the nasal area with scales. Measurements of the features were then taken using NIH's ImageJ. The data are compared and analyzed for their superficial nose characteristics. Specific measurements include Angle from glabella to the bridge (nasofrontal angle); angle from the tip of the nose to the philtrum of the nose (nasolabial angle); length of nose; and width of nose. In addition the types of nose and root are assessed according to the Olivier and Thomas chart. As not all individuals could be assigned to these categories, new categories were created to accommodate for these trends. The new categories for nose type include Slight Curve and Deep Curve; for nose root, the new categories are Slight Point, Flat Point, and High Elevated Point.

The data were analyzed using Microsoft Excel and ImageJ. Linear measurements were converted to proportions. ANOVA was used to assess the difference between ancestral groups while Chi Squares was utilized for the categorical date.

Results show that the most common nose type across all five ancestral groups is Elevated Point with a Slight Curve. It is only the secondary traits of the nose and root that differentiate the various ancestral groups. Also, individuals of Mongoloid ancestry have the lowest nasal measurements altogether, while individuals of Caucasoid ancestry have the highest nasal measurements altogether. And finally, the author has noticed that the frontal views of the noses are quite different, while the lateral views of each of the noses tends to be extremely similar.

Ancestral, Nasal, Characteristics

H33 Morphometrics Using Radiographic Study of Thyroid Cartilage for Age-Estimation in Korean Males

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The goal of this presentation is to show the results of a study on the analysis of the thyroid cartilage of unknown Koreans by morphometrics using radiography for age estimation.

This presentation will impact the forensic community and/or humanity by demonstrating the usefulness of thyroid cartilage for age estimation in Korean males and another method for age estimation using radiographic analysis of thyroid cartilage.

The need for accurate methods for age estimation has increased in the last decade. One reason is the increasing number of unidentified cadavers and human remains, and the other is a rise in cases requiring age estimation in living individuals with no proof of date of birth (Ritz-Timme *et al.*, 2000). Most of earlier studies of age estimation are focused on the hard tissue such as teeth and bones. However, studies about the soft tissue such as cartilage are fewer. The thyroid cartilage, the biggest among the laryngeal cartilages, undergoes endochondral ossification with age. There are several references on the patterns of ossification of the thyroid cartilage, but reports on quantitative analysis of ossification are lacking. The purpose of this study is to estimate the age of the Koreans whose age is unknown, based on radiographic analysis of the thyroid cartilage.

The thyroid cartilages were separated from the larynx and dissected from the surrounding connective tissue. Dedicated mammography was carried out in 124 specimens of the thyroid cartilages including 76 males and 48 females. Radiographed films were scanned and 17 quantitative

measurements were carried out with Adobe® Photoshop® CS (version 8.0). Using this program, the scanned radiographs were converted into gray scales, with the command "Histogram," and it was possible to distinguish the pixels for ossification or calcification of thyroid cartilages. These measurements were analyzed using SPSS (version 11.0) statistical software package.

The radio-opacity increased with advancing age in both sexes, but the pattern of ossification was different. The data were divided into four age groups as follows: G0: age below 14 years, G1: age between 15 ~ 30 years, G2: age between 31 ~ 45 years, G3: age above 46 years. The discriminant functions for the age group and multiple regression functions for each age group were obtained for age-estimation of male subjects, but the application for female subjects was still limited due to the small sample size for each age. In male subjects, the ossification appeared first at the posterior border and spread along the inferior border, the anterior angle (anterior border) and the notch, and finally resulted in the formation of the window with advancing age. In female subjects, the ossification appeared first at the posterior border and spread into the middle and the upper part of the laminae, but the front parts of the lamina and midline remained cartilaginous.

This research indicates the thyroid cartilage is useful in estimating the age for Korean male subjects whose age is unknown. Further investigations must be conducted to verify its utility and the application in for female subject.

Thyroid Cartilage, Age Estimation, Koreans

H34 Isotopic Determination of Region of Origin in Modern Peoples: Applications for Identification of U.S. War-Dead From the Vietnam Conflict

Laura A. Regan, MS, and Anthony B. Falsetti, PhD, C.A. Pound Human Identification Lab, Department of Anthropology, University of Florida, PO Box 112545, Building 114, Gainesville, FL 32611; and Andrew Tyrrell, PhD, Joint POW/MIA Accounting Command-CIL, 310 Worchester Avenue, Hickam Air Force Base, HI 96853*

After attending this presentation, attendees will understand the benefits and limitations of undertaking a multi-element approach when utilizing stable isotopes for determining region of origin of dental remains.

This presentation will impact the forensic community and/or humanity by facilitating identification efforts in a variety of contexts. When compared to isotopic signatures developed for geographic areas of Southeast Asia, the information in this study will assist in identifying the origin of unknown dental remains unilaterally turned over to, or recovered by, the Joint POW/MIA Accounting Command Central Identification Laboratory. Additionally, this information may be applied to identification efforts of fallen servicemen and women in conflicts outside of Southeast Asia, the identification of decedents resulting from mass fatality incidents and in the identification efforts of undocumented aliens or otherwise unprovenienced human remains.

To facilitate the construction of identification shortlists, especially from large open ended decedent populations, a highly effective means of excluding possible candidates for identification would be the establishment of the geo-political region of origin for a set of remains. However, ascertaining the national origin of unidentified human skeletal remains whose provenance is either unknown or suspect is particularly problematic. Factors that can encumber this process include long postmortem intervals, highly fragmented friable remains, and diagenesis.

The goal of this study is to create a geographic "fingerprint" utilizing carbon, oxygen, strontium, and lead isotope ratios sampled from the teeth of modern people. This fingerprint will enable identification of region of origin for unidentified skeletal material without an established or well-documented provenance. The initial efforts of this project have focused on the approximately 1,800 service members who remain unaccounted for from the Vietnam conflict. The authors have utilized a two-pronged approach based on the operating hypotheses that: 1) discernable differences exist between the isotope ratios incorporated into North American and South East Asian tooth enamel and that these differences can be used to determine region of origin; and 2) regional differences in natal isotopic signatures are also discernable within populations raised within the United States (and hence, by implication, other global regions as well).

Stable isotope analyses, long used in paleontological and archaeological studies, are emerging as a powerful tool in the forensic realm as well. Forensic pilot studies have hinted at the utility stable isotopes may provide to forensic anthropology. This study is unique in that it employs a multi-element approach in combination with a large sample size. The standard deviations of isotope ratio values often overlap in single-element studies making discrimination between regional signatures virtually impossible. This tendency is reduced through the introduction of multi-element analyses to forensic work. A multivariate, multi-element approach should allow finer resolution, especially since deposition of different elements within dental enamel depends upon very different factors. Carbon isotope ratios reflect the photosynthetic pathways of ingested plants and echo cultural food preferences. It is expected that individuals who have subsisted on a rice-based (C_3 plant) South East Asian diet will differ significantly in their carbon isotope signature from individuals who have subsisted on a heavier corn and sugar-reliant (C_4 plants) American diet. Oxygen isotope signatures rely on the variation of oxygen isotope ratios in meteoric water according to variations in temperature, altitude, and distance from major bodies of water. Variations in strontium and lead isotopes reflect underlying bedrock and soil as well as exposure to pollutants.

Tooth enamel is ideally suited for isotope studies. Teeth are much more robust than bone, exhibiting preferential preservation and reduced susceptibility to diagenetic processes. Dental enamel does not remodel and hence the in- and outflow of materials ceases once amelogenesis is complete. This means that examining the permanent dentition provides a snapshot of the "nutritional ecology" of that individual during the period of crown mineralization for a specific tooth.

A Southeast Asian reference population of 61 individuals was sampled from the Joint POW/MIA Accounting Command (JPAC) Central Identification Laboratory's "Mongoloid hold" collection. Remains originating from South East Asia are unilaterally turned over to the Central Identification Laboratory. Despite best efforts, the Governments of South East Asia are often reluctant to repatriate those remains thus obtained by the Central Identification Laboratory that are identified as Asian in origin. This reference sample was compared against stable light isotope ratio data obtained from living subjects at two separate dental facilities, the U.S. Air Force Academy, Colorado Springs, Colorado and the Malcolm Randall Veterans Affairs Medical Center, Gainesville, Florida. At each clinic, patients already identified for tooth extraction were asked to donate their extracted teeth and participate in a brief survey listing their childhood residency and biological and cultural factors that might potentially affect isotopic deposition in enamel. Military members and their dependents were chosen as subjects due to their varied geographic backgrounds. Spatial analyses were layered with temporal analyses by comparing cadets (ages 18-25) to veterans. The results to date are presented as well as the distinct advantages and limitations to undertaking a mosaic approach to stable isotope analyses of dental tissues.

Stable Isotopes, Region of Origin, Vietnam Conflict

H35 Non-Destructive Microscopic Differentiation of Human From Non-Human Fragmentary Burned Bone

Elayne J. Pope, MA, Trey Batey, MA, and Jerome C. Rose, PhD, University of Arkansas, 330 Old Main, Fayetteville, AR 72701*

After attending this presentation, attendees will learn the Non-destructive methods for differentiating human from non-human bone in cases of fragmentation and burning encountered in mass disasters and forensic cases.

This presentation will impact the forensic community and/or humanity by improving field analysis of fragmentary and burned bone for differentiating human from non-human bone.

Fragmentary burned bone presents challenges to field investigators questioning the fundamental probability of skeletal remains being of human or animal origin. This affects the development or termination of criminal investigations, recovery techniques, and methods of identification. These issues are important when human remains are suspected in addition to animal remains or encountered among debris of mass disasters (aircraft and mass transit accidents, wild fires, or explosions) involving fragmentation and burning. Normally this problem is resolved by identifying morphological variations in anatomical landmarks present on suspect fragments. However, fragmentation of brittle burned bone reduces diagnostic features producing small pieces of compact cortical and trabecular bone as primary specimens for analysis. In these cases, examining microscopic structures of bone is necessary for differentiating human from non-human fragments.

Routine forensic cases encounter this issue when unknown skeletonized remains are discovered by the public and relinquished to law enforcement for identification. To the untrained observer, this question is resolved by consulting a biological anthropologist, zooarchaeologist, or medical professional trained in osteology. Morphological variants of size and shape in skeletal anatomy distinguish extreme cases of small (cat, opossum, or chicken) and extremely large (horse or cow) animals as obviously differing in size from humans. However, postcranial skeletal remains of medium-sized animals such as pig, deer, sheep, or large canine may resemble human bone in relative dimensions of cortical thickness for extremely fragmented remains and require definitive identification. Burning increases the difficulty of this task and the degree of fragmentation of bone, especially if larger diagnostic remains are purposely crushed or removed to a secondary location for disposal to conceal criminal acts and destroy evidence of identity.

Compounding the identification problem is the variable degradation of bone's structure through stages of unburned, initial burning, charring, and calcination. Pyrolosis of organic constituents through progressive stages of cremation gradually leaves bone structurally deficient as a dry and brittle material. In calcined bone this reduction produces shrinkage, deformation, embrittlement, and heat fractures from prolonged burning. Partial fragmentation of skeletal material is expected from the dynamic fire environment from heat, movement, or impact. Changes in microstructure of human burned bone have been previously documented by Bratmiller and Buikstra (1981) and Nelson (1992). The presenter's intention is not to redefine their research but instead expand it into the general identification of animals similar in human size or cortical thickness called into question as potential forensic specimens.

A sample of southeastern American domestic and wild animal species were selected as household food refuse and common animal types suspected as human remains; *Sus scrofa* (pig), *Odecolius virginanis* (white tailed deer), *Canis familiaris* (medium-large dog), *Bos tarus* (cow), *Ovis aries* (domestic sheep), and *Terrapene carolina* (box turtle carapace). Specimens were burned and sampled for cranial and postcranial exemplars of unburned, charred, and calcined bone for each species. Identical burn stages of human cranial and postcranial bones were obtained for comparative analysis.

Due to the fragmentary nature of burned bone, traditional destructive and expensive techniques were not necessary since fracture margins were exposed and amenable to microscopic analysis. Specimen margin surfaces were visually examined under a basic stereoscopic laboratory scope with low power magnification (10-40X) and angled lighting. Specimens were placed on a variable height platform, often secured with clay under the lens, analyzed, photographed, and morphologically documented first for progressive degradation from burning within each species and then later comparatively to identify differences among species.

Characteristics of human microstructure were first established in dry bone for cranial and postcranial fragments, noting differential size, shape, and distribution of osteons ranging from endosteal to periosteal lamellar bone and texture of external cortical surfaces. The identical protocol was applied to each non-human species. Fragmentary surfaces of non-human bone yielded unique patterns of osteon size, distribution, shape, banding, and external cortical surface morphology different from human.

Microscopic analysis of fleshed bone fracture surfaces presented difficulties under low power magnification as grease and organic materials were still present in Haversian canals and skeletal matrix. Charred bone with its uniform blackened structures was also challenging to visually differentiate unique microstructural patterns for each species. Calcined and dry bone surfaces yielded the best conditions from loss of their organic constituents for accurately analyzing microscopic characteristics. Descriptions of techniques and a comparative visual atlas of microstructural differences among human and non-human specimens will be presented for use in problematic cases involving fragmentary and burned bone.

Burned Bone, Fragmentary Bone, Mass Disasters

H36 The Detection of Microscopic Markers of Haemorrhaging and Wound Age on Dry Bone: Beating the Barriers Between Forensic Anthropology and Forensic Pathology

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After attending this presentation, attendees will learn that it is worth trying to apply immunohistochemical techniques on dry bone in order to verify the antemortem nature of a fracture.

This presentation will impact the forensic community and/or humanity by demonstrating that the application of histopathology techniques for detection of survival may be useful also on dry bone and therefore in forensic anthropology.

An example of the barriers and conceptual differences between forensic anthropology and pathology can be seen in determining the vitality of a wound. Pathology can make use of skin color and microscopic techniques, anthropology needs different criteria. The diagnosis of the vitality of a wound (whether it is produced ante-mortem or postmortem) as well as determination of the time elapsed between the production of the wound and death is a crucial issue in forensic pathology. In fresh skin, the red-purplish coloration of a cut or bruise will reveal its vitality whereas the change in coloration, from a macroscopic perspective, will reveal the time of survival. In more difficult cases, microscopic analyses can be performed. A plethora of data from classical histological techniques and newer immunohistochemical techniques provides more accurate statements of survival time, although this depends on the stain used, time from death, etc. One however must keep in mind that unless there has been at least a four hour survival time, histological distinction between ante-mortem and postmortem skin wounds is not possible, regardless of sporadic studies which declare better

results for short survival times with immunohistochemistry. Similar statements can be said concerning bone trauma, in particular fractures. Bone follows similar "laws" with regards to the progression of histological changes during healing. Even if the beginning of the healing process (periosteal bone production and callus formation) can be detected macroscopically and radiologically, these processes require a long time.

The scope of this pilot study was therefore to collect bone fractures from cadavers with a known time of survival, have them undergo a simulated putrefaction procedure until they became "dry bone" and perform macroscopic and microscopic analysis to verify the potential of histology in identifying "vital" processes in putrefied soft-tissue-free bone. This would allow one to verify if histopathological techniques can be useful in determining the antemortem nature of fractures in dry bone.

Six samples of fractured bone (cranium, rib, tibia) were taken from cadavers with known time of survival between trauma and death. Time intervals ranged from a few seconds after the bone fracture had been inflicted, to several hours, days, and weeks. A negative control was included (postmortem fracture). At the time of sampling, before starting the decalcifying process (using the following solution: distilled water 80%, HCl 10%, formic acid 10%), ink was painted onto the fracture surface to be studied. Fractured edges were observed macroscopically and then macerated in water in order to clear the bone of residual soft tissue and "simulate" dry bone. The bone was then decalcified and stained with H&E, PERLS (for the demonstration of hemosiderin deposits), and PAS, PTAH and Weigert (for the demonstration of fibrin). Immunohistochemistry was performed using a monoclonal antibody anti-human Glycophorin A. Two staining methods were used for antigen detection, the first with boiling of the sections and the second with incubation at room temperature.

Preliminary results indicate that not only do the PTAH and glycophorin tests show the presence of thrombi and red blood cells residues, respectively, on the fractured margin, but also within Haversian canals. This study, though certainly not conclusive, shows that it may be worth pursuing the study of bone fractures from a histopathological point of view even on "dry bone."

Bone Fractures, Microscopy, Haemorrhaging

H37 Differential Diagnosis of Gout in Skeletal Remains

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The goal of this study is to describe the lesions created from gout that can be identified through osteological and radiological examination.

This presentation will impact the forensic community and/or humanity by defining characteristic skeletal lesions from gout that can be used in creating a more specific osteological profile.

Characterized by the deposition of monosodium urate monohydride crystals, gout is the most common form of degenerative arthritis in males over 40, affecting approximately 1% of males in Westernized regions. It is predominately a male disorder, with rates ranging from 7:1 – 9:1 incidence of males to females. Typically first attacks of gout occur in males 30-50 years of age and in females after menopause. The prevalence of gout is rising worldwide, especially in the elderly, often in association with drug therapies such as loop diuretics and with organ transplants.

Without treatment, gout typically progresses through stages of acute inflammation known as acute gouty arthritis, followed by periods of no symptoms known as intercritical gout. As gout progresses, the intercritical periods become shorter and eventually nonexistent as the attacks become chronic. The development of urate crystal masses, called tophi, characterizes this stage. On average, chronic tophaceous gout develops twelve years after the initial attack but with a wide range; gout associated with a known cause tends to progress more rapidly than idiopathic gout. Osseous lesions typically develop when the tophi dissolve the underlying cortical bone. Roughly 50-70% of untreated gout cases progress to chronic tophaceous gout, but with treatment less than 5% of cases progress to tophaceous gout. Most individuals who develop tophaceous gout will develop skeletal lesions.

Gout shows a predilection for smaller joints and lower limbs, especially the 1st metarso-phalanygeal joint and can be monoarticular, oligoarticular, or polyarticular. The lesions can be located on the intra-articular surface, periarticular surface, or the diaphysis near the joint surface and tend to be asymmetrical in occurrence and/or severity. Clinically, the presence of urate crystals is considered to be diagnostic, but they are not always present at the time of diagnosis so a combination of other characteristics such as hyperuricemia, asymmetric joint swelling, and multiple attacks can also define gout. However, these characteristics are all associated with soft tissue and/or patient history and will be obscured and/or absent in decomposed and skeletal remains. Urate crystals are water-soluble and most likely will not be present in skeletal remains. Radiological studies have identified unique features of skeletal gout lesions. These lesions are characterized as being round or oval, eroded and scooped-out with well-defined, sclerotic margins, and little to no bone density loss.

A gross osteological examination of gout lesions has never been made from clinically diagnosed gout. Recently, an individual with a documented case of gout donated his body to the Maxwell Museum at the University of New Mexico. Gross skeletal examination of this case confirms the radiologic description of gout lesions as the scooped-out circular erosive lesions that remain in the subchondral surface and do not invade the marrow cavity. The well-defined overhanging margins are more obvious than in radiographs, are sclerotic to varying degrees, and can have a slightly different texture than the surrounding bone. Some cortical expansion may be present, but with subchondral destruction.

Gout lesions can be differentiated from similar conditions by combining osteological and radiological observations. Rheumatoid arthritis produces erosive symmetrical lesions with osteopenia and nonsclerotic, less defined margins that are limited to the joint surface. Early skeletal lesions can have a slight overhanging edge, but more developed lesions do not. Chondrocalcinosis, a form of calcium phosphate deposition disease, produces erosive, irregular symmetrical lesions with nonsclerotic, poorly defined margins that are limited to the joint surface. Psoriatic arthritis produces erosive symmetrical and asymmetrical lesions with little to no osteopenia but with poorly defined margins limited to the joint surface. Septic arthritis can produce erosive asymmetrical lesions not limited to the joint surface, but typically the lesions invade the marrow cavity with a less organized underlying bone structure. Furthermore, radiological analysis shows less defined margins and a lace-like periosteal reaction. Amyloidosis resulting in carpal tunnel syndrome, which is rare, can create erosive lesions with sclerotic margins which are not limited to the joint surface, but are often accompanied by a loss of bone density. No gross osteological description has been made for this condition.

As gout skeletal lesions are relatively rare, identifying gout lesions can be an important step in creating an osteobiography from skeletal remains. The severity of the disease required to produce a lesion should be an identifiable characteristic of an individual in life.

Gout, Differential Diagnosis, Osteological Profile

H38 Bevel, Bevel in my Bone, Be it Bullet or Be it Stone? Misidentification of Blunt Force Trauma as Ballistic Entrance Wounds in Burned Cranial Bone

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After attending this presentation, attendees will come away with an understanding how heat affects preexisting injury. During the postmortem examination, it is possible to mistake blunt force trauma for ballistic if one is simply looking for an internal bevel to evidence injury type. Awareness of bone's plastic deformation from blunt insults, the telltale tags of bone driven into the calvarium and detached by heat, and metric analysis, can overcome misidentification of traumatic injury.

This presentation will impact the forensic community and/or humanity by providing awareness to the possibility of blunt force traumatic injury in crania being mistaken as ballistic injury in burned human remains.

Analysis of gunshot wounds in cranial bone utilizes characteristic signatures of entrance wounds and its associated internal beveling. These defects are produced by a high energy projectile penetrating the external table, punching out and beveling the diploe, and finally creating a defect on the internal table of a diameter greater than the external defect. Focally delivered blunt force trauma is similar in mechanism but is of lower energy and forces create depression fractures with crushing, plastic deformation, and incomplete beveling of the opposite impacted surface in viscoelastic bone. Fresh blunt force skeletal wounds typically appear as internally levered bone or a punched in plug partially attached or driven into the cranial vault. Burning of the body after these events can produce confusing appearances if the thermal effects are not taken into account.

With burned human remains, heat degrades organic components, leaving bone brittle, and subject to fragmentation. The internally levered fragments or bone plugs from blunt impacts become highly fragile and may detach from the original wound defect. The absence of levered bone or bone plug leaves an internal bevel for postmortem analysis identical to ballistic beveling. Misidentification of this wound type as ballistic injury instead of blunt force trauma allows erroneous estimation of death determination, a misguided search for weapons, and contradictory autopsy findings against testimony.

In order to investigate morphological differences among blunt force and ballistic wounds in burned cranial bone, twelve cadaver heads were subjected to mechanical focal blunt impacts with known weapons and injury sites. Specimens were burned in environments simulating forensic fires. Wound morphology, internal beveling of focally traumatized crania and radiographs were compared to fifteen crania with ballistic injury, burned under similar conditions, and evaluated for morphological differences between traumatic injury types.

Visual inspection revealed blunt injuries ranging from patterned external depressions, crushing with plastic deformation and partial or full penetration of external and internal tables. Focal injuries produced by hammer faces, blunt angled instruments, and edged weapons created circular, angular, or rounded injuries with corresponding internally levered bone or detached plugs in the neurocranium. The embrittlement typified in charred to calcined cranial bone left internally beveled fractures easily mimicking gunshot wounds. The wound morphologies for thirteen blunt force injuries penetrating layers of cranial bone were found to have an internal bevel similar to ballistic entrance wounds. At times portions of bone remain attached in unburned blunt force trauma, but the effects of heat causes structural embrittlement and fragmentation; therefore leading to the detachment of this delicate bone evidence during burning or following recovery. Evidence of this fragile fragment remained attached in only one of the experimental specimens. Blunt injuries were distinguishable from gunshot wounds only when small tags of internally levered bone remained around the external surface of the impact site, reflecting slow deformation and shape of instrument.

Diameters of entrance wounds and their corresponding internal bevel dimensions from blunt force trauma and ballistic injury were subjected to a MANOVA. Results demonstrate the two trauma groups are statistically different ($p<.0001$). Further, a discriminant function analysis correctly identified eight of the 11 blunt force trauma wounds and 14 of the 15 gunshot wounds with an overall cross-validated classification rate of 83%. Ballistic and blunt force injuries overlapped slightly in dimensions but tended to favor smaller diameters for ballistic injury and larger diameters for blunt force trauma. This is also a function of differential penetrating object sizes since a firefighter's pickaxe was indistinguishable in size and beveling from ballistic injuries. Gunshot wound entrances measured around 9 mm- 14 mm with an internal bevel of 12 mm- 23 mm while the blunt force entrances measured from 11 mm- 26 mm with an internal bevel ranging from 17mm-40+ mm.

Both trauma types were radiographed to identify presence of metallic or lead wipe residues retained in bone as evidence of weapon material. Only two of the twelve gunshot wound crania retained radiopaque evidence of bullet penetration and were only present in unburned bone, while none of the blunt force impacts retained metallic residue, thus further complicating differentiation of ballistic from blunt injury in burned bone.

During the postmortem examination, it is possible to mistake blunt force trauma for ballistic if one is simply looking for an internal bevel to evidence injury type. Awareness of bone's plastic deformation from blunt insults, the telltale tags of bone driven into the calvarium and detached by heat, and metric analysis, can overcome misidentification of traumatic injury. Fragile skeletal evidence, altered or destroyed from fragmentation during the fire, or by any taphonomic influence [collapse of debris, handling, transportation, and reconstruction] may become impossible to decipher. Immediate documentation and preservation of burned skeletal evidence is critical for correct identification of traumatic etiology.

Burned Bone, Blunt Force Trauma, Ballistic Trauma

H39 The Difference Between "Pala" and "Palo" is the Instrument of Death

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After attending this presentation, attendees will better come to appreciate the value of detailed taphonomic observation, eyewitness accounts, and the value of both a gross morphological and microscopic analysis of bone.

This presentation will impact the forensic community and/or humanity by demonstrating the use of subtle skeletal features of trauma to corroborate a questionable eyewitness account.

In late 2004 the remains of a mysterious death were brought to the attention of the Washoe County Coroner, Reno, Nevada. The case involved two other Nevada counties, and ultimately six agencies from three states. It addressed the kidnap and murder of a 33-year-old Hispanic female, an eyewitness account offered by the victim's three-year-old non-English speaking son, and the assistance of both a gross morphological and microscopic skeletal analysis in corroborating the questionable eyewitness. Additionally, various taphonomic factors became important to the case.

During the morning hours of November 10, 2003 a young middle-aged women dropped her son off at an elementary school in Carson City, Nevada. Later that day another son, a three-year-old, was found bloodied, clutching a dollar bill, in a parking lot at a supermarket in Lyon County, 15 miles east of the school. The three-year-old told authorities that a man had stuck his mother over the head with a "pala" and drove off after placing his mother in the back of his truck.

Eight months later, on September 14, 2004 a middle-aged man reported that his dog had discovered some bones in a rural portion of

Churchill County, a few miles further East of the supermarket. Sheriff's deputies investigated the call and soon found the remains of a partially mummified, buried, and burned body. Blunt force trauma to the head was suspected as the cause of death and over the next few weeks DNA positively identified the remains as the mother. On September 28 the Washoe County Coroner's Office of Reno, NV delivered the remains to the Physical Anthropology Human Identification Laboratory (PAHIL) at California State University, Chico. The authorities were particularly interested in confirming the cause of death, but more specifically the nature of the bludgeoning instrument.

While the DNA analysis was performed a typical morphological/forensic anthropological examination of the remains revealed a classic appearing female who had died between the ages of approximately 30 and 40 years. The decedent's age was assessed from the degree of dental development and ware, the recent closure of the sternal ends of both clavicles, and the lack of vertebral osteophytes. While both morphologically and discriminant function analyses suggested the victim was of White ancestry, slightly shovel shaped incisors were notice on teeth numbers 7, 8, and 9. Furthermore, the decedent's stature was estimated at 60.5 ± 2.3 inches. In addition to extensive evidence of blunt force trauma to the head and thorax a unique cut-mark was encountered on the upper left humerus, just proximal to a burned area and proximate spiral fracture. A microscopic analysis of the cut revealed various small associated fractures as well as a laterally directed hairline fracture. The combination of these features as well as what was deemed an appropriately wide kerf was used to suggest that a heavy dull-bladed instrument, perhaps a shovel, had been used in striking the bone. The possible use of a shovel to create all of the trauma was then reported to the Nevada authorities. At that time the investigating officer reported that the then identified victim's three-year-old son, who did not speak English, had said that his mother had been beaten with a "pala". However, due to both the witness' age and confusion in the term's translation the authorities were not certain if a shovel or "pala" had been the bludgeoning instrument, or a club, or "Palo."

The skeletal analysis suggesting the use of a shovel was accepted as affirmation that the young boy had used the Spanish word "pala." When the suspect was confronted by investigators with the evidence he began to express remorse and on December 9, 2004 he was found dead in a jail cell in Salt Lake City after having hung himself with his bed sheets.

Blunt Force Trauma, Cut-Marks, Taphonomy

H40 Scanning Electron Microscopy of Saw Marks in Bone: Assessment of Wear-Related Features of the Kerf Wall

Laurel Freas, MA, Department of Anthropology, CA Pound Human ID Laboratory, University of Florida, PO Box 112545, Gainesville, FL 32611*

After attending this presentation, attendees will learn the results of qualitative and quantitative analysis of wear-related patterns of change in cut mark morphology, as visualized in scanning electron microscope images of kerf walls from saw marks in bone.

This presentation will impact the forensic community and/or humanity by addressing the utility of scanning electron microscopy for the analysis of saw marks in bone, and will refine the understanding of the impact of increasing tool wear on cut mark morphology and the forensic interpretations thereof.

The use of scanning electron microscopy in the analysis of patterns of bone modification, including cut marks, is favored because of a number of features and capabilities of the scanning electron microscope, including greater image resolution and depth-of-field; a broad range of continuous magnification (sometimes up to 3000X); and improved visualization of surface contour profiles and bone microstructure, relative to normal light microscopy. In recent years, the SEM's enhanced image-capture capabilities have been used frequently and to great advantage by archaeologists and paleoanthropologists in their analyses of bone modification patterns from their respective contexts. Such studies have yielded important insights on many facets of cut mark analysis, including differentiation of true cut marks from "mimics" produced by scavenging animals, sedimentary abrasion, and other taphonomic processes; determination of the directionality and sequence of individual cut marks; and distinguishing among cut marks produced by different materials (e.g., stone versus metal tools). Yet in spite of the potential gains to be derived from the application of electron microscopy to the analysis of tool marks in bone from forensic contexts, only a few such studies exist. This limited use is owed to several factors, including the restrictions on sample size imposed by the dimensions of the SEM vacuum chamber; the need to cast and/or sputter-coat the sample to be imaged; the difficulties of imaging a material so structurally complex as bone; and the considerable cost of SEM imaging. It is easy to see why forensic anthropologists would be reluctant to submit irreplaceable forensic specimens to such analyses. However, recent advances in scanning electron microscope technology have gone a long way towards ameliorating many of these concerns, such that SEM imaging is drawing nearer to the realm of practicality for use in forensic anthropology, particularly with regards to cut mark analysis.

A poster by the author at the 56th Annual Meeting of the American Academy of Forensic Sciences presented the results of a preliminary study investigating the impact of increasing saw blade wear on the appearance of the kerf wall. Under light microscopy, it was observed that the patterns of coarse and fine striations visible on the kerf walls became progressively more shallow and indistinct with increasing saw blade wear. The purposes of the present study then, are two-fold: 1) to further consider these patterns of change—and their impact on the interpretation of saw marks in bone—by reexamining these sequences of cut marks under a scanning electron microscope; and, 2) to evaluate the utility of SEM imaging for the analysis of saw marks in bone.

Qualitative analysis of the SEM images of the kerf walls confirmed the prior observations of progressive loss of fine detail over the course of the cut mark sequences, and supports the interpretation that such changes are due to the blunting of sharp edges on the saw teeth. Nevertheless, other diagnostic features of the kerf wall persist in spite of these wear-related changes, indicating that even well-worn saw blades will still leave behind clues as to their class characteristics. In recognition of the growing drive within the forensic science community to develop quantitative analytical methods, it had also been hoped that the greater detail observable in the SEM images would permit accurate quantification of the features of the kerf walls, thereby facilitating statistical analysis of the observed patterns of wear-related changes. However, two separate approaches to quantification of these patterns were met with a number of difficulties, and ultimately proved to be unworkable, suggesting that such cut marks are perhaps not suited to a statistical analysis.

These results suggest that, although forensic investigators should consider wear-related features of the kerf wall during their analyses of saw marks, such features do not necessarily undermine the validity of the established methods for determining the class characteristics of the saw in question. Furthermore, the difficulties encountered in the analysis of the SEM images suggest that this imaging modality may not be of significant advantage to the forensic analysis of saw marks in bone.

Cut Mark Analysis, Scanning Electron Microscopy, Forensic Anthropology

H41 Seasonal Variation of Scavenging and Associated Faunal Activity on Pig Carcasses in South Western Australia

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After attending this presentation, attendees will have some understanding of the pattern of scavenging of carcasses by animals in south Western Australia and how this varies with seasonal climactic factors.

This presentation will impact the forensic community and/or humanity by demonstrating that seasonal faunal scavenging variation does occur in south Western Australia. Such information is useful to the forensic community when examining a body that has animal modifications associated with it. These modifications can influence the rate of decomposition, removal of bones and soft tissue, and artifacts created on the tissues by the act of scavenging.

Scavenging after death is inevitable for bodies which remain exposed for any length of time. Previous research on the effects of scavenging on the body focused mainly on the activities of carnivores and rodents which are indigenous to North America and Europe including coyotes, wolves, bears, dogs, cats, and rats. There has been little direct observation of scavenging in the wild, however, and no research on scavenging in Western Australia (surrounding the capital city, Perth).

This project was designed to discover which animals scavenge remains and how this varies with seasonal climate changes. Female pig carcasses, weighing approximately 40 kg, were placed outdoors in different seasons and allowed to decompose to roughly the same state, partial skeletonization with mummification of the remaining skin in environments which would allow access by scavengers. Decomposition of the pigs was filmed using an infrared camera and recorded on a time lapse VCR. The resulting videos were viewed and records made of the state of the carcass (in terms of decomposition), each feeding animal, time of scavenging, and length of feeding session. The type of feeding was also noted, either direct feeding on the animal or indirect feeding (feeding on the animals and insects associated with the body). Weather data (temperature, rainfall, and hours of sunshine) were collected from the Australian government's Bureau of Meteorology which has weather stations situated throughout the area.

Animals which were observed feeding on and around the body included bandicoots, varanid lizards, possums, skinks, honeyeaters, Willie wagtails, frogs, and rats. The predominant animal which scavenged on the bodies was the Australian raven *(Corvus coronoides)* which fed throughout the year both directly on the body and the associated insects. Birds were more active in scavenging during the winter months when other food resources were unavailable, while in summer, when food resources were scarce, reptiles fed on the body and the associated insects. Mammalian scavenging by possums, bandicoots, rats, and mice occurred almost exclusively at night in all seasons.

This study has demonstrated that seasonal faunal scavenging variation does occur in south Western Australia. Such information is useful to the forensic community when examining a body that has associated animal modifications. These modifications can influence the rate of decomposition, removal of bones and soft tissue, and artifacts created on the tissues by the act of scavenging. This preliminary research suggests that further studies of this type should be conducted throughout Australia.

Scavenging, Seasonal Variation, Western Australia

H42 A Preliminary Investigation of Decomposition in Cold Climate

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After attending this presentation, attendees will how cold climate generally affects the decomposition process. Such information will be useful to medico-legal practitioners for the estimation of postmortem interval (PMI) of decedents recovered from comparable environments.

The research findings presented will be useful for forensic scientists practicing in cold climate environments in the United States and internationally. This is a much-needed data set, as to date; no systematic cold climate assessment of decomposition has been conducted and widely-reported. This presentation will impact the forensic community and/or humanity by assisting Medico-legal professionals in utilizing these data for general comparative purposes in estimation of postmortem interval (PMI) for decedents recovered from similar environmental and climatic contexts.

Actualistic studies of environmental factors affecting PMI have been ongoing in particular regions of the United States for years (Anderson and VanLaerhoven 1996; Baldridge *et al.* 2004; Cornelison 1999; Dupras and Williams 2001; Haefner *et al*. 2004; Haskell 1996; Latham *et al.* 2004; Lopes de Carvalho and Linhares 2001; MacGregor 1999; Shean *et al.* 1998; Walsh-Haney and Warren 1999). At the most recent meeting of the American Academy of Forensic Sciences (AAFS), 18 separate studies directly addressing decomposition were featured (e.g., Wallace and Zimmerman 2005, Forbe *et al.* 2005, Gremillion 2005, Srnka 2005, Synstelien 2005, Schoenly *et al.* 2005, Russo 2005, Wacker *et al.* 2005, Bullard 2005, Tibbett and Carter 2005, and Carter *et al*. 2005).

None of the above-referenced studies and publications addresses the issue of decomposition in cold climate. A systematic study of decomposition in this type of environment represents a large gap in the scientific literature. The most relevant study is that of Komar (1998), which reviewed past cases of the Edmonton, Alberta Medical Examiner's Office. Here Komar presents preliminary data regarding the impact of cold climate on skeletonization and decomposition, since, in her words "studies in cold weather climates typical of the northern United States and Canada have not been widely reported" (1998).

Small grant funding was obtained from the State University of New York at Oswego's Rice Creek Field Station in 2004 to begin a preliminary study of this problem (Bunch 2005). The initial 2004-2005 project, which is still ongoing, used three child-sized (approximately 35-40 lbs) pigs (*Sus scrofa*) as surrogates for human remains. Numerous current and prior studies use/have used pigs in this capacity (Baldridge *et al.* 2004; Cornelison 1999; Dupras and Williams 2001; Gremillion *et al.* 2005; Haefner *et al*. 2004; Haskell 1996; Latham *et al.* 2004; Lopes de Carvalho and Linhares 2001; MacGregor 1999; Shean *et al.* 1998; Wacker *et al.* 2005; Walsh-Haney and Warren 1999). The pigs were placed in three distinct microenvironments (sparse hardwood forest near water source, dense hardwood forest, and spruce forest) soon after they were killed in late October 2004. Enclosures were set up to protect the pigs from larger scavengers so that stations could be easily monitored until skeletonization had occurred.

Preliminary results indicate that, as in other types of well-studied environments, decomposition rates vary greatly from one microenvironment to another: while the spruce forest specimen is in an extremely advanced state of decomposition as of Day 224, the two hardwood forest specimens are still completely fleshed and could be described as moderately decomposed. Possible reasons for this discrepancy will be discussed. In addition, the activity of insects and scavengers varied greatly. Spruce forest insect activity was relatively minimal yet mammal scavenging did occur at this station; hardwood specimens attracted numerous insects until mid-December and again in spring months, yet scavenger activity was notably absent.

The results of this study will be useful as comparative data for forensic science practitioners. It is important to note that not only local law enforcement and medical examiners/forensic anthropologists will find this information useful, but those located in similar climates in the US, Canada, and abroad would undoubtedly be able to utilize these results for their own general comparative purposes.

PMI, Microenvironment, Decomposition

H43 Assessing the Effect of Repeated Physical Disturbance Associated With Data Collection in Experimental Decomposition Studies

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After attending this presentation, attendees will learn whether the type of physical disturbance associated with data collection affects the progress of decomposition. They will learn how the decomposition process is reflected in a number of variables such as weight loss, soil pH, and temperature; and how these variables relate to each other. In addition they will have received information about the legislation governing decomposition studies in the UK.

This presentation will impact the forensic community and/or humanity by identifying how the act of data collection may alter variables under study in decomposition experiments. It identifies the need for adequate controls, an understanding of the varying ways in which decomposition can be measured, and how these measured variables interact.

Postmortem interval can be estimated using a variety of methods. One of those is the assessment of the stage of decomposition of the remains in question. The stages of decomposition have been well documented and many studies have been made of the relationship between decomposition and the elapsed time interval since death.

Few of these studies, however, make any reference to the effects of physical disturbance that may have occurred as a result of data collection. How accurately do existing published studies actually reflect the process of decomposition as it occurs naturally? This study compares physically disturbed rabbit carcasses with a series of undisturbed carcasses in order to assess the presence and magnitude of any effects.

The carcasses were placed on scrub-free level ground at the edge of a wheat field in Dickleburgh, Norfolk, UK, for a period of three weeks during July 2004. Environmental data was obtained from a computer-controlled weather station that took readings every 30 minutes. Experimental data collected included carcass weight (taken by suspending the carcass from a spring balance), internal temperature, soil temperature (at a depth of 5cm), and interface temperature (surface soil temperature from directly beneath the carcass). In addition, soil samples were taken from beneath the carcass for pH analysis. Visual observations of the state of the carcass and insect activity associated with the carcass were also recorded. Three replicates of eight carcasses were used, and the experiment was concluded once skeletonisation had been reached.

Synchronous placement of all carcasses minimized environmental differences between the groups. Decomposition was scored using a visually based scoring system based on that used by Megyesi (2001, 2005), where individual anatomical regions are scored independently, and the scores summed to give an overall indication of decomposition. Some carcasses were repeatedly picked up and replaced in order to take measurements of weight loss, temperature, soil samples, etc. The remainders were left undisturbed and once data had been taken from them they were not disturbed again until the end of the experiment. This enabled a time series of data for undisturbed carcasses to be constructed from the composite data that was acquired. The effect of disturbance on weight loss, carcass temperature, soil pH and overall decomposition was studied.

Predictions of the time taken for the carcasses to skeletonise were made using data from Vass et al., (1992). Time to skeletonisation was calculated in accumulated degree-days (ADD) and converted to days using average daily temperature data for the area. This was necessary to allow the correct number of carcasses to be obtained depending on how long the experiment would take. These predictions were shown to be accurate to within just a few hours.

Analysis of the results showed disturbance to have a significant negative effect on both weight loss and carcass temperature, i.e. both weight loss and internal temperatures were reduced compared to the undisturbed carcasses. No significant differences could be found, however, between the disturbance groups in terms of soil pH change or overall decomposition stage. It was not clear whether disturbance had any effect on time to skeletonisation of the carcasses. An insect-mediated mechanism for the disturbance effect in weight loss and carcass temperature is suggested, along with indications as to why this effect may be lost in overall decomposition. Studies comparing the effects of disturbance in the presence or absence of insects could confirm or refute this assertion.

Conclusions drawn from this work indicate that further research is needed in order to understand the effects that repeated disturbance has on individual decomposition parameters. In particular, study of the time to skeletonisation and the relationship between carcass temperature and weight loss merit further attention.

Decomposition, Accumulated Degree-Days, Disturbance

H44 Beetle Poop: Interpret With Caution in Southeast Texas

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The goal of this presentation is to present new data on Coleoptera peritrophic membrane. The observed postmortem interval (documented by investigational evidence and independent entomologic data) is significantly shorter than has been previously described, specifically as little as one month. The results suggest that use of peritrophic membrane as a temporal marker should be only cautiously made when correct species/variety can be established and when detailed environmental information is available. Through novel data, this paper extends the usefulness of coleopterids, and, in particular, the peritrophic membrane, as forensically useful time markers in the estimation of death interval.

This presentation will impact the forensic community and/or humanity by presenting new data documenting the presence of Dermestes maculatus peritrophic membrane associated with a recent, well-documented recovery, autopsy and subsequent entomological evaluation in a case with a postmortem interval of approximately one month. Independent documentation of the minimum period of time since death, including developmental data for a species of Phoridae (Diptera), Megaselia scalaris, is presented. This case suggests that presence of peritrophic membrane may be associated with significantly shorter postmortem intervals than previously reported.

Numerous species of Coleoptera (beetles) are associated with insect mediated decomposition of human remains. These different species have different relationships to the remains and, typically, arrive in a predictable successional pattern. This pattern has been used to provide an estimate of the minimum period of time since death. Typically, those Coleoptera species feeding directly on the remains tend to arrive during the mid to late stages of decomposition (postdecay to skeletal). Insect species produce a peritrophic membrane to protect their gut from mechanical trauma after ingestion of hard food particles. In late arriving species, particularly those in the family Dermestidae (skin beetles), this peritrophic membrane is quite durable; its appearance on remains provides a temporal landmark for esti-

mation of minimum time since death. At present, most documented cases involve remains with a postmortem interval of at least three months.

The decedent was a 67-year-old man with a medical history of atherosclerotic disease, including coronary artery stenosis, cerebrovascular atherosclerosis (with prior ischemic cerebral strokes and resultant hemiparesis), depression and shortness of breath. He was also a heavy alcohol user. His prescription medications were common drugs for cardiovascular disease, with consistent pill counts. A neighbor reported having not seen the decedent in one month. A survey of the man's house confirmed the neighbor's recollection in that the oldest dated mail was from one month prior to discovery of his body. Independent entomological confirmation of the minimum postmortem interval in this case was provided by developmental data for a species of Phoridae (Diptera), *Megaselia scalaris*, also present at the scene. The setting was in southeast Texas (Houston), during late June – early July. The month in question was quite warm with unusually low humidity and precipitation; the average high temperature was 95.2° F (range 82 – 101° F), the average low 74.1 °F (range 69 -80° F), and the total precipitation measured 4.19 inches. The decedent was in a locked and secure residence, with all windows and doors closed and secured, and all curtains and blinds drawn. An air conditioner unit was available but was not on. The decedent was inside the residence, supine on the floor of the living room. The anterior aspect of the body was mummified, while the posterior aspect was moist, with skin slippage. Abundant adult and larvae of *Dermestes maculatus* beetles were on the body surfaces, and crawling through the orifices. Abundant tangled masses of peritrophic membrane were packed on various parts of the body. The decedent's genitalia were essentially replaced by a mass of the stringy residue, with admixed beetle larva and exuviae.

Our observations present new data on Coleoptera peritrophic membrane. The observed postmortem interval (documented by investigational evidence and independent entomologic data) is significantly shorter than has been previously described, specifically as little as one month. The results suggest that use of peritrophic membrane as a temporal marker should be only cautiously made when correct species/variety can be established and when detailed environmental information is available. Through novel data, this paper extends the usefulness of coleopterids, and, in particular, the peritrophic membrane, as forensically useful time markers in the estimation of death interval.

Coleoptera, Peritrophic Membrane, Postmortem Interval

H45 Temperature Variability in the Burial Environment

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After attending this presentation, attendees will gain a better knowledge of the relationship between body temperatures during decomposition and the ambient and sediment temperatures of the burial environment.

This presentation will impact the forensic community and/or humanity by helping in establishing time since death estimations when temperature data is used in relation to decomposition and/or insect data.

The aim of this study is to demonstrate the relationship between external body temperatures throughout decomposition and corresponding sediment and ambient temperatures of the burial context. Rates of decomposition are temperature and thus insect dependent making them useful for time since death estimations. Therefore, ambient temperature data is often used in forensic investigations in relation to rates of decomposition and/or insect evidence. Temperature data are usually collected from the nearest weather station or weather station records, which are corrected using site temperature data, but the potential variability between temperatures of the body, surrounding sediment, and air has not been well established. A better understanding of the relationship between all relevant temperatures of the burial environment will help in estimations of time since death.

In this investigation two pigs (*Sus scrofa*) were buried using two burial types, one under stone and one under sediment, in Edmonton, Alberta. A datalogger was installed next to the burials with thermisters attached to the top and bottom of the thoracic regions of each pig as well as in the sediment adjacent to one of the pigs. Ambient temperature data were collected from an on-site weather station. Temperatures were recorded for four months from July 7 to October 6, 2002. Unobtrusive observations regarding insect activity and collapse of burial provide insight as to the associated stages of decomposition.

Temperatures varied between each probe and between the probes and ambient temperature throughout the study. In no cases did the temperatures of each of the probes and ambient air exhibit the same temperature results. However, as ambient and sediment temperatures of the burial environment changed, similar changes occurred in exterior body temperatures of both anterior and posterior thoracic regions. These changes depended on factors such as burial type. Patterns are seen throughout each day and throughout the four-month time span of the study. Daily patterns tend to follow an s-shaped curve in which temperature increased throughout the day and decreased at night with some notable exceptions. Temperatures throughout the day fluctuated more among stone-covered than sediment-filled burials and more at the top of the burial than at the bottom. Body temperatures showed less fluctuation than those of both the surrounding matrix and ambient air during the four months. Temperatures on the anterior thoracic region (top of pig) were consistently warmer than the posterior (bottom of pig). Temperatures of both the top and bottom of sediment-filled burials were generally warmer than stone-covered. All temperatures followed the same general pattern of fluctuations throughout the study period.

Ambient Temperature, Decomposition, Body Temperature

H46 The Shallow Grave as an Option for Disposing of the Recently Deceased: Goals and Consequences

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The goal of this presentation is to show that processing a clandestine grave following a classic approach will result in the destruction of contextual evidence, as this type of evidence can only be accessed and registered sequentially. Consequently, scene processing must be planned with consideration of the multi-layered structure of the evidence, and ultimately, can only be properly processed by employing contemporary archaeological methods.

This presentation will impact the forensic community and/or humanity by increasing the awareness about the risk of information-loss derived from improper shallow grave recovery.

Edmond Locard's astute observations (*Locard's Exchange Principle*) regarding the correlation of evidence, suspects and place have served as a central tenet in the discipline of forensic science and forensic investigation since the turn of the 20th century. As a guiding principle during the location and collection of evidence at the indoor crime scene, the resultant precise documentation of the minutest of details has served the discipline well. Unfortunately, the application of these principles at outdoor scenes has lagged very far behind.

In the present contribution a perpetrator is followed who has chosen to hide a body through emplacement in a shallow grave. The different alternatives presented to her during the process will be examined, from the time of acquisition of the body, through transport to the grave location, and finally, through the act of digging the grave. For example, early in the grave digging process, the perpetrator faces an important decision involving a trade-off between time employed in the entire process (from killing, to transport, to digging of the grave) and likelihood of body detection. The longer the time and greater the effort spent in hiding the

body, the less likely the remains will be discovered and the case investigated. On the other hand, a protracted effort to hide the body will increase "exposure" time (time involved in transporting the body and digging the grave) and increase the probability of the perpetrator being discovered while doing so.

Aside from the transference of physical evidence, depending on the option chosen at each step of the process, different types of contextual evidence will be produced and imprinted on the scene in a *sequential* way. Therefore, the sequential nature of the decision-making and inhumation processes translates into a layered ordination of the contextual evidence, similar to the deposition of geological and archaeological materials at larger time scales, so that the relevant contextual information can only be retrieved through a similarly ordered and sequential process. Classical scene processing methodologies, however, focus almost exclusively on the *amount* of physical evidence present at the scene (which is believed to be primarily a function of the area, number of victims and physical objects, and cause and manner of death). This mindset results in scene recovery protocols in which the recovery of discrete and isolated types of evidence (fingerprints, body parts, blood stains, etc) is tantamount. This approach, however, does not take into account the order in which that evidence was deposited on the scene. For example, parameters related to the shape of the grave or the shape and number of tools employed in its digging will be altered or completely destroyed if not identified at the moment when they are revealed in the recovery process. The same applies to relative position of items of evidence in different stratigraphic layers. Therefore, the advantage gained from the larger amount of information imprinted on the scene by more complex efforts to hide the evidence on the side of the perpetrator will be lost if stratigraphic and archaeological principles are not applied during the processing of the shallow grave.

This presentation will show that processing a clandestine grave following this approach will result in the destruction of contextual evidence, as this type of evidence can only be accessed and registered sequentially. Consequently, scene processing must be planned with consideration of this multi-layered structure of the evidence, and ultimately, can only be properly processed by employing contemporary archaeological methods.

Shallow Grave, Recovery Methods, Trade-Offs

H47 How to Look a Gift Corpse in the Mouth: Season at Death Determined by Cementum Increment Analysis

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After attending this presentation, attendees will learn how dental cementum increment analysis can help forensic anthropologists narrow their estimates of postmortem interval.

This presentation will impact the forensic community and/or humanity by helping forensic anthropologists using this technique to be able to better assist law enforcement in determining time since death.

Forensic anthropologists are often called upon to estimate time since death in the analyses of decomposing and skeletonized human remains. Estimates are based on the overall condition of the remains, the presence of insect activity, and the decomposition microenvironment. Postmortem interval estimates are usually expressed as broad ranges of months or years, especially when forensic anthropologists are not present at the time of recovery. Dental cementum increment analysis could help us make much more specific determinations.

Dental cementum anchors teeth into their sockets via the periodontal ligament. Increments are identified in the cementum deposits on the roots of human teeth, and under microscopic examination appear as alternating dark and light bands, analogous to tree rings. Research with comparative samples of known-age and known date-of-death individuals has demonstrated a consistent relationship between annual seasons and the formation of distinct increment types. In general, the winter or arrested cementum increment appears as an opaque band while the summer or growth increment appears as a translucent band. Together these represent one year of an individual's life, providing an annual record of that person's life history. The total number of increments provides a means of determining the individual's age at death (Wittwer-Backofen 2004).

Zooarchaeologists have long used dental cementum increment analysis to estimate season at death in mammals (Pike-Tay 1991; Lubinski and O'Brien 2001), yet the authors are aware of no study to date that has tested this method in humans. The current project seeks to identify the timing of increment formation in humans and thus provide a means by which season-of-death could be determined in forensic cases. Once the transition periods are identified, they can be correlated to seasons of the year.

A pilot study for which extracted teeth were donated by the patients of Santa Cruz oral surgeon Dr. Erick Eklund was conducted. Each tooth was cleaned and embedded in Buehler Epoxide. Embedded teeth were sectioned to a thickness of 400 microns, mounted to glass slides, and ground and polished. The polished sections were viewed under 125X magnification and transmitted polarized light using an Olympus BX40 light microscope. Digital photographs were taken using a Nikon D70 SLR camera mounted directly to the microscope. Once the outer (nascent) band was identified, the widths of like bands were measured and averaged in Adobe Photoshop. The thickness of the outer band was divided by this average thickness to determine the percent growth. For example, if the outer band was translucent, its width was divided by the average thickness of the other translucent bands present in the section.

An outer increment 75-100% complete marked the end of the growth cycle. An increment 50-75% complete indicated growth three-quarters completed, 25-50% complete half completed, and 0-25% just beginning. The pilot study results indicate that dental increments are visible on cross sections of human teeth, and they appear to vacillate between opaque and translucent in regular cycles. Preliminary data suggest that the transition between the growth (translucent) and dormant (opaque) seasons occurs between August and October. Teeth extracted during these months have nearly complete outer translucent increments. Teeth extracted between November and January has newly visible opaque outer increments. It appears that the translucent increment is completely formed by late September or early October, with the opaque increment beginning to form immediately following and visible under magnification by the second week of October.

Dental cementum increment analysis for estimations of season at death shows great potential for use in forensic anthropology. Teeth are very durable and are commonly recovered, even at death scenes where bone tissue quality is poor, advanced mummification or fragmentation is present, or cremation has occurred. As such, one full calendar year's worth of samples needs to be examined, and the sample size needs to be expanded. At present, the method appears most effective in middle to older aged adults, as the increments are more clearly identified than in adolescents and early adulthood when some of the dentition has only recently erupted.

Postmortem Interval, Dental Cementum, Season at Death

H48 Anthropological Saw Mark Analysis on Bone: What is the Potential of Dismemberment Interpretation?

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After attending this presentation, attendees will gain a better understanding of the utility of saw mark analysis on bone, and the five features that can be used to correctly identify the class of tool used in dismemberment.

This presentation will impact the forensic community and/or humanity by enhancing the utility of saw mark analysis, and purposes a standard methodology for the recognition of saw mark features and characteristics in bone.

Tool mark analysis is a highly specialized area of forensic science with new techniques for the refinement of weapon analysis and comparison. Despite recent advancements, saw mark analyses have received little research attention and currently have few standards for analysis. Regardless of the lack of standardization and *Daubert* criteria, forensic practitioners, including anthropologists and pathologists, continue to conduct saw and knife mark analysis and testify on the results. The high number of these "unusual" cases and the investigative and judiciary benefit of the testimony, coupled with the lack of a standard methodology, demonstrate a growing need in the forensic community.

Even though a majority of this research was done over a decade ago by the first author (Symes 1992), forensic anthropological tool mark analysis appears stagnant, while at the same time, criminalists seldom work with saw marks in human bone. Even more alarming is the continued lack of communication between criminalists and anthropologists, despite the fact that each is attempting tool mark analyses with similar goals in mind.

The authors propose a tool mark recognition system that approaches analysis of cut marks from five recognizable class features. Within these class features, there are multiple characteristics, ranging from simple to complex. This presentation will illustrate the utility of how even the simplest characteristics of a saw mark can contribute to systematically narrowing the potential class of tool used in a criminal act. By examining saw mark trauma for each of these recognizable class features, it is possible to detect many of these characteristics without extensive training and sophisticated equipment. The recognizable class features presented by this research include:

1. Saw Cut Direction—After documentation and retrieval of all contextual evidence, bones can be examined for saw kerfs, useful in determining orientation and direction of cut. This information is dependent upon an understanding of osteology and saw cut action. Direction of saw progress is indicated by false starts and entrance cuts progressing to break away spurs and notches. Direction of power stroke is essentially parallel to wall striations with exit chipping occurring in the power direction.

2. Saw Power—Since mechanically powered saws cut with more force and speed, their blades are manufactured to withstand more pressures (unless the blade is supported in a frame like a band saw, or the blade has little movement like a cast/autopsy saw). The simple fact that power saws generally have wider blades means that a simple measurement of minimum kerf width quickly seriates the saw class potentially used. If you add the features of energy expression and polish, differences between hands versus mechanical saws are recognizable.

3. Saw Design (Shape)—Saws are generally classified into rip versus crosscut. This simply indicates whether a saw has filed teeth or not. Because filed teeth essentially taper more to a point than non-filed teeth, filed teeth form a 'W' shaped kerf floor as opposed to non-filed teeth that form a flat, squared-off floor. Curved versus straight blades also fit into this category.

4. Saw Tooth Size—Erratic sawing behavior can leave solid evidence behind. If a saw is stopped in mid-stroke and removed, measurable features may exist. Close examination with low powered magnification may indicate tooth imprints on kerf floors, pull out striae may indicate the saw tooth frequency, or simply the introduction of succeeding teeth to a cutting stroke may create a wavy striation that indicates distance between teeth. Each of these features provides the potential for a measurement between teeth that can result in Teeth per Inch (TPI) assessments.

5. Saw Tooth Set—Saws designed to cut hard materials usually have tooth set. Set is simply lateral bending to the teeth so that the combination of bent teeth creates kerfs wider than the actual blade cutting the bone. Tooth set is usually in the form of alternating, but can be a wavy or raker set. Tooth set influences blade drift. Where raker set doesn't appear to let the blade drift, alternating set does put the blade in motion with the introduction of every tooth, and this motion is predictable and measurable. Wavy set is like alternating, but on a larger scale.

This research attempts to confront existing misconceptions, communication gaps, relieve anthropologist 'microscope anxiety,' and ignore individual characteristics mindset (as opposed to class characteristics), while giving a hierarchy of recognizable characteristics among cut mark features, many of which can be scored without expensive equipment or SEM confusion. Finally, it is important to realize that every aspect of the proposed research will communicate the potential of highly ignored types of evidence found in every case of dismemberment and mutilation—tool marks in bone.

Saw Marks, Bone, Class Characteristics

H49 Working With Family Members of Decedents: A Discussion of Techniques for Forensic Scientists

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This session features short presentations and a discussion by forensic scientists who have worked with family members of decedents in a range of events and a variety of ways. The goal of these presentations is to elucidate techniques to help forensic scientists interact more effectively with family members. The areas of disasters, human rights, body donation, and the medical examiner office are represented on the panel.

This presentation will impact the forensic community and/or humanity by demonstrating how forensic scientists possess important information for the family of the murdered, missing, or killed. Sharing this information allows families to understand the circumstances of death and may help them move through the grief process. The techniques used by forensic scientist to provide this information to family members are important in the humanitarian efforts of the field.

For the family and friends of the murdered, missing, or killed, an important measure of dignity afforded them is the professionalism employed by forensic scientists when analyzing and identifying the remains of the deceased. Despite differences in the process of grief throughout the world, families typically want information about the death of the deceased. Obtaining information about the circumstances of death (whether through intentional violence, natural disaster, accident, or suicide) helps family members move through the grief process, despite the fact that the particulars of the death may be difficult to hear. When families seek out this information, they often turn to forensic scientists, whose knowledge, experience, and work product become the sources for answers to their questions.

This session features short presentations and a discussion by forensic scientists who have worked with family members of decedents in a range of events and a variety of ways. The presenters will elucidate techniques to help forensic scientists interact more effectively with family members. The areas of disasters, human rights, body donation, and the medical examiner office are represented on the panel.

Interacting with family members of the deceased presents the forensic scientist a challenge. Forensic scientists engage with family members in a variety of situations, from individual cases to group settings, in person and via email or telephone, but most have little or no training in working with the bereaved, despite knowing that forensic information is vital for family members. Families expect compassion, directness, and honesty from forensic scientists. However, forensic scientists may not be able to reveal all aspects of their analysis for legal reasons. The counterpoise to family needs is the sometime conflicting demands of science. Data collection, sampling, and storage ensure that scientific methods are created and refined. Forensic scientists are often the lone representatives of science to families, and they must reflect the importance of science and the nature the remains play in the scientific process.

The Aviation Disaster Family Assistance Act of 1996 tasks the National Transportation Safety Board (NTSB) with managing family needs following aviation disasters. To provide this support, the NTSB establishes and manages a multi-agency family assistance center. Among other types of information, the center provides updates about the search for and recovery of remains and the identification process. Families who visit the accident site often have questions of a forensic nature. After departing the center, NTSB staff members keep families updated as the investigation proceeds, and often answer forensic questions that were not asked at the center. Their desire for information may often extend for months or years following the accident. Family concerns encompass questions of suffering of the deceased just prior to their death, information related to condition of remains, and methods used to identify remains.

The experience of the body donation program at the University of Tennessee Forensic Anthropology Center (FAC) reveals that families want their experience to benefit others who may go through similar experiences in the future. Body donations originate by self-donation, family donation or, as in Tennessee, as unclaimed remains donated by the state medical examiner. For FAC staff, interaction with the family is very important. When a person donates their own body as an expressed desire, the next of kin must agree to the donation, or the donation will not occur. Because donation to the FAC is different than traditional anatomical school donations, families may not understand the process of donation and what happens to the remains. Many are concerned about what remains, if any, will be returned to them. FAC staff realize that once families understand the process and grasp the importance of the science that will result from the donation, the donation takes on greater meaning, and families become more comfortable with the process.

The primary function of medical examiners is to document the condition of remains and the presence of illness and injuries. Sometimes overlooked is the importance of providing family members with information to understand the circumstances of death. Based on the experience of one medical examiner's office, several actions appear to be appreciated by families. These actions, sometimes overlooked by medical examiners, include initiating contact with the family, facilitating access to other appropriate services and agencies, and making provisions for adequate viewing and/or meeting facilities.

At the World Trade Center disaster, family members relied on anthropologists for clear and honest descriptions of the remains recovered. The questions from family members extended beyond description of remains to include explaining decomposition, fragmentation, and the process of preserving remains, of which the anthropologists were a part. Anthropologists went beyond their expertise in analyzing human remains to help family members understand the forces involved in the disaster and why the decedent was not completely recovered.

The Argentine Forensic Anthropology Team (EAAF) supports improved direct contact between families of victims and forensic teams. EAAF believes that forensic scientists should assist victims' families in gaining access to investigative sites. Families are provided basic information before, during, and after forensic examinations, and the potential outcomes of a mission are explained to them. EAAF anthropologists address families' concerns, doubts, questions, and objections and they promote tools to provide families with the results of forensic investigations (following international recommendations and forensic protocols.) EAAF also supports respect for cultural differences in religious and funeral rites, with the goal of assisting families with dealing with grief. The group believes that failure to consider these issues may lead to a secondary assault for family members—that forensic scientists may cause additional suffering to those they are assisting. Cultural and religious practices of death and reburial should be respected during the investigation.

The experience of the Joint POW/MIA Accounting Command/Central Identification Laboratory with family members is unique. The visibility and political nature of the POW/MIA issue in the United States complicates their interactions with families.

Family Members, Death Information, Grief Process

H50 Anthropologist Directed Triage Teams From Three Distinct Mass Fatality Events Involving Human Fragmentation

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After attending this presentation the attendee will learn the various functions that can be performed by anthropologist directed triage teams at mass fatality events involving human fragmentation.

Due to the increasing number of incidents involving human fragmentation, this presentation will impact the forensic community and/or humanity by helping the forensic community learn about the skills and contributions of forensic anthropologists during these types of events.

This presentation will describe the process of triage as the first stage in identifying fragmented human remains from mass fatality incidents. Specifically, it will discuss the role of forensic anthropologist directed triage teams in three distinct mass disaster events.

Triage is defined by the Oxford English Dictionary as, "the actions of sorting according to quality" "to pick or cull" and, "… the assignment of degrees of urgency…in order to decide the order or suitability of treatment…" It was commonly used in the early 1700's when describing the sorting of wool in degrees of fineness and quality. Triage has also been used in the military to describe the sorting of injured in accordance to the seriousness of their injuries, to ensure that the most critical are medically treated first.

In mass disasters, the first stage in the identification of human remains is often the triage station. Traditionally, an anthropologist or pathologist, depending on the disaster type and the condition of the remains, directs triage. This paper will discuss anthropologist-directed triage stations in three very different mass fatality scenarios, involving significant variation

in the number of human remains as well as their condition and degree of fragmentation. Significantly, the process of recovery was also quite different in all three incidents, which affected the composition and duties of the triage teams. The World Trade Center disaster, with 2749 victims, involved nearly 20,000 fragments of human remains, recovered predominantly by fire personnel, over a period of eight months. The crash of American Airlines Flight 587, with 256 victims, involved just over 2000 fragments of human remains, recovered within a few days by police personnel, with the assistance of the medical examiner's staff. Finally, the Staten Island Ferry crash will be discussed, with 10 victims, involving the recovery of approximately 35 fragments of human remains. These were recovered within a few hours, again with the assistance of the medical examiner's staff. In each of the three disasters mentioned above, the human remains had first been collected at the scene of the disaster and later transported to the Office of Chief Medical Examiner for processing and identification.

Upon reaching the Medical Examiner's office the remains were examined at the Triage Station, which was directed by a forensic anthropologist. This was an important first step in the lengthy process of identification. The triage team was empowered to sort human from non-human remains, separate out commingled remains and multiple remains in one recovery bag, as well as to re-articulate or re-associate disparate pieces within a body bag. This team also labeled anatomical elements and recorded recovery locations, which were later documented at the medical examiner's table. Importantly, the differential manifestation of fragmentation in each of these incidents dictated that the anthropologist's role at triage be tailored to that incident.

In addition to detailing the differences and similarities between the role of triage at these three distinct mass disaster events, this paper will present lessons learned, including proposals for actions to be undertaken by anthropologists at triage stations, depending on the type of disaster.

Triage, Commingling, Human Fragmentation

H51 The Accuracy of Ante-Mortem Data and Presumptive Identification: Appropriate Procedures, Applications and Ethics

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After attending this presentation, attendees will have gained an awareness of ante-mortem data collection procedures in mass fatality situations, mass disasters, and mass disappearances relating to violations of human rights. Methods for tailoring the ante-mortem data questionnaire to individual circumstances will be discussed. The presentation will emphasize transparency and the need to provide a realistic understanding of expected identification outcomes to both relatives of the missing and other concerned parties.

This presentation will impact the forensic community and/or humanity by increasing awareness of problems with presumptive identification, particularly in relation to mass disasters, mass fatality incidents, and mass disappearances related to human rights violations. It is hoped that after attending the presentation, participants will be able to make more informed and ethical choices regarding both employing standardized methods of presumptive identification and presenting identifications to victims' families in a transparent manner.

Increasingly during the last ten years, forensic anthropologists have been members of teams of forensic scientists working to identify victims of mass disasters, mass fatality incidents, and mass violations of human rights. Traditional forms of ante-mortem data (including the individual's biological profile as well as details of their clothing and personal effects) have been considered useful in the identification process. Presumptive identification is not usually conducted in a particularly systematic manner. Codifying the procedure for matching ante-mortem and postmortem data has rarely been attempted and "identifying" an individual via this method, particularly in post-conflict situations, has seldom come under close scrutiny. It is even rarer that quality assurance procedures are employed to assess the outcomes and provide feedback as to the advisability of the process. Yet, presumptive identification for repatriation of remains has been utilized extensively as "identification" in post-conflict situations throughout Latin America, in the Balkans, and in East Timor (e.g., Gruspier 2001).

Recently however, significant questions have arisen concerning reliance on traditional antemortem data for identification and the advisability of conducting presumptive identification at all. Figures for regions from the former Yugoslavia, including Kosovo, obtained by the International Commission on Missing Persons (ICMP) indicate that 30-38% of those individuals exhumed by various agencies, or government authorities involved in the exhumation and identification of victims from the conflicts between 1992 and 1999 have proved incorrect subsequent to comparative analysis with the DNA of purported relatives. These presumptive identifications were often based on clothing identifications made by families supplemented by consistent postmortem observations. The DNA-based system of identification, fully implemented by ICMP at the end of 2001 provides exclusion reports and prevents misidentifications based on 'presumptive' markers. Prior to this system, bodies exhumed in the former Yugoslavia were identified using presumptive markers and returned to authorities and families for burial. As is now known, a significant proportion of these may have been misidentified which presents a technical problem and an ethical dilemma to those involved with identification procedures, both then and now.

In 2000, the Organization for Security and Cooperation in Europe (OSCE) began an undertaking to presumptively identify those individuals in Kosovo exhumed by the International Criminal Tribunal for the Former Yugoslavia (ICTY) via a standardized and systematic approach of weighting variables and assigning agreement scores. This system operated in parallel with ICTY's data on presumptive identifications attested to by surviving relatives. It is unfortunate that, given the high failure rate of presumptive identification in regions of the former Yugoslavia as shown by the DNA, data are unavailable concerning which presumptive method was used to identify the victims in both the correctly and incorrectly identified cases. It would be important to know if a more standardized means of comparison improved the correct identification rate. If not, then the usefulness of conducting *any* presumptive identification might well be questioned.

Without universally applicable antemortem and postmortem databases (designed to allow the inclusion or exclusion of relevant and available data) and a rigorous and standardized system of comparison, presumptive identification should be approached with caution. If presumptive identification is to be employed, then all the stakeholders need to aware of the potential for misidentification. It is imperative that the use of the word "identification" be qualified when identification is not done through accepted means of *positive* identification.

Presumptive Identification, Ante-Mortem Data, Ethics

H52 Anthropological Aspect of Mass Disasters

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After attending this presentation, attendees will learn the usefulness of forensic anthropology in the context of a mass disaster. The role of anthropologists varies from one mass disaster to another. Three examples will illustrate the subject.

This presentation will impact the forensic community and/or humanity by facilitating the discussion of the anthropological aspects of three examples which confronts the experiences of other specialists in the field.

Forensic anthropology can make a vast difference in providing important information for describing the biological profile of victims by determining age, sex, ancestry, and height. Nevertheless, the usefulness of this discipline depends on the kind of disaster. An accident concerning a well known group of non-decomposed airplane passengers requires a different approach with respect to a traffic accident with no list of victims. The authors therefore illustrate three concrete and very different mass disaster situations: the tsunami incident of December 2004 (Phuket, Thailand), a tunnel traffic accident (Mont-Blanc, France, 1999), and an airplane crash (Linate, Italy, 2001).

During the tsunami event of December 2004 in south-east Asia, about 270 000 people were killed. Approximately 5400 people died in Thailand with an equal number of Thai and foreign victims. Within a few days, all of the countries who had citizens listed as possible victims sent disaster victim identification (DVI) teams. Recovery of the bodies and separation between presumed Thai and foreigner bodies was organized by the Thai authorities. Each body was put in a separate container (containers for foreigners and containers for Thai people). This selection was possible and relevant for the first two or three days, but soon became almost impossible because of decomposition, even though body recovery went on for days. Thus, it was clear that containers marked "foreigners" contained Thai people, and containers marked "Thai" contained foreigners. During the first month no global protocols were used by all the teams in the field (fingerprint, pathology, anthropology, odontology, DNA sampling). After the opening of Site 2, a global approach was applied with standardised protocols inspired by Interpol procedures. The first two months, the DVI teams were supposed to collect postmortem data on foreigners only, so Thai authorities allowed access only to the containers marked "foreigners". In this context, the quality control team decided not to estimate the anthropological features, though the Interpol protocol entails it, in order to avoid wrongly excluding individuals. Two other reasons were the small number of skeletonized bodies and the lack of forensic anthropologists on the site. Most of the bodies were decomposed but not skeletonized, so anthropological features could not be used without sampling, which brings up questions of conservation, preparation, and restitution of the samples. Positive identification was to be performed with DNA, odontological data or fingerprints.

In the case of the Linate mass disaster, with 118 victims, it was clear from the ante-mortem data available that most carbonized victims would be identified by odontological or genetic methods. However the applied protocol took into account the possible application of anthropological methods. Therefore sampling of pubic symphysis, fourth ribs, and monoradicular teeth was performed. Aging turned out to be useful in quick exclusion of possible decedents and in creating possible ante-mortem and postmortem matches to be confirmed by dental and DNA methods.

In the case of the Mont-Blanc mass disaster, 39 victims died in the tunnel. Because of the effects of the intense heat, DNA analysis could not be performed. In this context, anthropological methods had an essential importance in the identification procedure.

Mass Disaster, Anthropology, Identification

H53 Traumatic Modifications of Human Remains of Victims of Mass Disasters and Long-Term Abuse

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After attending this presentation, attendees will learn how conditions of preservation of decomposed bodies and skeletons of human victims of natural and man-made fatalities are compared with markers of long-term abuse, as with prisoners and kidnapped individuals held under harsh circumstances. Three forensic anthropological case histories are examined by this investigator in defining distinctive markers of trauma of victims of mass disasters and long-term physical abuse. Absence of skeletal and dental markers of tortured individuals may indicate non-invasive practices of interrogation.

This presentation will impact the forensic community and/or humanity by acquainting forensic anthropologists with military and civil law practices of interrogation of political and criminal prisoners, some methods revealing markers of abuse on bone tissues. These are more easily recognizable among inmates imprisoned after civil court sentencing than among prisoners under military jurisdiction, as at Guantanamo and Abu Ghraib where psychological stressors are inflicted with less involvement of the cranial and postcranial skeleton. The author's examination of the skeletal series of prisoners from a civil prison in a foreign country is described in order to alert forensic anthropologists to recognize markers of interrogation or punishment. Humanity benefits from this and related prison studies in questioning the ethical practice of physical and psychological torture.

How may forensic anthropologists distinguish traumatic modifications of human body parts resulting from mass disasters from skeletal evidence of long-term abuse, as among prisoners held under harsh conditions? Victims of suicide bombers, airplane and train crashes or of natural agencies (earthquakes, floods, mud-slides, fires, etc.) are often represented by fragmentary body parts, thereby making positive personal identification a challenge for forensic scientists associated with Disaster Mortuary Operational Response Teams, the Joint POW/MIA Accounting Command Central Identification Laboratory, and other recovery teams. However, for incarcerated individuals personal identity is usually known. The problem posed in this investigation is the determination of methods used by prison staff for interrogation, punishment, neglect, or withholding of medical treatment. Markers of these traumatic conditions may be documented as skeletal evidence of abuse.

Stress markers are not uncommon on skeletal remains of prisoners who were incarcerated by civil law. The author has investigated a series of skeletons of twentieth century prisoners, all males, from prisons in a Eurasian nation. Trauma is frequently encountered in cases of unset fractures of long bones inflicted by wooden or metal rods (fellow prisoners would not have the skill to reset bones), facial damage resulting in loss of anterior teeth, and injuries of the cranial vault. In cases where dental reconstruction was attempted (following traumatic force to the face), the crudest and cheapest materials were used. Medical records are not available for this prison series, but sex, age and time of death, pathological conditions, and estimates of time passed since the infliction of injuries can be assessed.

Illustrations of skeletal modifications induced in this series of civil law prisoners who were victims of abuse in order that forensic anthropologists may more clearly recognize bone modifications under stressful penal conditions, features less often encountered in victims of mass fatalities or in psychological methods of interrogations, will be presented.

Forensic Anthropology, Mass Fatalities, Prisoners

H54 Anthropology Responds to Hurricane Katrina

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After attending this presentation, attendees will learn about the unique challenges of victim identification presented by Hurricane Katrina and the subsequent failure of the levies surrounding New Orleans.

This presentation will impact the forensic community and/or humanity by conducting a review of the forensic response to the Hurricane Katrina disaster and offering a positive after-action critique of the way in which several new challenges were met. The forensic effort following Hurricane Katrina serves as a way-point in further developing an efficient model for victim identification following a major natural or man-made disaster.

When Hurricane Katrina slammed into the coastal towns in Louisiana, Mississippi, and Alabama, and breached the levies surrounding New Orleans, it created some extraordinary obstacles for the disaster aid workers responsible for recovering and identifying the victims. Among the many challenges were a recovery effort that spanned a broad geographic area; poor preservation of the bodies from prolonged exposure in a warm, wet environment; and contamination of the bodies by water-borne bacteria, chemicals and toxins. The storm surge also damaged coastal cemeteries and mausoleums, resulting in previously interred and entombed bodies being scattered among the debris. Two other unique factors posed significant problems for victim identification. The evacuation of hundreds of thousands of people who lived in the path of the approaching storm – as well as evacuations during the aftermath – hampered the ability of federal personnel to set up a single, physical location to serve as a family assistance center where antemortem data could be collected to facilitate identification. Additionally, the loss of antemortem medical and dental records destroyed by winds and flooding, combined with the relatively low socio-economic status of many of the victims, made acquisition of the required medical and dental information difficult, and in some cases, impossible. The widespread flooding and subsequent loss of housing also prevents collection of nuclear DNA exemplars from the homes of victims, resulting in decreased effectiveness of the best identification tool.

Hurricanes Katrina marked the first time that the Disaster Mortuary Operational Response Team (DMORT) deployed two Disaster Portable Morgue Units (DPMUs) to one event. Having both morgues operational required an extraordinary effort to insure adequate numbers of qualified personnel, supplies and provisioning, physical plant, and the many other considerations that make such a response successful. The subsequent passing of Hurricane Rita forced a shutdown of all disaster victim identification efforts for several days, creating a severe test for those involved in logistics and planning.

In this presentation, the authors hope to address many of these issues and provide several different perspectives on the response by DMORT members and others in the forensic community, as well as answer questions by attendees.

Mass Disaster, Hurricane Katrina, Forensic Science

H55 To Measure or Not to Measure: An Analysis of Maximum Length of the Tibia

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The goal of this presentation is to inform the reader of the history of metric analyses of the tibia and present the possible adjustments necessary dependent upon the metric technique applied.

This presentation will impact the forensic community and/or humanity by presenting correction factors necessary for alternate methods of metric analysis for the maximum length measure of the tibia for stature estimation.

The goal of this presentation is to inform the reader of the history of metric analyses of the tibia and the implication of these estimates on stature. The attendee will learn the possible adjustments to be applied, dependent upon the metric technique utilized.

Techniques of metric analysis for post cranial human remains have been developed in physical anthropology to quantify the morphological features of these elements. However, in recent years some of these methods have been modified and re-formulated to suit the changing direction of morphological analysis or in the case where the original definitions have been forgotten, lost, or misinterpreted. This presentation offers a re-evaluation of the maximum length measure of the tibia including and excluding the intercondylar eminences, and tests the accuracy and validity of these metric methods experimentally across population, age, and sex.

Trotter and Gleser (1952) analyzed the remains of WWII war dead and a sample from the Terry Collection, in order to develop living stature estimation formulae. These authors later (1958) re-evaluated their stature assessment by including a sample of Korean War casualties. Upon re-examination of Trotter and Gleser's original sample data by Jantz et al. (1994) it was discovered that, contrary to Trotter's own definition, her maximum length measurements of the tibia for the WWII and Terry collection excluded the malleolus from assessment. Measurements of the Korean War casualties were also unusually shorter than expected, however those measurements were taken by technicians utilizing Trotter's definitions and the original human remains were not available for re-analysis by Jantz et al.

Other authors, such as McHenry's (1974:330) analysis of stature in Australopithecines, describe the maximum or "total length" measurement for the tibia as the maximum distance between the "most proximal and most distal points" on the tibia. This definition leads the reader to believe that the intercondylar eminences are to be included by McHenry's description of the measurement, as these eminences are truly the tibia's "most proximal point."

This presentation explores three main points: (1) Why were intercondylar eminences originally excluded from the maximum length measurement of the tibia? (2) If these eminences do bias the maximum length measurement as age progresses, is this a universal effect or is it population or sex dependent? (3) If there are no significant differences produced by including the intercondylar eminences in the maximum tibia measurement by sex, age and ancestry, is there a common adjustment that can be applied for measurements including/excluding the intercondylar eminences to determine maximum length of the tibia?

Results show that the inclusion of the intercondylar eminences has no significant effect on age or sex estimates. However, the significant differences between the means of the two measurements (inclusion or exclusion of the intercondylar eminence) were noted when considering ancestry (Terry White N=94, Terry Black N=100, and South Dakota Arikara N=138 – all housed at the National Museum of Natural History, Smithsonian

Institution)($P < 0.0001$). Standard correction factors (sums of the differences) were calculated for each population and an overall correction factor was included in cases when ancestry is unknown.

	Terry White	Terry Black	Arikara	Overall
Correction Factor	3.27 mm	2.46 mm	1.86 mm	2.44 mm

Possible reasons for excluding the intercondylar eminences from maximum length analysis for the tibia include age-related arthritic changes or the high frequency of eminence fracture in archaeological and modern assemblages.

Tibia, Metric Analysis, Intercondylar Eminence

H56 Extensive Rat Modification of a Human Skeleton From Central Indiana

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After attending this presentation, attendees will be provided with a discussion of the pattern of rat modification on a nearly complete human skeleton with hypertrophic bone formation due to diffuse idiopathic skeletal hyperostosis (DISH).

This presentation will impact the forensic community and/or humanity by illustrating the ability of hypertrophic bone growths to withstand rodent modification due to the density of the bony growths. Future studies on the density of remodeled bone may provide insight into similar cases.

In September of 2004, partially skeletonized human remains with apparent degenerative joint disease were found on a couch inside an abandoned house. The presumed decedent had been missing since January of 2004. The remains were transported to the University of Indianapolis Archeology and Forensics Laboratory for processing and analysis. Initial examination revealed mold growth on the remains and clothing. Additionally, the individual was wearing several layers of clothing that contained rodent feces. The remains were simmered in a water, borax, and bleach solution for four to six hours and then air dried for 48 hours. The individual had already been positively identified from dental records; therefore, the analysis focused on three primary issues: making sure that only one individual was represented in the assemblage that all bones were consistent with those of the presumed decedent, and checking for any evidence of perimortem trauma. A full battery of measurements and analysis of morphological characteristics was conducted. The analysis determined that the remains were consistent with those of an African American male between the ages of 60 to 80 years. Stature could not be determined because all of the long bones had extensive rodent damage to the proximal and distal ends. No perimortem trauma was observed on the skeleton.

This individual exhibited bony abnormalities on the spine and os coxae. Osteophytic lipping was present on the vertebral bodies, and calcification of the anterior longitudinal ligament was observed on the right side of the lower cervical vertebrae, thoracic vertebra, and lumbar vertebrae. Osteophytes with a 'candle wax' appearance connected several vertebral bodies; however, there was no fusion between the elements. Enthesopathies were present on the ischial tuberosities and iliac crests. There was also extensive calcification of the costal cartilage. However, the sacroiliac joint was not involved and the intervertebral spaces were maintained. This overall pattern of bone formation is consistent with DISH.

Extensive rodent modification was present on all skeletal elements, especially on the proximal and distal ends of the long bones and the vertebral bodies. Bony eminences and areas with only thin cortical bone were heavily modified, including the eye orbits, mandibular condyles, coracoid, and acromion processes. The 'pedestal phenomenon' (isolated arches of bone) was found on the ends of the long bones due to chewing and tunneling into the spongy bone in the rodents' attempt to retrieve trapped fats. Striae arranged in parallel bands or fan-shaped arrangements were found in many areas of the shafts of long bones. The narrow striae were consistent with the chisel-like incisors of the rat rather than those of larger rodents (such as squirrels), and the destructive pattern of tunneling is also more consistent with scavenging rather than with field rodents opportunistically chewing dried bones.

There was little modification to the hypertrophic, sclerotic bone growth associated with DISH. This phenomenon may be due to small rodent tooth size relative to the density of the osteophytes. Despite extensive rodent modification of much of the skeleton, important pathological indicators remained.

Rodent Modification, Diffuse Idiopathic Skeletal Hyperostosis, Taphonomy

H57 Mass Disasters and Non-Human Remains

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The goal of this presentation is to stress identification of non-human remains.

This presentation will impact the forensic community and/or humanity by demonstrating how identification of non-human remains can dramatically alter an investigation and why proper identification can save investigation time and expenses.

When disaster struck on 9-11 anthropologists from across the United States responded to lend their expertise. As in any disaster, large or small, anthropologists are often called upon to perform the same or similar tasks that they face in their own forensic setting at home. Often the importance of human verses non-human determination is underplayed in the mass disaster arena. During the 9-11 response 30% of the remains the first author examined in a three-day period were non-human and did not need further identification processing. The frequency and type of animal remains recovered or found in a mass disaster certainly depends on the setting. Airplane crashes in the ocean usually result in a variety of sea mammal remains; those in an urban setting often include processed domesticated animals, such as pig, cow, bird, sheep, or pets such as cats and dogs. This poster focuses on a problem in identification which is not stressed in the literature. In a review of bone specimens submitted over a ten-year period to Southern California Coroner offices in Los Angeles, Orange, Riverside, and San Bernardino counties, the authors of found the "pig knee" to be the most problematic. Variability in "pig knees" is shown using photographs and line drawings and comparisons are made with the adult human skeleton. Graphs are also presented to show the frequency of animal types from 9-11 and from a year (2004) at the Riverside County Sheriff-Coroner. While the fully cleaned "pig knee" or ham bone does not necessarily offer a challenge to the trained anthropologist, partially fleshed ham bones pulled from garbage cans by the neighborhood dog have proven to be the most often misidentified element by specialists with some degree of knowledge. In the cases presented the "pig knee" was misidentified as being human by emergency room doctors, chiropractors, radiologists, and an orthopedic surgeon.

Mass Disaster, Human/Non-Human Identification, Faunal Analysis

H58 Antemortem vs. Perimortem Infant Rib Fracture: The Histological Evidence

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After attending this presentation, attendees will understand healing (or chronic) infant rib fractures compared to acute (or perimortem) and the histological appearance of these fractures. This knowledge will better enable them to specifically identify these lesions in both fresh and dried specimens, i.e., at autopsy or in the field, respectively.

This presentation will impact the forensic community and/or humanity by demonstrating how the diagnosis of antemortem and perimortem rib fractures in infants and children has major significance to the forensic investigation. Being able to sequence these wounds enables the investigator the ability to provide a history of abuse which allows the pathologist discernment of the cause and manner of death and the investigator a time line to possibly place a perpetrator with a victim.

Even though malleable, infant ribs are vulnerable to fracture when the torso is impacted during abuse. Besides numeric, sequencing and mechano-functional interpretation, a temporal understanding of rib fractures is critical to the forensic investigation, especially in diagnosis of antemortem from perimortem breakage. Interpretation is more difficult than seemingly simple visual ascertainment of a fresh fracture versus callus formation. Decipherment of the antemortem insult becomes complex when the woven bone callus disintegrates under a later perimortem stress to reveal a macroscopic fresh break. How are such events interpreted and what effect may this have on the admissibility of evidence on a temporal assignment of antemortem fracture? For instance, a suspect is charged on a specific date with perimortem assault and the anthropologist may or may not be prevented from testimony that demonstrates a history of abuse. What can the anthropologist contribute to the interpretation of "time since trauma" when it comes to rib fractures? Sauer (1998) advanced the initial understanding of these phenomena by explaining precise criteria for diagnosis of these events. Can accuracy be achieved macroscopically or is histology a necessity to diagnose?

Six antemortem and perimortem fractured ribs from two abused infant victims and the distal humerus from one of them were transversely sectioned for light microscopy following the methods of Tersigni (2005). These wounds were inflicted four to eight weeks prior to death. All damaged bone was past the inflammatory and in the reparative phase of healing as defined by Martin *et al,* (1998). From the midline of the fracture callus posterior to the non-traumatized bone cortex, half of each rib was embedded in epoxy resin and sectioned using a Buehler Isomet 1000 with a diamond blade. The sections were glass slide mounted with Permount and reviewed using a Leica DMRX research light microscope at 15x, 50 xs, and 100x magnification. Digital images were taken using a Sony video uplink and captured using Image Pro Express 4.0. The anterior half of the rib was reviewed using SEM using a LEO 1525 Field Emission. This rib portion from the other side was examined to identify the extent of active bone remodeling following the segments anterior to the fracture.

Not surprisingly, under LM and SEM the fracture callus appears as a disorganized, amorphous mass of woven bone similar in many ways to a periosteal inflammatory response or the response involving cartilage. The latticework within the callus is poorly organized and minimally and marginally attached to the underlying periosteal surface of the rib through small bony spicules/projections. The callus structure functions specifically as an immobilizer for the compromised bone so that healing may take place at the fracture site. The resulting osseo-cartilagenous structure is congruent with the typical blastic events characteristic of the ossification processes of the hematoma. However, the quality of bone making up the callus proper is not the quality of uncompromised bone given the lack of true lamellar and Haversian organization. In the heart of the callus there is evidence of a specific endosteal/ medullary callus forming between the originally severed ends.

In the non-traumatized bone adjacent to the fracture site there is a gradual level of involvement typical of the inflammatory tissue response of the periosteum. However, this may be difficult to decipher. The adjacent periosteal layer demonstrates a gradual thickening from the fracture site to normal thickness further away from the fracture. The cortical bone appearance within the fracture proper and immediately adjacent demonstrates remodeling given a higher rate of blastic activity. The SEM examination of the rib surfaces moving away from the callus reveals a three dimensional cone-shaped zone of healing that gets narrower as the examiner moves toward uncompromised bone along with a decrease in cortical thickness.

Given the time frame of one to two months post-trauma, all wounds examined were beyond the inflammatory phase and the reparative phase is active and near completion. In fact, within one month, Martin *et al's* (1998) inflammatory response, i.e., the reason for the callus and the reparative phase of callus formation has been achieved and is moving toward the remodeling phase. Here, diminution of the woven bone callus with new bone contoured and molded as the re-instated functional demands are placed on the structure is seen.

Like any newly formed woven bone, the quality of bone in the fracture callus is poor and unsuited to withstand subsequent rigors of compression trauma/loading. Therefore, it is not uncommon, in cases of episodic child abuse, to find seemingly fresh breaks contained within the antemortem callus since no remodeling of the original fractured parts are macroscopically visible until the bone initializes Martin *et al's* "remodeling phase." If the portions of the callus are lost at autopsy or during skeletal processing, care must be taken not to interpret a perimortem fracture site from an antemortem event

Histology, Child Abuse, Infant Bone Fractures

H59 Evaluation of the Relationship Between Fifth Metatarsal Length and Foot Length/ Shoe Size: A Possible Aid in Human Identification

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The goal of this presentation is to demonstrate new methods for assisting in the identification of human remains utilizing bones of the foot, specifically the length of the fifth metatarsal. This particular element is useful because it can be manually palpated and measured in test subjects, thus avoiding invasive procedures or ionizing radiation.

This presentation will impact the forensic community and/or humanity by demonstrating that the metatarsal bones of the foot, specifically the fifth metatarsal, can provide information useful to forensic anthropology research and casework, contributing information potentially useful for personal identification. This seemingly inconsequential bone has an unprecedented body of data to share and this study demonstrates the strong association between the length of the fifth metatarsal and weight-bearing foot length and also in the estimation of potential shoe size worn by an unidentified individual. In general, the findings of this study may prove useful as an additional resource when faced with the difficulty of attributing individual characteristics to unidentified isolated osteological material. The results also warrant consideration by the footwear industry with regard to the standardization of shoe sizes.

Significant data exists with regard to the information gleaned from the metatarsal bones. This has been well documented by a number of researchers, in particular with regard to the estimation of sex, stature, and race. However, there is potentially additional valuable information to be obtained from this unique collection of bones, which are easily identifiable and often survive due to there size and robusticity. This research explores the relationship between the length of the fifth metatarsal and overall length of the human foot. This data is of potential relevance to a multitude of disciplines including forensic podiatry and the footwear industry. In an effort to raise the issue of utilizing feet and footwear evidence to assist with the identification process, the research also considered the relationship between the fifth metatarsal size and an individual's correct (recommended) shoe size, as a possible unique supporting aid in the identification process. This could potentially provide supplemental information to well established techniques when more conventional means of anthropological identification, such as examination of skeletal anomalies or sinus configurations, are not possible.

This research was conducted with the intention of testing two alternative hypotheses: First, that a strong positive relationship exits between the length of the fifth metatarsal of the foot and the overall foot length and second, that a similar relationship also exists between the length of the fifth metatarsal of the foot and shoe size worn by test subjects.

Biological and metric data, including the fifth metatarsal length, foot length, weight, shoe size worn and correct shoe size, were collected from 120 British subjects (50 males and 70 females, of primarily European ancestry) with ages ranging from 18–94 years old. The fifth metatarsal length, defined as 'the measured distance between the most laterally-protruding aspect of the styloid process (approximating the proximal end), and the distal head of the bone', was measured to the nearest millimetre using digital sliding calipers. The individual extremities were located by manually palpating the lateral side of the foot. Foot length and 'correct' (best fit) shoe size were determined using a modified 'Brannock' device, with the subjects standing in a weight-bearing position. Interestingly, slightly more than half the subjects were found to be wearing an incorrect shoe size (i.e. 0.5 to 1 size too large), a result which was greater for women, due to factors such as personal choice and variation in manufacturing practices. Linear regression equations were constructed from the data using least squares formulae to determine the degree of relationship between the pairs of data. A blind test was subsequently undertaken using a small sub-sample of data collected independently, but consistent with the population from which the main sample of individuals were taken, to assess the reliability and accuracy of the calculated regression equations.

The construction of the linear regression equations revealed that the fifth metatarsal length displays a significant correlation with foot length (left foot: $r = 0.764$; right foot: $r = 0.778$, $p < 0.0005$). For the right foot, the calculated regression equation is $Y1 = 149.102 + 1.531 \times MT$ (where: Y1 = right foot length, MT = fifth metatarsal length; $r^2 = 0.605$). In addition, a significant relationship was shown to exist between the fifth metatarsal size and the determined correct shoe size, with strong positive correlations identified between left and right metatarsal lengths and 'correct' shoe size ($r = 0.741$ and 0.782, respectively; $p < 0.0005$). The calculated regression equation for right-foot shoe size is $Y2 = -5.344 + 0.188 \times MT$ (where: Y2 = correct shoe size, MT = fifth metatarsal length; $r^2 = 0.612$). The blind test results indicated that foot length can be predicted to within ± 7.3 mm of the actual values, within a 95% confidence interval, using known fifth metatarsal lengths of either side. The regression models correctly assigned 85% of individuals to within ±0.5 (one-half shoe size) of their correct shoe size and the remaining 15% correct to within ±1 whole shoe size. These small inaccuracies are consistent with the errors calculated in the subjects wearing the incorrect shoe size for their foot.

The results of this study demonstrate that the metatarsal bones of the foot, specifically the fifth metatarsal, can provide information useful to forensic anthropology research and casework. This seemingly inconsequential bone has an unprecedented body of data to share and has in this instance been shown to have a strong association to foot length and also in the estimation of potential shoe size worn by an unidentified individual. In general, the findings of this study may prove useful as an additional resource when faced with the difficulty of attributing individual characteristics to unidentified isolated osteological material. The results also warrant consideration by the footwear industry with regard to the standardization of shoe sizes.

Foot Length, Fifth Metatarsal Length, Shoe Size

H60 Nail or Bullet? A Comparison of Typical Cranial Gunshot Wounds to a Defect Resulting From a Nail Gun

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After attending this presentation, attendees will be able to distinguish between typical gunshot wound entrances and a defect resulting from a nail gun utilizing the morphology of the cranial defect and patterns of secondary fractures. This can assist investigators and anthropologists in assessing the type of projectile producing circular cranial vault defects in rare cases when the projectile is not recovered, contextual evidence is missing, or only skeletonized remains are present.

This presentation will impact the forensic community and/or humanity by presenting both the bony morphological characteristics for a nail and typical bullet wounds, aiding in the identification of the projectile used, and by elucidating factors contributing to the difference in mortality between contact wounds involving nails versus bullets.

The medical literature on nail guns revealed numerous construction site accidents but relatively few incidences of their use in suicides or homicides. The preponderance of on-the-job cranio-cerebral injuries occurred as a result of accidental discharge or ricochet; fatalities from these injuries were uncommon. The intentional use of a nail gun to commit suicide is rare. Based on published cases of cranial nail gun injuries, most wounds were survivable with prompt medical attention. Deaths resulting from accidental and suicidal nail gun wounds were typically prolonged and attributed to sequelae.

A male, who had committed suicide by shooting himself in the head with a nail gun, was drawn from the Maxwell Museum of Anthropology documented collection to illustrate the bony morphology of a nail entrance wound. This defect was directly compared to .22 caliber bullet entrance wounds in the crania of four individuals drawn from the Museum's various skeletal collections. This caliber was specifically chosen to ensure comparability, as .22 caliber bullets are nearly equal in diameter to the nail's head (1/4 inch) and are likely to produce defects similar in size to the nail gun wound.

An examination of the cranial defect in the suicide victim revealed an entrance wound located roughly 8 millimeters posterior to the coronal suture, just superior to the frontal angle of the right parietal and inferior to the temporal line. The nail removed a plug of bone as it entered the cranium, leaving a sharp-margined circular defect approximately 8 millimeters (1/3 inches) in diameter. Spalling produced irregular beveled edges internally, with a wider beveled area along the anterior and superior aspects. No exit wound or radiating fractures were present, and no secondary fractures of the orbital plates resulted.

The typical .22 caliber bullet entrance wounds were round or oval in shape, with sharp edges and internal bevelling. Uniform bevelling was typical for right angle gunshots, whereas irregular bevelling indicated oblique strikes. Orbital fractures were often present; these thin plates of bone were particularly susceptible to fracture because of the sudden increase in intracranial pressure produced when the bullet entered the cranium. Differences in gunshot wound morphology were noted between

short and long cartridges, as well as among various ranges of fire. With the exception of the orbital plates, short cartridges rarely produced secondary fractures in the cranium. In contrast, long cartridges usually produced orbital plate fractures as well as linear fractures of the cranial vault. These fractures resulted from temporary cavity formation and, in the case of contact wounds, the additional pressure produced by the expansion of gases entering the neurocranium. Distant .22 caliber gunshot wounds often lacked sufficient energy to produce exit defects, whereas contact wounds resulted in perforating injuries.

Although they share some similarities, the nail gun wound described is distinct from .22 caliber bullet wounds. Differences in the defect morphology and variation in secondary fracturing serve to distinguish between nail and bullet wounds. Perhaps more interesting is the dramatic difference in lethality recorded in the literature between contact gunshot and nail gun wounds, even when comparing roughly equivalent projectile diameters. Factors influencing the survivability of intracranial injuries following gunshot and nail gun contact wounds will be discussed.

Nail Gun, Penetrating Cranial Defect, Lethality

H61 Observations of Decomposition in Southern Coastal North Carolina

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The goal of this presentation is to allow attendees to gain information on decomposition rates and patterns during early spring in a southeastern coastal U.S. region. These findings can be used to more accurately assess the postmortem interval specifically in this type of geographical location.

This presentation will impact the forensic community and/or humanity by increasing knowledge of rates and patterns of decomposition in a southeastern U.S. subtropical microclimate allowing for more accurate assessments of time since death.

The authors hypothesized that in a coastal microclimate; there would be similarities in the overall pattern of decomposition, but differences with regard to rates of decomposition and entomological findings due to variations in temperature, humidity, and or rainfall when compared to other locales.

Inasmuch as pig carrion is an acceptable substitute for human cadavers, eight pigs ranging from 18-50 pounds were used in this study. For protection from possible scavenging, five of the pig carcasses were placed on the surface of the ground inside a chain link fenced area open at the top. Three pig carcasses were placed on the surface of the ground just outside the fenced area. All eight pigs were within ten feet of a saltwater marsh with no shade. The study lasted from March 28, 2005, when the pigs were initially laid out, until April 20, 2005, when full skeletonization was reached. During the course of the study, observations of decomposition, weather, temperature, humidity, wind speed, insect activity, and plant growth were recorded daily.

Patterns of decomposition—such as bloating, discoloration, skin slippage, and breakdown of tissues—were found to be similar to what would be expected in most other regions. However, it was interesting to note that in early spring, when the average temperature approached 70 degrees Fahrenheit with 55.37% humidity and significant rainfall, full skeletonization was attained in three weeks. Sun bleaching was evident on many of the bones. All three of the unprotected pig carcasses exposed on the surface were lost to scavenging, but not until much decomposition had already occurred. Details of insect activity on the five remaining pig carcasses will be discussed, along with features of peculiar and rapid plant growth. These findings, compared to findings from other similar studies, will also be discussed. Results of this study will provide descriptive data useful in assessing the postmortem interval in a southeastern coastal subtropical region.

Postmortem Interval, Decomposition, Forensic Entomology

H62 The Differential Diagnosis of Skullbase Osteomyelitis Secondary to Necrotizing Otitis Externa

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After attending this presentation, attendees will understand the importance of microscopic examination in the diagnosis of pathological conditions and the necessity of cooperative efforts in the resolution of cold cases.

This presentation will impact the forensic community and/or humanity by calling attention to the occurrence of skullbase osteomyelitis secondary to necrotizing otitis externa and illuminating the potential usefulness of a differential diagnosis in the evaluation of pathological conditions.

A case study in which the skeletal remains of a man recovered in 1963 were recently identified through the cooperative efforts of forensic specialists will be presented. Initially described as a woman in 1963, the remains were stored as evidence at the Fort Worth Police Department for 40 years. In 2004, the remains were turned over to the Tarrant County Medical Examiner's Anthropology Laboratory for reevaluation. Metric and non-metric evaluation indicated that the remains were those of a white male, age 33-45 years. A facial reconstruction was produced and recognized in a local newspaper by friends of the decedent. Identification was confirmed through mitochondrial DNA comparison with a maternal first cousin. No antemortem medical records were located. The decedent's military records had been destroyed in a fire in 1973.

Differential diagnosis began with gross and radiological evaluation of the skull. Multiple osteolytic lesions affecting the endocranial lamina and diploë of the cranium were noted. The lesions bilaterally affected the petrous bones, the sphenoid, and the frontal bone at the terminations of the middle meningeal arteries. Two lesions were removed from the cranium and retained for microscopic analysis before the remains were released to the family.

The lytic samples were embedded in epoxy resin and thin ground sections were prepared for microscopic examination. Microscopic examination revealed the presence of abnormal bone resorption due to osteoclastic hyperactivity and reactive new bone growth at the lytic foci. This resorptive and formative bone behavior is a diagnostic characteristic of skullbase osteomyelitis.

Skullbase osteomyelitis (SBO) secondary to necrotizing otitis externa, first described by Meltzer and Kelemen in 1959, is an inflammatory pyogenic infection affecting the temporal and sphenoid bones. It is an uncommon complication that arises from chronic ear infections. The infection begins in the soft tissues within the external auditory canal and extends into the retromandibular fossa through the Santorini fissure. The infection continues its extension into the parotid space and throughout the petrous apex and sphenoid. Pus is produced within the bone, causing abscesses. These abscesses deprive the bone of its blood supply, causing necrosis of the bone tissue. If left untreated, the progressive infection will continue its extension posteriorly and medially, resulting in cranial nerve palsy, sigmoid sinus thrombosis, intracranial extension, and death (Schultz, 2001). If prompt and aggressive antibiotic treatment is administered, the infection may be arrested. This particular individual shows progressive skullbase osteomyelitis, an anticipated finding in a case associated with the pre-antibiotic era.

This poster presents the differential diagnosis of skullbase osteomyelitis secondary to necrotizing otitis externa. Anecdotal information obtained from the family members supports this hypothesis as this individual suffered from chronic ear pain.

Osteomyelitis, Necrotizing Otitis Externa, Differential Diagnosis

H63 Sexual Dimorphism in the Vertebral Column

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The goal of this presentation is to demonstrate the extent of sexual variability existing throughout the vertebral column.

This presentation will impact the forensic community and/or humanity by demonstrating sexual dimorphism in the vertebral column and the usefulness of various vertebrae as sex indicators.

This poster will demonstrate the potential ability of the vertebral column to assist in sex estimation. Sex determination is a key characteristic in developing a biological profile of an individual. Sexual dimorphism has been demonstrated in various skeletal elements, including the pelvis and cranium. Previous studies have also demonstrated that elements of the axial skeleton are useful in determining sex. The atlas, axis, twelfth thoracic, first lumbar, and sacrum have all demonstrated usefulness as sex indicators. Since forensic and archaeological remains are often fragmentary, the ability to determine sex from as many skeletal elements as possible is important. The ability to determine sex from any specific vertebra would prove very useful.

A series of measurements were taken on a small sample of males and females from the William M. Bass Donated Collection at the University of Tennessee. This collection was utilized because it represents a sample of a modern population of known age, sex, and ancestry. Though studies have already demonstrated that the axis, atlas, twelfth thoracic, and first lumbar are sexually dimorphic, measurements from these vertebrae were included in this study in order to obtain a better picture of the variability of the entire vertebral column and to consider the variability of these vertebrae in a different population from the ones in which they were originally tested. Measurements used in this study were based on measurements defined by previous studies on vertebrae. Measurements taken on all vertebrae include the anterior-posterior length of the vertebral foramen (LVF), length and width of left superior and inferior facets (LSF, WSF, LIF, and WIF, respectively), maximum breadth between superior/inferior facets (SFB/IFB), maximum height from superior to inferior facets (MHF), maximum length of the vertebra from posterior point of spinous process to most anterior point of the vertebra (XSL). Width of the fovea (WFV) was taken on first cervical vertebrae and the maximum height and diameter of the dens (MHD/MWD) was taken on second cervical vertebrae. Measurements taken on all but the first two cervical vertebrae include the maximum sagittal and transverse length of the vertebral body (SLVB, TLVB) as well as the anterior and posterior heights of the vertebral body (MHVA, MHVP). All measurements were taken to the nearest millimeter using a Mitutoyo digital sliding caliper.

Preliminary analyses of results in this study indicate several features may exhibit sexual dimorphism throughout the vertebral column. The maximum length of the vertebrae appears to exhibit strong variability between the sexes, while the length of the vertebral foramen does not. The differences in the lengths and widths of the superior and inferior facets also suggest sexual dimorphism. Breadth between facets, height of superior to inferior facets, and dimensions of the vertebral body also appear to demonstrate differences between the sexes. Though differences are noted between the heights of the vertebral bodies of males and females, this pattern may be due more to age than to sex. These preliminary results suggest that sexual dimorphism exists throughout the vertebral column and that vertebrae can be used in estimating sex. Further investigation using a larger sample of individuals from the Bass Donated Collection will be conducted to determine the extent of sexual dimorphism in the vertebral column and the level of accuracy and reliability obtainable when using vertebrae to determine sex. This research could demonstrate that any vertebra can be used for estimating sex, possibly even if fragmented and/or specific vertebra number is unidentifiable, which could prove useful in forensic and archaeological situations, especially where skeletal material is fragmented or commingled.

Sex Determination, Vertebrae, Physical Anthropology

H64 Heat Intensity Versus Exposure Duration Part I: Macroscopic Influence on Burned Bone

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The goal of this presentation is to provide attendees with information regarding the impact of duration of exposure compared to intensity of heating upon bone.

This presentation will impact the forensic community and/or humanity by providing an understanding of the contribution and interaction of intensity of heating and duration of exposure to the state of burned remains.

Throughout the last several decades burned bone has received copious attention in the anthropological literature, as the focal point of numerous forensic and archaeological examinations. Specifically, investigations, both laboratory and replicative, have focused upon developing criteria for identifying and assessing the degree of heat alteration through classification of color variation. Research has also focused upon change in surface morphology towards determination of pre-incineration condition. In addition, examinations have sought to recognize the micromorphological impact of heating.

At the most basic level, the condition and appearance of burned bone is due to exposure to heat, specifically the combined factors of duration and the intensity of heating. As noted in the literature, these two variables undoubtedly have a profound impact upon the condition of the remains, color changes, and fracture patterns. Nonetheless, the degree to which these variables influence the modification or destruction of the organic component of bone has not been systematically assessed. To potentially illuminate this situation, and understand the contribution and interaction of the intensity of heating and the duration of exposure to the state of burned remains, bone was heated using two exposure scenarios. One model represents a residential structure fire in which temperatures grow gradually and reach a maximum of approximately 1000 degrees Fahrenheit (F). The second model mimics an automobile fire in which temperatures build rapidly, exceeding 1400 F after less than two minutes. These models provide an opportunity to compare the varied effects of duration and intensity of heating on specimens and the resultant impact upon bone.

Our sample (15 specimens in total) was divided into two groups to represent each of the scenarios. Samples were heated in an electric kiln. Thermocouple devices positioned inside the kiln continuously monitor temperatures which are then relayed to a laptop computer running DaqView 5.0. For each model, seven samples of fresh bone, complete with soft tissue, were loaded into the kiln, prior to heating. One specimen was retained as a control. For model one, temperatures were raised in increments of 150 degrees every 3 minutes, resulting in a maximum temperature of 1050 degrees F over an interval of 21 minutes. For model two, the temperature was raised in increments of 250 degrees every 2 minutes resulting in a maximum temperature of 1750 degrees F over a period of 14 minutes. Prior to each temperature increase interval, one specimen was removed for analysis.

All extracted specimens were evaluated macroscopically. Surface color was assessed using a photospectrometer. Resultant analysis showed the differing effects of the two variables, specifically their impacts upon surface colors and fracture patterns. Specimens from scenario one, a lower temperature, longer duration fire displayed a range of color changes and fracture patterning. Specimens from burn scenario two, characterized by a high intensity shorter duration fire experienced a rapid loss of the organic component generating warping and characteristic fracture patterns. The differences seen in surface color changes, as well as fracture patterns between the two scenarios offer criteria to the forensic anthropologist tasked with interpreting and examining burned remains.

Burned Bone, Heat Fractures, Fire Models

H65 Odd Man Out: Separation and Identification of Terrorist Remains in Suicidal Bombings

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After attending this presentation, attendees will be familiar with basic methods and techniques useful in separating commingled remains of terrorist in suicidal bombings. In addition the attendees will be provided information concerning injuries sustained by suicidal bombers in relationship to the type of explosive device detonated.

This presentation will impact the forensic community and/or humanity by assisting the forensic community in conducting investigations dealing with terrorist bombings and helping to determine remains which may be those of the bomber.

One of the biggest threats facing the world at large today is terrorism. In many countries such as Iraq, Afghanistan, Pakistan, and Israel there are constant attacks by terrorists on both military and local civilians. The attacks commonly employed are those committed by suicidal bombers, who strap themselves with explosives and detonate them in strategic areas of commerce or other areas where crowds coalesce. Detonation of these explosive devices has caused tremendous causalities in addition to destruction of property. The greatest perpetrators of these suicidal bombings are fanatical Islamic fundamentalists who believe that by killing themselves, they will become martyrs and will be richly rewarded in heaven.

Forensic examination of evidence recovered after a bombing includes the identification of fatalities including the bomber, and associated explosive injuries. In most cases there will be commingling of both the remains of the bomber as well as the innocent personnel. Separation of the bombers remains from those who were killed is important for two reasons. One it is important to identify the remains of the innocent by-standers and return them to their families to help provide some degree of closure. Secondly it is important to identify the remains of the bomber as they provide important clues as to the identity of the bomber, and the type of explosive device utilized.

In many bombing cases separation of the commingled remains requires forensic anthropological examination of the remains in order to determine the anatomical portions represented and the minimum number of individuals present. Once the minimum number of individuals is established the anthropologist can undertake developing a biological profile for each set of remains identified in reference to sex, age, and race. In addition to anthropological separation based on morphological characteristics, the anthropologist can collect tissues specimens for DNA analysis.

Anthropological separation of the bomber's remains can also be accomplished by identifying the personal characteristics of the bomber. Characteristics utilized in identifying middle-eastern bombers includes evidence of dark or olive skin tone, abundant body hair, dark head and body hair which is thick or coarse, presence of a beard, dry and worn feet (evidence of everyday sandal wear in a desert environment), absence of U.S. or European dental work, and the presence of embedded electrical components such as wires in various body portions. Although these traits are not necessarily exclusive they have been found to be extremely useful in separating those of Middle Eastern decent from Europeans. Age estimation can also be of use, as the great majority of suicide bombers encountered are between seventeen and thirty years of age.

Examination of injuries involving belt type explosive devices worn by the bombers leads one to expect to see separation of the body into two to four major portions (being the upper torso from above the lower rib cage in addition to one or both arms out to the elbows, and the inferior pelvic border which may be attached to one or both upper legs). The lower arms and lower legs tend to be separated from their respective torso area and may be also further separated from the hands at the wrist and feet at the ankle. Injuries involving larger explosives such as those carried in a large backpack or transported as a car bomb produce greater fragmentation of the body with upper limbs separated into the hands, the lower arms and wrist complex, the elbow complex, the upper arm and shoulder complex, the lower limbs separated into the feet, lower leg and ankle, middle femoral shaft, the left and right innominate and their respective proximal femur head and neck, the lumbar vertebrae column, the lower thoracic vertebral column and inferior rib cage, the upper thoracic vertebral column and upper rib cage, the cervical vertebrae column with a portion of the inferior base of the skull and mandible portions, and the upper cranium divided into four sections, the maxillary and temporal portions, the occipital bone, and the parietal portions.

The use of nuclear DNA extracted from soft tissues or bone can provide evidence of an unknown profile or "odd-man-out." Additional DNA studies, in particular mitochondrial profiling can be used to denote a possible suicide bomber based on sequence comparison to reported world databases indicating that an individual is likely of Middle–Eastern origin. Multiple case examples of suicide bombings will be presented, highlighting anthropological methods for sorting the human remains involved.

Anthropology, Bombs, Explosive Injuries

H66 Evidence vs. Identification: The Role of Humanitarian Organizations in the Balkans 1992-2002

Abbie K. Cuff, MSc, and Tal Simmons, PhD, University of Central Lancashire, Department of Forensic & Investigative Science, Preston, PR1 2HE, United Kingdom*

After attending this presentation, attendees will appreciate the need for a co-ordinated approach to victim identification and the determination of cause and manner of death in situations of mass violations of human rights, to prevent duplication of effort between organisations and re-traumatisation of victims' families.

This presentation will impact the forensic community and/or humanity by contributing to the ongoing discussions regarding the development of best practice methodology for dealing with 'missing person' and identification issues following a mass disaster (natural or man-made) or mass violation of human rights.

Following the ethnic cleansing and genocide in the Balkans in the 1990s, over 30,000 individuals were thought to be missing. There were many humanitarian organisations active in the region investigating these disappearances, each with a different mandate. There was ample scope for duplication of efforts if a coordinated approach was not taken to the issue of missing persons and the identification of recovered remains.

The humanitarian organisations performed a variety of roles, mainly exhumation, determination of cause and manner of death, victim identification, and psycho-social support. No one organisation had a complete portfolio of services at that time, and depending on their mandate, different emphasis was placed on the importance of identifying remains. It is

inferred that initially, identification was of secondary concern to evidence collection (Nowak, 1998). The artificial separation of responsibilities between organisations, specifically victim identification, and the determination of cause and manner of death created inefficiencies in the identification process. Postmortems had to be repeated, families re-interviewed and in some instances remains re-exhumed. This not only lengthened the process, but also re-traumatised families, as they had to go back over details for a second or even third time (Keough, *et al.,* 2004).

A cross-sectional survey (41% response rate) was carried out on individuals who worked for international humanitarian organisations in the region (ICTY, ICRC, PHR, ICMP, TPO, OSCE) to examine the interaction amongst organisations. The results showed that in a majority of cases the various entities cooperated and collaborated well together, however, it was clear that some organisations had territorial issues, an issue also discussed by Skinner & Sterenberg (2005) in their paper of turf wars, and this influenced working relationships both in the field and the laboratory, and in turn impacted the frequency and usefulness of information exchanged. The survey suggested that in the absence of formalised lines of communication and information flow, the information exchanged among organisations was on an ad-hoc basis with variable impact on the task of identification. The emergency intervention programme run in Kosovo by PHR with ICTY is an example of how organisations can collaborate to meet the needs of both the forensic experts and the families. PHR acted as family liaison between the ICTY's forensic teams and families (Keough *et al.,* 2004). The programme was successful because each entity had a defined role and they work closely together with each other and local organisations to achieve their aims.

Providing a complete portfolio of forensic and community services, managed by either one organisation or by a working group depending on the size of the project is the best approach to dealing with missing person and identification issues. If the situation does not allow for this then internationally agreed standards and protocols should be adopted to ensure there is no disconnect between organisations and to avoid duplication of effort.

The ICRC conference "The Missing" in 2003 began the task of bringing together experts to formally discuss missing person issues (ICRC, 2003). They ran a panel session on the collection, exhumation, and identification of human remains whose aim was to show the necessity of a standard framework of action. The participants came from both national and international organisations, many of whom had carried out work in the former Yugoslavia, Latin America, and Rwanda. One outcome of the session was a set of recommendations for a framework, incorporating the needs of all parties concerned – evidence, identification (anthropological and DNA) and psycho-social support. The framework would cover such things as terms of reference, resources, equipment, logistics, and legal considerations. Importance was also placed on the need for standard guidelines and protocols relating to exhumation, postmortem, and identification. Unfortunately, there is no information in the public domain concerning any further work resulting from these recommendations.

The recent tsunami in Southeast Asia and the mass graves in Iraq have raised the issue of managing large scale recovery and identification initiatives effectively and with due care given to the victims' relatives. Isn't it about time the forensic community became more proactive than reactive?

Identification, Organisational Dynamics, the Balkans

H67 Children's Traumas Caused During the Civil War in Guatemala

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After attending this presentation, attendees will learn about the different perimortem traumas in subadult skeletons.

This presentation will impact the forensic community and/or humanity by revealing to the international community the violations against children during the civil war in Guatemala.

During the civil war in Guatemala, children suffered in a cruel way the violation of their essential human rights. Their right to live was affected by arbitrary executions, death of the unborn, neonates, and death as a result of forced displacement and forced disappearance. The right to physical and psychological integrity was violated by acts of torture and sexual violation. Their right to individual liberty was affected through the illegal privation of liberty and forced servitude.

According to data registered by the Guatemalan Historical Clarification Commission (CEH) "18% of the total of violations to human rights (against victims of known age) was performed against children" (4,249 out of 23, 313). This means that at least one out of five victims is under age. Of the total of victims with known age, children comprise 20% of the people killed by arbitrary execution; 14% of victims of torture or otherwise cruel, inhumane, and denigrating treatment; 11% of victims of forced disappearance; 16% of the deprived of their liberty; and 27% of the sexually violated.

Even though these cold numbers and the horror of civil war in Guatemala are known, there still exists unresolved issues that are products of war such as: children separated from their families after witnessing acts of extreme cruelty against their loved ones; children found alive after massacres or confrontations; children lost during forced displacement or left in the custody of people or institutions; and children deprived of their fundamental human rights, including the right to have an identity, a name and to have a family free from illicit interference.

The forced movement of juveniles from their ethnic group to others, especially after massacres to indigenous communities, causes a loss of identity and affects the children's cultural rights. At the same time, it affects the collective rights of the ethnic group by impeding biological and cultural reproduction of the group.

During more than 13 years the Guatemalan Forensic Anthropological Foundation (FAFG) has performed more than 500 forensic anthropological investigations. In each one of them testimonies are collected and bone evidence that unveil the cruel violations of fundamental and specific human rights that children have suffered. In this report, the authors will show violations to human rights of children using specific cases as well as general data that FAFG obtained through forensic anthropological investigations.

Finally, it will be stated how, after the peace accords signature, the culture of violence borne of the civil war, still affects this most vulnerable group of children.

Children, Massacre, Trauma

H68 Burial Patterns of Korean War Casualties as an Indicator of the Social Relationships Between the Dead and the Living

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The goal of this presentation is to present two case studies of battlefield casualty burial pattern as examples of the social relationship between the decedent and the burial party. This paper will provide forensic investigators in both modern and ancient recovery/crime scenes with essential information for the reconstruction of events and relationships to the decedent.

This presentation will impact the forensic community and/or humanity by discussing critical elements of the social relationships between the living and the dead concerning burial practices encountered in several post-battlefield bio-archaeological settings in North Korea. These observations can be applied to war time casualties as well as modern crime scene investigations. (Needs to cite Holland 2001)

The position of a body in a burial has long been important in the understanding of the reconstruction of past events, whether this occurred several years ago or in a recent crime scene. Additionally, body position in a burial is often seen as an indicator of the relationship between the decedent and the burial party. Examination of burial practices at two sites associated with the Korean War (1950-1953) sheds light on this relationship and its importance in scene reconstruction. The primary social relationships that will be examined are whether the decedent held friendly or enemy status.

Two recovery scenes are examined below, both are associated with the Battle of Ch'ongch'on. In late November 1950, the 25th and 2nd Infantry Divisions had advanced up the Ch'ongch'on River basin to the town of Kujang-Dong. The Chinese forces launched a major attack along both divisions' line of defense. Due to overwhelming odds, the divisions were forced to withdraw to the town of Kunu-ri for consolidation.

In September 2000, a scene was located on the southwestern slope and ridge line of Hill 219. Scattered over the area were numerous "foxholes," one of which contained a burial of three individuals. The positions of the bodies ranged between extended to semi-flexed. The position of limbs and orientation of bodies suggest rapid placement with little or no concern for any ritual position. The burial feature consisted of the expedient use of an already dug pit (i.e., "fox hole"). The presence of a fragment of looped wire suggests that the bodies were dragged to this pit from some other locale. The bodies were oriented west, east and roughly south.

In 2004, three separate individuals were excavated from a drainage ditch that functioned as a makeshift cemetery located near a known Prisoner of War holding area in Pyongan Putko, North Korea. The bodies were separated by approximately 12 meters, with one individual buried alone and two individuals buried in close proximity to another. The body positions of all three burials were extended. Particularly interesting is that in two of the burials, an arm was placed across the chest. One burial (minus skull) had both hands crossed in front of chest. Care was obviously taken in the placement of these bodies. The bodies were oriented such that two were oriented to the south and one was oriented to the north. According to witness testimony, these individuals had died during captivity and their fellow internees buried them under guard by members of the Chinese Volunteer Army.

From these two examples, two situations representing the opposite ends of a continuum are presented. One represents a series of burials that appear to have been done in haste as well as suggesting a social relationship of antagonism. The second scene represents three burials in which care was taken to lay the individuals out in a standard Western (re: Christian) pattern, save for the body orientations. However, these burial patterns are more common when the social relationship is amicable.

Forensic Archaeology, Burial Pattern, Battlefield Casualty

H69 Characterizing Primary and Secondary Mass Graves and Their Impact on Identification Methodology: The Experience in Bosnia and Herzegovina

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After attending this presentation, attendees will learn new ways of approaching the methodology of exhumation, recognizing it as the first stage in the identification process. Furthermore, the attendee will learn of the different types of mass graves and its influence on the identification process.

This presentation will impact the forensic community and/or humanity by showing that a more detailed analysis of the archaeological context of the recovery and a customized exhumation strategy is an important first step in the identification process.

This presentation evaluates the procedure of body identification in remains obtained from primary and secondary mass graves. It is maintained that the process of identification starts with a sound methodology for collecting the body parts in the field using a procedure which acknowledges the characteristics of the mass grave. The material evidence that indicates a primary grave is reviewed to show how it differs from the more common cases found in the Bosnian, secondary mass graves. The author also describes a third situation: the robbed mass grave. The characterization of a mass grave is dictated, to start with, by the archaeological data encountered during excavation. However, in many cases, human physical remains often provide evidence that runs contrary to the archaeological interpretations.

This small-scale study is based on data recovered in the excavation of mortal remains from the mass graves of Tomašica and Stari Kevljani, two of the many graves produced during the 1992-95 war in Bosnia and Herzegovina. The excavation was a joint task between the International Commission on Missing Persons (ICMP) and the local National Commission for the Disappeared. This joint task force for identification of victims of the war has been working over the past five years to identify as many remains as possible, including isolated body parts. Currently, the identification is made with the use of DNA testing, which has replaced traditional methods as the primary means of identification.

The objective of the excavations of mass graves by ICMP and the National Commission in Bosnia is to identify the bodies recovered. As such, the process of identification begins in the field, where it is imperative to collect parts of a single body together. Furthermore, it is paramount to have a clear understanding of the conditions of the grave: Is it primary grave? Is it a secondary grave? Or is it a grave used during a period of time that only resembles a secondary mass grave, where body parts of a single individual might be spread over a small area? The author uses archaeological as well as anthropological evidence to define the various possibilities of graves: primary, secondary, combination of primary and secondary graves, as well as robbed graves. Evidence is presented that is used to link remains obtained from robbed graves with remains, from the same body, and from secondary graves. There have been several cases of a body re-associated from body parts from several sites.

It is concluded that an exhumation strategy subordinated to the assessment of the kind of mass grave being excavated will greatly facilitate the re-association work at the morgue, as it will help in keeping parts of the body intact. This more detailed work in the field will save time and money in the process of identification, even in the context of a DNA-based identification, where re-association is important to produce the more complete bodies for their return to families and final reburial.

Exhumation, Mass Graves, Re-Association

H70 Forensic Anthropology and the Current Politics of the US- Mexico Border

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The goal of this study is to identify the current and forthcoming U.S. immigration policies that have an influence on border deaths and to discuss the potential impact of these policies on the forensic anthropology community. This research highlights the capability of forthcoming policies to prevent deaths along the U.S. Mexico border and the political sway that forensic anthropologists can exert to stop border deaths and continue repatriations

This presentation will impact the forensic community and/or humanity by pinpointing current and upcoming policies that may heavily impact the numbers of border deaths, providing up to date information on what these effects might be, and clarifying pathways to action for forensic anthropologists working on the border.

Immigrant deaths on the U.S.-Mexico border pose a tremendous problem to U.S. death investigators. Third-world nations like Mexico lack the appropriate databases for missing persons to which U.S. investigators are accustomed. The U.S.-Mexico border has long been a popular gateway of entry for immigrants attempting to enter the U.S. economic system and has consequently been the site of a number of crossing-related deaths. Motivated by a Mexico-U.S economic discrepancy of more than 8: 1, undocumented immigrant workers from Mexico are a cheap, readily available labor pool. As non-citizens, immigrant workers have been historically considered a docile community existing beyond the law. It is under this pretense that these individuals have been systematically incorporated into the economic fabric of this nation for the cheap, often unregulated labor they provide. Revolutions of economic instability and threats of terrorism in the U.S. have encouraged the formation of regulatory national and state policies targeted at keeping undocumented immigrants from crossing the border. Unfortunately these polices have often increased both the dangers and numbers of deaths associated with the border. With border deaths on the rise, the forensic anthropological community must familiarize itself with the effects of enforcement policies, the ever changing demographics of undocumented border crossers, and proactive measures the forensic community can take to help stop border deaths.

In conjunction with an up to date assessment on border crossing demographics this analysis focuses on several key policies including IRCA, IIRIRA, the PATRIOT act, the Gatekeeper Complex, the Secure America Act, and AG jobs. Results from this policy analysis suggest that the current waves of immigration policy may have a highly negative impact on border deaths. The majority of current polices equate long time flows of immigrants from Mexico as a terrorist threat and systematically work to criminalize both legal and illegal immigrants, which effectively increases the numbers of border deaths. Only a few policies such as AG jobs and the Secure America Act demonstrate the potential to reduce the numbers of border deaths; unfortunately, these bills currently lack the support needed to pass.

A review of the literature demonstrates a dire lack of communication concerning the affect of current immigration policies on border areas. Statistics on county and state costs and numbers of deaths per area are highly variable in the literature. Forensic anthropologists working in border regions are in the ideal situation to bring the numbers and case accounts to policy makers and demonstrate the anthropological side of policy failure. While politics and policy has traditionally been out of the realm of forensic anthropology the current status of border deaths demonstrates the need for anthropologist to be up to date on immigration policy and active in policy change.

Immigration, Policy, Border Death

H71 Identification of the Living From Video Tape and Photographs: The Dynamic Orientation Technique

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The goal of this presentation is to introduce the Dynamic Orientation Technique (DOT), an image capturing and analytical improvement for the identification of the living from video tape and photographs. This new technique is an enhancement of the conventional image comparison and superimposition methods that the authors previously employed in identification cases involving the living. The DOT has a variety of applications, including images of the face, parts of faces, the hands, and other body parts.

This presentation will impact the forensic community and/or humanity by providing a useful identification tool for a variety of forensic cases, including: crimes recorded on surveillance video tape; internet crimes depicted on digital photographs (such as criminal sexual conduct involving children); and the publication of photographic images without the subject's permission. Case examples will be used to demonstrate the utility of the technique.

Photographic image analysis and superimposition have been used for human identification for many decades. Dating back to the famous 1930s Van Ess/Ruxton case, forensic scientists have been comparing antemortem photographs with skulls for the purpose of positive identification and exclusion. A number of improvements have been added to the process, such as the employment of a dual camera and mixer system to facilitate orientation and the addition of landmark indicators to facilitate alignment. Possibly because of the relative lack of antemortem X-rays, skull/photo, and photo/photo superimposition is more advanced in some countries in Asia and Europe. For example, Yoshino and colleagues have developed a "3-D physiognomic range finder" and computer assisted identification system.

At the Michigan State University Forensic Anthropology Lab, the authors have recently consulted on a variety of identification of the living cases in which the Dynamic Orientation Technique has been employed. These cases have included the identification of perpetrators in bank and store robberies, ATM violations, internet crimes (criminal sexual conduct involving children), and the publication of images without a subject's permission. In addition, it is believed that the Dynamic Orientation Technique can enhance the ability to identify perpetrators of terrorist activities in public places, such as mass transit systems, where images have been captured on surveillance video tape.

One of the most significant problems with identification from video tape or photographs involves orientation. The known and unknown images must be sufficiently similar in orientation that the investigator is confident that an exclusion (or failure to identify) is due to actual proportional differences, not because images were not oriented properly. In the past, the authors' method for increasing the likelihood of proper orientation was to take multiple photographs of a suspect (or known individual) in hopes of capturing images that sufficiently match the image of the unknown individual. The method is cumbersome, time consuming and necessarily "hit and miss." On several occasions the authors have asked investigators to take multiple images of a suspect only to have to ask for more when none have lined up properly with the unknown images. The authors now call that the "get lucky" method.

In response to this problem, the authors have recently developed, and routinely incorporate, the Dynamic Orientation Technique to capture images of suspects, or other known individuals, for comparison. The process involves the use of a high definition digital video camera, a suitable

playback machine, a mixer, and a quality monitor. A digital video camera is essential in this process because each image is complete and clear and there is no possibility of an image being caught between frames. Ideally, all of this equipment, and studio lights if needed, must be portable so that images may be captured in a prison or other security facility. The technique is relatively quick (rarely more than an hour with a suspect is needed), the equipment is readily available, and the likelihood of success is much higher than the still image method.

With the equipment set up, either in or away from a lab, the following steps are taken:

1. A selected unknown still image is projected and held on a video monitor.

2. The suspect, or known individual, is seated and positioned in such a way that the face (or other body part) is oriented similarly to the held image.

3. Using a digital video camera and mixer, a live image is received through the camera and superimposed onto the held image on the monitor. Careful attention is paid to orienting the live image exactly onto the held image. By moving the camera up and down, side to side, and in circular patterns, the likelihood of capturing images with matching orientation in increased. From the video footage produced during this Dynamic Orientation Technique, the best images are selected in the lab.

4. Carry out side-by-side comparison and superimposition analysis.

A short 3-5 minute video will be played to illustrate the process and the expected results to the audience.

Facial Identification, Video Image Analysis, Photographic Comparison

H72 Trace Element Analysis of Medical School Cadaver Cremains

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After attending this presentation, attendees will learn how the identification and concentration (mg/kg) of trace elements in human cremains can determine whether the cremains are legitimate or have been contaminated with non-human "filler." This technique is being developed to provide a new scientific methodology to assist in crematory/funeral home litigation.

This presentation will impact the forensic community and/or humanity by demonstrating the utility of trace elemental analysis in the examination of cremated remains.

Complete powderization of cremated bone fragments is becoming the standard among professional crematories, leaving no identifiable bone fragments for the forensic anthropologist to analyze. At present, the current methodology used in forensic anthropology to analyze human cremated remains (cremains) lacks the ability to identify scientifically the powderized portion of the cremains set. A critical question in the Tri-State Crematory Incident, Noble, GA, USA, revolved around the powderized portion of cremains. Was it human ash or non-human "filler?" Because of this past incident, and so forensic scientists are prepared for future litigation, an empirical method to determine if the powderized ashes are human or not must be developed Attendees will independently test this technique to verify or refute the findings.

Cremains, Trace Elements, Forensic Anthropology

H73 Bone Fracture Mechanics: *In Vitro* Strain Gauge Analysis of the Ribs and Mandible During Failure

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The goal of this project is to employ *in vitro* strain gauge analysis to better understand the mechanism of two types of fractures which are commonly seen in forensic cases: (1) rib fractures secondary to thoracic compression and/or blunt force, and (2) indirect mandibular fractures secondary to high velocity gunshot wounds of the cranial vault.

This presentation will impact the forensic community and/or humanity by helping to understand how bone responds to particular loading conditions. This information will allow investigators to more accurately reconstruct how rib and mandibular fractures occur, thus better understand their forensic importance.

Understanding the mechanism of trauma to the skeleton is vital if forensic anthropologists are to address issues of cause and manner of death. In this paper, the authors utilize *in vitro* strain gauge analysis, a technique used by biomechanists and anthropologists to examine the relationship between morphology and function of bone, to explore two different types of fractures for which the mechanism is unclear. Strain gauges measure the amount of bone deformation, i.e. strain, at the specific sites to which the gauges are bonded. The skeletal material for this project consists of teaching specimens that were re-hydrated in a saline solution. For both projects, the specimens were secured beneath the transducer of an MTS mechanical testing system so that they could be placed under a load along an axis simulating the direction of force under investigation (i.e., for the ribs, an anterior-posterior compression of the thorax, and for the mandible, lateral expansion of the condyles). The strain gauges were bonded along several locations where the greatest loads were anticipated, based on common fracture locations.

The first research problem is a buckling fracture of the ribs as noted by Symes *et al.* (2005). Long bones fail initially on the side experiencing tension, but Symes and colleagues have provided evidence that curved structures such as ribs can fail in compression. This has been noted during autopsy and is contrary to currently understood biomechanical beam theory. Initial experiments confirmed the findings of Symes and colleagues, that is, the authors were able to load a rib and reproduce a buckling fracture with the side in compression failing before the side in tension. This phenomenon was further explored experimentally by attaching strain gauges to several ribs along various locations (inner angle, outer angle, inner shaft, and outer shaft). The strain gauges allow the local bone deformation, i.e. strain, to be measured quantitatively. Each rib was loaded individually until failure. Both load cell forces and types of fractures are reported.

The second problem is a type of lesion best described as a secondary fracture of the mandible, often produced by a single gunshot wound to the cranial vault. This fracture is particularly well-documented among victims of genocide killed with 7.62 mm. projectiles, as well as in domestic homicide cases in which a relatively high velocity and/or high energy projectile is the cause of death. The fracture is known as a Kolusayen fracture among Turkish human rights investigators. In many of these cases, blunt trauma to the face and mandible can be ruled out on the basis of lack of associated fractures to the fragile bones of the face, alveolar bone, and dentition. These mandibular fractures can occur in the corpus at the canine alveolus, the gonial angle, the mental foramen, or the mental symphysis and they are often unilateral. The fractures are rarely found in the ramus or neck of the condyle where many blunt force fractures occur. Because the fracture is associated with uniformly fatal gunshot lesions of the cranial base and vault, it has been of little clinical interest and is therefore not referenced in the clinical literature. Since the mandibular fracture is sec-

ondary to the primary cause of death, this lesion is most likely underreported in autopsy protocols and is only discovered during examination of remains that have become skeletonized. Reconstruction of the events surrounding the death of the victim would be erroneous should these mandibular fractures be interpreted as being the result of direct blunt force trauma.

These experiments sought to record the amount of force needed to cause a mandibular fracture via lateral displacement of the condyles and test whether rapid glenoid expansion secondary to basilar fracture or temporary cavitation of a passing projectile can generate sufficient strain forces to produce a Kolusayen fracture. The condyles and superior rami were embedded in a resin compound and then one condyle was restrained. The contralateral condyle was then pulled away from the restrained condyle, simulating a spread of the glenoid fossae and the temporo-mandibular joint capsules. Initially a manual load was applied to gain a better understanding of how much strain the mandible experienced. After the manual application of load the mandibles were positioned beneath the transducer and the mandible was pulled until the bone failed. Preliminary data confirm that when the mandibular condyles are distracted, the corpus fails in tension and a fracture occurs in the most vulnerable part of the mandible. Again, both load force and fracture type is reported.

Forensic Science, Functional Morphology, Trauma Analysis

H74 Evaluation of Date of Death Through Analysis of Artificial Radiocarbon in Distinct Human Skeletal and Dental Tissues

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After attending this presentation, attendees will understand how radiocarbon analysis of different human tissues within an individual can be used to clarify the approximate date of death

This presentation will impact the forensic community and/or humanity by allowing forensic scientists to determine the date of death of skeletonized human remains with greater precision.

Estimation of the date of death from human remains recovered from forensic contexts represents an important but frequently elusive aspect of anthropological analysis. Such interpretation can be augmented through analysis of artificial radiocarbon, especially in consideration of the type of tissue sampled and the age at death of the individual.

Atmospheric testing of thermonuclear devices between about 1950 and 1963 produced artificially elevated levels of carbon-14 which are reflected in tissues of humans and other terrestrial organisms. Atmospheric levels of carbon-14 increased dramatically between 1950 and 1963 and subsequently declined following cessation of such testing. Interpretation of carbon-14 values in human remains recognizes that different tissues are formed at varying periods in the human lifespan and have distinct rates of turnover. Dental enamel forms during the childhood years and does not remodel. Many areas of cortical and cancellous bone not only have distinct times of formation but also different rates of turnover. Radiocarbon values derived from dental enamel and selected areas of cortical and cancellous bone from the same individual provide opportunities to determine if death occurred before or during the bomb-curve period. If radiocarbon analysis suggests that death occurred after 1950, the values for the different tissues assist correct placement on the curve and thus more precise estimation of the date of death. Most cancellous or trabecular bone, especially that located in areas of red or hematopoietic marrow has more rapid bone turnover than most cortical bone. Thus radiocarbon values of the former would more closely approximate atmospheric levels at the time of death than those derived from the latter. If bone formation occurred between 1950 and 1963 (the ascending range of the bomb-curve) radiocarbon analysis should reveal greater fraction values for cancellous bone than for cortical bone. If bone formation occurred more recently than 1963 (during the descending age range of the bomb curve) cancellous bone values should be less than those of cortical bone.

Samples were collected from two human female skeletons of known birth and death dates. These samples consisted of permanent teeth, cortical bone from the femoral diaphyses, and cancellous bone from vertebral bodies. One individual was born in 1925 and died in 1995 at the age of 70 years. The other individual was born in 1926 and died in 1959 at the age of 33 years. Radiocarbon analysis was conducted at Lawrence Livermore National Laboratory using standard techniques.

As expected, analysis of the dental tissues revealed carbon-14 fractions below 1.0 suggesting that formation of those tissues predated the bomb-curve. The dental tissues studied in these two individuals formed between the dates of 1925 and 1933.

Three of the four bone samples yielded modern fractions which fell above 1.0 and thus within the bomb-curve. The exception was a cortical bone sample from the 33-year-old. In consideration of the ages at death of the individuals and the shape of the bomb-curve, the radiocarbon analysis suggests more recent formation of the trabecular bone than the cortical bone, as expected, although in the older individual the difference was only about one year. The formation date for the cancellous bone (calculated from radiocarbon analysis) preceded death by about five years in the younger individual. In the older individual, analysis suggested death was preceded about 39 years in the average formation of cortical bone and about 38 years in cancellous bone. This nearly four decade differential between average bone formation and death reflects the slower bone turnover in older adults.

Radiocarbon values derived from dental structures, especially enamel provide information about the dates of formation during the childhood years. Such data can be used to suggest a pre-bomb curve childhood date or help establish the birth date if the dental radiocarbon values fall within the bomb-curve.

Variation of the values derived from bone reflects variation in the timing of both bone formation and remodeling. If these values fall within the bomb-curve they provide the information needed for proper placement on either the earlier ascending or later descending aspect of the curve. Once values are correctly placed on the curve, the date of death can be estimated, in consideration of the age of the individual and other factors.

Although radiocarbon analysis provides unique and valuable information attention must be given to both the age of the individual and the sampling site. Dental enamel provides the ideal source of information to estimate the birth date, particularly if that date falls after 1950. In the absence of soft tissue, cancellous bone from the central skeleton provides radiocarbon values ideal to evaluate the death date and in comparison with values from cortical bone and the age at death can help determine if death occurred on the ascending or descending sides of the bomb curve.

Artificial Radiocarbon, Date of Death, Tissue Analysis

H75 The Impact of High Speed-High Resolution Three Dimensional CT Scans on Forensic Anthropology

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After attending this presentation, attendees become aware of scientific advancements involving the examination of human remains utilizing high speed/high resolution CT scans. In addition attendees will be informed on the various applications this new technology will have in forensic anthropology.

This presentation will impact the forensic community, forensic Anthropology, and forensic pathology by demonstrating new imaging technology which will allow for non-evasive anatomical examination.

In the past few years tremendous scientific advancements have been made in the field of three dimensional medical imaging. One of the greatest advancements has involved the development of Computerized Tomography scanners which can produce high resolution – three dimensional images of the human body within a matter of minutes. The new generation CT scanners utilized in hospitals and medical clinics have had an unparalleled impact on the diagnosis and treatment of living patients. Recent research by scientists at the Institute of Forensic Medicine, University of Bern, Switzerland, have pioneered a new use for the CT scanners, that being in the field of forensic pathology. Unlike in living individuals, the postmortem examination of bodies by high speed CT is not limited to regulated radiation safety levels, and therefore greater resolution can be obtained during CT scans by increasing the power/radiation levels.

In 2005 the U.S. military acquired an advanced CT unit, a GE Light Speed 16, for postmortem examinations at the Dover Port Mortuary located at Dover Air Force Base, Dover Delaware. The mortuary is a large state of the art morgue facility utilized by the Armed Forces Medical Examiner. Presently the CT unit is being utilized routinely to scan the bodies of military fatalities from around the world. Use of the CT scanner in the postmortem examination of fatalities, has provided a wealth of new information not obtainable by the two dimensional views provided by standard film or digital radiography.

One of the primary focal points of postmortem examinations is the presence of skeletal injuries. Cases involving skeletal trauma may require removal of the particular skeletal element/s in order to conduct a detailed examination. Removal of the skeletal elements and associated soft tissues may not be practical or acceptable, and therefore a limited amount of information may be obtained. Extensive fragmentation of skeletal elements can also pose many problems, as it may be very difficult to access the pattern of damage due to disruption of anatomical position. Similar problems are encountered when dealing with badly decomposed remains. In cases requiring anthropological evaluation, the skeletal element/s must be rendered free of soft tissues and decompositional debris, which requires expertise and time. The use of new generation CT scanners virtually eliminates problems associated with removal of skeletal elements and soft tissues, and provides a new level of assessment of skeletal trauma and anthropological attributes which is non-invasive.

Key attributes of the new generation CT scanner utilized at the Dover Port Mortuary, include its rapid scan speed, high resolution, three – dimensional capability, and the ability to target in on differential densities so as to provide specific imaging of various anatomical features such as skin, muscles, internal organs, the skeleton, or injury sites. The resolution obtained by the Dover CT unit is .26 mm and the average full body scan can be accomplished in as little as two minutes. Images created by the scan can be viewed in as fixed two dimensional images represented by single or multiple sectional views, two dimensional overall views, or animated three-dimensional views. Highly accurate measurements can be made from two or three dimensional views of virtually any anatomical location. Measurements include linear, area, and density.

The impact of the new CT technology will have profound effects in forensic anthropology. For example in the case of a fresh body with extensive blunt force trauma to the skull, examination of the cranial fragmentation pattern may be difficult to determine as a portion of fragments may be displaced into the cranial vault, covered by soft tissues and fluids, or possibly missing. Also manual manipulation of the skull to examine a fracture site may result in collapse of the cranial fracture site thus requiring cranial reconstruction. Utilizing the new CT technology one would be able to see the actual positional state of fragmentation in a three dimensional view, and each fragment can be isolated for detailed examination of the fracture lines and edges along the fractured bone.

Anthropometric analysis of various aspects of the human body will greatly be enhanced, as the CT scans are non-invasive and will allow for detailed measurements of body parameters, and areas of the skeleton such as the cranial vault or sinuses, which are not readily accessible by calipers or other measuring tools. Osteometric data collection will be brought to such a high level that biological traits such as racial classification will become more highly refined allowing differentiation between geographical populations. Osteological changes relating to skeletal age, for the first time, can be accurately quantified, rather than relying on subjective assessment of bony changes. All of the images produced by the scanner can be easily stored and transmitted as they are in a digital format supported by most computer systems.

Although the CT units are very expensive at this time, the price will decrease over time and the units will become available for use by universities and colleges. The use of the new CT imaging technology will be a major new stepping stone for forensic anthropology, answering old questions and creating new ones.

Anthropology, Digital Imaging, Radiology

H76 Identification of the Living on Video Surveillance Systems: A Novel Approach

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After attending this presentation, attendees will learn that the use of a total station may ameliorate the quality of identification of the living from images taken from video surveillance systems.

This presentation will impact the forensic community and/or humanity by demonstrating the comparison of height and facial physiognomy of images of criminals taken from video surveillance systems with those of suspects the use of a total station may provide a more accurate means of identification.

More and more often the identification of criminals whose facial or body image has been taped on videos and photographs (thefts, pedopornographic material, etc.) is performed by comparing such bidimensional images and photographs with bidimensional images of suspects. However visual identification is frequently difficult or impossible due to several problems: the low resolution of images, distortion, inclination of the face or the presence of glasses, hats, and other artifacts used to hide physiognomy. These are cases in which experts are called in to determine whether it is possible to identify the criminal as the suspect, or, indeed, to exclude him or her. Commonly used methods include height estimation, the comparison of facial morphological traits, facial anthropological indices and in the superimposition of the two images (pertaining to the criminal and suspect).

A novel method which consists in using a total station, which gives tridimensional coordinates of set points via a laser beam, and which has been used in three actual judicial identification cases will be described. The total station was used to obtain topographical information of the environment in which the crime took place and from this information a virtual reconstruction of that environment was performed. This virtual environment was then superimposed onto images of the environment on video; in order to correct any distortion caused by the optics of the video surveillance systems. This method also allowed the authors to calculate the height of the subjects represented on the videos.

The total station was also used to pinpoint on the suspect standard cephalometric points and a series of other points between these. This data allowed for the subsequent tridimensional reproduction of the cephalometric points (anthropological landmarks) and of the facial profile of the suspect (who must give his or her consent) which was reconstructed on the computer. This reconstructed face of the suspect was then superimposed onto the face of the criminal (or rather, the facial images of the criminal extrapolated from the video surveillance system) and matching of anthropological landmarks was then assessed. The use of the total station resulted in a useful and accurate comparison of height and facial morphology in order to exclude or confirm identity of a criminal.

Identification, Living, Total Station

H77 Lumbosacral Transitional Vertebrae, Spondylolysis and Spondylolisthesis: Prevalence in a Modern Forensic Skeletal Population

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Attendees will be introduced to the prevalence of the varying presentations of transitional vertebrae in clinical populations and a modern forensic sample. Implications for their usage as unique identifying features will be discussed.

Sacralization of the fifth lumbar vertebra (L5) (i.e., fusion to S1) is generally thought to be an abnormal morphological expression of the anatomical transition between the lumbar and sacral spine. Information in the clinical literature indicates that the majority of all cases of anomalous transitional vertebrae occurs low on the lumbar spine and typically involve the sacrum. The specific cause of sacralization is not well understood, but is usually considered to be of developmental, rather than activity-related, origin. The timing of this fusion has been noted as early as birth, but most instances seem to manifest during early childhood development. In adults, sacralization of L5 is often accompanied by degenerative spondylolisthesis (translation or movement) of L4 relative to L5. In this instance, the degeneration of the L4/L5 articulation is due to intersegmental instability and facet arthropathy.

Many forms of non-traumatic transitional vertebrae exist; their morphological expression is highly variable, and they (transitional forms) have been associated with different demographic profiles. For example, isthmic (anterior translation) spondylolytic lesions are less prominent in young females, while adult females appear to be more prone to progressive displacement and may need surgical intervention more often than males. The congenital forms of spondylolisthesis (e.g., dysplastic type) comprise 14-21% of all cases of spondylolisthesis and occur in a 2:1 female-to-male ratio, with symptoms beginning around the adolescent growth spurt. Congenital/dysplastic spondylolisthesis has been documented in children as young as 3.5 months; more commonly, however, they go undiagnosed until later in life, after an individual has been ambulating for some time. Degenerative spondylolisthesis also occurs more commonly in females, with a 5:1 female-to-male ratio and the incidence increases after age 40.

In addition to varying by sex, the frequencies of transitional vertebral and lumbosacral vertebral defects also appear to vary by population/ancestry group. A review of the literature finds that sacralization has been observed in 18% of Australian aboriginals (Mitchell), 16% of Indians (Bustami), 10% of Arabs (Bustami), 8.1% of natives of Britain (Brailsford), and 5.8% of Japanese (Toyoda). Bustami studied 340 sacra of two population groups (Arab and Indian). Of these 340 sacra, 46 instances (13.5%) of sacralization were observed, with 32 (9.4%) showing unilateral sacralization and 14 (4.1%) showing bilateral sacralization. Lumbarization was not found in that sample. The incidence of total sacralization was 10% in Arab and was 16% in Indian population groups, with Arab males and Indian females having higher incidences of all stages of sacralization within their respective population groups. Isthmic spondylolytic defects have been found to affect roughly 6.4% of white males and 1.1% of black females. Degenerative spondylolisthesis also affects black females more commonly than white females (and females are more commonly affected than men. Additionally, Eskimo (Inuit) populations are observed to have a very high incidence of spondylolytic defects due to a combination of genetic and environmental factors.

Over the past several years, the authors noted what seemed to be a rather high incidence of abnormal transitional vertebrae and spondylolysis in human skeletal remains under examination at the C.A. Pound Human Identification Laboratory at the University of Florida. These instances were noted on the individuals' biological profile and presented to the medical examiner or submitting agency as unique, individuating characteristics with the associated caveats.

Since 1996, 27 instances total of transitional vertebrae were noted in the total sample of approximately 800 human cases (3.375%). Of these, 16 were males, 11 were females; 22 were European or white (12 M/ 10F) and included two possibly Hispanic males and one possible Hispanic female. Further breakdown reveals one (1) Asian female, one (1) Black male, one (1) male of mixed or admixed ancestry, and two (2) unknown or unspecified males. Of these, there were 15 instances (to varying degrees) of sacralized L5's, including two cases of ankylosing spondylitis (7M/8F; 13W/1B/1Asian); two instances of spondylolisthesis of L5 (both White males) and six (6) cases of spondylolysis of L5 (5M/1F; 3W/1 "mixed"/two unspecified). Of these 27 two cases presented with cervical ribs that were both White females and two cases with "lumbarized" S1; both White males.

Comparisons show that the frequency of anomalous lumbosacral transitional vertebrae in this modern forensic sample percentage-wise compares, albeit on the low end, favorably with clinical findings of such anomalies in 4 to 8 percent of the clinical population. Thus, the frequency of these defects in the forensic population is not an idiosyncratic characteristic of this population. Despite their frequency within the general population, the presence of and unique morphological configuration of these anomalous vertebrae in a given individual should still be of considerable value to the forensic anthropologist in antemortem versus postmortem identifications.

Sacralization, Individuating Traits, Forensic Anthropology

H78 "The (Almost) Exhumation of Billy the Kid: Why We Aren't Digging Him up (and Why You Shouldn't Either)"

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After attending this presentation, attendees will understand how to conduct "biohistorical" forensic investigations, specifically how to identify a well-known historical figure using modern forensic methods

This presentation will impact the forensic community and/or humanity by serving as a cautionary tale, describing the dangers inherent in participating in "criminal" investigations driven by politicians and the media.

"Sometimes biohistorical analysis is undertaken for commercial consideration or mere sensationalism" (Andrews et al., 2004).

On June 10, 2003, New Mexico Governor Bill Richardson held a press conference to announce his support for the reopening of the investigation into the events surrounding the death of Billy the Kid (BTK). The focus of the investigation was to determine whether the remains of the legendary outlaw were buried in a well-known tourist attraction in New Mexico or, as had been previously claimed, interred in either Texas or Arizona. Leading the BTK investigation was a team comprised of the sheriffs of Lincoln and De Baca counties, the Mayor of Capitan, a county attorney and a University of New Mexico History professor. Conspicuously absent were the forensic scientists necessary to achieve the goal of the investigation as stated in the press release: "to put modern forensic science to the test to answer the questions surrounding those days in New Mexico history."

Following the press conference, the senior management of the New Mexico Office of the Medical Investigator (OMI) felt that the high-profile nature of the case warranted greater involvement by the OMI, as New Mexico statutes (1978 NMSA 24-14-23D) outlines the involvement of the OMI in exhumations. To lend credibility to the pursuit, and to clarify jurisdictional issues, the BTK investigators declared the case a criminal investigation, going so far as to open an official homicide file three days before the press conference (case no. 03-06-136-01, Lincoln County Sheriff's Office). Despite repeated requests by the OMI for a copy of the file during the early stages of the investigation (and through the legal battles that ultimately ensued); no official documentation was ever provided.

"At the very least, investigators should disclose to the group the investigative question posed" (Andrews et al., 2004).

During preliminary meetings, the BTK investigators outlined the primary goals of the criminal investigation: 1) to determine if Sheriff Pat Garrett did, in fact, shoot William Bonney (aka Billy the Kid) at the Maxwell House in Fort Sumner, NM on July 14, 1881; 2) in order to determine this, the investigators proposed to exhume the remains of William Bonney for the purposes of DNA testing; 3) the investigators also proposed exhuming the remains of William Bonney's mother, Catherine Antrim, to serve as the comparative standard for mitochondrial DNA tests with William Bonney's remains. With this information, the author began research into the determining the exact location of the graves of both Billy the Kid and his mother, as well any information that could assist in establishing identity. Following data collection at seven major archives in New Mexico and Arizona, as well as Fort Sumner and Silver City (the reported location of the grave of BTK's mother), it was the opinion of the author that the exact location of the remains of Billy were not known and that the exhumation of Catharine Antrim may result in the disturbance of adjoining graves. Upon informing the investigators of these findings, it became clear that the focus of the investigation would be the exhumation of Catharine Antrim, as the general location of her grave was at least known.

"Often, investigators fail to pose an investigative question capable of resolution by genetic testing" (Andrews et al., 2004).

When asked what purpose Antrim's exhumation would serve to the criminal investigation, absent the exhumation of BTK, the investigators indicated that a direct male heir of William Bonney had stepped forward and that they proposed testing his DNA against that of Catharine Antrim. Despite the author's best attempts to explain how mitochondrial DNA worked and how such a test was scientifically invalid (not to mention pointless within the context of the criminal investigation), the investigators remained resolved. They also indicated their intent to test Antrim's DNA against "Brushy" Bill Roberts, a well-known character in the southwest who claimed to be Billy the Kid and John Miller, an individual from Arizona also claiming to be BTK. As both these men were deceased, this line of inquiry would necessitate their exhumations as well. At this stage, the medical examiner's office declined to issue a permit for any exhumation and stated that the office would require either a letter from Governor Richardson or a court order before proceeding.

This presentation will detail the court battle that then ensued and the research findings that indicate the remains of Billy the Kid are unlikely to ever be found. It also serves as a cautionary tale regarding participating in "criminal" investigations involving private funding and documentary film companies, and how media or politically driven biohistorical investigations can rapidly spiral out of control.

Biohistorical Investigations, Personal Identification, DNA

H79 Reducing Observer Error Through Choice of Histological Evaluation Technique

Christian M. Crowder, PhD, Joint POW/MIA Accounting Command Central ID Laboratory, 310 Worchester Avenue, Hickam AFB, HI 96853-5530*

After attending this presentation, attendees will understand the importance of scrutinizing techniques used in methods of skeletal analysis in order to limit the amount of observer error.

This presentation will impact the forensic community and/or humanity by underlining the importance of identifying and differentiating method error from biological variability. Addressing the issue of method repeatability is essential for selecting current, as well as developing new, macroscopic, and microscopic methods of skeletal analysis in the field of forensic anthropology.

The traditional approach to the estimation of adult age at death has been a macroscopic, morphological evaluation. Another approach utilizes a microscopic, histomorphological evaluation, which is often presented as less subjective and more accurate than gross morphological methods. Compared to morphological methods histological methods of age estimation have been tested haphazardly, leading to a literature that is confusing, inconsistent, sometimes conflicting in terms of recommended methodology, and reported rates of precision and accuracy. The application of histological methods has been criticized from a number of different perspectives ranging from problems with intra- and inter-population variation caused by environmental and hormonal influences on skeletal physiology to the influence that skeletal preservation holds over effectively using such methods. Furthermore, research demonstrates that there will be a spatial and temporal variance in remodeling dynamics in response to mechanical loading. These concerns may all be deemed secondary to the concerns inherent in the methods themselves. This paper focuses on an aspect of observer error related to the histological technique in order to determine the best technique needed to develop more precise histological methods of age estimation. Differentiating method error from biological variability will provide a baseline interpretation of histological methods as useful age predictors for skeletal analysis. Furthermore, a more solid methodological foundation for future histological methods will be established.

The Singh and Gunberg (1970), Thompson (1979), and Ericksen (1991) techniques for collecting histomorphometric data were compared in this research allowing for the comparison of precision amongst three different data collection techniques. The Singh and Gunberg method uses osteon counts per open circular microscopic field. The Thompson method requires a 100-square grid to perform the point count method. The Ericksen method uses a combination of microstructure counts per rectangular photographic field and predominant microstructure type per square in a 100-squared grid. To evaluate intra- and inter-observer error, 30 femur thin-sections were randomly selected from a larger sample of 187 femoral sections. A *true* test of inter-observer error would require individuals with a certain level of familiarity with the methods or histological analysis in general. Instead, three individuals (1 per method) with little to no histological experience were used, thus testing the ability for novices to learn the methods. The author refers to this error as the novice application error. Each observer was given an extensive tutorial at the microscope, the article associated with the method that they were selected to perform, and Chapter 7 from *Biological Anthropology of the Human Skeleton* (Robling and Stout, 2000). This chapter provides a comprehensive discussion on the application of cortical bone histomorphometry for the estimation of age at death. Two statistical methods of observer error analysis were employed. The first analysis followed the procedure outlined by Bland and Altman (1986, 1995) for testing the repeatability of methods. The second followed the procedure outlined by Nichol and Turner (1986), which is a commonly used method for error analysis in anthropology. Observer error was evaluated for the microstructure counts and age estimates between the two trials.

The intra-observer results indicate that only the Thompson method passed repeatability standards. This method uses a predictive variable that consists of two variables. Evaluating the constituent variables individually produced some repeatability failures, indicating that the combined variable will reduce the amount of potential error in determining the microstructure type. Therefore, it is not surprising that the other methods, which use single and not combined microstructure counts, failed repeatability standards. The largest variable intra-observer error occurred using the Ericksen method. Higher error levels can be expected in the Ericksen method using the subjective determination of the predominant microstructure per square in a 100-squared grid.

The novice application error demonstrates that, for the most part, the novice observers were unable to repeat the results of the primary investigator, thus indicating that more experience is necessary to perform histological analyses. The Singh and Gunberg method produced the highest percentage of novice application error (43% for the variable and 25% for the age estimates) suggesting that open microscopic field methods have potential to produce higher levels of observer error.

Histological methods of age estimation have been presented in the literature as being more objective than the traditional gross morphological methods. This analysis shows that the histological evaluation technique chosen is an important factor in the amount of objectivity, accuracy, and observer error that is expected or introduced. Open microscopic field evaluations, such as that of the Singh and Gunberg method, provide no reference points for counting structures. In older individuals, with large numbers of intact and fragmentary osteons, one can easily loose their place in the microscopic field. Using a grid in the microscope provides points of reference and reduces observer error. The Thompson method demonstrated the lowest intra-observer error, which may be due to a combination of the point count grid method and simple variable definitions. Furthermore, methods that employ the principles of stereology, such as the point-count method, allow for changes in grid size, and are less subjective compared to methods that are based on assessing the percentage of a microstructure in a gridded area.

Precision, Histology, Histomorphometry

H80 Resolving Extremely Commingled Skeletal Remains From the Korean War Through Mitochondrial DNA (mtDNA) Testing

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After attending this presentation, attendees will learn how to implement bioinformatic strategies into their standard practices for separating out extremely commingled sets of remains.

One of the primary missions of the Armed Forces Identification Laboratory (AFDIL) mtDNA section is to aid the Joint POW/MIA Command, Central Identification Laboratory (JPAC-CIL) in the identification of missing service members from past U.S. military conflicts, including World War II, the Korean War and the conflict in Southeast Asia. While all of the conflicts have large numbers of commingled remains, the Korean War has presented sets of remains that are particularly difficult to resolve into individuals.

The Korean War, often (1950-1953) and resulted in over 30,000 American casualties of which, over 8,100 service members are still considered missing. More than 800 of these missing are buried as unknowns in the National Memorial Cemetery of the Pacific, known as the "Punchbowl." Two hundred eight caskets of skeletal remains were unilaterally returned by North Korea to the United States between 1990 and 1994. The remains of approximately 200 other individuals have been recovered through Joint Recovery Operations (JRO) undertaken by JPAC-CIL inside North Korea since 1994.

Over the past five years, AFDIL has processed a total of 1472 skeletal elements from the 208 unilaterally repatriated remains stored at JPAC. MtDNA has confirmed what anthropologists had already discovered: that most unilateral turnovers purported to represent one individual actually represents numerous individuals. After the anthropologists have sorted each set of remains into hypothetical individuals, the next step in determining the extent of the commingling is to test samples from each set to generate a mtDNA profile. Concurrently, a massive outreach to the public has been underway in order to collect maternal DNA references. The Defense POW/MIA Personnel Office holds a meeting every month in different parts of the United States in order to update family members on the progress of the identification process as well as collect any references that may not yet be in the database. To date, there are references for over 3,000 of those missing in the Korean War in the AFDIL mtDNA database. This represents over 42% of the missing, all of which have been processed either in both Hypervariable Regions One and Two or the entire Control Region of the mtDNA genome. While the ultimate goal is to build a database consisting of references for 100% of the missing individuals, this current system of testing the control region of the mtDNA genome has its limitations, not the least of which is that many individuals with the most common mtDNA types cannot be individualized. New technologies are currently in validation at AFDIL that have the potential to overcome many of these issues.

As any laboratory that has processed a mass disaster is aware, interpreting the data from over a thousand evidence specimens and thousands of references specimens is a daunting task; one that cannot be achieved manually, at least in any desirable time frame. By building a database of representing 42% of the missing individuals of the Korean War, bioinformatics techniques for database searching have provided numerous leads for JPAC-CIL and AFDIL to follow in the search to bring even more missing soldiers home. Other scientists can take these techniques for use in their own laboratories and perhaps expand upon them for more efficient database searching protocols.

The views expressed herein are those of the authors and not The Armed Forces Institute of Pathology, the U.S. Army Surgeon General, nor the U.S. Department of Defense.

Bioinformatics, mtDNA, Commingled Remains

H81 Reducing Problems With Osteological and Dental Samples Submitted to Missing Person DNA Databases

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After attending this presentation, attendees will be better informed about the Federal Bureau of Investigation's National Missing Persons DNA Database (NMPDD) Program and how it may better assist forensic anthropologists, odontologists, medical examiners, coroners, law enforcement officials and those they serve in identifying human remains.

Using case examples, this presentation will impact the forensic community and/or humanity by 1) illustrate how samples of various types are submitted and entered into NMPDD; and 2) through case examples, share information and suggestions concerning storage, handling, and sample preparation methods which will insure increased success in using the database. This presentation will impact the forensic science community by providing a more thorough understanding of the types of samples which will yield useable DNA for identification purposes.

Over the past five years, tissue samples from unidentified human remains have been submitted to the NMPDD by anthropologists, odontologists, medico-legal authorities, and law enforcement agencies. Most of the unknown specimens are osteological materials. These samples are typed for mitochondrial DNA and nuclear DNA (STRs). Genetic profiles from the unidentified remains are compared to genetic profiles of missing persons and appropriate biological relatives of missing persons entered into the database. Osteological samples that cannot be associated with a missing person are uploaded into the National DNA Index System, (NDIS), of the Combined DNA Index System, (CODIS).

Osteological specimens represent some of the most challenging samples that DNA analysts process. Challenges to successful genetic typing of osteological specimens will likely arise when the useable DNA content of specimens have been degraded or lost by improper sampling, cleaning techniques or other environmental insult. Experience shows that successful DNA extraction and comparison correlate with the initial condition of samples received. Improved methods of DNA extraction and the sensitivity of DNA typing techniques also means increased sensitivity to degradation and contamination. Thus, successful genetic typing and the identification process are hindered from the outset by factors which can be controlled by fairly simple means. Problem areas may be reduced to issues of 1) recovery, handling, and long-term curation; 2) maceration and cleaning; and 3) sampling.

As remains are collected or exhumed, all operators should attempt to reduce contamination by gloving, using clean containers and instruments, and reducing the number of individuals handling the remains. Those charged with maceration, cleaning, and sample selection should avoid using chemicals that damage DNA, (especially oxidizing agents), and high temperatures. This is particularly important when samples are small and already highly degraded, particularly when additional samples cannot be obtained for re-extraction. Instruments used for cutting samples should be used only once to avoid cross-contamination when multiple samples are involved, (single-use fiber Dremel blades should be used once and discarded). Some laboratories prefer to cross-link DNA on contaminated sample surfaces before sanding or cutting.

Case examples will demonstrate model working relations between various forensic agencies and laboratories already in operation. Clearer mutual understanding of various functions and responsibilities will improve sample processing and lead to an increase in the numbers of missing person identifications.

Missing Person DNA Database, Osteological and Dental Samples, CODIS

H82 Is This Bone Human or What? In Pursuit of Human vs. Non Human Determinations in Small Osseous Fragments

Mark D. Leney, PhD, Central Identification Laboratory, Joint POW/MIA Accounting Command, 310 Worchester Avenue, Hickam AFB, HI 96853*

After attending this presentation, attendees will learn the advantages and disadvantages of applying osteological, histological, and immunological and DNA based analyses to determining human versus non-human from small and degraded osseous fragments.

Protein radio-immunoassay, osteohistology, and cytochrome-B testing have been around for years but have not been applied much to forensic casework. This study examines and compares the techniques on a series of known samples, closely simulating actual casework with tiny and degraded osseous fragments. This presentation will impact the forensic community and/or humanity by providing scientists a better place to make good choices in their own casework in this area after examining the lessons learned in these trials.

Forensic anthropologists are sometimes faced with osseous fragments obtained from a recovery scene that are either too small or too degraded to make a definite determination of human versus non-human origin on the basis of traditional comparative osteological methods. Determining what is and is not human can assist in defining the scope of further investigation in the field. In the event that only morphologically uninformative bone fragments are recovered from a particular location, species determination (or minimally human/non human determination) for such items could be a critical evidentiary finding. A number of technologies for approaching this problem have been available for some time. This study reports preliminary comparative results for a set of test samples. Each test sample was derived from known human or faunal remains obtained from a variety of highly challenging recovery environments. The relative merits of four techniques are compared: traditional comparative osteology, histological osteology from thin section, protein radio-immunoassay (pRIA), and sequencing of species-specific mitochondrial DNA (cytochrome-B). The advantages and limitations of these methods will be evaluated in the context of the test sample set.

Histology, Immunology, DNA, Osteology

H83 Applications of DNA Identification to Human Rights: Additional Informative Sites in the mtDNA Genome

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After attending this presentation, attendees will gain a broader understanding of the variability found in the mtDNA genome and how this knowledge can be applied to better discriminate individuals sharing common mtDNA sequence motifs.

This presentation will impact the forensic community and/or humanity by demonstrating the value of mtDNA analysis as a principal identification strategy in human rights and mass-disaster investigations.

Over the last decade, the use of the mtDNA genome in forensic identification has increased due both to its suitability for identification of degraded human remains and for its capacity to be used in a high-throughput, cost-efficient manner. High throughput and low cost are particularly important when developing strategies to identify those killed in extrajudicial executions, a situation where sheer numbers can overwhelm available resources. For over two decades, the authors have been working with human rights organizations and families of disappeared persons to identify human remains. The initial analysis compares HVI and HVII sequences retrieved from human remains with those from maternal families. Consistent with current forensic standards, remains are considered excluded from membership in a family if they differ at two or more sites in HVI and HVII. Those who cannot be excluded are analysed for nuclear markers to further resolve the probability of family membership.

There are, however, situations where human remains are found to differ from multiple families by only zero, or one sites in HVI and HVII and thus cannot be excluded from family membership. This study considers whether sufficient mtDNA variation exists outside HVI and HVII to be informative in these situations. To address this question, anthropologists considered a single test family and 28 unrelated individuals who all share the same HVI and HVII motif of 16223 16298 16325 16327 and 73 249D 263 290D and 291D respectively. Outside of this combined HVI and HVII motif, the 28 unrelated individuals each differ by only zero or one substitutions from the test family. Three regions outside of HVI and HVII were selected for sequencing. These included HVIII (nt 438 to 574) and portions of the MTATP8/MTATP6 (nt 8366-8900), and MTCYB (nt 14750-15887) genes. Sequence data produced from these regions revealed three common single nucleotide polymorphisms (SNPs); these were found in HVIII at nt 493, nt 8772 in MTATP6 and nt 15740 in MTCYTB. The HVIII nt 493 A/G substitution was particularly informative in this comparison. Of the 23 unrelated individuals with one difference from the test family in HVI and HVII, 18 were also found to differ from the test family at 493 and could thus be excluded from membership. Additional private polymorphisms were detected in MTATP at nt 8790 and MTCYTB at positions 15462, 15644 and 15700. When all of the SNPs detected in these three regions were included in the analysis, 24 of the 28 unrelated individuals (86%) were found to differ from the test family at two or more sites. These results suggest that there is value sequencing additional mtDNA loci outside of HVI and HVII in order to discriminate individuals with shared mtDNA motifs.

mtDNA, Coding-Region SNPs, Human Rights

H84 MtDNA From Degraded Human Skeletal Remains: Is Quality Affected by Storage Conditions?

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After attending this presentation, attendees will learn the effects of storage practices on degraded skeletal remains as demonstrated by a case study involving remains of missing U.S. service members from the Korean War.

This presentation will impact the forensic community and/or humanity by providing the forensic community with a case study describing the impacts of storage conditions upon the quality and quantity of mtDNA from degraded skeletal remains. Forensic laboratories facing similar situations can take some guidance from the results of this study; potentially implementing the suggestions for their own labs. Osseous samples need to be stored in a manner in which DNA will be preserved. Failure to do so could lead to an inability to identify a missing individual in the future.

In the missing persons program for the United States military, skeletal remains are recovered from a variety of environments. Anthropologists from the Central Identification Laboratory of the Joint POW/MIA Accounting Command (JPAC-CIL) go into the field to recover the remains and any other archaeological information that may lead to the identification of the individuals. Frequently, samples taken from the osseous remains are sent to the Armed Forces DNA Identification Laboratory (AFDIL) for generation of a mitochondrial DNA (mtDNA) profile for comparison to profiles garnered from maternal reference materials.

Examination of remains submitted to AFDIL for testing over the past ten years has shown that there is a marked difference between osseous elements and the mtDNA sequence information that they yield, a result possibly dependent not only on the structure of the bones themselves, but on environmental conditions (Edson, et al., 2005; Leney, 2006). Hence, there is also a difference in ability to generate full mtDNA profiles between the different conflicts. The environments in which remains are located vary in the extreme, depending on the conflict in which the individuals were lost. Incidents from World War II tend to have the most varied recovery sites, from salt marshes in Tunisia to mountainous regions in China, while remains from the conflict in Southeast Asia are found across sites that are more environmentally homogeneous.

Remains from the Korean War have been recovered in two specific manners. First, remains from this conflict are not always recovered *in situ* from the incident site. Between 1990 and 1994, the Democratic People's Republic of Korea (DPRK) repatriated 208 caskets of osseous samples to the U.S. government. These sets of remains were supposedly comprised of single individuals. However, upon anthropological examination by JPAC-CIL and mtDNA testing by AFDIL, multiple individuals were found to be present in each group of samples. These remains were stored for an indeterminate period of time since death, presumably at room temperature. Secondly, anthropologists from JPAC-CIL have been allowed into the DPRK under extremely regulated conditions to recover remains from burial sites in what are called Joint Recovery Operations (JRO).

The quality of the mtDNA obtained from skeletal elements submitted from both JRO and the unilateral turnovers will be presented. In this instance, quality is determined by the number of bases of mtDNA sequenced from each skeletal element in each group of remains. Success rate is presented as having a reportable sequence of 100 or more base pairs. In order to report sequence information for a sample, AFDIL requires two separate amplifications from a single extract or one amplification from two extracts of that sample. Success rate is standardized by extending the same reporting criteria across all samples. The goal is to determine if the random storage conditions of the unilateral turnovers had a detrimental effect on the mtDNA of the remains versus those of samples recovered in a JRO.

Skeletal elements that have remained *in situ* since the time of the fatal incident are subjected to the ambient regional temperatures and conditions irrespective of whether they are left on the surface or interred by local residents. Internment in these instances typically does not include any type of preservation of the remains, but rather simply the placement of the body in the ground. Soil pH, water levels, temperature, and other environmental conditions are thus free to act upon the remains, potentially damaging *or* preserving them. These effects will also be discussed.

By examining the effects of storage on samples that have a similar time of origin, guidance can be given to other laboratories that specialize in the handling and treatment of skeletonized human remains. Appropriate measures should be taken to preserve osseous remains even if mtDNA testing is not currently being considered as a means of identification. Anticipation of this future need is a conservative step to be taken as failure to sufficiently preserve remains in the present may lead to an inability to identify and return the remains to the families of the missing.

The views expressed herein are those of the authors and not necessarily those of the Armed Forces Institute of Pathology, the U.S. Army Surgeon General, nor the U.S. Department of Defense.

mtDNA, Degraded Skeletal Remains, Storage Conditions

I1 Review of Forensic Neuropsychiatry

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After attending this presentation, attendees will have a basic understanding of basic science, psychopathology, diagnostic testing, controversies, and legal implications of brain disorders in forensic settings.

This presentation will impact the forensic community and/or humanity by promoting the understanding of brain disorder as it relates to civil and criminal cases.

Neuropsychiatry is the study of emotional and behavioral disorders in which disturbed brain functions are either scientifically established or strongly suggested. Prior to the 80s, the term neuropsychiatry was limited to conditions with identified etiologies, i.e., the depression or mania following a stroke, delirium/dementia associated with hepatic encephalopathy, or the paranoid/religious psychosis of a temporal lobe epileptic? However, with the rapid advances in the neurosciences, the more serious psychiatric disorders such as schizophrenia, obsessive-compulsive disorder, Tourette's, ADHD, bipolar disorder, and autism are undeniably recognized as brain disorders.

Considerable skepticism is raised in the courts when brain disorders are used to explain away horrific acts or serious antisocial behaviors. Mental health professionals may identify brain damage as a causal mechanism in wrongful behavior without adequate scientific basis. This may be the result of honest differences in opinion, advocacy, or in some instances (unfortunately) the willingness to provide a desired opinion for the referring party. Advocacy is counterproductive to the advancement of forensic science.

On the whole, there is little doubt that there are systemic failures in the identification of neuropsychiatry conditions in forensic setting. The brunt of this failure may be borne, (even to the point of receiving capital punishment), by those who have both psychosocial and neuropsychiatry vulnerabilities.

It is important that legal and mental health professionals develop and maintain sensitivity to the presence of neuropsychiatry conditions, especially among those who are multiply disadvantaged. Professionals also need to recognize the limits of scientific evidence in this area.

Forensic Neuropsychiatry, Traumatic Brain Injury, Neurotoxicology

I2 Bad Nature, Bad Nurture, and Testimony at Murder Trials

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After attending this presentation, attendees will have an understanding of how a person's nature (genetic make-up) and nurture (life experience such as child maltreatment) may interact to increase his risk for violence as an adolescent or adult, and how this information might be presented at a criminal trial.

This presentation will impact the forensic community and/or humanity by demonstrating how an increased awareness of how a person's genetic make-up might be used as mitigation at a criminal trial.

Mental health professionals have thought for many years that violent behavior is partly caused by a person's life experiences and partly by inborn genetic influences. Recent research – in which subjects were studied longitudinally from childhood until adulthood – has started to clarify how a child's environment and genetic makeup interact to create a violent adolescent or adult. (1) For example, Caspi et al. (Role of Genotype in the Cycle of Violence in Maltreated Children, *Science* 297:851, 2002) studied the monoamine oxidase A (MAOA) gene. When there is a low activity of this gene, neurotransmitters in the brain (serotonin, dopamine, and norepinephrine) are not properly metabolized. Caspi et al. found that when male subjects had a low activity of MAOA *and also* were maltreated as children, there was a much greater likelihood the person would manifest violent antisocial behavior in the future. (2) Also, Caspi et al. (Influence of Life Stress on Depression: Moderation by a Polymorphism in the 5-HTT Gene, *Science* 301:386-389, 2003) studied the 5-HTT (5-hydroxytryptamine or serotonin transporter) gene. The "transporter" is the cellular structure that reuptakes serotonin from the synapse. The 5-HTT gene can have either the "long allele" or the "short allele." Caspi et al. suggested that individuals with one or two copies of the short allele "exhibited more depressive symptoms, diagnosable depression, and suicidality in relation to stressful life events" than individuals with two long alleles. Information regarding a defendant's genotype, exposure to child maltreatment, and experience of unusual stress may be appropriate to present during the mitigation phase of criminal trials, especially when capital punishment is a consideration. The presenters will discuss their experience in genotyping criminal defendants and in presenting genetic information at criminal trials. Presenters will review how testimony regarding this use of genotyping has fared in light of *Daubert* criteria.

Genotyping, Violence, Death Penalty

I3 Mental Retardation and the Death Penalty: Issues in the Assessment of Adaptive Functioning

Daniel A. Martell, PhD, UCLA Neuropsychiatric Institute, 2906 Lafayette, Newport Beach, CA 91660*

After attending this presentation, attendees will understand the limitations of current methods for the assessment of adaptive functioning in the determination of Mental Retardation in death penalty proceedings.

This presentation will impact the forensic community and/or humanity by demonstrating how to utilize multiple adaptive functioning assessment approaches in evaluations of defendants facing capital litigation.

This presentation will address the problems encountered in efforts to evaluate the Adaptive Functioning of capital defendants in assessments of Mental Retardation pursuant to Atkins v. Virginia. A diagnosis of mental retardation generally involves three prongs: significantly sub-average intellectual functioning; deficits in adaptive functioning; and onset during the developmental period. Approaches to the assessment of adaptive functioning are often particularly problematic in death penalty cases. The extant published measures will be discussed with attention to the limitations in their design and applicability in the forensic arena. Alternative approaches to the assessment of adaptive functioning utilizing interview methods, investigative techniques, and review of records will be discussed. An integrative approach, drawing on convergent data from multiple sources is advocated.

Mental Retardation, Death Penalty, Adaptive Functioning

I4 Intellectual Quotient (IQ) in Teenagers Evaluated at the Bellevue Forensic Psychiatry Clinic After Committing a Violent Crime

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After attending this presentation, attendees will understand the importance of considering intellectual functioning assessment as part of the general evaluation of violence and impulsivity in adolescents.

This presentation will impact the forensic community and/or humanity by demonstrating the association between intellectual deficits and violent behaviors in adolescents that perpetrate violent crimes.

Hypothesis: There is a difference among defendants aged 14-17 years of age who were referred to the Bellevue Forensic Psychiatry Clinic after committing violent crimes and those among the same age group in the general population of the United States, as defined by the norms of the psychometric testing WISC-IV.

Aim: Evaluate a possible association between violent criminal behaviors in adolescents and their cognitive functioning.

Summary: This study will examine 28 charts of adolescent defendants who perpetrated violent crimes. The presentation will evaluate five sets of scores obtained through the WISC-IV administered to 28 adolescents referred to the Bellevue Forensic Psychiatric Clinic after committing violent crimes. The WISC-IV is a psychometric instrument designed to evaluate the intellectual functioning of adolescents and children and has been standardized to the general population of adolescents and children in the United States.

Importance of the Study: Deficient intellectual functioning may play a major role in teenagers who perpetrate violent crimes. This study will analyze the data provided by psychometric testing (WISC-IV) done in adolescents who committed violent crimes. Low WISC-IV scores may be associated with violent criminal offenses by adolescents. The WISC-IV may be a useful instrument to detect adolescents at risk of committing violent crimes. This information will assist the judiciary mental health services and correctional institutions in the processing and management of this population.

Methods: The method used for this study is a retrospective chart review of 28 defendants between the ages of 14 and 17 who were referred from the New York County Supreme Court to the Bellevue Forensic Psychiatry Clinic and who had psychometric testing done (WISC-IV) as part of their forensic evaluation. Once the data is obtained, it will be analyzed by using a Chi Square test with the help of the computer program SPSS. The data obtained will be compared with the WISC-IV norms for that population.

There will be no contact with the subject individuals for the purposes of this study. Information will be collected from court reports and the notes used to create the reports. The study investigator will record information into a de-identified data set. There is no risk of harm or discomfort to the individuals whose charts will be assessed. All original identifying documents will be maintained in a secure locked cabinet in the Bellevue Forensic Psychiatry Clinic, a locked office suite within a State Courthouse protected by armed court officers so that at least 4 different keys would be needed to access the material.

Results: The study sample consisted of 28 teenager defendants who were evaluated at the court clinic and who completed a WISK-IV assessment. The average age of the sample was 14.90 years. Out of the 28 subjects, 18 were African Americans, 9 Hispanics and 1 Caucasian. 27 of them were males, and only 1 female. The mean for the Full Scale IQ was 82.7143, which is more than one standard deviation less than the average IQ for their age groups in the United States. The averages for Processing Speed Index (PSI), Working Memory Index (WMI), P average was 78.46; Perceptual Reasoning Index (PRI), and Verbal Comprehension Index (VCI) were 78.46, 90.89, 87.17, and 86.71 respectively. A Pearson Correlation analysis demonstrated a significant difference between the IQ scores of the defendants studied and the general population at the 0.01 level.

Conclusion: There is a statistically significant difference between the IQ scores obtained in the population being studied when compared to those of the general population. There may be an association between intellectual deficits and violent behaviors. Intellectual functioning tests should be routinely administered when assessing violent adolescents. This information is extremely relevant in assisting the judiciary mental health services and correctional institutions in the processing and management of this population. Prospective studies are needed to establish a causal association between violence, impulsive behaviors and intellectual deficits.

Intellectual Deficits, Adolescents, Violence

I5 Interdisciplinary Peer-Review in Action

Michael Welner, MD, Kanthi De Alwis, MD*, and Ashraf Mozayani, PharmD, PhD*, The Forensic Panel, 224 West 30th Street, Suite 806, New York, NY 10001*

After attending this presentation, attendees will understand the application of an optimized, multidisciplinary peer-review protocol in forensic evaluations.

This presentation will impact the forensic community and/or humanity by demonstrating the integration of multiple interrelated scientific disciplines affording the opportunity for rigorous, thorough evaluations for complex forensic questions.

Increasing attention has been given to the potential imperfections of expert testimony, with dishonesty and bias all too prevalent in courts today. Accountability and oversight have inspired stipulations for peer-review in legislation. Expert testimony remains, however, largely the work of solitary consultants.

Mimicking the medical model, peer-review, the process by which scientists review and vet the findings of a primary physician, has emerged as mechanism that can enhance diligence, reduce potential bias and ensure that opinions are reflective of scientific standards.

The authors have optimized a peer-review protocol for forensic evaluations, in which clinicians with complementary areas of expertise provide oversight to the examination and conclusions of a same-specialty primary examiner.

Recently, however, the advantage of interdisciplinary peer review has been recognized the advantage of interdisciplinary peer-review: wherein peer-reviewers in multiple interrelated fields of relevance to a given case provide oversight to ensure that an evaluation is thorough and reflective of the standards of all fields overlapped.

To illustrate this application, *the authors* will present a case study of an investigation into the death of a 33-year-old man with a history of panic disorder and benzodiazepine dependence who died suddenly while in a correctional facility. In this case, the primary examiner is a pathologist, peer-reviewed by a toxicologist and psychopharmacologist. This unique collaborative approach enabled a complete inquiry into the scientific truths of this complex case with medical certainty, providing the confidence of a "last word" to the court.

Forensic Evaluation, Death Investigation, Multidisciplinary

I6 Science, Law, and the SVP Controversy

Amy Phenix, PhD, PO Box 325, Cambria, CA 93428; David Hackett, JD*, District Attorney, Washington State SVP Civil Commitment Program; Michael J. Aye, JD*, 117 J Street, Suite 202, Sacramento, CA 95814-2212; Dennis Carroll JD*, Office of the Public Defender, Washington State, 5724 35th Avenue NE; Seattle, WA 91805; and Mohan Nair, MD*, 433 North Camden Drive, Suite 600, Beverly Hills, CA 90210*

After attending this presentation, attendees will understand the SVP Civil Commitment laws and processes; assessment instructions such as the STATIC 99.MNSOST-R, SORAG; and paraphilias.

This presentation will impact the forensic community and/or humanity by demonstrating the relevant controversies of commitment programs from both a psychological and legal perspective.

Few issues in *a* community draw the kind of concern that sex offenders do. An increasing number of states (and nations) have instituted programs aimed at identifying and civilly committing those perceived as being at high risk to repeat violent sexual crimes. Critics see the programs as sacred cows, driven by fear rather than pragmatism and riding slipshod over civil liberties and backed by questionable science. The workshop will give a balanced education on this issue for the mental health, the legal community as well as for individuals who work with sex offenders.

Sexually Violent Predators (SVP), Paraphilia, Psychopathy

I7 Involuntary Hospitalization in Russia and the USA: Similarities and Differences

Roman Gleyzer, MD, Center for Forensic Services, Western State Hospital, 9601 Steilacoom Boulevard, SW, Tacoma, WA 98498; Alan R. Felthous, MD*, Chester Mental Health Center, PO Box 31, Chester, IL 62233; and Olga A. Bukhanovskaya, MD, PhD, and Alexander O. Bukhanovsky, MD, PhD, Rostov State University, Pr. Voroshilovsky 40/128, #15, Rostov On Don, 344010, Russia*

After attending this presentation, attendees will learn about the similarities and differences in Civil Commitment procedures in two countries with different legal and mental health systems and traditions.

This presentation will impact the forensic community and/or humanity by providing information to attendees about Civil Commitment procedures in countries with different legal and mental health systems.

Federal Law number 3185-1 "On psychiatric treatment and rights of citizens receiving it" was introduced in the Russian Federation for the first time in its history on July 2, 1992. Paragraph 4 guarantees voluntary psychiatric treatment "except for cases outlined by the law". The law, in turn, describes involuntary treatment in the following forms:

1. Involuntary psychiatric evaluation to determine the presence of mental illness, need for psychiatric help and determination of the help needed.
2. Involuntary psychiatric hospitalization.
3. Outpatient follow up.

The first two types of involuntary treatment are implemented if the patient presents with the evidence of serious psychiatric disorder signs of which are defined in commentaries to the Law and at least one of the following requirements is met:

a. Danger to self or others.
b. Helplessness
c. Significant threat to health if psychiatric help is not provided.

Both forms of involuntary treatment are implemented exclusively with the permission of the court. If the patient requires involuntary hospitalization the court's permission is obtained after hospitalization takes place. (Not more than eight days after admission). The court hearing is conducted in the presence of the state prosecutor, representative of health care facility and the patient or his or her legal representative. The legal process is strictly regulated in regards to its timeliness. The law (paragraph 4 page 11) allows for treatment to be started prior to the court decision and immediately after involuntary hospitalization. Outpatient follow up (in psychiatric dispensary) is ordered, implemented and terminated without the court's involvement. Hospitalization without proper indications is a serious criminal offense.

Involuntary hospitalization procedures in the State of Illinois: Involuntary hospitalization procedures in the State of Illinois were selected for comparison with the outlined above legal regulations.

The Illinois Mental Health Code (405ILCS 5/3 "Admission, Transfer, and Discharge Procedures for the Mentally Ill" Section 3-400) allows for the hospital admission into a state mental health facility of any person 16 years or older upon application of the facility director, "if the facility director deems such person clinically suitable "for voluntary admission. Chapter III also describes two categories of involuntary hospitalization:

1. Emergency Admission by Certification
2. Admission by Court Order

Emergency admission by certification applies to any person 18 years and older who is "subject to involuntary admission and [is] in such a condition that immediate hospitalization is necessary for the protection of such person or others from physical harm." Admission by court order pertains to a person 18 years and older who is subject to involuntary admission. "Person subject to involuntary admission means":

"(1) A person with mental illness who because of his or her illness is reasonably expected to inflict serious physical harm upon himself or herself or another in the near future which may include threatening behavior or conduct that places another individual in reasonable expectation of being harmed; or

"(2) A person with mental illness and who because of his or her illness is unable to provide for his or her basic physical needs so as to guard himself or herself from serious harm without the assistance of family or outside help."

Emergency admission can be accomplished immediately with the appropriate petition, but the person cannot be held more than 24 hours without submission of a certificate. At the court hearing for involuntary hospitalization by court order, the person must be represented by counsel and is entitled to a jury, if requested. The person is expected to be present at the hearing unless the person's attorney requests that his presence be waived, and the court is satisfied by a clear showing that the respondent's

attendance would subject him to substantial risk of serious physical or emotional harm." The initial court order is valid for up to 90 days, a second period for 90 days, and then180 day periods of involuntary hospitalization can be sought thereafter, if criteria persist.

Involuntary administration of psychotropic medication in not authorized by involuntary hospitalization. Legal regulations specify criteria for emergency and court ordered medication, and these differ from the criteria for involuntary hospitalization. A treatment plan must be submitted to the court within 30 days of hospital admission, and again 90 days after admission and then every 90 days thereafter. Outpatient treatment and voluntary hospitalization at private or non-state operated facilities do not involve such court oversight.

This presentation will summarize similarities and differences of the Civil Commitment procedures in Russia and the USA.

Involuntary Hospitalization, Psychiatry, Civil Commitment

I8 Did Graham Young Suffer From Asperger's Disorder?

J. Arturo Silva, MD, PO Box 20928, San Jose, CA 95160; Gregory B. Leong, MD, Western State Hospital, 9601 Seilacoom Boulevard SW, Tacoma, WA 98498; Barbara G. Haskins, MD, Western State Hospital, PO Box 2500, Staunton, VA 24401; Mohan Nair, MD, 5212 Katella Avenue, Suite 106, Los Alamitos, CA 90720; and Michelle M. Ferrari, MD, Kaiser Permanente Child Psychiatry Clinic, 900 Lafayette, Santa Clara, CA 95050*

After attending this presentation, attendees will learn the basic diagnostic aspects of Asperger's Disorder and its potential relevance to understanding serial poisoning behavior and other types of serial offenses.

This presentation will impact the forensic community and/or humanity by providing the psychiatric and neuropsychiatric aspects of serial poisoning and serial killing behavior.

Graham Young was first convicted of poisoning people when he was 14 years of age. At that time, he was convicted of non-lethally poisoning his father, his sister, and a school acquaintance. Although he was never charged with the killing of his stepmother, he eventually acknowledged having killed her by poisoning her with thallium. At the time of his arrest, a large supply of poisons was found in his home, sufficient to kill 300 people. Following his convictions, he was sent to Broadmoor Hospital where he was confined for a period of eight years. Although, there was substantial evidence that Mr. Young continued to be fixated on poisoning and on themes involving death, he was declared sufficiently rehabilitated to allow for early release into the community.

Within six months after his release, he killed two of his co-workers by poisoning them with thallium. In addition to two murder convictions resulting from these two homicides, he was also convicted twice with attempted murder as a result of having non-lethally poisoned two other co-workers. Four other charges were made as a result of non-lethally poisoning other co-workers. He was found dead at age 42, apparently secondary to a myocardial infarction. Although the possibility that he committed suicide via poisoning has been raised, no evidence exists that he died due to self-induced poisoning.

Graham Young was the second of two children born to a housewife and a father who was an engineer. His birth delivery was associated with having been a "blue baby." His mother died when he was about three months old. He was raised by his father and other family members. When Graham was about three years old, his father remarried. Thereafter, his stepmother raised him until he killed her approximately 11 years later.

Although he was not a particularly good student, he was considered to be an intelligent person. He appeared to have had a heightened olfactory sensitivity, and during his adolescence he abused ether. Eventually he developed Alcohol Abuse. Graham Young also presented with a history of psychopathology dating back to his early childhood that is strongly suggestive of high functioning autism. With regard to a history of qualitative impairment in social interaction, there was evidence of marked impairment in the use of multiple nonverbal behaviors involving social interaction and a failure to develop peer relationships appropriate to his developmental level, and there was a lack of social or emotional reciprocity. With regard to restricted repetitive and stereotyped patterns of behavior, interests, and activities, he manifested an encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus. He also manifested an apparently inflexible adherence to specific, nonfunctional routines or rituals. Specific examples of Young's autistic psychopathology are presented.

There is no evidence that Graham Young suffered from delays in language, cognitive development, acquisition of age-appropriate self-help skills, or adaptive behavior skills other than socialization. There was insufficient evidence for schizophrenia. During his early childhood he exhibited repetitive movements. Given the available information, it is concluded that Mr. Young likely suffered from Asperger's Disorder.

The case of Graham Young highlights the notion that serial poisoning may be intrinsically associated with Asperger's Disorder. Poisoning associated with autistic spectrum pathology may be more common than currently reported. A more contemporaneous case of Asperger's Disorder associated with criminal poisoning appears to be that of Robert Alsberg, who was recently convicted, after having prepared the highly poisonous agent, ricin, and stating "It's now exciting working with poisons. Perhaps I'll find a way to end all life on Earth through some interesting items."

Given that Graham Young killed three persons at different times, as well as the nature of the killings; he also qualifies as a case of a nonsexual serial killer. The present study indicates that combined biopsychosocial and psychohistorical approaches constitute viable strategies in the study of serial crimes such a serial poisoning or nonsexual serial homicide, which is intrinsically associated with high functioning autistic psychopathology (Asperger's Disorder).

Serial Poisoning, Serial Killing Behavior, Asperger's Disorder

I9 Anti/Pro: Castration and Anti-androgen Medications Can Help in the Management of Sex Offenders

Fabian Saleh, MD, PhD, 55 Lake Avenue North, S7-802 Department of Psychiatry, Worcester, MA 01655; and Jesus Padilla, PhD*, Atascedero State Hospital, Atascedero, CA 93423-7001*

After attending this presentation, attendees will understand the debate regarding the use of castration and anti-androgen drugs in treating sex offenders.

This presentation will impact the forensic community and/or humanity by providing more information for professionals dealing with sex offenders to help them deal with this population and the needs of the community.

An in-depth review on castration and medications used in treating sex offenders is presented. This is followed by the current study Penile Plethysmography findings as it relates to anti-androgen use**.**

In the treatment group (n=26) mean age was 43 and the comparison group (n=11) mean age was 41.3. They were assessed in both Arousal and Suppress conditions and a Two-way Analysis of Variance was performed.

Testosterone levels for subjects on Anti-androgens ranged from 10 to 155 ng/dl and the mean was 37.12 (Normal range is approximately 300 to 1500 ng/dl). All subjects were concurrently enrolled in cognitive-behavioral and relapse prevention treatment. Almost all of the subjects in both groups were able to obtain an erection sufficient to calibrate the instrument.

Treatment with anti-androgen does not appear to have any impact on sexual deviance or arousal as measured by the PPG. Objective measures of sexual functioning should be employed to assess the effectiveness of anti-androgen. *One* cannot rely on self-report alone.

The literature though conflicting suggests that both castration and medications including anti androgen medications can be helpful for the management of sex offenders. Low recidivism rates are noted after castration. Sex drive will prevail longer if the patient is castrated at a younger age. Rapid extinction of sex drive is seen in older castrated patients (30 and above). Sexual behavior declines/ceases in most castrated patients. Based on pharmacodynamic properties, medications can be grouped into: sex hormone-lowering agents (e.g., testosterone), serotonergic agents (e.g., serotonin-specific reuptake inhibitors), others (e.g., dopaminergic), luteinizing hormone-releasing-hormone agonists (LHRH-A), medroxyprogesterone acetate (MPA), cyproterone acetate (CPA).

Manifold combined pharmacological effects decreases serum and tissue sex hormone levels (testosterone). There is also a decrease in intensity and frequency of deviant sexual urges, cravings, and behaviors. There can be serious side effects (e.g., cardiovascular, liver, endocrine, etc.). Anti-androgens and hormonal decrease within a short period of time may impact the frequency and intensity of paraphilic symptoms. Castration, Anti-androgen and other medications can be invasive and intrusive Rx with potentially serious side effects.

Sexually Violent Predators, Anti-androgen Drugs, Castration

I10 Current Understanding of False Allegations of Sexual Harassment

Suma F. Gona, MD, New York University Residency in Forensic Psychiatry, Forensic Psychiatry Clinic, 100 Centre Street, Room 500, New York, NY 10013; and Stephen B. Billick, MD, 11 East 68th Street, #1-B, New York, NY 10021*

After attending this presentation, attendees will have an understanding of the current psychiatric literature about false allegations of sexual harassment.

This presentation will impact the forensic community and/or humanity by fostering an interest in further research and study into sexual harassment issues.

This presentation will review the current understanding of false allegations of sexual harassment. The presenter reviewed the current literature on false allegations of sexual harassment, with a particular emphasis on the psychiatric literature. The presentation will begin with a discussion of the legal definitions of sexual harassment. Relevance of a discussion about sexual harassment will be presented, including the incidence of sexual harassment cases, as well as sociological trends that are contributing to sexual harassment being an important workplace issue. A literature review of the psychological aspects of sexual harassment will be presented, as well as a discussion of the role of the psychiatric evaluation in these cases. Other areas of false allegations of sexual trauma will also be covered: child sexual abuse, rape and False Victimization Syndrome will be briefly reviewed in order to offer possible additional insight and applicability to the topic of false allegations of sexual harassment.

Sexual Harassment, False Allegations, Forensic Psychiatry

I11 A Pilot Study: Do Paraphilic and Non-Paraphilic Sex Offenders Differ on Measures of Compulsive and Impulsive Traits?

Denise C. Kellaher, DO, 1750 Kalakaua Avenue #2404, Honolulu, HI 96826*

After attending this presentation, attendees will 1)be able to distinguish difference between paraphilic and nonparaphilic sex offenders; 2) be able to appreciate difference between impulsivity and compulsivity; 3) will be able to become acquainted with current assessment methods and treatments of sex offenders; and 4) will be able to learn of current legislation involving sex offenders.

This presentation will impact the forensic community and/or humanity by demonstrating a hopeful impact of this presentation on the audience is to stimulate more thought regarding improved clinical assessment of the sex offender. Improving assessment may lead to improved treatment, potentially decreasing recidivism.

Objective: Sex offenders may be categorized clinically as "paraphilic" and "non-paraphilic" and also has been described as either "impulsive" and as "compulsive." There have been few studies to determine whether traits such as obsessive-compulsiveness or impulsivity differentiate paraphilic from non-paraphilic sex offenders. Such delineation between these groups or even among subsets of these groups may provide a more focused approach in the administration of treatment that is currently more governed by legal history than by clinical variables.

Method: 21 male adjudicated sex offenders, 9 paraphiles and 12 non-paraphiles, participating in outpatient group therapy were evaluated by the Millon Clinical Inventory-III, the Yale-Brown Obsessive-Compulsive Scale (YBOCS), and the Barratt Impulsive Scale, Version 11 (BIS-11) to determine if significant differences in obsessive-compulsive and impulsive traits existed between paraphilic and non-paraphilic sex offenders.

Results: 44.4% of the paraphiles showed measurable obsessive-compulsive traits versus 25% of the non-paraphiles on the YBOCS. Only 44.4% of the paraphiles demonstrated significant impulsive traits versus 83.8% of the non-paraphiles as measured by the Barratt Impulsiveness Scale, Version 11.

Conclusion: These results indicate significant differences in the presence of obsessive-compulsive and impulsive traits between groups of sex offenders. Paraphilic offenders demonstrated more obsessive-compulsiveness and non-paraphilic offenders demonstrated more impulsivity. These findings may indicate that clinical assessment of such traits could direct future treatment efforts.

Sex Offenders, Impulsive, Compulsive

I12 Psychological Reconstruction and Crime Scene Analysis in Cases of Equivocal Manner of Death

William Cardasis, MD, 202 East Washington Street, Suite 208, Ann Arbor, MI 48104*

After attending this presentation, attendees will understand how forensic psychiatric consultation with the medical examiner's office on cases in which the manner of death is equivocal can provide needed assistance with the determination of the manner of death – suicide versus accident or homicide, for example.

This presentation will impact the forensic community and/or humanity by fostering a collaborative multidisciplinary approach between areas of forensic medicine and diminishing uncertainty on manner of death determinations in difficult cases.

Psychological reconstruction ("psychological autopsy") and crime scene analysis involve the study of the risk factors and psychiatric underpinnings of suicide along with study of crime scene indicators, historical information of the decedent, and review of collateral source information to determine whether the cause of death was self-inflicted and intentional. Risk factors for suicide, methods of suicide will be reviewed. The general principles of crime scene analysis: information gathering, decision making about victim and perpetrator intent/motive, and sequential reconstruction of events will be discussed. Representative cases will be presented to elucidate relevant issues and to identify how further collaboration between forensic psychiatry and other areas of forensic science can be mutually beneficial.

Psychological Reconstruction, Death Scene Analysis, Psychological Autopsy

I13 Mass Disasters: Natural and Man Made - The Return of Personal Property After Disaster

Lucy C. Payne, MSc, 46 Harris Road, Armthorpe, Doncaster DN3 2FE, United Kingdom; and Anne Eyre, PhD, Trauma Training, PO Box 2590, Leamington Spa, Warwickshire CV31 1GQ, United Kingdom*

After attending this presentation, attendees will understand the technical and sociological aspects of the return of personal property after worldwide disasters.

This presentation will impact the forensic community and/or humanity by demonstrating best practice methodology for addressing personal property after a mass disaster.

When it comes to the specific details relating to the recovery, processing, and return of personal property to survivors and the bereaved there are varying degrees of understanding about the meaning and significance of personal property and a lack of clarity within and across the various responding organizations about protocols for dealing with such property. This project, in association with leading UK Police Officers, Coroners, charities and government agencies is tackling this with the production of technical advice, guidance leaflets and a Charter of Rights.

Motivated by experiences as a disaster response worker with specialist responsibility for the return of "personal effects" after numerous mass fatality incidents, the researcher initially embarked on an analysis of available literature in this area on both sides of the Atlantic followed by presentations, workshops, and articles to a variety of audiences.

The purpose of this work is to now highlight key issues relating to the treatment and return of personal property and for the AAFS meeting would place this in both a forensic and therapeutic context for those working in a response capacity. The technical elements of the work would be emphasised such as the best practice methodologies used for identification and the critical factors for storage and sensitive process of items (which may be contaminated with fuel, chemicals and blood borne diseases). This issue would also be placed in the wider context of the researcher's ongoing studies into the interlinking of forensic and "human aspects" work.

References:
American Aviation Disaster Family Assistance Act, 1998, including accompanying guidance, material provided by Red Cross, Association of Chief Police Officer Family Assistance.

Return of Personal Property, Disaster, Mass Fatality

I14 Validity of Different Instruments in Assessing ASPD

Michael B. Jackson, MD, St. Vincent's Hospital Manhattan, 144 W 12th Street, New York, NY 10011; and Stephen B. Billick, MD, New York Medical College, 11 East 68th Street, #1B, New York, NY 10021*

After attending this presentation, attendees will gain knowledge of the various instruments in the assessment of ASPD and the validity of these measures.

This presentation will impact the forensic community and/or humanity by demonstrating the usefulness and thoroughness of each of the instruments in the assessment of ASPD and its severity.

Psychopathy, sociopathy and antisocial personality disorder (ASPD) are important entities for forensic psychiatrists and forensic psychologists. Although ASPD is a clinical diagnosis made using DSM-IV-TR criteria, it is very important to have an understanding of the various psychological measures and rating scales that can be useful in refuting or supporting the diagnosis. The Psychopathic Personality Inventory (PPI) is a self-report measure, which assesses the primary facets of primary psychopathy. The Psychopathy Checklist-Revised (PCL-R) developed by Robert Hare, Ph. D., is the most extensively validated measure of psychopathy. One of the most widely used multi-scale inventories, the Minnesota Multiphasic Personality Inventory (MMPI-2), also has been used in assessing antisocial psychopathology specifically the psychopathic deviant (Pd) sub-scale and the antisocial practices (ASP) scale. The Personality Diagnostic Questionnaire-Revised (PDQ-R) - ASPD scale is a self-report measure assessing DSM-III-R criteria for ASPD. The Structured Clinical Interview for DSM (SCID-2) - ASPD scale, is a structured psychiatric interview that is also designed for assessing DSM-III-R criteria for ASPD.

Antisocial Personality Disorder, Psychopathy, Assessment

I15 Forensic Evaluation of Psychological Reactions to Mobbing in the Workplace

Giuseppe Troccoli, MD, University of Bari, Largo Giordano Bruno, 65, Bari, 70121, Italy; and Ignazio Grattagliano, Laura Amerio, Vincenzo Castaldo, MD, Leonardo Soleo, MD, and Roberto Catanesi, MD, University of Bari, Policlinico - Piazza Giulio Cesare, Bari, 70124, Italy*

After attending this presentation, attendees will gain an understanding of business strategy, verification of effects, and evaluation methodology.

This presentation will impact the forensic community and/or humanity by demonstrating the value of conclusions based on elements of greater objectivity regarding both the quality of mobbing and the interpsychic dynamics and consequences produced.

First, a business strategy could be conducted in such a systematic way with the use of instruments of psychological pressure in order to break the will of workers to the point of producing negative consequences on their health. The existence of an ample judicial investigation and two consecutive guilty verdicts allows for a clear understanding of the facts that act to remove the possibility of subjective interpretation.

Second, the concrete verification of the effects produced by mobbing on the psychological and emotional states of an individual, eliminating the doubt which always arises on this subject, that is to say, whether the event was truly mobbing, or only experienced as such by the worker.

Third, to help in the selection of the most correct methodology of evaluation of those cases in legal-medical circles that are different than those of clinical circles; the choice of the best-suited psycho-diagnostic tests; the differences between clinical and medical-legal diagnoses, etc. Above all because of the distinctiveness of this case, unusual with respect to typical, current case histories.

Due to the data that come from both clinical as well as judicial investigation. In a field of study where the risk of subjectivity is very high, this case offers uniform characteristics regarding both the alleged pathogenic working environment, as well as the chosen clinical observation method.

The focus of the study presented here is based on the presence of two uncommon factors that are in contrast to the usual observations of employees who complain of mobbing. One is the uniformity of the environment and the act of mobbing itself. The other is the significantly high number of workers observed (20). In this case a judicial proceeding was initiated and is currently being conducted, and the employer has been found guilty. The course of investigations made it possible to identify acts of mobbing with greater objectivity, dispelling possible doubts that the workers who were subjected to such actions were exaggerating the facts.

The work environment in question is that of a large and important industrial company in which, subsequent to the arrival of privatization, a certain number of employees in the late stages of their careers were offered the option of entry-level jobs. In cases of refusal, that employee was sent to work in a crumbling building situated inside the industrial complex, absent of work supplies, including desks and chairs in sufficient numbers for all. The transferred workers were not assigned any tasks, regardless of their level of education, their previous qualifications, or seniority reached.

During the course of their stay in the assigned workplace, in which these employees remained for about a year before the courts intervened by

closing and sequestering the building, the workers began to present with significant psychological disturbances which included glaring behavioural reactions accompanied by agitation and the threat of self destructive behaviour.

At the request of the institution responsible for social security in Italy (INAIL), the presenters observed twenty of these workers at the Department of Forensic Psychiatry and the Department of Industrial Medicine of the University of Bari. Each of the subjects underwent psychiatric observation and was seen by an industrial physician. Each was also administered psycho-diagnostic testing. The presence of such similar conditions and pathogenic stimuli for all the subjects, whether regarding the mechanism of the action, or the duration of the exposure, has led the group studying these workers (comprised of psychiatrists, psychologists, and industrial physicians) to concentrate their attention on the manner and type of each individual's response to the mobbing elements. Among the more notable elements that seemed to have played a relevant role in determinism and the duration of the psychological reactions by the worker was the violation of one's professional and or working image, putting the employees' sense of security into a state of crisis that, up until that moment, were intact and well-recognized).

The obtained results (i.e., with regard to the type and duration of symptoms, the individual's experience, familial and environmental reactions, therapies provided, duration of exposure, etc.) are discussed in detail, and are supported by the scientific literature on the subject.

Mobbing, Psychological Reaction, Forensic Evaluation

I16 Deception Leaves a Linguistic Trace: Assessment of Lying Using Computational Discourse Analysis

Robert K. Welsh, PhD, Kevin Reimer, PhD, David Arney, BA, Wendy Chan, BA, Lauren Stevenson, BA, Joshua Morgan, BA, and Rhea Holler, BA, Department of Graduate Psychology, Azusa Pacific University, 901 East Alosta Avenue, PO Box 7000, Azusa, CA 91702*

After attending this presentation, attendees will understand the basics of computational linguistics and its application as new methodological approach for research on deception.

This presentation will impact the forensic community and/or humanity by demonstrating a new paradigm for future research on deception.

This paper presents a new methodology for the assessment of deception through computational discourse analysis. Preliminary data are presented for three studies where a computational model (Latent Semantic Analysis – LSA) was able to significantly detect group differences in college students who provided brief language samples when instructed to tell the truth or lie.

The common thread that runs through all methodologies that seek to detect deception is language. Arguably observance of behavior is a central component to one who is malingering, but the forensic examiner still questions the examinee about his/her behavior and seeks an interpretation of the behavior. Language is a fundamental feature of psychometric assessment, polygraph and integrity testing and clinical interviews designed to detect deception.

Latent Semantic Analysis (LSA) is an unsupervised method of computational linguistics designed to statistically represent the contextual-usage meaning of words (Landauer, Foltz & Laham, 1998). LSA was developed at Bellcore Laboratories and refined at the University of Colorado, Boulder. Conceptually, LSA uses a matrix-driven decomposition technique, much like factor analysis, called singular value decomposition (SVD). In LSA words, sentences and paragraphs are assigned a vector as a knowledge representation estimate in high dimensional space based on cosine values ranging form -1.0 to +1.0. Cosine vectors represent the similarity and dissimilarity that are interpreted as meaning associations. High scores represent consistency and coherence of knowledge representations.

One strength of LSA that is clinically useful in the detection of deception is its ability to detect internal consistency and coherence of knowledge representation. Knowledge representation is central to the task of accurately reporting one's history. A reliable self-report requires that one has direct personal experience with the history being reported. Moreover, the author's propose that internal coherence of knowledge representation can only happen when an examinee is telling the truth. When evaluating whether or not an individual is accurately representing themselves, the forensic examiner pays close attention to the coherence, consistency and amount of convincing detail given in the examinees personal account. When inconsistency is discovered in an examinees narrative account, the forensic examiner uses the inconsistent information as data to strengthen the case that the examinee has given an unreliable self-report. However, for individuals who are adept at deception, it is often not possible, even through extended interviews, to "catch" an examinee in a lie.

The strength of LSA as an unsupervised computational linguistic model is that it mathematically approximates the same features found in human representations of meaning based on past experience. Through an individual's narrative, LSA will be able to approximate the extent to which the account reflects induction and representation based on lived experience.

LSA does not utilize word order or syntax to extract meaning representations from the narrative. Rather, it is able to use comparisons between words, sentences and paragraphs to extract the meaning from the whole at a deeper or "latent" level. Accordingly, LSA is able to determine how word choice represents meaning (Landauer, Fultz & Laham, 1998).

In this paper, the presenters use LSA to detect inconsistencies or lack of coherence of knowledge representation. Discussion of computational linguistics as a research and clinical tool will follow the presentation of the experimental data.

Deception, Malingering, Computational Linguistics

J1 Questioned Documents and the Crime Scene

Gerry LaPorte, MSFS, United States Secret Service, Forensic Services Division, 950 H Street NW, Washington, DC 20223*

After attending this presentation, attendees will understand the importance of the appropriate collection, handling, and preservation of a questioned document (QD) and related evidence. As well, the author will discuss suggested procedures regarding the collection of known standards (non-handwriting) of various materials that may be associated with a QD such as photocopier and inkjet exemplars, paper standards, and writing inks.

This presentation will provide a thorough discussion of pertinent questioned document materials that should be collected at a crime scene. The author will present some adjudicated cases as a learning tool for forensic scientists.

Some of the most infamous modern criminal cases such as the Unabomber, the mailing of anthrax spores, the "DC Sniper Shootings," and the BTK serial killer have all been associated with questioned documents. The focus of an investigation may include letters, envelopes, packages, calendars, diaries, identification cards, financial documents, contracts, wills, and business records. Obviously, there are numerous types of crime scenes that may arise, so the type of evidence collected may vary. In cases such as kidnapping, extortion, and death threats where a questioned document may be left by an unknown subject, a request is often made to immediately conduct a latent fingerprint examination. Many criminals that leave anonymous letters, however, have an awareness of the evidentiary value of fingerprints and typically do not handle a document with their bare hands. Therefore, if a suspect(s) is apprehended, the QD can sometimes be the pivotal link.

The use of printers and copiers is often utilized in crimes because of the widespread availability and ease of use. The author will discuss the types of specimens that may be collected if an office machine is involved such as inkjet and toner cartridges, print samples, and peripheral hardware (e.g. scanners and digital cameras). Indeed, investigators should also be cognizant of comparative examinations that may be conducted on items such as paper, envelopes, inks, and stamps. As well, forensic document examiners should remain attentive to preserving documents for subsequent examinations such as trace evidence and DNA analysis. Other crimes such as counterfeiting and financial fraud will also be presented. Counterfeiting crimes may involve collecting offset lithography materials, original documents from a suspect (e.g. the suspect's drivers license or social security card may have been used as a template to create other fraudulent identifications), and miscellaneous materials such as plastic card stock and laminate.

Questioned Documents, Crime Scene, Threatening Letters

J2 Development and Validation of an Automated Biometric Handwriting Comparison System

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After attending this presentation, attendees will learn about key technologies underlying the development, implementation, and validation of an automated handwriting-derived biometric identification system, as well as the conceptual basis for the "Biometric Kernel" of user-specific characteristics that can be used to distinguish among writers and the empirical/ statistical basis for using the kernel as a handwriting-based biometric identifier.

This presentation demonstrate how the development of an automated handwriting identification system can assist document examiners with sorting through large numbers of documents from various writers and provide potential candidate writers from previous offenses. The existence of an objectively-derived writer's biometric identity supports *Daubert* challenges to the premise of individuality of handwriting, and the development of this system provides a tool for future statistical studies of handwriting individuality.

Forensic document examiners routinely perform handwriting comparisons for writer identification. The underlying premise for such identifications is that each person incorporates individual features into handwriting, which can be used to distinguish it from that of other writers. During *Daubert* admissibility hearings, the validity of this foundation of individuality and the significance of handwriting characteristics as associative evidence have been challenged. In order to assess the frequency of occurrence and significance of handwriting characteristics, a collection of handwriting samples from a large number of individuals must be acquired. Further, in order to evaluate this premise, it is advantageous to compare handwriting using an automated system, which can provide quantitative data for verification of common features and process a larger database of samples than can manual examination. This presentation provides a discussion of key technologies underlying the development, implementation, and validation of an automated handwriting-derived biometric identification system, the Biometric Handwriting Comparator (BHC). It will also address the conceptual basis for the "Biometric Kernel" of user-specific characteristics that can be used to distinguish among writers, as well as the empirical/statistical basis for using the kernel as a handwriting-based biometric identifier. Finally, the results of blind testing of the BHC for automated writer identification utilizing small amounts of text will be presented.

Handwriting and hand printing samples from approximately 500 individuals were collected. Because it is the current practice in the document community, when possible, to collect writing exemplars from individuals in a single sitting, and for convenience of sampling such a large population of volunteers, exemplars for this project were collected in this manner. Exemplars were collected from volunteers at various locations, including government agencies, professional meetings, and via personal contacts. Each participant was given a packet containing a writing passage (modified London business letter), personal information form, informed consent form, ten sheets of unlined paper and a Bic® pen (medium black

RoundStic™). Exemplars from each participant consist of the passage written five times in cursive (script) and five times in hand printing on separate pages. Collected exemplars were optically scanned and used as reference and test sets in automated BHC. These writing exemplars, which provide a measure of both intra- and inter-writer variability, aided in the development and validation of the BHC for the comparison of writers. While these samples of convenience are suitable for this purpose, additional targeted sampling is needed to fully explore the premise of the individuality of handwriting.

The BHC is a portable, PC-based system that permits automated, real-time identification of the writer of a document. Handwriting-derived biometric identification exploits the rich set of measurements available through Isomorphic Graph Matching, a technique based on Graph-Theory that is used to identify the same written forms in different writing samples. By statistically comparing measurements on similar objects across different writing, identifying those writing characteristics that best distinguish or characterize individual writers is possible. A writer's biometric identity, or "Biometric kernel," is defined through the measurements that are determined to characterize that person's writing, in the sense that those measurements have the power to distinguish his/her writing from that of other writers. Handwriting-derived biometric identification is a computationally intense process that utilizes statistical discrimination algorithms.

The BHC with statistical discrimination algorithms has been tested utilizing text with large and small quantities of characters with good results. Using a database of cursive handwriting from 100 writers, when a sample of 15 or more characters was used to locate a true writer, over 95% of the time that true writer had the highest score. That is, the true writer was identified by testing as the most likely writer for the sample of characters. Additionally, the true writer was virtually always identified as one of the two top scoring candidate writers.

In order to test the system under a more realistic case scenario, a blind test is currently underway using mock bank robbery notes collected from various individuals, both writers who previously submitted samples and some not currently in the database. These writing samples were collected using unlined paper and a blue or black ink pen, which was chosen by the writer. The bank robbery note exemplars were collected almost three years after the original reference documents to which they will be compared.

Automated Handwriting Identification, Forensic Document Examination, Handwriting Individuality

J3 Examining the Minor Printing Screen-Dots and Micro-Printing Features by Using the USB Interface Microscope

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After attending this presentation, attendees will understand the function of the USB microscope and how it is used to examine the minor features of different kinds of printed materials and other related documents.

This presentation will impact the forensic science community with a new concept of following the progress of the computer and digital science new technology, the questioned document identification technology also has been connected intensively to the computer related equipment and special computer soft program. If the USB interface microscope becomes popular in questioned document identification work, traditional methods may no longer be adopted and fade away gradually.

In most cases involving printing materials identification, an examiner comparing the minor differences of the screen-dots, micro-printing, and other specific features from the questioned printing evidence to the genuine specimen can usually determine the authenticity of the questioned printing evidence. Traditionally, by using the different kinds of microscopes available in the laboratory, most document examiners can do the job very well. However, if the examination is conducted outside the laboratory or at the crime scene, identification work may be interrupted.

This presentation is going to describe a specific portable USB interface microscope which, unlike the traditional microscope, does not need direct or alternating current or a battery. This microscope was designed to connect a notebook PC by USB interface. The enlarge ratio can be adjusted from 30X to 1000X simply by changing the lens. The examiner can capture the enlarged image directly to the PC monitor by using the specially designed software. The result of the side by side comparison work can be obtained and printed out immediately.

Experimental results in many real cases show that the USB interface microscope not only can be used to provide instant side by side comparisons, but also can be used to obtain an instant report or chart. This presentation will describe the functions and processing methods of the microscope.

Screen-Dots, Micro-Printing, USB Microscope

J4 The Forensic Document Examinations in the Case Concerning Maritime Delimitation and Territorial Questions Between Qatar and Bahrain at the International Court of Justice

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After attending this presentation, attendees will become aware of a major international dispute that involved numerous non-genuine documents. Familiarity with the way basic techniques were used to examine unfamiliar documents and the resultant findings in this matter can aid examiners who may encounter documents from the same non-genuine source or a source using similar methods of fabrication.

This presentation will impact the forensic community by highlighting that the non-genuine documents presented to the International Court of Justice in this matter are known to be only part of a larger group of similar non-genuine documents, and that the actual number of these fabricated documents is not known, as well as by noting that future disputes may see more of these documents or others from the same or a similar source.

On 16 March 2001 in The Hague President Guillaume of the International Court of Justice, the principal judicial organ of the United Nations, delivered the Court's Judgment in the Case Concerning Maritime Delimitation and Territorial Questions between Qatar and Bahrain, the longest running case in the Court's history. The case centred on a territorial dispute between the State of Bahrain and the State of Qatar, involving Qatar's claim filed in July 1991 to "sovereignty over the Hawar islands, sovereign rights over the shoals of Dibal and Qit'at Jaradah, and the delimitation of the maritime areas of the two States," an area that in total represented sizable portion of the territory of Bahrain. While the judgment (which preserved Bahrain's sovereignty over the Hawar Islands) is considered by some to be among the most important ever handed down in the area of boundary rights by that tribunal, it did not take into consideration a collection of almost seven dozen documents from the Qatari Diwan Amiri Archives that were submitted in support of Qatar's position.

These documents, which would have virtually 'made the case' for Qatar, were examined by a team of experts for Bahrain including scholars specializing in Gulf and Ottoman history and in the development of international boundaries in the area, as well and American and Egyptian forensic document examiners. The experts for Bahrain concluded that the entire collection was not genuine.

It is not surprising that a similar team of experts for Qatar reviewed and criticized the reports of the various experts for Bahrain; however, what may

be surprising is that the forensic document examiners for Qatar concluded that virtually all the questioned documents "contain faults or flaws which cannot be refuted or rebutted." Largely as a result of the examinations of the forensic document examiners (on both sides), Qatar "decided [to] disregard all the 82 challenged documents for the purposes of the present case…." Subsequently Qatar expressed "its regret at the situation that has arisen and the inconvenience that this has caused to the Court and Bahrain."

The presentation will focus on the basic methodologies used in the technical examinations of the questioned documents. These included examinations of the paper, paper fracture (tear) matches, rubber stamp impressions, seal impressions in wax, and inked impressions on paper. Both questioned to known and questioned to questioned comparisons were involved in the examinations.

Issues of methodology and serendipity (or the recently popular psychological idea of rapid cognition) will also be addressed.

Age of Documents, Historical Documents, Team of Experts

J5 Making Serendipity Happen

M. Beth Olsen, PhD, Office of the Prime Minister's Legal Advisor, PO Box 145, Manama, Kingdom of Bahrain*

After attending this presentation, attendees will have increased awareness of the coordination, logistical, and equipment issues for a forensic document examination "in the field" by a team of experts with different specialties and sub-specialties, as well as the use of multi-field expertise to cross-verify results. Attendees will also learn about the methodology for documenting manufacturer information to demonstrate fatal anachronisms and anomalies in the source of materials used to create a document.

This presentation will demonstrate coordination, logistical, and equipment issues in team examinations in the field, and illustrate the documentation of significant information from manufacturers. It will also demonstrate the idea that even after an examination or a case is completed, if prepared for and open to it, new avenues for further research and proof can present themselves.

A border dispute between the Arab Gulf states of Bahrain and Qatar had been simmering, and sometimes boiling over, for generations when the case was finally brought before the International Court of Justice (ICJ). When Qatar submitted initial filings on the issues to the ICJ in 1996, Bahrain noticed numerous problems with many of the documents relied on by Qatar. Bahrain soon realized that it had been unavoidably tasked with determining whether these documents were authentic, and if not, proving it.

An international team of historians, legal experts, archival researchers, and forensic document examiners was assembled, and in September 1997 the team was given three weeks to complete an examination of the original documents. Because the documents would not be allowed out of the Court, equipment normally associated with a major crime laboratory had to be assembled and set up on site. Furthermore, because a full series of expert reports was required, facilities were set up in the 'team hotel' for writing and fully illustrating the findings reports.

Historians and archival researchers found distortions of well documented historical fact; letters written by non-existent personages; official letters written by people who were dead, or by school children yet to enter government service. Document examiners were able to determine that many of the documents had been written on recycled paper; that personal seals had been reused by a variety of people many years apart; that handwriting and word choice indicated something less than multiple authorship; and that letter formats differed from those of authentic documents.

But the case for proof was helped as well by two serendipitous events — one just after the original reports on the suspect documents were submitted to the Court, and the other a year after the case had been finally adjudicated. In both instances, the origin of some of the seals used on the documents came to light — once in a novelty boutique in Amsterdam and once at a street market in London. In the first, a commercial set of seals first produced in 1990 was found to match impressions on documents dating from 1860-1870. In the second instance, a group of stamps made and sold by a present day street vendor in London matched impressions on documents purportedly from a diverse variety of sources and dating from 1867-1938, matching both at the level of overall design and at the level of unique accidental manufacturing flaws.

While serendipity may have led to these discoveries, methodologically sound documentation was required to establish the significant details for use in evidence. These included interviews with individuals personally involved in the manufacture of the seals, as well as comparison of the questioned seal impressions with manufactured seals.

Age of Documents, Questioned Documents, Stamps and Seals

J6 What is the Basis for Eliminating a Writer?

Ronald N. Morris, BS, Ronald N. Morris & Associates, Inc., 7416 Falmouth Street, Springfield, VA 22150-4003; and Gerald R. Richards, MS, Richards Forensic Services, 15307 Alan Drive, Laurel, MD 20207*

After attending this presentation, attendees will review the basic elements necessary to eliminate or identify a writer based on the writer's demonstrative handwriting characteristics. In addition, a review of the pertinent literature and foundational basis necessary to reach these absolute opinions will be thoroughly examined.

The impact this paper will have on the questioned document community is very simple. Today, too many examiners are eliminating writers on the basis of insufficient evidence in the examined writing. This presentation will explore the history of writer elimination and try to re-establish the core principles on which writer elimination is based. Examples of eliminations based on insufficient evidence will be shown and the time tested basis for eliminating a writer will be presented.

The essence of this paper is to research the literature, try to establish the context in which some forensic document examiners (FDE) eliminate a writer, and to define the criteria necessary to justifiably eliminate a writer based on historic principles and common sense. The authors have observed over the years that some FDEs have either lacked sufficient training in what constitutes the basis for elimination or have not fully understood the criteria necessary to make that determination. Although the determination of identification and elimination are on the opposite ends of the opinion scale, the criteria needed to reach these opinions are considerably different. However, both are based on a writer's skill level, the quality of the writing, the quantity of the writing, the complexity of the writing, the variation of the writing, and the outside or accidental factors that can influence the writing. To opine an identification, there must be a number of significant individual writing characteristics in common between two sufficient amounts of writing with no unexplained differences. To conclude that a known writer did not write a questioned handwriting, the FDE must determine that there is sufficient repeatable evidence within the known writing to determine that the writer could not have produced the questioned writing under any circumstances, including, but not limited to, intentional distortion, accidental distortion, more than one writing style, writing position, drugs, etc. In most instances involving signatures and short writings, the evidence is not available to make such a determination. A key to eliminating a writer is to roughly understand the meaning of a combination of truly significant differences that provide the basis for the elimination. The authors have noted that even minor variations from the known exemplars have led some FDEs to declare a significant difference and positively conclude that a different writer is responsible.

Handwriting, Elimination, Differences

J7 Traced Signatures: A Quantitative Analysis

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After attending this presentation, attendees will be able to compare a traced signature with its master in an objective manner instead of using subjective terms. Specific steps will be demonstrated so that uniform comparisons can be made.

By using digital imaging software, which easily shows a statistical readout of the components of an image, this presentation will demonstrate how an objective comparison is possible. For the first time forensic document examiners are now able to use objective terms when comparing traced signatures with the master signature that was traced. This presentation will impact the field of forensic document examination by providing yet another tool in the hand bag of digital image techniques.

Since the very beginning of forensic document examination much has been written about traced signatures. This is one of the most basic examinations in the field and most of the classic literature in forensic document examination discusses this phenomenon. When determining if a signature is in fact a tracing, the best proof is that a tracing will "match precisely" when superimposed over the signature that was copied. In these cases it is assumed that the genuine signature that was traced is available for examination and comparison. Many cases have been demonstrated in court with a dramatic plastic overlay showing the similarity. While the similarities are obvious to any layman the experts have described this matching only in the most general terms. Every tracing will of course produce variations from the original, so the question becomes "How Similar?" Since the very first examination of this type this question has been answered in rather general and subjective terms. Using the computer, it is now possible for the first time to answer this question objectively and statistically.

Analysis with digital imaging software has been in common use by document examiners for approximately 10 years. This analysis is another specific tool to be added to the base of established techniques. The first steps for superimposing one image over another are used rather commonly in the field of forensic document examination and will be repeated here briefly. In this technique some preparation of the signatures is necessary so that unnecessary data is removed. To make comparisons of like things in digital imaging software, the two items are superimposed one over the other when both have been made semi-opaque. This technique constitutes an addition to the forensic document examiners toolbox because, after specific preparation superimposing one signature over another and by making reference to the "histogram" feature, the similarity or dissimilarity can be made objectively. The histogram gives a quantitative readout of all the pixels in an image based on shades.

While no real case images are used in this demonstration numerous variables and controls are shown which typify the range of possibilities when comparing signatures. The author suggests that by fine-tuning the process a quantitative analysis came be made. The process generally follows two major steps, which can be subdivided, into several intermediate steps. Comparisons of normal genuine signatures with like kind signatures show little superimposition and that tracings have a much higher index of coincidence when compared to their master. These matters are now quantifiable.

Traced, Signature, Forgery

J8 The Admission of Expert Linguistic Evidence in Cases of Disputed Authorship

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After attending this presentation, attendees will understand the position of forensic stylistics both within the field of forensic linguistics and with respect to the current criteria for admissibility of expert evidence.

This presentation will impact the forensic community and/or humanity by clarifying aspects of the current scientific and legal statutes of the analysis of style in disputed authorship cases. It is aimed at those working in the area of questioned authorship.

Thumbnail History of Admissibility Standards: FRE 702 authorizes judges to allow expert testimony under these conditions: "If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise."

The basis for evaluating the conditions of FRE 702 for the admission of expert testimony was (and still is in many States) the "general acceptance" test as prescribed by *Frye v. United States, 293 F. 1013 (App. D.C. 1923)*, specifying that expert opinion based on scientific technique is admissible if the technique is generally accepted as reliable in the relevant scientific community.

The basis for meeting the conditions of FRE 702 were then expanded and changed in *Daubert v. Merrell Dow Pharmaceuticals, Inc., 951 F.2d 1128 (1991)*: general acceptance was no longer a condition for scientific evidence to be admissible, and determining the reliability and relevancy of the evidence was the task of the Court. *Daubert* recommended that the trial judge flexibly apply four criteria to assess the reliability of expert testimony: 1. Can or has the theory or technique be tested? 2. Has the theory or technique been subjected to peer review and publication? 3. Is there a known or potential rate of error? 4. Are there standards controlling the technique's operation? 5. Is the theory or technique generally accepted within a relevant scientific community?

The *Daubert* criteria for meeting the reliability requirements of FRE 702 were then clarified by *Kuhmo Tire Company, Ltd., v. Carmichael, 119 S.Ct. 1167 (1999)*, which held that the *Daubert* standards of admissibility applied to all expert testimony, whether scientific or technical, and that the criteria suggested in *Daubert* were factors that "may" be used by the trial judge in gate keeping role, emphasizing that the Court was not required to use each factor in making its decision.

State of the Science: How and to what extent forensic stylistics meets admissibility criteria will be discussed. Examples from a few challenging cases and from interesting data sets will be used to demonstrate strengths and limitations of the present approach.

State of the Law: The extent to which linguistic evidence has been proffered and admitted in disputed authorship cases will be presented in the following three categories:

Non-admission of expert testimony in cases of disputed authorship: Discussed will be cases which have been cited as not admitting evidence of disputed authorship: *U.S. v. Clifford*, 704 F.2nd 86 (3d Cir. 1983); *U.S. v. Van Wyk* (83 F. Supp.2d 551 (D. N.J. 2000). Included are two additional cases in which there is a difference of opinion regarding admission of linguistic testimony.

Admission of expert testimony by non-linguists in cases of disputed authorship: Mentioned and cited are over 60 case decisions wherein linguistic evidence of authorship was admitted, including stylistic features such as format of document (physical arrangement, indentation, margin width, spacing, use of a letter for a number or vice-versa, strikeovers and corrections, opening and closing of letters, typist identification, word division); capitalization; abbreviations; dates and titles; punctuation; spelling; word choice; syntax; paragraph structure; content; and first language other than English.

Admission of expert testimony by linguists in cases of disputed authorship: Cited and briefly discussed are a large number of U.S. and foreign cases of disputed authorship wherein the testimony of one or more linguists was admitted. These cases include appellate decisions as well as lower court trials of various civil and criminal matters.

Forensic Linguistics, Forensic Stylistics, Admissibility Criteria

J9 Computer Forensics, an Emerging Discipline and the Forensic Document Examiner

David L. Swartzendruber, BS, David Lee & Associates, 1420 NW Gilman Boulevard, Suite 2612, Issaquah, WA 98027*

Attendees will learn the importance of computer forensics in investigations for document and information gathering. This presentation will provide knowledge of other avenues of investigation and evidence gathering related to questioned documents cases. Attendees will learn about the evolution of computer forensics from the prospective of a field investigator. The presenter will relate the synergy between other forensic science disciplines, specifically that of documents examination.

This presentation will impact the forensic community by shedding light on this emerging forensic discipline that can yield significant information in proving the facts of civil and criminal cases.

In a criminal or civil investigation a computer has the potential to yield a tremendous amount of useful information; however, keyboard input provides a certain amount of anonymity to the user, unlike a typical documents case.

The presentation will provide scenarios that will demonstrate through the analysis of computer data such as time and date stamps, associated data fragments, and the subsequent examination of printed and signed documents, how a strong evidentiary case can be presented.

Computer Forensics, Information, Scenarios

J10 Graffiti Tagging Behavior and Its Forensic Identification

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After attending this presentation attendees will have gained information on the graffiti subculture and in particular tagging behavior. Attendees will have an understanding of the relationship between forensic document examination and the forensic identification of graffiti tagging.

This presentation will impact the forensic community by demonstrating applications to the field of Forensic Document Examination where empirical studies may result in improvements to current method and a possible mechanism to determine the probative value of opinions expressed on graffiti tags.

The financial burden of graffiti tagging across the world is colossal. It has been estimated that world wide sixteen million square feet of graffiti is removed every year. Keep South Australia Beautiful estimates the costs of removing and attempting to eradicate graffiti to the Australian community is approximately $200 million annually. In 1992 the City of Los Angeles spent more than $15 million cleaning up graffiti while the Southern California Rapid Transit District spent $12 million. These figures do not include volunteers' time or the costs to home owners and private businesses. According to the National Graffiti Information Network, graffiti eradication costs the American public $4 billion per annum.

As well as the financial burden there is a human cost. In New South Wales, Australia in 1986 four people were killed attempting to tag trains. Communities can become fearful and concerned about their safety whilst using public transport and the removal of graffiti can cause delays. Graffiti can also have a powerful negative impact on property value.

In many countries forensic document examiners (FDE's) are involved in the comparison and analysis of graffiti tags in situ, in sketchbooks and in photographs. However the identification of graffiti tags by FDE's has remained virtually unresearched in spite of evidence being led in courts of law around the world.

Traditional validation studies on handwriting and signature expertise are unlikely to offer significant support to the claimed expertise in this area due to graffiti being much larger in size to normal handwriting and the use of atypical writing implements (for example modified spray cans) and writing surfaces (which are usually vertical rather than horizontal).

The aims of this research are to determine whether construction features alter oversize conditions, whether tags scale proportionally oversize conditions, the ability of taggers and lay people to simulate a given tag, spatial consistency between tagger's simulations and lay people's simulations, and the ability of FDE's compared to lay persons in determining authorship and process of genuine and simulated tags.

This study involved the use of six graffitists whom each gave samples of their tag at a number of different sizes. The sizes ranged from a 'normal' handwriting sized sample as may be found in a sketchbook up to an extra large size representing a wall. The smaller sizes were tagged with a black ball point pen, the medium sizes were tagged with a black marker pen and the larger sizes were tagged with spray paint.

Two of these tags were chosen and four graffitists and eight lay people then attempted to simulate each of the tags a number of times on two different sized pieces of paper. One size was completed with a black marker pen and the larger size was completed with spray paint.

The results were analyzed using a software program named Matrix Analysis and spatial consistencies and inconsistencies were calculated.

A combination of genuine and simulated tags were compiled and distributed to fifteen forensic document examiners and fifteen lay persons to establish claimed expertise in forensically identifying tags. Major outcomes of the research will be discussed at the presentation.

This research has applications in the prosecution of offenders and by being able to analyze the spatial consistencies between any number of samples of a given tag, different offences may be able to be linked together or discarded with a high degree of certainty.

The validation trial completed by FDE's and lay people will provide empirical data on the claimed expertise of FDE's in determining authorship and process. This may validate and contribute to the weight given to any opinion evidence delivered in a court of law.

Forensic, Graffiti, Identification

J11 A Total Solution of Chinese Seal Registration and Management System in Taiwan

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This presentation will impact the forensic community by demonstrating the current method of seal's authentication and its deficiencies. The solution will be building up a standard procedure of stamping with a uniquely specified seal. With a unique coded RFID cemented to a registered seal, each time a seal is needed a special designed stamping machine will check the validity of the seal online or in the administrative areas' database. After the seal has been recognized by the system it will initiate the stamp machine. The stamp machine will stamp the seal in a standard procedure with specified inks, pressure and substrate incorporated with the registration number, date and time of stamping, code of the stamp machine, and serial number. Then there will be no need for the seal's authentication.

The traditional Chinese seal was a piece of metal, stone, bone or wood on which special characters were engraved. Since it was engraved by hand, every seal was unique and different from one another, and thus it was representative of honor, dignity, and nobility in Chinese society. The using of the Chinese seal involves staining the engraved side with red ink paste from an inkpad, then stamping (transferring the red ink) the specially engraved characters on paper.

The Ministry of Interior of Taiwan is holding a 'SEAL REGISTRATION SYSTEM' which keeps only the stamped seal - engraved characters' images of the registered seals in the administrative areas. But since the computer aided seal engraving system has been in wide use, anyone can duplicate a computer engraved seal.

The current methods of authentication only check the engraved characters' images - stamped seal. Not only the image of the engraved characters, but also the materials, the engraving methods, the shapes, the pressure used to stamp the substrate under the paper, and anything concerning the seal will be a factor. First of all, a standard stamping procedure is needed and then a three dimensional inspection would be meaningful.

The author devised a method making use of a RFID chip to resolve registration and management. The registered seals contain a fragile uniquely coded RFID with unbreakable cement to prevent the RFID chip from being transferred. Each time the seals are needed, a specially designed stamping machine will check the validity of the seal online in real time, or offline in the administrative areas' database. After the seal been recognized by the system the stamping machine will initialize, stamp the seal in combination with a string of alphanumeric characters containing the registration number, date and time of stamping, code of the stamping machine and its location, and the serial number of the stamping. This combination of data will change with every stamping.

Chinese Seal Registration and Management System, Computer Aided Seal Engraving System, Standard Stamping Procedure

J12 Examination of a "Velasco" Signature on an Oil Painting

Sandra Ramsey Lines, BA, 6200 East Cholla Lane, Paradise Valley, AZ 85253*

Attendees will learn the importance of research on the works of the artist in question and the use of an "Art Worksheet." This presentation will impact the forensic community by demonstrating original research that offers a step-by-step process on the examination of an art signature, particularly and oil painting signature.

In September of 2003, an investor bought an oil painting at auction in Denmark. The painting was signed "José Maria Velasco." The investor attempted to sell the painting in the United States, but found that he needed confirmation that this was an authentic Velasco painting. The provenance of the painting was questionable because it came to Denmark from Cuba without appropriate documentation. If the signature was determined to be authentic, the painting would have an approximate value of one million dollars. Initial research on the life and works of the artist and a literature review resulted in the preparation of an "Art Worksheet." Known signature specimens were obtained from reputable sources. A comparison of the known signatures with the questioned signature concluded the questioned signature was very probably not executed by José Maria Velasco.

Forensic Science, Questioned Documents, Oil Painting Signature

J13 Autopen Technology in the 21st Century

Alicia M. Baumann, MA, and Brea N. Foster, MSFS*, Federal Bureau of Investigation Laboratory, 2501 Investigation Parkway, Quantico, VA 22135*

After attending this presentation, attendees will be able to distinguish autopen writing from other processes.

During a recent tour of a company manufacturing autopens, devices used to simulate signatures and other forms of writing, document examiners from the FBI Laboratory were made aware of current technology used to simulate signatures, hand printing, and handwriting.

From the information obtained, it was observed that few modifications have been made in the design of the autopen since it was patented in 1939. However, the most significant changes were introduced within only the last few years. Current modifications include, but are not limited to, the use of computer software, password protection, improved fluidity of writing, additional simulations including letters, words, and sentences in text files, and the use of autopen specific plotter pens.

Autopen, Mechanical Impression, Signature

J14 Applications of Novel Methods of Elemental Analysis to the Field of Document Examination

Robert D. Koons, PhD, and JoAnn Buscaglia, PhD, FBI Laboratory, Counterterrorism & Forensic Science Research Unit, FBI Academy, Quantico, VA 22135; and Kim E. Mooney, PhD, FBI Laboratory, Visiting Scientist Program, FBI Academy, Quantico, VA 22135*

This presentation will provide the forensic document community with knowledge of recent developments in analytical instrumentation for the determination of elemental concentrations in solid materials, which have resulted in improved capabilities for nondestructive or minimally destructive examination of documents. These techniques could prove useful in the forensic analysis of inks and obliterated writings.

Several recent developments in the design of analytical instrumentation for the determination of elemental concentrations in solid materials have resulted in improved capabilities for nondestructive or minimally destructive examination of documents. Attendees of this presentation will learn about the results of studies applying two techniques, micro-x-ray fluorescence (μXRF) and laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS), to several problems of interest to document examiners.

LA-ICP-MS is an analytical technique in which a laser is used to ablate a solid material into a fine particulate mist that is swept into argon inductively coupled plasma for atomization and ionization, and finally, a mass spectrometer for quantitation of the isotopic ions produced. This technique is minimally destructive, in that an ablation area between 50 and 300 μm in diameter is typically removed from the sample surface. By appropriate selection of laser power and wavelength, a microscopic portion of an ink layer may be removed from a document without visible destruction of the underlying paper. Such a small sample is adequate for semi quantitative determination of the concentrations of several elements with only minimal destruction of to the document (not visible to the casual observer). In a study using a collection of BIC® ball point pens containing black ink, most of the pens could be distinguished from each other by analysis of ink strokes directly on paper. Variations in elemental response over the course of writing with ink throughout a pen reservoir and corrections for elements present in the paper will be discussed. Variations in the elemental composition of the ink reservoir of a pen and the paper chemistry will be discussed.

XRF methods have long been used for characterization of documents, primarily because they can provide useful elemental information in a nondestructive manner. The development of instruments that utilize a capillary for transmission of the x-rays from the x-ray tube to the sample surface has provided new opportunities for use in document examination. By irradiating a small area on the surface of a sample that is mounted on a motorized stage, mapping of the elemental distributions over a two-dimensional area is possible. This technique has been previously been utilized in the characterization of inks and papers of documents of historical interest. This presentation, will discuss the utilization of μXRF for the visualization of obliterated writing. An ink utilized used to obliterate writing made by a different ink or other medium will often contain differences in its x-ray fluo-

rescence spectrum from that of the underlying writing. By scanning the document with an x-ray beam in a grid pattern, the differences in x-ray intensities from the two writing media layers have been utilized used to form a digital image of the underlying obliterated writing by measurement of the x-rays escaping through the obliterating layer. Because these images are based on minor elemental compositions, they may be formed for ink combinations that cannot be visualized using molecular spectroscopy, visual spectral comparison measurements, or hyperspectral imaging. The combination of methods provides the document examiner with an arsenal of complimentary techniques for visualization of obliterated writing.

Trace Evidence, Ink Analysis, Obliterated Writing

J15 The Characterization of Envelopes for Questioned Document Examinations

Douglas K. Shaffer, MS, Joseph C. Stephens, BS, and Gerry LaPorte, MSFS, United States Secret Service, Forensic Services Division, 950 H Street NW, Washington, DC 20223*

Attendees will be introduced to the evidentiary importance of envelopes and understand how physical and chemical examinations can be used to associate questioned or known documents, and determine if multiple documents have a common origin. Questioned document examiners will be provided with information regarding the feasibility and limitations of linking multiple questioned envelopes to a common source.

Envelopes can be associated with a variety of serious crimes, including sending mail that contains threatening correspondence, transmitting chemical and/or biological agents or controlled substances (drugs) through the mail, and the delivery of extortion or kidnapping demands. Oftentimes, forensic examiners are requested to conduct examinations on envelopes to associate questioned or known documents or to determine if multiple questioned documents have a common source. There are numerous physical examinations that can be conducted which include the size, shape, color, printed pattern, the placement and dimensions of adhesive strips, and the general format of the flaps and seals. Production markings (including repeating or transient defects) can also be examined as discriminating features from various batches of envelopes. Furthermore, chemical examinations can be performed on various components of an envelope to determine if there are commonalities that may link the sample with a comparable similar specimen(s).

The authors obtained several different types of envelopes from various retailers in the United States market and performed numerous examinations in an attempt to characterize and differentiate them based on their physical properties. The envelopes were also examined to determine if they had significant (diagnostic) defects in their printed patterns (when applicable), and in their construction, to identify possible class characteristics that could yield critical information during a criminal investigation. Finally, the authors will present some additional findings, including the date(s) of production changes and the introduction of new components, the chemical analysis of adhesives using Fourier transform-infrared (FT-IR) spectrometry and scanning electron microscopy coupled with energy dispersive X-ray analysis (SEM/EDXA), and the examination of markings or striations using an electrostatic detection device. Occasionally, envelopes may be traced to a manufacturer and its respective location, so the authors will attempt to ascertain whether this information can be valuable to investigators based on the distribution channels utilized by the various manufacturers.

Questioned Documents, Envelopes, Threatening Letters

J16 Preservation of Archived Documents: A Case Study of the Arson Fire at the University of Washington Elizabeth C. Miller Library

Gary L. Menges, MS, University of Washington Libraries, PO Box 352900, Seattle, WA 98195*

Attendees will learn about the measures taken by document repositories seeking protect collections from disasters such as fires or floods. The case study will provide examples of techniques which can restore damaged archives.

This presentation will impact the forensic community and humanity by providing information and a point of contact that will be useful in the event of a natural or man-made disaster which affects archived documents.

Preservation is about providing stewardship to protect the enormous investments that archives, libraries, and museums have in their collections. Gary Menges, Preservation Administrator at the University of Washington Libraries will talk about the measures universities take to protect these investments. What happens when disasters strike? A case study will be the arson fire at the University of Washington Center for Urban Horticulture which damaged the Elizabeth C. Miller Library.

Archives, Document Restoration, Library Arson

J17 The Use of Liquid Chromatography - Mass Spectrometry for the Analysis of Writing Inks

Yvette Thomas, MFS, and Gerry LaPorte, MSFS, United States Secret Service, Forensic Services Division, 950 H Street NW, Washington, DC 20223*

After attending this presentation, attendees will learn the discrimination potential of High Pressure Liquid Chromatography – Mass Spectrometry (LC-MS) for the analysis of ballpoint and non-ballpoint ink samples. The advantages of LC-MS in the comparison of questioned and known inks will be demonstrated. This presentation will describe the utility and efficiency of LC-MS in comparison to thin layer chromatography (TLC) for different groups of ballpoint and non-ballpoint (e.g., roller ball, felt tip, and gel) writing inks. This presentation will demonstrate results from this research which will allow forensic examiners to assess the overall utility of LC-MS for the characterization and discrimination of writing inks. The authors will also evaluate the feasibility of developing and maintaining an ink database of LC-MS spectra.

TLC is the most widely used method in ink analysis due to its effectiveness and efficiency. However, although very different inks can be easily distinguished, it is also possible that different inks with similar formulations may produce colorant profiles on a TLC plate that can sometimes be indistinguishable. It may be difficult to determine differences in component ratios. TLC is not feasible for the detection of volatile and semi-volatile organic compounds and other components such as resins.

Mass Spectrometry can differentiate dyes and other components with differing molecular structures. This level of discrimination is not possible by chromatographic means alone, which relies on the properties of each dye to result in separation. Therefore, ESI-MS is capable of providing additional analytical information on the relative abundances of ions produced from components in a given ink, thus allowing otherwise identical formulates to be distinguished. In addition, ESI-MS may be able to detect resins and other additives not visible with TLC.

The discrimination potentials of ESI-MS and TLC were compared for several classes of inks. For each class examined, the inks were sorted into

groups based on the TLCs available in a database. Each group consists of several unique inks, including some that were considered indistinguishable by TLC analysis alone. Each ink was analyzed using ESI-MS. To assist in the identification of individual components within the spectra, several standard dyes of known composition were also analyzed by ESI-MS.

The results from this research will allow forensic examiners to assess the overall utility of LC-MS for the characterization and discrimination of writing inks. As well, the authors will evaluate the feasibility of developing and maintaining an ink database of ESI-MS spectra.

Questioned Documents, LC-MS, Ink Analysis

J18 The Authentication of the Questioned Documents By Using a Commercial Digital Camera - Starting From the Questioned Banknotes

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The goal of this presentation is to impact the forensic community and/or humanity by introducing an ordinary way to authenticate questioned banknotes by using a commercial digital camera with properly controlled light and filters as a secondary source.

Since the printing of banknotes is a very complicated technique which involves much state-of-the-art technology, so the authentication of banknotes might be more challenging than for other kinds of questioned documents. Using optical analyses, professional document examiners can find the differences between authentic and counterfeit banknotes. However, for the general public or members of front-line agencies, it is rather difficult to identify those notes from simple observation.

The author studied an ordinary way to verify without specialized equipment the 'Counterfeit Deterrence' or 'Security Features' on banknotes. Such methods could be helpful to authenticate counterfeits. This alternative procedure applied tungsten light and IR filters for the IR 'Security Features' check, macro shooting function for the intaglio prints, and security thread check. These procedures were verified by specialized questioned document examination thereafter. This experiment is suitable for almost all banknotes in the world, and seems to be more convenient and inexpensive.

These secondary methods were verified against the techniques used by document examiners and were determined to be a valuable, inexpensive and convenient screening method for identifying fraudulent banknotes. This was suitable for almost all banknotes from around the world and, in fact, is not limited to banknotes alone.

Questioned Banknotes, Banknote Authentication, Commercial Digital Camera

J19 Fiberoptic Reflectance UV-Visible Spectroscopy of Paper Currency, Driver's Licenses and Other Questioned Documents

John Allison, PhD, Joyce Shabo, PhD, Adam Ross, PhD, Renee Butler, Erin Sigwart, and Lauren Munoz, The College of New Jersey, Department of Chemistry, PO Box 7718, Ewing, NJ 08628*

After attending this presentation, attendees will understand how a UV-Visible absorption spectrum can be obtained using fiber optics, and how personal identification items and other question documents can be characterized with this method.

This presentation will impact the forensic community and/or humanity by showing attendees how to assemble a fiberoptic spectrometer and interpret the resulting spectra.

Reflectance spectroscopy, using infrared, visible or ultraviolet light, is conceptually a simple experiment in which absorption spectra of materials on surfaces can be obtained. In the experiments to be described, a fiberoptic probe that illuminates and collects reflected light from a small area is used. The angle between the probe and sample can be easily changed, and components of documents and related items can be quickly studied. Spectra of dyes and pigments on a surface can be obtained and compared. In some cases, the number of colorants used can be easily determined. The method is very powerful for comparison of samples. Several examples will be shown to demonstrate the utility. Recent work in the aging of ink on paper suggests that simple spectroscopic methods may be developed for providing information on the age of a signed document. In some experiments with this instrumental setup, UV spectra were collected that appeared to have considerable 'structure', much finer than would be expected for a condensed-phase sample. This was observed when inks on licenses were under study - when spectra were being taken through transparent coatings. The "beats" observed in the spectra are due to interference of the light that occurs due to the method used, and the fact that a thin film was encountered. One can take advantage of the phenomenon and estimate the size (thickness) of the film. (While film thickness can be calculated using a simple relationship, the result is consistent but not necessarily correct. This will be explained based on the mathematical relationship commonly used.)

Spectroscopy, UV-Visible, Documents

J20 Validation of LAB Color as a Non-Destructive Technique to Differentiate Black Ballpoint Inks

Derek L. Hammond, BA, United States Army Criminal Investigation Laboratory 4930 North 31st Street Forest Park, GA 30297-5205*

After attending this presentation, attendees will understand some of the principles associated with the use of digital imaging in the differentiation of inks, the necessary elements for the application of LAB Color mode as a digital technique in the differentiation of black ballpoint inks, the validity and discriminatory power of LAB Color mode, and examples of the application of LAB Color in differentiating black ballpoint (stick) pen inks.

This presentation will impact the forensic community by providing empirical data relating to the validity of an alternative method to be used in the non-destructive differentiation of black ballpoint pen inks.

The conversion of a digital image from RGB mode to LAB Color mode in combination with basic image enhancement techniques can be utilized to differentiate black ballpoint inks. Depending upon the ink(s) examined, this technique may have a higher discriminatory power than traditional non-destructive optical techniques such as microscopy, visible and near infrared reflectance, and near infrared luminescence.

The author will present empirical data obtained through the analysis of 990 pen-pair samples created using 44 different black ballpoint pens. Each sample was "processed" using the LAB Color mode conversion method and the results recorded as: 1) pen-pair specimens are different, 2) pen-pair specimens similar, or 3) unable to determine. All possible pen-pair combinations were created and analyzed; no pen-pair combinations were repeated. Each sample contained two specimens of writing written by a single writer. All samples were produced on the same type of paper. The samples analyzed included 44 pen-pair samples in which the pen-pair specimens were created using the same pen.

The preliminary data appears promising as the use of the technique did not erroneously differentiate any of the 44 samples that were created using

pen-pair samples from a common pen. Furthermore, the technique succeeded in differentiating 738 out of the remaining 946 samples (78%). The remaining 208 samples (22%) could not be differentiated using LAB color mode conversion.

Although these results are promising, chemical analysis of the ink(s) from each of the 44 pens is necessary in order to determine if any of the ballpoint pens used in the study share a common ink formulation. The results of this additional testing and re-analysis of the data will provide further evidence indicative of the validity of this technique.

Questioned Documents, Ink Differentiation, Ballpoint Pens

J21 The Use of Hyperspectral Contrast Imaging for the Examination of Writing Inks

Joseph Stephens, BS, and Gerry M. LaPorte, MSFS, United States Secret Service, Forensic Services Division, 950 H Street NW, Washington, DC 20223*

Attendees will learn and understand some of the principles associated with evaluating the spectral and absorbance properties of inks by using a technique referred to as hyperspectral contrast imaging. HCI combines digital imaging and molecular spectroscopy for the analysis of various materials.

This presentation will impact the forensic community by providing validation of a new technique, which will prove to be extremely beneficial as a supplementary and complimentary examination to further characterize inks.

The examination of writing inks can be significantly important during criminal and civil investigations. Forensic ink analysis can be used to decipher obliterated entries, determine whether written notations were altered or inserted, ascertain if entries are authentic, and help link multiple documents. One important step in the examination process is to evaluate the inks non-destructively by utilizing filtered light, or a variation such as video spectral comparison. Occasionally, requests are made to conduct only non-destructive examinations on questioned documents (e.g. valuable documents), so a very powerful spectral technique may be warranted. Similar looking inks can have different compositions (e.g. colorants, volatiles, resins) that may affect their reflectance and absorbance properties. The benefit of examining writing inks using various illumination sources in combination with selected filters to aid in the discrimination of inks is well documented.

The authors in this study assessed the use of HCI by non-destructively examining black and blue ballpoint inks from 350 to 1700 nm using a Quartz-Tungsten Halogen light source. The spectral reflectance and luminescence characteristics of each were collected and cross-compared. The system that was utilized is capable of operating in the ultraviolet, visible and NIR regions for measuring fluorescence, reflected light, and luminescence through the use of liquid crystal tunable wavelength filters. The software allows for a high level of automated operation, data collection, and data processing.

Hyperspectral Contrast Imaging (HCI), Inks, Spectroscopy

J22 Using Adobe® Photomerge® to Prepare Demonstrative Charts

Linton A. Mohammed, BSc, MFS, and Denys R. Williams*, San Diego Sheriff's Crime Laboratory, 5255 Mt. Etna Drive, San Diego, CA 92117*

After attending this presentation, attendees will learn how to use Adobe® Photomerge® to produce working and demonstrative charts.

This presentation will impact the forensic community and/or humanity by providing a glimpse of a technique which is available to all members of the forensic community.

In forensic examinations, documentation of evidence is vital. Court room presentation of evidence often includes demonstrative charts to show the basis for the opinions given to the trier of fact. The Photomerge® feature of Adobe® Photoshop® has been found to be very useful in preparing both working and demonstrative charts in examinations that require photography of evidence which involves low light sources and various lighting angles.

This poster shows how Photomerge® can be used to produce such charts.

Questioned Documents, Testimony, Documentation

J23 Visualization of UV Pepper Spray Using a Video Spectral Comparator

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This poster will explain the importance of using an alternate light source to visualize various pepper spray residues that contain an ultraviolet dye. Pepper spray is a non-lethal chemical agent often used in riot control, personal self-defense and by an attacker to subdue a victim. The active ingredient in pepper spray is capsaicin. Some manufacturers have also added a UV dye to the spray. Knowledge of the presence of this dye on a suspected perpetrator will greatly facilitate the investigation.

This poster will impact the forensic community and/or humanity by educating investigators about an alternate method to screen for pepper spray residue that have the UV component. Because they are in virtually constant use for drug analysis and toxicology, criminalists may have limited access to instruments like GC/MS and HPLC. An alternative method must be developed and used in order to locate the spray. Every Questioned Document Section in a forensic laboratory has either a video spectral comparator or an instrument that closely resembles its capabilities. Therefore, any investigator should be able to locate an ultraviolet dye on an article of clothing.

Various swatches of clothing, different colors and types, were sprayed with different self-defense sprays and observed using a Video Spectral Comparator [Foster & Freeman Ltd, UK (www.fosterfreeman.com)]. Pepper spray residue was extracted from the swatches and a GC/MS was used to confirm the presence of the capsaicin and UV dye. These materials were then washed with laundry detergent and observed again using the VSC without specialized equipments. Previous reports have shown that the concentration of the active ingredient, capsaicin, is greatly reduced after washing. However, the UV dye remained and fluoresced while using the Video Spectral Comparator. As long as the UV dye is initially present in the self-defense spray, it could be used as a marker due to its resilience to washing.

In addition, a Direct Analysis in Real Time (DART) ion source combined with a mass spectrometer was used to sample various self-defense sprays on different baseball hats. The results were available within seconds and there was no need for any kind of sample preparation or chromatography. The Video Spectral Comparator located the fluorescent dye residues from the pepper spray. The correct area of the hat was placed in front of the DART and within seconds the mass spectrum for capsaicin, dehydrocapsaicin, and the dye, BBOT, was identified. This type of evidence would stand up to the closest scrutiny in court and only took a few minutes to obtain.

The finding of pepper spray residues on evidence items may substantiate resistance if used by an assault victim, show premeditation if used by an assailant, or may corroborate a law enforcement officer's claim of first attempting non-lethal methods to subdue a subject. The Video Spectral Comparator allows an investigator to locate fluorescent pepper spray

residue quickly and without chemically altering the forensic evidence. Although any source of UV light or ALS can detect fluorescence, the Video Spectral Comparator's wide selection of excitation wavelengths, filters, and signal integration times permit it to discriminate between the fluorescence produced by the dye, BBOT, and other sources of fluorescence.

Self-Defense Spray, Video Spectral Comparator, Ultraviolet

J24 Track Down Data on Forged Currencies Using Encase® Computer Forensic Software

Chuan-Hui Chang, MS, Fu-Hsiung Chuang, MS, Hsiang-Feng Hsu, BS, Kuei Liu, BS, So-Lin Yen, MS, and David H. Liu, PhD, Ministry of Justice Investigation Bureau, 74, Chung-Hwa Road, Xindian City, Taipei, 231, Taiwan, ROC*

The goal of this presentation is to improve the accuracy of questioned documents analysis. This presentation will impact the forensic community by demonstrating how EnCase® forensic software could help the examiners to uncover relationships between the questioned documents.

EnCase® forensic software is a powerful and noninvasive investigative tool, and is used by many law enforcement agencies and officials to create a hard drive image of a suspect system. In a previous study, it was found that the combination of DRIFTS, reflectance spectrophotometer, and Py-GC/MS could be used successfully to differentiate paper evidence on questioned documents. Here, the authors identify the origin of the forged currencies which were delivered from different courts by these previously mentioned systematized paper analysis methods. On the other hand, EnCase® was also conducted to scan the entire database from seized computer systems including hard-drives, USB pen drives, floppies, and CDs/DVDs. Although the origin of the forged currencies paper did not came from the same origin, the experimental results demonstrated that the forged currencies processed from examined computer systems was due to all the evidence files that could be extracted, retrieved, and reported completely. In conclusion, the findings indicated that EnCase® forensic software could acquire and analyze the evidence without altering or damaging the origin of the data or scene, and greatly help the examiners to uncover relationships between the questioned documents.

EnCase® Forensic Software, Forged Currencies, Questioned Documents

K1 Clinical vs. Forensic Toxicology - A Comparison of Methods for Case Evaluation

David M. Benjamin, PhD, 77 Florence Street, Apartment 107, Chestnut Hill, MA 02467; and Robert H. Powers, PhD*, State of Connecticut Toxicology Laboratory, 10 Clinton Street, 4th Floor, Hartford, CT 06106*

After attending this presentation, attendees will be able to identify the similarities and differences between the practice of clinical and forensic toxicology. Toxicologists will be able to identify the limitations involved in relying on pooled or random mean blood levels and ranges.

This presentation will impact the forensic community and/or humanity by assisting forensic experts in identifying the limitations of relying on pooled, random blood level concentrations published in the professional literature. The need to standardize the units of concentration will be presented, and acceptable practices recommended.

Clinical and forensic toxicology often share the objective of trying to determine the toxic agent in patients or subjects. However, while medical and clinical toxicologists are chiefly involved directly with patient care, forensic toxicologists often deal with retrospective data involving a past event or death. In contrast to clinicians, forensic toxicologists are frequently called upon to help the courts resolve disputes in which drug toxicity has been a factor. Because forensic toxicologists often deal with cases years after the actual event, they lack the advantage of having been present at the time of the patient's treatment, and frequently lack critical laboratory test results which were not ordered by a clinician whose priorities were to try to save the patient, not determine a cause and manner of intoxication and/or death. Despite sharing a common body of knowledge, clinical and forensic toxicologists generally see cases involving a different spectrum of drugs, drug combinations, and dosages. The suicidal patient who intentionally overdoses on massive doses of his/her prescription medications differs significantly from the drug addict who inadvertently overdoses on "street drugs" taken to become euphoric or prevent withdrawal. Both of these scenarios differ from the patient presenting to the ER with unexpected side effects from a new medication, or inadvertent drug/toxin exposure. Clearly, any case can "convert" from a strictly medical or clinical exercise to a post-mortem forensic case, based on the outcome.

In addition to the differences between clinical and forensic toxicology described above, both specialties rely on different batteries of laboratory tests and literature sources generally utilized in the practice of their professions. Patient-centered toxicologists treat the signs of drug overdoses and poisonings, relying on non-specific screening tests as guides while employing life-saving interventions to support the patient's respiration, blood pressure and cardiac function. Sensitive, quantitative GC/MS results cannot generally be obtained within a rapid enough turn-around time to assist the clinician before the patient expires or recovers and specific information beyond the identification of a suspected toxidrome may be of limited use to the clinician. Forensic toxicologists generally employ sophisticated methodologies which can determine the presence of suspected drugs down to the nanogram level. While clinicians rely heavily on the a prescription drug's product labeling, and textbooks such as Goodman and Gilman's The Pharmacological Basis of Therapeutics and Ellenhorn's Medical Toxicology for recommendations on treatment, forensic toxicologists frequently cite blood level data from Baselt's Disposition of Toxic Drugs and Chemicals in Man. This commonly employed forensic reference has a more chemical and quantitative orientation, and is designed not to aid in the treatment of toxic patients, but to present a compendium of analytical data from drug cases involving reports of toxic or lethal outcomes. Cases reported in Baselt's book report drug blood levels of unspecified source and timing, and often combine the results of many incidents which may involve polypharmacy. Interpretation of the data may be further confounded by a lack of information regarding the time of drug ingestion, co-ingestions, and the presence of other drugs or factors affecting metabolism (e.g., induction, inhibition, or pharmacogenetic expression of the CYP 450 enzymes.) Moreover, interpretation of the data from "Baselt" may be further complicated by post-mortem redistribution, and a lack of specifics regarding the site from which the blood sample was obtained (e.g., right atrial vs. left ventricular vs. peripheral venous blood), the type of anticoagulant that was used (if any) and the presence or absence of NaF or other preservatives to retard or eliminate post-mortem production of ethanol or bacterial degradation of drugs.

This presentation will review differences between the clinical and forensic toxicology literature regarding certain drugs that frequently are encountered by both groups of professionals. These drugs include: ethanol, alprazolam, tricyclic antidepressants, local anesthetics, and morphine. Blood level data and the use of the appropriate units of measure from respective literature sources will be compared and contrasted in an effort to highlight the similarities and differences between the populations of patients (subjects) from which the samples were drawn, and recommend preferred practices. The potential for errors in interpretation will be presented in relation to the use of unreliable techniques (e.g., the use of single blood level values and "Volume of Distribution" to calculate the ingested dose). The risks associated with an uncritical reliance on reports of "mean blood concentrations" and ranges for toxicity and fatality published in "Baselt" will also be presented.

Interpretation Errors, Reliability, Postmortem Distribution

K2 Application of Laboratory Information Management Solution Software System Supporting Forensic Toxicology Operations

Arvind K. Chaturvedi, PhD, John W. Soper, PhD, Dennis V. Canfield, PhD, and James E. Whinnery, PhD, MD, Bioaeronautical Sciences Research Laboratory (AAM-610), Federal Aviation Administration Civil Aerospace Medical Institute, PO Box 25082, Oklahoma City, OK 73125-5066*

After attending this presentation, attendees will learn the application of the Laboratory Information Management Solution (LIMS) software in a forensic toxicology operation.

This presentation will impact the forensic community and/or humanity by providing examples and detailed information on the toxicology LIMS software system, illustrating that the system can be used in laboratories to maximize their operation and services. Use of this type of software system can effectively improve multiple aspects of laboratory performance required by current scientific and legal standards.

The Federal Aviation Administration's Civil Aerospace Medical Institute (CAMI) toxicologically evaluates postmortem biological samples collected from victims involved in transportation accidents. Such biosamples are analyzed for the presence of primary combustion gases (carbon monoxide and hydrogen cyanide), alcohol/volatiles, and drugs. During the entire evaluation process, beginning with receiving samples through dispatching toxicology reports, there is a critical need to ensure the quality and integrity of the chain-of-custody, demographic, accessioning, and analytical data/records. Additionally, retrieving case-related information is frequently desired in an expedited manner. Therefore, an effective quality assurance/quality control (QA/QC) program is an absolute

necessity. Information pertaining to these case-related components could effectively be achieved using a suitable software system.

Based on the need for this approach, the CAMI Laboratory has been using the LIMS software since 1997. Initially, this system was tailored to fulfill the unique needs of the Laboratory. However, since the inception of this software system, it has been going through continuous developmental improvements and has become a dynamic forensic toxicology application, designed with input from the biologists, chemists, and toxicologists. Characteristics of this software system are described herein.

This software system has the components to allow laboratories to meet the requirements necessary to conform to the accreditation standards of the College of American Pathologists, the American Board of Forensic Toxicology, and any similar agencies. The basic components are oriented toward a forensic laboratory, covering sample receiving, report generating, record maintaining, QA/QC monitoring, and associated rapid information retrieving.

Specific features of the software include the ability to reliably track the chain-of-custody and acceptance of unlimited specimens per case, utilizing barcode labels created for all specimen vials. Information pertaining to the types and stability of blind QA/QC samples can be created, thereby allowing the accumulated specimen history to be easily tracked. Samples of analytical batches may be re-accessioned for additional analysis. The final case and batch information is locked from changes when completed. A case status snapshot feature shows the progress of a case. Multi-level security prevents analysts from being aware of the cases they are analyzing. If required, additional process-specific modules can be easily incorporated into the system. For example, incident reporting and Freedom of Information Act (FOIA) request processing modules have been easily added.

A case-edit-history view is available for upper-level management. This feature displays case or batch edits including date, time, and user. Management can also view system login history. Requests for case information under the FOIA can be easily tracked. Analytical and statistical report capabilities include information pertaining to QA/QC, internal and external specimen chain-of-custody, case status, and other specialized aspects of a case. Analytical reports can be easily generated through the batch-based case results with an option to include any notes that might enhance the interpretation of the analytical findings by report receivers. Laboratory incidents, along with their evaluations/resolutions and cost, are documented with a Lab Incident Report methodology. An archive feature stores historical data in a separate location, while preserving easy access to needed information. Data can be exported to a Microsoft® Excel worksheet, and report information to a Microsoft® Word document. The dynamic character of the LIMS makes it user-friendly and suitable for rapidly extracting information necessary for research. In essence, this software system is an effective tool to optimize the operation of a laboratory, covering its entire operational spectrum.

Forensic Sciences, Toxicology LIMS Software, Aviation Accident Investigation

K3 A Validated PCI GC/MS Method for the Quantification of Amphetamine, Opiates, Cocaine and Metabolites in Human Postmortem Brain

Ross H. Lowe, PhD, Allan J. Barnes, BS, and Marilyn A. Huestis, PhD, Chemistry and Drug Metabolism Section, National Institute on Drug Abuse, 5500 Nathan Shock Drive, Baltimore, MD 21224*

After attending this presentation, attendees will learn about a sensitive and specific method for the simultaneous detection and quantification of amphetamine, opiates, cocaine, and cocaine metabolites. The presentation will allow an attendee to evaluate the performance characteristics and implement the assay in their laboratory.

This presentation will impact the forensic community and/or humanity by demonstrating an assay which provides reproducible recovery and quantification of amphetamine, morphine, codeine, 6-acetylmorphine, cocaine, benzoylecgonine, ecgonine methyl ester, ecgonine ethyl ester, cocaethylene, and anhydroecgonine methyl ester in human brain tissue. The assay has application in forensic and postmortem toxicology laboratories.

Determination of drug concentrations in human brain has applications in forensic and postmortem toxicology and in biological studies of cellular responses to drug exposure. Direct measurement of drug and metabolite concentrations in discrete brain regions also is used to study mechanisms of drug action, regional distribution, and preferential accumulation of drugs. Most quantification methods have focused on a single class of drugs, such as cocaine, amphetamines, or opiates. The objective of this study was to develop and validate a reliable extraction and quantification method for multiple classes of drugs in brain tissue.

The method employs ultrasonic homogenization of brain tissue in pH 4.0 sodium acetate buffer and solid phase extraction (SPE) utilizing copolymeric octyl/benzyl sulfonic acid extraction columns. Extracts were concentrated and derivatized with *N*-methyl-*N*-(tert-butyldimethylsilyl) trifluoroacetamide (MTBSTFA) and *N,*O-*bis*(trimethyl) trifluoroacetamide (BSTFA). GC/MS analyses were performed with an Agilent 6890 gas chromatograph interfaced with a 5973 mass-selective detector. Analyte separation was achieved on an HP-1MS capillary column (30 m x 0.32 mm i.d., 0.25 µm film thickness) with helium carrier gas. Initial column temperature of 70°C was held for 1.00 min, increased to 175°C at 30°/min, ramped to 250°C at 23°/min and increased to a final temperature of 310°C at 18°/min that was held for 5.00 min. The MS was operated in PCI mode with methane reactant gas. Target and qualifier ions acquired for each analyte and deuterated internal standard were: amphetamine 158, 250; amphetamine-*d10* 162, 245; ecgonine methyl ester 314, 256; ecgonine methyl ester-*d3* 317, 259; anhydroecgonine methyl ester 182, 210; ecgonine ethyl ester 328, 196; cocaine 304, 182; cocaine-*d3* 307, 185; cocaethylene 318, 196; cocaethylene-*d3* 321, 199; codeine 282, 356; codeine-*d3* 285, 359; benzoylecgonine 404, 282; benzoylecgonine-*d3* 407, 285; morphine 456, 382; morphine-*d3* 459, 385; 6-acetylmorphine 382, 470; and 6-acetylmorphine-*d3* 385, 473, respectively.

Developing a validated method for simultaneous quantification of multiple drug analytes in human brain required optimization of numerous factors. First, a technique for successful tissue disruption coupled with an efficient extraction methodology was required. This was addressed by brief ultrasonic homogenization of 0.10 g of tissue in pH 4.0 sodium acetate buffer followed by centrifugation. SPE was rapid and reproducible with suitable recoveries, and required small volumes of organic solvents. Second, the need to quantify multiple analytes at low concentrations required reliable chromatographic separation of analytes and a suitably specific and sensitive detection method. A third objective was to utilize instrumentation readily available in most research and forensic toxicology laboratories, which was met by a bench-top GC/MS operated in PCI mode. Each analyte was adequately resolved from other analytes or from tested interferents with the chromatographic parameters described. Positive chemical ionization GC/MS in SIM mode provided sensitive and specific quantification.

Linearity, carryover, limits of detection and quantification, selectivity, extraction efficiency, precision and accuracy were investigated to evaluate method integrity. The limits of detection and limits of quantification for all analytes were 50 pg/mg of brain. Calibration curves were linear to 1000 pg/mg for anhydroecgonine methyl ester and 6-acetylmorphine, and to 2000 pg/mg for all other analytes. Precision and accuracy were evaluated over the linear range with four QC materials at target concentrations of 120, 240, 480, and 1600 pg/mg. Accurate quantification and precision is achieved over the linear dynamic range of the assay with accuracy ranging from 89.5% to 113.7%, and inter-assay precision, as percent relative standard deviation, ranging from 3.0 to 16.6%.

The method provided adequate and reproducible recovery of amphetamine, morphine, codeine, 6-acetylmorphine, cocaine, benzoylecgonine, ecgonine methyl ester, ecgonine ethyl ester, cocaethylene, and anhydroecgonine methyl ester from human brain tissue. The assay was developed to identify and quantify drugs in human postmortem brain tissue and to identify drug users and validate controls for microarray analysis of the transcriptional neurobiology of drug abuse.

Drugs of Abuse, GC/MS, Brain

K4 Validity of the Cozart Rapiscan Test for Drug of Abuse Screening in Hair by GC/MS Confirmation

Roberto Gagliano-Candela, PhD, Lucia Aventaggiato, Anna Pia Colucci, PhD, and Giuseppe Strisciullo, University of Bari, Dipartimento Medicine Interna Medicina Pubblica, Policlinico, Piazza G. Cesare n.11, Bari, 70124, Italy*

After attending this presentation, attendees will understand the analysis of opiates, cocaine and cannabinoids in hair by Cozart Rapiscan oral fluid Test® and GC/MS confirmation.

This presentation will impact the forensic community and/or humanity by providing information on the testing of drugs of abuse in hair.

Goal: This project was carried out to evaluate the performance characteristic of the immunoassay Cozart Rapiscan oral fluid Test® for drugs of abuse screening in hair extracts.

Methods: Hair samples (70) collected from dope addicts and drug-involved deaths in 2004 were selected from routine analysis samples at the Forensic Toxicology Laboratory, Bari University. The method involves decontamination in 1% sodium dodecyl sulfate, distilled water, and methanol, pulverization in a ball mill, overnight extraction in methanol at 60°C. The methanol extract was then blown until dry under nitrogen and reconstituted in 140 mcL of Cozart buffer for immunoassay analysis. Both positive and negative samples were confirmed by gas chromatography-mass spectrometry (GC/MS/EI) operating in selected ion monitoring mode. Before extraction, deuterated internal standards were added to hair specimens. For opiates and cocaine metabolite analysis, BSTFA/TMCS 1% silylation was used. The 72 positive results were confirmed by GC-MS analysis.

Sensitivity and specificity: The number of true positives, false negatives, false positives and true negatives was determined by comparison of the Cozart results to GC-MS as the reference method. Sensitivity, the true-positive rate, was calculated from the totality of true positives and false negatives as TP/(TP + FN). Specificity was calculated as TN/(TN + FP).

Results: The confirmation in GC/MS determined 39 true positives for opiates, 18 for cocaine, and 15 for delta-9-THC versus 72 total positive results. True negatives were 11 for opiates, 32 for cocaine and 35 for delta-9-THC. False negatives were 1 for cocaine and 3 for delta-9-THC. No false positive results were obtained.

The Cozart Test for opiates in hair, using a cut-off of 0.2 ng/mg with a 50-mg hair sample, had a sensitivity of 100% and specificity of 100%. The Rapiscan Test for cocaine in hair, using a cut-off of 0.5 ng/mg with a 50-mg hair sample, had a sensitivity of 94.7% and specificity of 100%. The Cozart Test for delta-9-THC in hair, using a cut-off of 0.5 ng/mg with a 50-mg hair sample, had a sensitivity of 83.3% and specificity of 100%.

Conclusions: The Cozart Rapiscan oral fluid Test® revealed good sensitivity and maximum specificity, proving to be a valid method of screening. To ensure the legal validity, confirmation analysis with chromatographic techniques (GC/MS or HPLC/MS) is required.

Hair Analysis, Drug Screening Analysis, Cozart Rapiscan

K5 Identification of Fentanyl in Urine From Drug Abuse Cases Using a Direct Multistage Mass Spectrometry Method

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After attending this presentation, attendees will add to their knowledge the use of ion trap and similar mass spectrometers for the identification of drugs of abuse in urine. The direct-injection, multistage mass spectrometric methods are faster and often more specific than traditional mass spectrometric identification methods.

Because the method involves direct injection into a mass spectrometer and does not require a chromatographic step, this presentation will impact the forensic community and/or humanity by providing considerable savings of time and costs compared to the application of mass spectrometric methods for the identification of fentanyl currently in the literature.

Multistage mass spectrometric analysis has become a powerful tool for quantitative confirmatory analysis of chemicals and drugs of abuse and has begun to spread in the field of forensic toxicology. In this presentation, the identification of fentanyl from six fentanyl positive cases provided by the Office of the Chief Medical Examiner of West Virginia is discussed.

The application of multistage MS to the identification of fentanyl in drug abuse cases was evaluated by developing a simpler and more rapid mass spectrometric method for identification of fentanyl in urine. Urine from six fentanyl-positive cases under review by the Office of the Chief Medical Examiner of West Virginia was included in the studies. Each of the six cases described in the presentation was investigated as an apparent drug overdose. A complete autopsy was performed on each of the decedents including comprehensive toxicology testing. Alcohol analysis was by direct injection gas chromatography with *t*-butanol as an internal standard. Drugs of abuse were screened by enzyme-multiplied immunoassay technique. Fentanyl was identified in each case by either enzyme-linked immunosorbent assay or by GC/MS. Blood fentanyl concentrations were determined on an Agilent 1100 Series LC/MSD. Chromatography was performed on a Zorbax 5SB-C_{18}, 4 x 150mm column using an isocratic solvent system (20% ammonium formate, 80% acetonitrile). The APCI interface parameters were drying gas 10 L/min, drying gas temperature 350^{o}C, nebulizer pressure 25 psi, vaporizer temperature 300^{o}C, and capillary voltage 4000 V. The ions monitored under SIM mode were m/z 337, 338 for fentanyl and 251, 252 for methaqualone (internal standard). A negative control consisted of pooled urine from normal healthy volunteers. To quantify fentanyl concentrations, $^{2}H_{5}$-fentanyl was used as an internal standard. Urine (1mL) samples from overdose cases were spiked with 10 µL of deuterium labeled internal standard (10 µg/mL), then filtered through a 0.2 µm PTFE membrane. A 50 µL aliquot was diluted to 200 µL total volume with 0.1% formic acid in acetonitrile. Samples were centrifuged for 5 min at 13,000 rpm. The solution was injected into the electrospray ionization (ESI) source of an ion trap mass spectrometer operating in the positive ion mode. A standard curve from control urine was constructed from spiked fentanyl HCl concentrations. Blank methanol/water mixture (50:50 v/v) was injected between two samples for cleaning purposes. Multistage mass spectra recorded in MS, MS/MS and MS/MS/MS (MS^3) modes were used to quantify and confirm the presence of fentanyl in the samples. Although present, ion suppression was not a problem at the concentrations measured above 100 ng/mL of urine.

Because the method involves direct injection into a mass spectrometer and does not require a chromatography step, considerable savings of time (3 to 4 min per sample) and costs are possible compared to the application of literature mass spectrometric methods for the identification of fentanyl. Multistage mass spectrometry methods were also developed from blood and liver for methamphetamine and MDMA.

Multistage Mass Spectrometry, Fentanyl, Forensic

K6 Determination of 2-Chloracetophenone in Air by SPME-GC/MS

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After attending this presentation, attendees will understand the analysis of 2-Chloracetophenone in air by SPME extraction and GC/MS analysis.

This presentation will impact the forensic community and/or humanity by demonstrating a robust, sensitive and simple analytical method for the determination and measurement of 2-Chloracetophenone (CN) in air. Sampling by SPME requires no pumps, and no polluting organic solvents, thus reducing the sampling cost.

Laboratory and field evaluations were performed to validate the solid-phase microextraction (SPME) technique for the determination of CN in air. This is a new, rapid air sampling/sample preparation methodology suitable for use in the working environment and in forensic applications. The Threshold Limit Value (TLV)-Time Weighted Average (TWA) for CN of 0.32 mg/m^3 is recommended by the American Conference of Governmental Industrial Hygienists (ACGIH).

CN is widely used as tear gas by law enforcement agents and also by civilians for the purpose of personal protection. Recently, there has been an increase in crimes involving robbery and rape using tear gas sprays (Kataoka M. et al., J Forensic Sci 2002; 47(1): 44-51). Exposure to this lachrymator produces an intense sensory irritation of the eyes, contact dermatitis, and respiratory distress.

SPME, introduced by Pawliszyn et al. in recent years, is a solvent-free technique that combines sampling and sample preparation in a single step. The SPME sampler is a 1 cm long fused-silica fiber core coated with a polymeric phase. The coated fiber can be moved into and out of a stainless steel needle (area of needle opening, 0.00086 cm^2). By retracting the coated fiber into its needle (Z, from 1 to 35 mm) during sampling, SPME can be used as a TWA diffusive sampler.

In the present work, a method involving gas chromatography/mass spectrometry (GC/MS) and SPME was developed for quantitative analysis of CN in air. The TWA concentration of CN was analysed in a military storage facility, containing tear gas canisters, for a period from 240 to 480 min to evaluate the risk.

For laboratory validation and field TWA sampling of CN with the SPME technique, a 65 µm fiber in PDMS/DVB was used. The sampling was performed adopting a Z value of 3 mm and exposing to the air for periods of time from 60 a 480 min. After the sampling, the fiber was analysed with GC/MS.

Vapors of CN (0.032-3.2 mg/m^3) were generated by a syringe pump in a dynamic system with monitored temperature (20 and 35°C), relative humidity (10 and 80%) and air velocities (0.2 and 83 cm/s). Every thirty minutes, 200 µl of CN generated vapors were injected into the GC/MS system to monitor the dynamic system CN concentrations.

The theoretical sample rate (SR, ml/min) of CN was estimated by the Fuller-Schettler-Giddings diffusion coefficient. The experimental SR was obtained by comparing GC/MS standard solutions of CN with the amount of CN adsorbed into the fiber allowed in the sampling chamber at known concentrations.

Statistical analysis of laboratory validations demonstrated that temperature, relative humidity and air velocity did not affect the absorption efficiencies ($p<0.05$). The theoretical and experimental SR values (0.01086 and 0.00891 ml/min, respectively, at 25°C for Z=3 mm), were in good agreement. The method's precision (n=5) was established to be 10% relative standard deviation for 0.032 mg/m^3 and 8% RSD for 3.2 mg/m^3 (for 240 min sampling and Z=3 mm). The total on-column limit of quantification (LOQ) was 5 pg (0.460mg/m^3/min), and the linearity of the method ranged from 5 to 5000 pg (105 m/z).

The results obtained from the field study for the determination of the TWA concentration of airborne CN showed values ranging from 0.049 to 0.206 mg/m^3.

2-Chloracetophenone , SPME GC/MS Detection, Chemical Weapons

K7 Mass Spectrometric Data Characteristics of 7-Aminoflunitraze-pam and 7-Aminoclonazepam With Multiple Derivatization Groups

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After attending this presentation, attendees will have an enhanced appreciation of the significance and important factors associated with the selection of derivatization reagent, internal standard, and ion pairs for GC-MS analysis of drugs in biological specimen.

This presentation will impact the forensic community and/or humanity by advancing the practice in the quantification of drugs/metabolites in biological specimens.

Detecting low-levels of flunitrazepam metabolites in blood and bloodstains was reportedly facilitated by sequential derivatization with pentafluoropropionyl (PFP) and *t*-butyldimethylsilyl (TBDMS) groups [1]. Based on these findings, this study was carried out to compare the effectiveness of several groups when used in sequential derivatization of 7-aminoflunitrazepam and 7-aminoclonazepam, two benzodiazepines with more than one active site. Commercially available deuterated analogs of these two compounds, d_3-7-aminoflunitrazepam, d_7-7-aminoflunitrazepam, d_4-7-aminoclonazepam, were also included in this study to determine their effectiveness as internal standards for quantification.

Trifluoroacetyl (TFA), PFP, and heptafluorobutyryl (HFB) were adapted as the first, while trimethylsilyl (TMS) and TBDMS were used as the second derivatization groups. Products resulting from the first step and the two-step derivatization processes were analyzed by GC-MS. Full-scan mass spectrometric data were used to select ions with the potential for designating the analytes and their respective deuterated analogs in quantitative analysis protocols. Selected ion monitoring data of these ions were then collected and assessed to determine whether the quality of these ions were significantly different when one or two different derivatization groups were adapted in these sample preparation processes (Table 1). A total of 54 full-scan mass spectra and 3 ion intensity cross-contribution tables, representing various forms of derivatization and isotopic analogs of these two compounds, are systematically presented for reference. Evaluations of these data concluded: (a) for 7-aminoflunitrazepam, combination of PFP/TMS derivatization with d_7-7-aminoflunitrazepam serving as the internal standard generated the most favorable ion pairs for quantification and as supporting parameters for qualitative analysis purposes; (b) data resulting from the 7-aminoclonazepam study were not as clear; however, the combination of TFA/TMS appeared to be the best choice.

Reference:

1. A.A. Elian. Detection of low levels of flunitrazepam and its metabolites in blood and bloodstain. Forensic Sci. Int. 101 (1999) 107–111.

Table 1. Double derivatization groups, most favorable ions (*m/z*) for designating the analytes and their deuterated internal standards, and percent cross-contribution by the internal standard to the intensity of ions designated for the analyte and vise versa.

	Ions (and % cross-contritbution) designating analyte and internal standard	
Derivatization Group[a]	d_0- and d_7-7-aminoflunitrazepam	d_0- and d_4-7-aminoclonazepam
Ethyl/ethyl	—[b]	312 (1.70), 341 (4.78), 342 (1.41)
	—	316 (6.32), 345 (6.87), 346 (2.29)
Propyl/propyl	—	340 (0.88), 369 (0.31), 370 (0.75)
	—	344 (2.71), 373 (1.00), 374 (0.34)
Butyl/butyl	—	354 (0.38), 397 (0.23), 398 (0.64)
	—	358 (0.90), 401 (1.18), 402 (0.35)
TMS/TMS	—	394 (0.36), 414 (0.23), 429 (0.33)
	—	398 (2.53), 418 (6.00), 433 (6.47)
t-Butyl-TMS/*t*-butyl-TMS	—	456 (0.38), 457 (0.61), 458 (1.01)
	—	460 (6.59), 461 (3.84), 462 (0.77)
TFA/TMS	423 (0.35), 450 (0.43), 451 (0.44)	—
	430 (0.08), 456 (0.50), 458 (0.00)	—
TFA/*t*-butyl-TMS	436 (0.16), 437 (0.20), 493 (0.15)	—
	443 (0.01), 444 (0.28), 500 (0.00)	—
TFA/2*t*-butyl-TMS	—	552 (1.52), 553 (1.61), 554 (2.00)
	—	556 (4.11), 557 (2.33), 558 (0.42)
PFP/TMS	473 (0.17), 500 (0.24), 501 (0.17)	—
	480 (0.64), 506 (0.05), 508 (0.00)	—
PFP/*t*-butyl-TMS	337 (6.58), 486 (5.45), 543 (5.72)	—
	340 (2.49), 493 (0.02), 550 (0.00)	—
PFP/2*t*-butyl-TMS	—	602 (0.13), 603 (0.24), 604 (0.51)
	—	606 (6.71), 607 (4.75), 608 (0.85)
HFB/TMS	523 (0.37), 550 (0.27), 551 (0.27)	—
	530 (6.10), 556 (0.09), 558 (0.00)	—
HFB/*t*-butyl-TMS	296 (4.81), 536 (3.00), 537 (3.10)	—
	299 (1.92), 543 (0.22), 544 (0.43)	—
HFB/2*t*-butyl-TMS	—	652 (0.27), 653 (0.32), 654 (0.67)
	—	656 (4.97), 657 (2.57), 658 (0.63)

a TMS: trimethylsilyl; *t*-butyl-TMS: *t*-butyldimethylsilyl; TFA: trifluoroacetyl; PFP: pentafluoropropionyl: FFB: heptafluorobutyryl.

b Attempts to attach the second derivatization group were unsuccessful.

Flunitrazepam, Clonazepam, GC-MS

K8 Simultaneous Determination of HFBA-Derivatized Amphetamines and Ketamines in the Urine by GC-MS

Jin Lian Tsai, PhD, and Hei Hwa Lee, BS, Kaohsiung Chung-Ho Memorial Hospital, Kaohsiung Medical University, 100 Shih-Chuan 1st Road, Kaohsiung, 807, Taiwan*

After attending this presentation, attendees will learn about a new method for HFBA derivatives for amphetamines and ketamine and its metabolites using GC-MS.

This presentation will impact the forensic community and/or humanity by improving analytical cost and time.

This study developed a rapid, sensitive, and accurate method for the simultaneous determination of 8 commonly abused drugs/metabolites containing amine functional groups, i.e., amphetamine, methamphetamine, MDA, MDMA, MDEA, ketamine, norketamine and dehydronorketamine. The protocol included solid phase extraction, HFBA derivatization and GC-MS analysis, using d_5-amphetamine, d_8-methamphetamine, d_5-MDA, d_5-MDMA, d_6-MDEA, d_4-ketamine and d_4-norketamine as the internal standards. Identification of these compounds was based on retention time information and the relative abundance of the following ions established for each analyte as derivatized by HFBA: amphetamine: 240, 118, 91; methamphetamine: 254, 210, 118; MDA: 135, 162, 239; MDMA: 254, 162, 210; MDEA: 268,162, 240; ketamine: 210, 236, 370; norketamine; 384, 356, 377; dehydronorketamine: 314, 382, 169. The following analytical parameters have also been established: linear range: 100–2000 ng/ml; limits of detection and quantitations (all in ng/ml): 60 and 75 for amphetamine; 60 and 75 for methamphetamine; 75 and 100 for MDA; 75 and 100 for MDMA; 75 and 100 for MDEA; 30 and 50 for ketamine; 50 and 75 for norketamine and 50 and 125 for dehydronorketamine. The overall method recoveries of HFBA-derivatized amphetamine analogs were 92–99%, with less than 5% CV of intra-day and inter-day data. In conclusion, this method provides a uniform procedure for confirmation tests of the amphetamines and ketamine drug categories under workplace drug testing settings. Under clinical testing environment, it can be effectively used for the preliminary and confirmatory testing of these 8 drugs/metabolites, without the need for screening by three separate immunoassays, specific for amphetamine/methamphetamine, MDA/MDMA/MDEA, and ketamines, respectively.

Ketamines, Amphetamines, GC-MS

K9 Quantitation of Quetiapine in Human Blood by Solid Phase Extraction and High-Performance Liquid Chromatography

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After attending this presentation, attendees will learn a simple but effective means of identifying and quantitating quetiapine in blood that can be implemented into their own laboratories.

This presentation will impact the forensic community and/or humanity by providing a simple, sensitive, and selective means of identifying and quantitating quetiapine at a range of therapeutic, toxic and fatal blood concentrations.

Quetiapine is an atypical antipsychotic drug indicated as monotherapy for the management of manic episodes associated with bipolar disorder and for the treatment of schizophrenia. Therapeutic concentrations of quetiapine have been reported to range from approximately 0.2 to 1 mg/L. Fatalities attributed to quetiapine overdose have been reported to occur at blood concentrations of 7 mg/L and greater. The incidence of detection of quetiapine, or its indication in case history in death investigations in Ontario, has increased progressively on a year-to-year basis between 1998 and 2004. Therefore, a sensitive and selective high-performance liquid chromatography (HPLC) assay employing solid phase extraction (SPE) has been developed and validated to analyze for quetiapine over a forensically-relevant range of blood concentrations. Selective detection of the analyte is achieved by utilizing an ultraviolet photodiode array detector (UV-DAD) to identify the distinctive UV spectra of quetiapine at a monitoring wavelength of 215 nm at the appropriate retention time. Carbinoxamine maleate, an antihistamine marketed in the United States but is not available in Canada, is used as an internal standard at a concentration of 1.0 mg/L. The limit of detection for quetiapine in this assay is 0.03 mg/L with a lower limit of quantitation of 0.125 mg/L. This method provides a linear response to quetiapine concentrations ranging from 0.125 to 4 mg/L, above which the sample can be diluted and quantitated using an external calibration curve. The extraction recoveries of quetiapine and carbinoxamine were 70±10% and 84±6% (mean± S.D.), respectively. Intra-assay linear regression analysis of the calibration curves in blood (n=5) had r^2 values ranging from 0.987 to 1.00. Inter-assay linear regression analysis of the calibration curves in blood (n=6) had r^2 values ranging from 0.990 to 0.999. The intra-assay precision in blood calibration standards (n=5) at each calibration level ranged from 4 to 8% relative standard deviation (RSD) over the concentration range 0.125 to 1.0 mg/L. The inter-assay precision in blood calibration standards over six days ranged from 6 to 9% RSD at each calibration level over the concentration range 0.125 to 1.0 mg/L. As a measure of accuracy, the percent difference from target concentrations ranged from 0 to 11% (mean 6%) based on the analysis of two internally-prepared, single-blind samples (0.25 and 0.50 mg/L) and one zero-blind sample (1.0 mg/L). This assay provides a simple, sensitive and selective means of identifying and quantitating quetiapine over a range of therapeutic, toxic, and fatal blood concentrations.

Quetiapine, HPLC, Solid Phase Extraction

K10 Detection of Benzoylecgonine in Urine Using the V-Flex System

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The goal of this presentation is to provide results of a validation study regarding the analysis of benzoylecgonine in urine using an automated solid-phase extraction system (V-Flex).

This presentation will impact the forensic community and/or humanity by evaluating an automated solid-phase extraction system, which provides rapid throughput for an increased sample load with minimal manual labor.

Solid-phase extraction (SPE) is a widely accepted isolation technique utilized for the analysis of drugs and drug metabolites in urine. BioIntegrated Solutions (Palatine, IL) is currently developing the V-Flex, an automated SPE system. This study evaluates the use of this system for the analysis of benzoylecgonine (cocaine metabolite) in urine.

Benzoylecgonine and its deuterated analog (internal standard), d_3-benzoylecgonine (Cerilliant Corporation, Round Rock, TX), were extracted from urine utilizing the V-Flex automated solid-phase extraction system. Prior to extraction, urine specimens were diluted in 0.1 M phosphate buffer (pH 6.0), alkalinized with 1 N NaOH, centrifuged, transferred to a clean glass culture tube, and submitted to the V-Flex system. With minimal manual intervention, the automated system conditioned the SPE copolymeric bonded phase cartridges (United Chemical Technologies, Inc., Bristol, PA), transferred specimens, performed washes, and eluted the desired compounds with ethyl acetate/methanol/ammonium hydroxide (68/28/4) elution solvent. The extracts were dried under a stream of

nitrogen at 50°C, derivatized with N-methyl-N-(tert-butyldimethylsilyl)trifluoroacetamide (MTBSFTA), and analyzed with an Agilent 5890 Series II Gas Chromatograph (GC) system equipped with a 5972 Series Mass Selective Detector (MSD) (Little Falls, DE). The GC was fitted with a Restek Rtx-5 capillary column (30 m x 0.25 mm x 0.10 μm) (Bellefonte, PA) with ultra-high-purity helium as the carrier gas at a constant flow rate of 1.0 mL/min. Automated injections were made in splitless mode. The mass spectra were obtained in selected ion monitoring mode by monitoring *m/z* 282.2, 346.2, and 403.2 for benzoylecgonine and *m/z* 349.2 and 406.2 for deuterated benzoylecgonine.

The automated SPE protocol was compared to a manual SPE method employed in the laboratory. Minor differences in the manual method include solvent volumes, an additional wash step with acetonitrile, and the elution solvent utilized was methylene chloride/isopropanol/ammonium hydroxide (78/20/2). Finally, the manual method employed a five-point calibration curve.

Validation studies utilizing one-point calibration at 150 ng/mL and control concentrations of 120, 180, and 500 ng/mL demonstrated intra-assay and inter-assay % CV values that were less than 3%, and intra-assay and inter-assay % accuracy values within 11%. The range of linearity was 75-750 ng/mL. Analysis of authentic urine specimens by the automated SPE and manual SPE operating procedures produced excellent correlation. Initial studies have demonstrated a correlation coefficient of 0.95.

In conclusion, automated SPE using the V-Flex system is an efficient method for the analysis of benzoylecgonine in urine.

Benzoylecgonine, Automated Solid-Phase Extraction, GC-MS Analysis

K11 Methadone to Metabolite Ratio in Cases of Fatal Overdose

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The goal of this presentation is to provide the attendees with information that is pertinent to the interpretation of methadone and methadone metabolite results in deaths that are due to methadone intoxication.

This presentation will impact the forensic community and/or humanity by demonstrating assisting forensic toxicologists and pathologists in evaluating methadone and methadone metabolite blood concentrations in cases of fatal methadone intoxication.

Identifying that a death has occurred due to accidental drug overdose requires consideration of a host of factors. The phenomenon of pharmacodynamic (cellular) tolerance is of particular significance in evaluating opioid blood concentrations in circumstances that suggest fatal overdose. Accordingly, opioid concentrations in those who have died from causes other than overdose are, for the most part, indistinguishable from those found in fatal overdose. With the recent increase in the prevalence of methadone in many areas, correctly identifying the extent to which methadone is causally related, whether as the sole agent in a fatal overdose, or its significance as a contributing factor in a multiple-drug overdose, is of increasing importance.

For many drugs, the concentration of parent drug relative to that of one or more metabolites provides an indication of the extent to which a drug was used during a period of time preceding death. With opioid drugs, awareness of their use prior to death is useful in assessing the degree to which the user may have developed cellular tolerance. A study published in 1988 by Hartman et al. (1) addressed the use of a propoxyphene metabolite as a means of evaluating chronic use, and hence, tolerance. Similarly, the purpose of this study is to assess the relationship between methadone and its principle metabolite, EDDP (2-ethylidene-1,5-dimethyl-3,3-diphenylpyrrolidine), in cases of fatal overdose in which no alcohol or other drugs were detected. As an adjunct to case information about previous drug use, the role of the metabolite, EDDP, in relation to parent drug, methadone, is suggested. EDDP is formed by spontaneous cyclization following cytochrome P450-mediated *N*-demethylation of methadone.

Each case considered for inclusion in the study received a full autopsy performed at the West Virginia Office of the Chief Medical Examiner. Toxicological analysis was performed to determine the presence of volatiles in blood by direct injection GC-FID, drugs of abuse screening of blood and/or urine by enzyme-multiplied immunoassay technique (EMIT), and GC-MS screening of acidic/neutral and basic drugs in blood and/or basic drugs in urine. Positive drug screening results were confirmed and quantitated by GC-MS or LC-MS. Methadone and EDDP concentrations were determined in subclavian blood in each case by GC-MS using SKF-525A as internal standard.

Data included in the study was limited to consecutive cases found to be "methadone only" drug overdoses which occurred in West Virginia between January of 2003 and July of 2005. During this time period, 21 deaths due to methadone intoxication were identified of which fourteen of the decedents were male and seven were female. Methadone concentration in subclavian blood averaged 665 ng/mL $\pm$ 470 ng/mL and ranged from 98 ng/mL to 1846 ng/mL. Average EDDP concentration was 48.2 ng/mL $\pm$ 39.3 ng/mL and ranged from 5 ng/mL to 150 ng/mL. The average ratio of blood methadone concentration to EDDP concentration was 16.1 $\pm$ 5.8 with a range of 7.9 - 29.4. EDDP concentration was found to be correlated with that of methadone, $r^2 = 0.82$ ($p < 0.01$). A previous study has shown that methadone can be converted to EDDP as an analytical artifact due to an elevated gas chromatograph injector port temperature (2). The method of analysis also resulted in methadone conversion to EDDP, but was found to be less than 1.0% of the methadone concentration.

Consistent with previous reports, these data demonstrate that methadone blood concentrations in fatal overdose vary enormously. The ratio of methadone to EDDP may, however, provide additional information in establishing overdose in cases where overdose is supported by case information and no drugs other than methadone and its metabolite(s) are found. Methadone has a longer half-life than most other opioid drugs. For EDDP concentration to be useful as an indicator of chronic methadone use, it would need to be shown that it has a long half-life and that its concentration becomes elevated with chronic methadone use. At present, however, EDDP's half-life has not been clearly demonstrated. To more thoroughly affirm EDDP concentration or the methadone to EDDP ratio as potential indicators of tolerance, further study is needed of parent drug and EDDP concentrations in deaths in which the decedent was positive for methadone, but methadone was not a contributory factor in the death.

References:

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Methadone, Opioid, Overdose

K12 Childhood Prilocaine Fatality

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The goal of this presentation is to inform the attendees of the circumstances and toxicology involving the death of a child that resulted from inadvertent excessive administration of the local anesthetic prilocaine during a dental procedure.

This presentation will impact the forensic community and/or humanity by emphasizing the need for extreme caution when administering a local anesthetic to a patient with a low body mass, such as a child.

Severe toxicity from local anesthetics used in dental procedures is often due to accidental intravascular injection. To lessen the likelihood of such an occurrence, aspiration is performed before the anesthetic solution is injected. In the event that blood is aspirated, the needle is repositioned until no blood is observed upon aspiration. Nevertheless, rigorous adherence to such a precautionary measure, although fairly preemptive, does not definitively abolish inadvertent intravascular injection.

Among the local anesthetics commonly used in dental procedures is prilocaine or Citanest® (AstraZeneca Pharmaceuticals, Wilmington, DE). As with other local anesthetics, the pharmacological activity of prilocaine is mediated by blockage of voltage gated sodium channels. Administration of local anesthetics involves injection into the region of the nerve fibers to be blocked. The onset of anesthesia occurs an average of two minutes following prilocaine injection and lasts for approximately two hours. Prilocaine has a volume of distribution of 0.7-4.4 L/kg with 30% of the plasma concentration bound to proteins (1).

In preparation for a dental extraction procedure, a healthy 2-year-old male was administered nitrous oxide for sedation. This was followed by injection of four 1.8 mL ampules of the local anesthetic, prilocaine, with another ampule applied topically. Shortly thereafter, the child became quiet, exhibited seizure-like activity and became cyanotic. The child's condition improved following administration of 100% oxygen. However, upon arrival at the hospital, he went into cardiopulmonary arrest and was pronounced dead approximately 85 minutes after conclusion of prilocaine delivery. Routine toxicology screening analysis of blood and urine revealed the presence of only prilocaine and lidocaine. Anaphylactic reactions to amide-type local anesthetics are rare and measurement of serum tryptase, an indicator of anaphylaxis, was negative. Prilocaine concentration was measured by GC-MS with SKF-525A as internal standard. Blood obtained from the subclavian vein and the heart contained prilocaine at 14.6 and 13.0 mg/L, respectively. Concentrations of prilocaine in additional samples obtained at autopsy are indicated in Table 1. The cause of death was determined to be prilocaine toxicity resulting from excessive administration by injection. Prilocaine was measured in several other samples obtained at autopsy with the results reported herein. Kaliciak and Chan reported the death of an elderly patient undergoing a dental procedure with the blood prilocaine concentration of 13.4 mg/L, very similar to that found in the present fatality (2).

Table 1

Heart blood	13.0 mg/L
Peripheral blood	14.6 mg/L
Liver	14.0 mg/kg
Lung	26.1 mg/kg
Bile	31.1 mg/L
Vitreous fluid	14.7 mg/L
Urine	12.4 mg/L
Gastric contents	76.4 mg/L

As with all drug administration in the pediatric age group, the maximum dosage of prilocaine that may be safely delivered is governed by the weight of the child. Based on the manufacturer's recommendation of a maximum dose of 8 mg per kilogram, the total administered dose of prilocaine to this child, who weighed slightly less than 15 kilograms, would be limited to 120 mg of prilocaine (15 kg x 8 mg/kg). Delivery of such a dose corresponds to a total of 3 mL of prilocaine solution; available only as a 4% solution. As such, a maximum of one and two-thirds dental cartridges of prilocaine should be administered simultaneously to a child of this weight. This indicates that the significantly elevated concentration of prilocaine in this child is the result of excessive administration of this local anesthetic rather than a complication of direct intravascular bolus administration; a conclusion that is further supported by the dentist's account of the delivery of the prilocaine injections.

References:

1. R.C. Baselt. *Disposition of Toxic Drugs and Chemicals in Man,* 7th ed., Biomedical Publications, Foster City, CA, 2004, pp 929-930.
2. H.A. Kaliciak and S. C. Chan. Distribution of prilocaine in body fluids and tissues in lethal overdose. *J. Anal. Toxicol*. 10: 75-6 (1986).

Prilocaine, Fatality, Anesthetic

K13 Case Report: Death Due to Snorting of Crushed Sustained-Release Morphine Tablets

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After attending this presentation, attendees will learn about potentially fatal low blood morphine concentrations that are not heroin-related can exist, especially if the route of administration and drug formulation administered are unusual.

This presentation will impact the forensic community and/or humanity by providing a case report of a death due to snorting of a sustained-release morphine formulation, especially one where heroin is not a potential confound. This case report will therefore address this specific absence in the literature.

MS-Contin® is a sustained-release morphine formulation that is administered orally to treat moderate to severe pain. MS-Contin® is available in tablets containing 15, 30, 60, 100 and 200 mg of morphine sulfate. Within four hours of the administration of 30 or 60 mg tablets of MS-Contin®, the reported peak plasma morphine concentrations are 10 and 30 ng/mL, respectively. Therapeutic plasma morphine concentrations persist for about 12 hours thereafter.

This report documents a morphine-related death in a male prisoner known to be an intravenous drug user who reportedly snorted three crushed 100 mg tablets of MS-Contin® in his jail cell. The prisoner died 8 hours later. Prior to death this individual exhibited symptoms of profound sedation and laboured breathing that progressed to apnea. At autopsy the pathologist observed pulmonary edema. In addition, two condoms were found in his rectum, one containing three 100 mg tablets of MS-Contin®, the other containing plant material suspected of being marijuana. Absorption of morphine from the condom was ruled out based on a visual assessment of condom integrity and the condition of the tablets. Toxicological examinations of post-mortem blood and urine samples were conducted to determine whether death was related to the presence of illicit substances or pharmaceutical preparations often encountered in death investigations. Analysis for heroin was not performed as there was no investigative information to suggest its use. The analytical procedures consisted of immunoassays and gas chromatographic methods, utilizing flame ionization, nitrogen-phosphorus, and mass spectrometric detection. A concentration of 103 ng/mL of free morphine was detected in the femoral blood, and cannabinoid metabolites were indicated by an immunoassay in heart blood. No alcohol, or other substances of toxicological significance were detected.

The reported symptoms, autopsy findings, and the results of the toxicology examination point to a fatal morphine overdose. In the experience of this laboratory, this is the first known death associated with the snorting of a crushed sustained-release morphine tablet.

Morphine, Snorting, Fatal

K14 Serum and Blood Concentrations of the Oxcarbazepine (Trileptal®) Metabolite, 10-Hydroxy-Carbazepine

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After attending this presentation, attendees will learn about the observed serum/plasma and blood concentrations of 10-hydroxycarbazepine, the active metabolite of oxcarbazepine (Trileptal®), in a patient population.

This presentation will impact the forensic community and/or humanity by providing a review of such a population is important as either an elevated or a sub-therapeutic circulating level of anticonvulsant drugs such as oxcarbazepine can be a significant finding in a forensic investigation.

Serum and blood concentrations from over 53,000 specimens were reviewed for the 10-hydroxy-carbazepine metabolite of oxcarbazepine (Trileptal®). Oxcarbazepine is an anticonvulsant drug used for the treatment of partial seizures alone or as adjunct therapy in adults and as add-on therapy in children ages 4 to 16 with epilepsy. Although it is chemically similar to carbamazepine, its metabolism is different. Following administration, oxcarbazepine is rapidly reduced to 10-hydroxy-carbazepine which is primarily responsible for the anticonvulsant activity of the drug. It is available as 150 mg, 300 mg and 600 mg filmed capsules for oral administration. In adults, 1200 mg/day and 2400 mg/day are typically administered for adjunct therapy and monotherapy, respectively. In children, depending on their weight up to 1800 mg/day can be given. It's recommended that all doses be given in a twice a day regimen. Peak concentrations following a single dose are within 1-3 hours for oxcarbazepine and 4-12 hours for the metabolite. Steady state plasma concentrations of 10-hydroxy-carbazepine are usually achieved in 2 to 3 days. The half-life of the parent is approximately 2 hours while that of the metabolite is about 9 hours. The suggested target concentrations for therapeutic monitoring of 10-hydroxy-carbazepine have been reported to be approximately 13 – 35 mcg/mL. Common adverse effects related to oxcarbazepine therapy included dizziness, somnolence, diplopia, fatigue, nausea, vomiting and ataxia among others. A review of patient samples was performed to determine the observed ranges of serum/plasma (n=53,485) or blood (n=174) concentrations in a patient population. Because samples were received from other testing facilities, no histories or dosing regimens were provided. The analyses were performed by HPLC with a reporting limit of 0.5 mcg/mL. In the serum/plasma population, 2154 samples had no 10-hydroxy-carbazepine detected. Of those patients with oxcarbazepine metabolite found, the concentration ranged from 0.5 to 110 mcg/mL with a mean = 16.9 ± 9.6 mcg/mL and a median = 16.0 mcg/mL. In those samples where blood was tested, 32 were none detected and the remaining patient samples had a mean = 18.9 ± 21.9 mcg/mL (range 0.5 – 140 mcg/mL) and a median = 14.5 mcg/mL. Approximately 60% of the serum/plasma samples, where 10-hydroxy-carbazepine was reported, were within the targeted therapeutic range of 13 – 35 mcg/mL, while about 45% of the blood samples were within this range. The percentage of samples greater than 35 mcg/mL was 4.2% for the serum/plasma samples and 9.9% for the blood samples. The serum/plasma concentrations with the highest frequencies of samples ranged between 9 and 18 mcg/mL. Although many factors may have influenced the concentrations observed, a review of such a population is important as either an elevated or a sub-therapeutic circulating level of anticonvulsant drugs such as oxcarbazepine can be a significant finding in a forensic investigation.

Oxcarbazepine, 10-Hydroxycarbazepine, Serum/Blood Concentrations

K15 Inhalant Abuse Involving Difluoroethane

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After attending this presentation, attendees will learn of two cases of intentional inhalation involving a readily available compound and the methods used to identify this compound.

This presentation will impact the forensic community and/or humanity by providing examples of non-fatal and fatal inhalation of difluoroethane and increasing the awareness of inhalant abuse.

1,1-Difluoroethane (DFE) is a colorless gas with a slight ethereal odor used in aerosol preparations and coolants. DFE can produce headache, weakness, dizziness, nausea, confusion, labored breathing, lung irritation, loss of consciousness, and cardiac arrhythmia. Overexposure may result in fatality due to displacement of oxygen.

The first case involves the intentional abuse of DFE by a motorist. A 32-year-old white male was observed slumped over behind the wheel of a stopped vehicle. Several aerosol cans labeled Endust for Electronics® were observed lying on the floor of the vehicle. After the subject was roused, he admitted he had been "huffing", stating he had consumed one aerosol can and was starting on another. Subject's face was red with watering eyes. A rapid head movement from left to right was also observed. Subject was placed under arrest for DUID and transported to a medical center where blood was collected.

Qualitative headspace analysis of whole blood samples as well as one of the suspect aerosol cans by gas chromatography-mass spectrometry (GCMS) indicated the presence of DFE. A standard was prepared by introducing propellant from an Endust for Electronics® can into a 20 ml headspace vial rapidly sealed. Confirmation of DFE was accomplished by the comparison of blood sample spectra to DFE standard spectra. No other toxicology analyses were performed.

The second case involves the intentional inhalation of DFE by a high school student. The decedent was a 14-year-old white male found by his mother lying motionless in his bed with his legs crossed and his head leaning to one side. An aerosol can labeled Dust-Off® was found in his hands with the delivery tube still in his mouth. Further investigation revealed the decedent had previously inhaled Dust-Off® with friends who referred to the practice as "dusting". A subsequent search of a neighboring school yielded the discovery of another aerosol dust remover labeled Clean Safe® containing 1,1,1,2-Tetrafluoroethane (TFE) in the possession of a student.

The father of the decedent was a police officer, the mother a nurse. A German shepherd police dog trained in the detection of drugs lived with the family. The decedent's father revealed that his son had experienced one episode of vomiting the week before and complained once of a numb tongue. Specimens obtained at autopsy included cardiac blood and femoral blood collected in sealed polypropylene vials as well as lung tissue from each lung and a tracheal air sample collected in 20 ml headspace vials. Specimens were stored at 4º C until analysis.

Specimens were submitted for toxicology testing, including a volatile screen by headspace gas chromatography with flame ionization detection and a drugs of abuse screen utilizing an enzyme-linked immunosorbent assay. The volatile screen on femoral blood indicated the presence of DFE while the drugs of abuse screen were negative. Confirmation of DFE was accomplished by qualitative headspace analysis by GCMS. A standard was prepared by introducing propellant from a Dust-Off® can into a 20 ml headspace vial rapidly sealed. DFE was identified in the cardiac blood and both lung samples. The tracheal air sample was negative. The cause of death was determined to be chemical asphyxia and the manner of death accidental.

According to the American Academy of Pediatrics, the peak age of inhalant abusers is 14 to 15 years, with onset occurring in those as young as 6 to 8 years. Use of inhalants typically declines by 17 to 19 years.

Difluoroethane, Headspace, Inhalant Abuse

K16 Fentanyl Concentrations in 23 Postmortem Cases From Hennepin County Medical Examiner's Office

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After attending this presentation, the attendee will have better interpretability of postmortem blood fentanyl concentrations and its role in one's death.

This presentation will impact the forensic community and/or humanity by improving the understanding of postmortem blood fentanyl concentrations and showing the importance of the deceased's past medical history in signing out the cause and manner of death.

The purpose of this study was to compare blood fentanyl concentrations in fentanyl-related deaths with fentanyl concentrations found incidentally at autopsy, as well as with fentanyl concentrations found in hospitalized patients receiving fentanyl. A retrospective study, between the years 1995 to 2005, of postmortem cases from the Hennepin County Medical Examiner's Office was conducted in which fentanyl was detected. Gas chromatography – mass spectrometry was used to quantify all fentanyl levels. Of the 23 postmortem cases in which fentanyl was identified, 19 (82.6%) were deemed to be drug overdoses. Fentanyl, alone, was responsible for 7 of the 19 (36.8%) overdose deaths. Mean and median fentanyl concentrations were 38.7 µg/L and 25 µg/L, respectively, with a range of 5 to 120 µg/L. Six of the cases were signed out as accidental, one as undetermined. The remaining 12 of the 19 (63.1%) cases were mixed drug overdoses, predominantly including other opiates, barbiturates, benzodiazepines, and alcohol. Mean and median fentanyl concentrations were 30.8 µg/L and 13.5 µg/L, respectively, with a range of 5 to 152 µg/L. All of the mixed drug overdoses were signed out as accidental. Four cases where fentanyl was an incidental postmortem finding were all signed out as natural deaths; blood concentrations in this group were 2, 2, 2, and 15 µg/L. The deceased with the blood fentanyl concentration of 15 µg/L was being treated for chronic pain related to metastatic squamous cell carcinoma of the head and neck. This fentanyl level was greater than or equal to three of the fentanyl-only overdose deaths and seven of the mixed drug overdose cases.

For comparison, 11 inpatients receiving fentanyl were identified over one 24-hour period. Two of the patients had fentanyl concentrations of 8.5 µg/L and 9.9 µg/L; these levels were higher than one of the fentanyl-only related deaths (5 µg/L) and two of the mixed drug overdose cases (5 µg/L and 7 µg/L). Both patients had been receiving opiates, including fentanyl, for chronic pain for more than three months. The other nine inpatient concentrations were less than 4 µg/L.

This study shows higher mean and median blood fentanyl concentrations in cases where fentanyl alone was determined to be the cause of death when compared to cases where fentanyl was part of a mixed drug overdose. There is considerable overlap between fentanyl concentrations in fentanyl-related deaths and fentanyl concentrations in hospitalized patients being treated for chronic pain. The interpretation of fentanyl concentrations in postmortem cases must be interpreted in context of the deceased's past medical history and autopsy findings.

Fentanyl, Postmortem, Chronic Therapy

K17 HS/GC Determination of Volatile Substances in Antemortem and Postmortem Blood and Urine Samples of Volatile Substance Abusers

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After attending this presentation, the results of Headspace Gas Chromatographic analyses for volatile substances in blood and urine from three groups represented by: 23 abusers of volatile substances which applied to volatile abusers hospital AMATEM-Istanbul; 6 cases of questionable death which were autopsied at the council of forensic medicine; and 10 non-abusers in Turkey will be available.

This presentation will impact the forensic community and/or humanity by providing data on volatile substance abuse in Turkey.

Volatile Substances are known to be inexpensive, easily and legally acquired and therefore have widespread use among youngsters. The mostly widely abused volatile substance in Turkey is toluene. Toluene is extensively used as an organic industrial solvent in paint thinner, detergents and glue. Chronic exposure to low concentrations of toluene causes impairment of the central nervous system. The recommended threshold limit value-time weighted average is 50 ppm for preventing such effects. Toluene is eliminated via exhaled air and as intact compound or its metabolites, hippuric acid and *o*-cresol, in urine. Therefore, indicators of toluene exposure are, beside toluene itself in exhaled air, blood and urine, urinary hippuric acid and *o*-cresol. Additionally, volatile substance abuse (VSA), including paint thinner abuse, represents an important health threat in Turkey. Some paint thinners used in Turkey are mixtures of solvents consisting of toluene as the major component in addition to benzene, hexane and heptane.

In this study, analysis of blood and urine for volatile substances from three groups: 23 abusers of volatile substances which applied to the Volatile Abusers Hospital (AMATEM)-Istanbul; 6 cases of questionable death which were autopsied at the Council of Forensic Medicine; and 10 non-abusers were carried out and compared by using Headspace Gas Chromatography.

The analyses of volatile substances were carried out in lithium-heparinized blood and unspiked urine for the solvents used by abusers according to the method described by Park SW. et al. (J. Forensic Sci. 43:888-890 [1998]). Blood toluene content of 23 antemortem blood samples, taken 24 hour after volatile substance sniffing, were 0.96, 1.49, not detected (ND), 1.33, ND, ND, 0.99, ND, ND, 2.80, 1.35, 2.39, 1.09, 6.56, 3.88, ND, ND, 5.49, 0.66, 0.81, ND, 0.38, 2.17 with the average being 1.61µg/ml ± 1.01 (SD) (range 0.38 to 3.88). Toluene and other solvents were not measurable in urine in the majority of cases; but in four cases, urinary toluene was measured as 0.89, 069, 032 and 0.35 µg/ml. None of the samples were found to contain measurable amounts of benzene, hexane or heptane. Toluene in postmortem samples was distinguishable from that in non-fatal abusers.

Conclusion: From the analysis of blood and urine for volatile substances by Headspace Gas Chromatography, three groups represented by: 23 volatile substances abusers which applied to the Volatile Abusers Hospital (AMATEM)-Istanbul; 6 cases of questionable death which were autopsied at the morgue of The Council of Forensic Medicine; and 10 non-abusers, showed only toluene. The amount of inhalation could not be calculated or explained since the chemical compositions of the abused thinners were not consistent.

Volatile Substance Abuse, Headspace GC, Toluene

K18 Comparative Analysis of GHB and GHV I

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The goal of this presentation is to summarize tests used in the detection of gamma-hydroxybutyrate (GHB) and to apply these tests to the analysis of gamma-hydroxyvalerate (GHV), an emerging drug threat. It will focus on both screening and confirmatory tests and complements the Scientific Session "Comparative Analysis of GHB and GHV II".

This presentation will impact the forensic community and/or humanity by bringing to attention the potential use of GHV as a date rape drug and outlines methods for its detection. The study offers details of simple crystal tests which are rapid and easy and can be applied to the development of a simple field test for the detection of GHB, GHV their analogs and precursors.

The illicit use of GHB and its precursors is well known and reported incidents of its exploitation as a date rape drug have increased worldwide. GHV, a 4-methyl-substituted analog of GHB, is reportedly used as an alternative to GHB and is commercially available as a dietary supplement and replacement for GHB. The behavioral effects of GHV are similar to GHB as both drugs cause sedation, catalepsy, and ataxia, however GHV requires larger doses to produce these effects. The inherent toxicity of GHV appears to be significantly higher than GHB, increasing concerns over abuse and making its detection and characterization an important issue in forensic toxicology and solid dose analysis. Like GHB, GHV is often used and abused in recreational settings and is frequently mixed with water or alcoholic beverages requiring fairly low doses commonly between 3 – 8g, correlating to between 0.8% - 2.3% w/v in a 12oz (355ml) serving.

The work to be presented here has two aspects; first, the application of presumptive tests for the screening of GHV and its precursor gamma-valerolactone (GVL) and second; the development of a head space solid phase micro extraction-gas chromatography-mass spectrometry (SPME-GC-MS) method for the confirmation of GHV and GVL. Methods used for GHB determination were applied as a basis for GHV method development.

A series of presumptive screening tests were evaluated for GHV. Both thin layer chromatography (TLC) and microcrystal tests were developed using a silver nitrate/copper nitrate mix, a reagent previously reported in the literature. Distinct crystals were observed for GHV with $Ag(NO_3)/Cu(NO_3)_2$ reagent. Infrared (IR) and Raman spectroscopy and x-ray crystallography were used for structural determination of crystals. The resulting structure was a planar, stacked crystal lattice with a silver backbone.

Confirmatory analysis was carried out using SPME-GC-MS. As the compounds of interest are small and thermally unstable under high temperature conditions a method was developed for the detection of derivatized GHV and GVL. The derivatizing agent used was N, O-bis(trimethylsilyl)triflouroacetimide (BSTFA) with trimethylchlorosilane (TMCS). SPME was carried out using a 50µm carbowax™/templated resin (CW/TPR) fiber mounted in a manual SPME holder. The fiber was adapted for GC injection by adding a spring and inserting it directly into the GC injection port at a temperature of 220^0 C for desorption of analytes from the fiber. This is the same method that has been successfully applied to GHB. GC data was collected on an Agilent gas chromatograph model 6890 coupled with an Agilent mass selective detector model 5973. The detection of GHV was successful in solutions of water and ethanol. However, problems were encountered with the detection of GVL due to the solvent delay employed to account for the presence of derivatizing agent. A method for the detection of both GHV and GVL simultaneously using liquid chromatography-mass spectrometry (LC-MS) has the potential to solve this problem as derivatization would not be necessary. This is discussed in the scientific session "Comparative Analysis of GHB and GHV II"

GHB, GHV, GVL

K19 Comparative Analysis of GHB and GHV II

Jennifer Wiseman Mercer, BS; Lucy S. Oldfield, MS; Diaa M. Shakleya, PhD; and Suzanne C. Bell, PhD, Bennett Department of Chemistry, West Virginia University, 217 Clark Hall, Morgantown, WV 26506; and Patrick S. Callery, PhD, School of Pharmacy, West Virginia University, Morgantown, WV 26506*

After attending this presentation, attendees will learn about an emerging drug threat, gamma-hydroxy valerate (4-hydroxypentanoic acid, GHV), and a rapid, sensitive, quantitative confirmatory technique for the simultaneous analysis of GHV and its analog gamma-valerolactone (GVL). In the body, GVL and PD are metabolized to GHV with the associated effects. In addition, the synthesis of GHV from gamma-valerolactone (GVL) will be discussed, as GHV is not available for purchase from classic chemical retailers. This presentation will focus on comparative analysis via liquid chromatography with ultraviolet detection (LC-UV) and gas chromatography with mass spectometric detection (GC-MS) and is meant to complement the related presentation entitled "Comparative Analysis of GHB and GHV I."

GHV has been shown to have effects similar to GHB but requires a higher dosage increasing the threat of toxicity and lethality. GHV is anecdotally reported to have a longer duration of action. Given that GHB and its precursors are controlled, drug abusers may switch to GHV. A recent comprehensive internet search revealed that commercial GHV products are sold on many websites. In addition, the effects of GHV also make it suitable for use in drug-facilitated sexual assault. The forensic community needs to be aware of this new drug and prepare to combat its use.

Gamma-hydroxy valerate (GHV) is the 4-methyl-substituted form of gamma-hydroxy butyrate (GHB). As GHV is not available as an analytical standard, a synthesis was developed which involves the hydrolysis of GVL. Thus, the similarities between the two should be exploited to formulate accurate and sensitive confirmatory tests for GHV and its precursors. Liquid chromatography with ultraviolet detection (LC-UV) is a suitable technique for the separation and confirmation of GHB and its analogs. Gas chromatography analysis is more difficult than liquid chromatography because generally GHB must be extracted from complicated matrices and subjected to derivatization due to the small size of the molecule. Thus, developed methods for GC-MS (with *in situ* derivatization) and LC-UV will be compared to determine the advantages and disadvantages of each method.

Since GHB and GHV are small polar molecules, LC provides a more desirable analysis than the more commonly used GC technique. Suspect solutions may be injected directly onto the column, thereby eliminating the need for extraction and derivatization steps required for GC analysis. The LC used in this study was a Shimadzu with the following components: SCL-10A controller, SPD-10A UV-Vis detector, SIL-10AD auto injector, LC-10AD liquid chromatograph (2), DGU-14A degasser, and CTO-10AS column oven. The software used was EZStart 7.2.1. The column used was a µBondapak™ C18 3.9 x 300 mm column. The method is made quantitative by the addition of (S)-(+)-carvone as an internal standard. Data obtained from LC analysis is shown in **Table 1**.

Table 1 – LC Results

Analyte	LOD	LOQ	Range
GHB	5 ppm	50 ppm	50 – 2000 ppm
GHV	5 ppm	50 ppm	50 – 2700 ppm
GBL	100 ppm	200 ppm	200 – 2700 ppm
GVL	25 ppm	100 ppm	100 – 2700 ppm

The GC was an Agilent model 6890 coupled with an Agilent mass selective detector model 5973. An HP-5 capillary column (30 m x 0.25 mm i.d, 0.25 µm film thickness) was used for chromatographic analysis. The method was made quantitative by the use of 1,5-pentanediol as an internal standard. Data obtained from GC analysis is shown in **Table 2**. Future studies will test the methods' suitability for beverage and urine analysis.

Table 2 – GC Results				
Analyte	LOD	LOQ	Range	Quantitative Ions
GHB	0.1 ppm	5 ppm	5 – 100 ppm	233
GHV	0.1 ppm	5 ppm	5 – 100 ppm	75

GHV, GHB, LC-MS

K20 Analysis of THC and Its Metabolites Utilizing LC/MS/MS

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After attending this presentation, attendees will understand the utility of LC/MS/MS for toxicological analyses. Analysis of THC and its metabolites will be presented, but the basic principles can be extended to other analytes of interest.

This presentation will impact the forensic community and/or humanity by demonstrating a simple, sensitive technique for analysis of THC and its metabolites in biological matrices. Sample preparation and analysis times are significantly reduced versus other techniques. This presentation will also give the community more exposure to LC/MS/MS, which can be used as a complementary technique to GC/MS.

Cannabis (marijuana) is the most commonly used illicit drug. Δ^9-Tetrahydrocannabinol (THC) is the active compound in cannabis and its major metabolites are 11-hydroxy- Δ^9-tetrahydrocannabinol (11-OH-THC) and 11-nor-9-carboxy- Δ^9-tetrahydrocannabinol (THC-COOH). Because of its prevalent use, there is an increased demand for detection and quantification of THC and its metabolites in toxicological assays. Until recently, screening has been accomplished by immunoassay and quantification utilizing GC/MS. Over the past 10 years, LC/MS/MS use has significantly increased in many analytical areas, including toxicology. LC/MS/MS often achieves better detection limits versus GC/MS and sample preparation is less labor intensive. A quick and rugged method for analysis of THC and its major metabolites was developed using a hybrid triple quadrupole/linear ion trap LC/MS/MS system. This instrument has the capability to acquire qualitative and quantitative data in a single experiment.

Sample preparation consisted of simple protein precipitation or solvent extraction followed by centrifugation. Detection limits of less than 0.1 ng/mL for all analytes were obtained with precision and accuracy within 10% and 5%, respectively. The reproducibility and ruggedness was shown to be extremely good.

An LC/MS/MS technique for extraction, detection, and quantification of THC and its metabolites was developed. This technique showed excellent precision and accuracy and improved detection limits versus GC/MS. Sample preparation was also greatly simplified versus GC/MS analysis, especially since no derivatization was required. Run times were less than 10 minutes, which further reduced the overall analysis time. The ability to acquire both qualitative and quantitative data in a single assay allowed for detection, confirmation, and quantification in a single run.

LC/MS, THC, Toxicology

K21 Simultaneous Analysis of Thebaine, 6-MAM and 6 Abused Opiates in Postmortem Fluids and Tissues Using Zymark® Automated Solid-Phase Extraction and Gas Chromatography-Mass Spectrometry

Robert D. Johnson, PhD, and Russell J. Lewis, PhD, Federal Aviation Administration, AAM-610, CAMI Building, Room 205, 6500 South MacArthur Boulevard, Oklahoma City, OK 73169*

After attending this presentation, attendees will gain knowledge in potentially differentiating between opiates derived from ingested poppy seeds and opiates taken as medication.

This presentation will impact the forensic community and/or humanity by assisting in the potential prevention of false opiate positives due to poppy seed consumption.

Opiates are some of the most widely prescribed drugs in America and are often abused. Demonstrating the presence or absence of opiate compounds in postmortem fluids and/or tissues derived from fatal civil aviation accidents can have serious legal consequences and may help determine the cause of impairment and/or death. However, the consumption of poppy seed products can result in a positive opiate drug test. A simple method for the simultaneous determination of 8 opiate compounds from one extraction was developed. These compounds are hydrocodone, dihydrocodeine, codeine, oxycodone, hydromorphone, 6-monoacetylmorphine, morphine, and thebaine. The inclusion of thebaine is notable as it is an indicator of poppy seed consumption and may help explain morphine/codeine positives in cases where no opiate use was indicated. It must be stressed, however, that it is possible following poppy seed ingestion to find morphine and codeine in urine without detecting thebaine. Therefore, the absence of thebaine cannot preclude poppy seed consumption as the source of morphine and codeine present in a case.

Specimens types analyzed during this study were blood, urine, liver, kidney, and skeletal muscle. Three mL aliquots of liquid specimens and 1 g aliquots of homogenized tissue specimens were precipitated with acetonitrile and extracted using a common solid phase extraction (SPE) procedure in combination with an automated SPE system. This method incorporated gas chromatography/mass spectrometry, and trimethyl silane (TMS) and oxime-TMS derivatives. The limits of detection ranged from 0.78 – 12.5 ng/mL. The linear dynamic range for most analytes was 6.25 – 1600 ng/mL. The extraction efficiencies ranged from 70 – 103%. Accuracy, measured as the relative error obtained from the concentration obtained from a control versus its target value, ranged from 1-14% and precision, measured as the relative standard deviation obtained from 5 repeated injections of the same control, ranged from 1-9%. This method was applied to 8 separate aviation fatalities where opiate compounds had previously been detected. The analytical results obtained will be presented.

Poppy Seeds, Thebaine, GC/MS

K22 A Novel LC/MS Method for the Quantitation of Vardenafil

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After attending this presentation, attendees will learn an accurate and reliable method for the detection of vardenafil.

This presentation will impact the forensic community and/or humanity by providing the forensic community with an accurate and reliable method for the detection of vardenafil.

Vardenafil is an oral medication used for the treatment of erectile dysfunction. Vardenafil, when used properly, is relatively safe. However, vardenafil has been shown to potentiate the hypotensive effects of nitrates commonly employed in the treatment of certain heart conditions. Moreover, while vardenafil inhibits phosphodiesterase type 5 enzyme, it also has a high affinity for phosphodiesterase type 6 (PDE6), which is a retinal enzyme involved in phototransduction. The inhibition of PDE6 can result in the inability to discriminate between blue and green colors, resulting in a condition known as "blue tinge." This blue-green impairment could cause problems in the execution of certain tasks. For example, this impairment could lead to a problematic situation for a pilot relying upon instruments during night flights or adverse conditions. During the investigation of aviation accidents, postmortem specimens from accident victims are submitted to the Federal Aviation Administration's Civil Aerospace Medical Institute (CAMI) for toxicological analysis. As new medications are introduced to the market and are subsequently used by aviation accident victims, CAMI's forensic toxicology laboratory is tasked with developing analytical methods for the determination of these compounds. This report presents a rapid and reliable method for the identification and quantitation of vardenafil in biological specimens using LC/MS/MS and MS/MS/MS. This procedure utilizes sildenafil-d_8, which is closely related to vardenafil, as an internal standard for more accurate and reliable quantitation. This method incorporates solid-phase extraction (SPE) and LC/MS/MS and MS/MS/MS utilizing an atmospheric pressure chemical ionization ion trap mass spectrometer in the positive chemical ionization mode. Using a common basic drug SPE procedure, the extraction recoveries for blood controls at 2, 20, and 200 ng/mL ranged from 94 – 97%. The limit of detection for vardenafil was determined to be 0.19 ng/mL. The linear dynamic range for this compound was 0.39 – 200 ng/mL. This novel analytical procedure proved to be simple, accurate, and robust for the identification and quantitation of vardenafil in biological specimens.

Vardenafil, LC/MS/MS, Aviation Death Investigation

K23 Oxycodone and Oxymorphone Glucuronide Conjuagtes in Urine From Pain Management Patients

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Oxycodone is generally present in urine as readily extractable free, unconjugated form; however, its oxymorphone metabolite is extensively conjugated. The goal of this presentation therefore, is to assure detection or extend the detection time for oxycodone, urine should be hydrolyzed prior to analysis.

This presentation will impact the forensic community and/or humanity by assisting forensic toxicologist in the detection of oxycodone and its oxymorphone metabolite in urine specimens and in evaluation of oxycodone urine concentrations.

The concentrations of free and glucuronide conjugates oxycodone and its oxymorphone metabolite in urine specimens collected from 200 different pain management patients will be presented. These patients were receiving oxycodone as the sole opiate derivative used for pain control either in combination with acetaminophen or in a sustained release dosage form. Daily doses ranged from 20 to 80 mg of oxycodone. Urine specimens were analyzed initially fluorescence polarization opiate immunoassay (FPIA) at a cut-off of 100 ng/mL and oxycodone enzyme immunoassay (EIA) at a cut-off of 100 ng/mL before and after enzymatic hydrolysis with beta-glucuronidase. Following the addition of hydroxylamine, oxycodone and oxymorphone oxime derivatives were isolated from urine by solid phase extraction in a Detectabuse™ Gravity GV-65 column as described by the manufacturer (Biochemical Diagnostics Corp.). Oxycodone and oxymorphone oximes were derivatized by the addition of BSTFA [N,O-bis (trimethylsilyl)trifluoroacetamide]. The residues were analyzed on a Hewlett Packard (Palo Alto, CA) 6890 gas chromatograph with a split/splitless injection port, a 7673 auto-sampler and a 5973A mass selective detector (MSD). The column was an HP-5 capillary column (5.0 m x 0.1 mm id x 0.40 um film thickness). Column flow rate was 1.0 mL/min; inlet pressure at 60.53 psi; and injection was in the 4:1 split mode with a split flow of 4.0 mL/min. The oven temperature program was: initial 170^0C for 0 min., then ramped at 30^0C/min. to 280^0C that was held for 0.33 min. Under these conditions the retention times in minutes of TMS derivatives were oxycodone-oxime, 3.32; and oxymorphone-oxime, 3.62. The MSD was operated in the SIM mode using the following ions: oxycodone-oxime-TMS, 459, 444 and 368; oxymorphone-oxime-TMS, 517, 502 and 412; $^2H_3$-oxycodone-oxime-TMS 462 and 447; and $^2H_3$-oxymorphone-oxime-TMS, 520 and 503. Oxycodone and oxymorphone were quantitated using a single point calibrator of each at 500 ng/mL with internal standards of the respective deuterated analogs. The assay was linear from 50 to 10,000 ng/mL of oxycodone and oxymorphone. The lower limit of quantification of each analyte was 100 ng/mL. In the 200 unhydrolyzed urine specimens, the mean oxycodone concentration was 2,450 ng/mL (range, 119-7,600 ng/mL) and the mean oxymorphone concentration was 131 ng/mL (50-1,000 ng/mL). Following glucuronidase hydrolysis of these specimens, the mean oxycodone concentration was 4,000 ng/mL (range, 149-18,600 ng/mL) and the mean oxymorphone concentration was 2,900 ng/mL (range, 172-54,000 ng/mL). The mean percent of oxycodone and oxymorphone as glucuronides in the urine specimens were 29% (range, <1-85%) and 95.5% (range, 66-99%), respectively. These data demonstrate that oxycodone is generally present in urine as the readily extractable free, unconjugated form; however, its oxymorphone metabolite is extensively conjugated. Therefore, to assure detection or extend the detection time for oxycodone, urine should be hydrolyzed prior to analysis.

Oxycodone, Glucuronides, Oxymorphone

K24 A Study of the Adulteration of Chinese Herbal/Patent Medicines Collected From New York City's Chinatown With Western Pharmaceuticals

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After attending this presentation, attendees will understand the dangers associated with consumption of some unregulated patent/herbal medications and the extent to which they contain western drugs.

This presentation will impact the forensic community and/or humanity by making the community aware of the potential exposure of individuals to western drugs upon consumption of some imported herbal preparations.

In America, recent growth in the popularity of Chinese Herbal/Patent Medicines (CHM/CPM) has generated concerns as to the safety of these and other herbal remedies. These agents are consumed due to their suggested ability to aid with many maladies ranging from hypertension, cold and flu, inflammation, chronic and acute pain, asthma, arthritis, sexual dysfunction, stress and anxiety, to name but a few. Lack of strict federal regulations has lead to the possibility of adulteration of these products with western drugs or other chemical contaminants. This may pose a problem among consumers unaware that they may contain hazardous ingredients. Additionally, potentially serious drug interactions are also possible due to the lack of proper labeling of these products. In order to determine the extent of adulteration and/or mislabeling of CHM/CPM in New York City's Chinatown, the laboratory has conducted a study to screen these products for mislabeled or undeclared pharmaceuticals and therapeutic substances. Representative samples in the form of pills, tablets, creams and teas were screened and confirmed by appropriate analytical techniques including, thin layer chromatography (TLC), gas-chromatography mass spectrometry (GC/MS), and high performance liquid chromatography (HPLC). To date, approximately 25% of all samples analyzed contained western pharmaceuticals, undeclared or mislabeled substances. Drugs that have been identified in CMH/CPM thus far will be presented and include; promethazine, chlorpheniramine, diclofenac, chlordiazepam, reserpine and steroidal anti-inflammatory drugs.

Herbal Medicines, Adulteration, Western Pharmaceuticals

K25 Comparison of the Intercept® and Salivette® Oral Fluid Specimen Collection Devices for the Detection of Marijuana Use

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The goal of this presentation is to inform forensic toxicologists concerning the analytical efficiency of two oral fluid collection devices for detection of marijuana constituents and their utility for detection of marijuana use as compared to urine specimens.

This presentation will impact the forensic community and/or humanity by improving understanding of oral fluid testing and detection of marijuana use.

A comparison of the analytical efficiency of two different oral fluid collection devices and immunoassay systems for detection of marijuana constituents; and the detection of marijuana use by these oral fluid methods as compared to urine drug testing will be presented. Oral fluid specimens were collected by both the Intercept (OraSure Technologies, Inc.) and the Salivette (Sarstedt) collection devices and a urine specimen was obtained from 519 suspected marijuana users. The oral fluid specimens collected by the Intercept device were initially analyzed by the Cannabinoids Intercept Micro-Plate Elisa Immunoassay (OraSure) in a Personal Lab (Trinity Biotech) at a cut-off tetrahydrocannabinol (THC) concentration of 1 ng/mL. The oral fluid specimens collected by the Salivette device were initially analyzed by the Oral Fluid Cannabinoid Enzyme Immunoassay (Lin-Zhi International, Inc.) in a Hitachi 717 modified for sample volume of 60 uL at a cut-off THC concentration of 5 ng/mL. Urine specimens were initially analyzed by the Emit II Plus Cannabinoid Enzyme Immunoassay (Syva Co.) in a Hitachi 717 at a cut-off tetrahydrocannabinolic acid (THCA) concentration of 50 ng/mL. Any positive initial test was confirmed by GC/MS. THC was isolated from oral fluid by liquid/liquid extraction and derivatized with MSTFA. TMS-THC was identified by monitoring 386, 303, 387 m/z ions. The LOQ of the method was 0.2 ng/mL. . THCA was isolated from urine by liquid/liquid extraction and derivatized with MSTFA. TMS-THCA was identified by monitoring 371, 473, 488 m/z ions. The LOQ of the method was 3.0 ng/mL. Approximately, 10% (51/519) of at least one of the specimens from the donors was positive for THC or THCA by GC/MS analysis; THC was detected in 32 oral fluid and THCA in 51 urine specimens. There was complete concordance between positive THC findings by both immunoassays and GC/MS for only 23 of the 32 oral fluids specimens. However, there was a 97% concordance between negative THC findings by both immunoassays and GC/MS for 477 of the 491 oral fluids specimens. Comparing results from the Intercept method with GC/MS, the analytical sensitivity of the Intercept/Elisa method was 94% and the analytical selectivity was 99.4%. Comparing results from the Salivette method with GC/MS, the analytical sensitivity of the Salivette/Enzyme immunoassay method was 78% and the analytical selectivity was 99.8%. The difference in sensitivity between these methods was due to the difference between the cut-off values; Elisa, 1 ng/mL and enzyme immunoassay, 5 ng/mL. The Salivette/Enzyme immunoassay method yielded 7 false negative results. The Intercept/Elisa method was less selective than the Salivette/Enzyme immunoassay as it yielded 3 false positive results. Urine testing resulted in a significant increase in positive cannabinoid findings as compared to oral fluid testing. While oral fluid testing yielded only 32 positive findings, 51 urine specimens tested positive by initial screening and GC/MS. This represents a 68% increase in the detection of marijuana use. This increase was due to the prolonged excretion of THCA in urine as compared to the presence of THC in oral fluid. The presented data demonstrates the need for very low THC cut-off concentrations (1 ng/mL) when screening oral fluids for consistent detection of cannabinoids. Additionally, marijuana use is best detected by urine drug testing, even at a THCA cut-off value of 50 ng/mL, as compared to oral fluid testing at 1 ng/mL.

Oral Fluids Testing, Urine Drug Testing, Cannabinoids

K26 The Detection of THC and THCA in Whole Blood Using Two-Dimensional Gas Chromatography and EI-MS

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After attending this presentation, attendees will learn about an improved method for measuring THC and THCA in blood by GCMS. The new method includes the easy use of 2-dimensional chromatography to greatly reduce matrix interference and improve the limit-of-detection.

This presentation will impact the forensic community and/or humanity by demonstrating an easy and inexpensive improvement for the determination of cannabinoids in whole blood by GCMS .

A method is described for the simultaneous analysis of THC and its carboxylic acid metabolite, THCA as their TMS derivatives using 2-dimensional chromatography and EI-MS detection, (2-D GCMS). The addition of a Deans switch to a standard GC oven allows the use of two chromatographic columns of differing stationary phase to greatly reduce matrix interference. The Limit of Quantitation (LOQ) for THC and THCA was determined to be 1.0 ng/ml. The between-run precision at 1.0 ng/ml (N=25) was 7.7 and 11.1 % for THC and THCA, respectively. The method is linear from 1 to 100 ng/mL.

Sample Preparation: Internal standard was added (10 ng of THC-d3 and THCA-d3 in methanol) to 1.0 mL of whole blood. To each sample 2.0 mL of cold (-20^{o} C) acetonitrile was added and immediately vortexed for 30 seconds before proceeding to the next sample. (The cold acetonitrile produces a more finely divided protein precipitate than did room-temp acetonitrile.) The samples were briefly centrifuged, the supernate was decanted to a clean tube and the solids were discarded. 2.0 ml of DI water was added to each sample before it was poured onto the SPE column (*Cerex*

polychrome THC columns from *SPEware*). The columns were washed with a 1.0 ml mix of water/acetonitrile/NH_4OH (85/15/1, prepared daily) and dried for 10 minutes by a flow of nitrogen. The THC was eluted into a tube with 2.0 ml of ethyl acetate followed by 10 minutes of drying. The THCA was eluted into the same tube with 2.0 ml of a hexane/ethyl acetate/acetic acid mix (90/10/3, prepared daily). All flows through the column were ~1 drop/sec controlled by positive pressure. The samples were evaporated to dryness at 50° C under a stream of nitrogen. 50 uL BSTFA+1%TMCS and 50 uL ethyl acetate were added to each tube, the tube was vortexed and the contents were transferred to a GCMS vial. The vials were crimp-capped and heated at 70° C for 20 minutes.

Instrumentation: GCMS-FID: The gas chromatograph was an Agilent 6890 equipped with a FID and a Deans switch. The Deans switch, from Agilent Technologies, consists of a second EPC (electronic pressure control) module, a solenoid switch that is outside the oven and a manifold inside the oven to connect the GC columns. The Mass Spectrum detector was an Agilent 5973. The carrier gas was helium. The injection port temperature was 250° C and the transferline was at 300° C. The MSD was operated at 200 volts above the tune. The SIM ions were: m/z 386.3, 371.3, 303.3 for THC, m/z 389.3, 374.3 for THC-d3, *m/z* 371.3, 473.3, 488.3 for THCA and m/z 374.3, 476.3 for THCA-d3. The dwell time for all ions was 25 milliseconds and "high" resolution was selected. The ion mass was determined by scanning each SIM ion in 0.1 *m/z* units. The oven program was: initial temp 120°C, increased at 20°/min to 200°C, further increased at 10°/min to 250° C, increased again at 25°/min to 300° C and held for 0.5 min. The injection port liner was a deactivated 4mm splitless gooseneck with glass wool from Restek. The injection volume was 2 uL.

Deans Switch Parameters: Column 1 was a RTX-200 (20m, 1.18mm id, 0.20 um df). Column 2 was a DB-17 (15m, 0.25 mm id, 0.25 df). The pressure for the injection port and the Deans switch were calculated using the Deans Switch Calculator software (Agilent Technologies) to achieve 1 ml/min flow through the primary column and 2.0 ml flow through the secondary column at an oven temperature of 200° C. The injection port was set for constant pressure at 41.06 psi and the Deans switch pressure was 16.98 psi. The post-run program was set for 1 minute with the oven temp at 320°C and the inlet pressure at 1 psi. With the inlet pressure at 1 psi in the post-run, the carrier gas flow through the primary column is reversed. This ability to back-flush the primary column is an advantage of the Deans switch system and reduces the maintenance frequency of the primary column. The secondary column stays remarkably clean because only a small fraction of the injection volume for each chromatographic run flows through it.

Marijuana, Blood, GCMS

K27 Combined Drug and Alcohol Use in Drivers Suspected of Vehicular Assault and Homicide

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After attending this presentation, the attendee will understand the limitations of current toxicological practices in identifying drug impairment by drivers involved in serious injury traffic accidents; recognize the major drug classes known to be involved, and the degree of combined alcohol and drug involvement.

This presentation will impact the forensic community and/or humanity by attempting to be the first to document the combined use of drug and alcohol use in drivers suspected of vehicular homicide and assault. This should improve practices of traffic law enforcement, provide a basis for allocation of enforcement assets to detecting symptoms of drug impairment, and encourage comprehensive drug testing in alcohol DUI cases.

Since the relationship between blood drug concentrations and the degree of effects associated with those is not well established for most drugs, investigation of vehicular assault and homicide cases should ideally include an assessment of the suspect's degree of sobriety by a trained officer proximate to the time of the accident. This is often not possible due to injuries sustained by the subject. In those cases when a blood sample is collected it falls to the forensic toxicologist to interpret those findings, and relate them to the suspects known driving behavior. Current practice in most jurisdictions however, driven by limited toxicological resources, is that if a suspect's blood alcohol exceeds the legal limit, no drug testing is performed and the subject is prosecuted based on the alcohol result and its known effects.

In an effort to assess the true rate of drug use and combined alcohol and drug use in the impaired driving population, samples taken from suspects in vehicular assault and homicide cases were subjected to comprehensive drug testing, irrespective of the blood alcohol concentration.

From a review of cases received during 2002 and 2003, 804 cases were identified where the driver was considered a suspect in a vehicular assault or homicide case. Of these, 700 were available in sufficient quantity for comprehensive testing for priority drug classes by immunoassay (EMIT for barbiturates, benzodiazepines, cannabinoids, cocaine metabolite, methadone, opiates, phencyclidine, propoxyphene and tricyclic antidepressants), alcohol, and basic drugs by gas chromatography. Since this was an assessment of incidence of drug use, determinations were qualitative only.

Table 1 shows the relative frequency of alcohol and drug use alone and in combination. Alcohol positive cases were those with blood alcohol concentrations 0.01g/100mL and greater. Drug positive cases were those with one or more drugs capable of causing impairment.

Table 1. Drug and alcohol positivity rates for all cases (n=700)

	Drug Positive	Drug Negative	Totals
Alcohol Positive	235 (33.5%)	223 (31.8%)	458 (65.4%)
Alcohol Negative	115 (16.4%)	126 (18.0%)	242 (34.5%)
Totals	351 (50.1%)	349 (49.9%)	700

Of the 700 cases tested, 126(18.0%) had no detectable alcohol or drugs. There may be a variety of reasons why samples were submitted in these cases. It would include the fact that some agencies have a policy of submitting samples from the driver in any serious injury accident, whether or not there is evidence of fault, or of drug or alcohol use. It would also include individuals who submitted samples to protect themselves in case of civil litigation resulting from the collision. Additionally, drugs such as gabapentin, GHB, lorazepam, and clonazepam, are not detected in the test batteries used in this study. Drugs which are generally not considered to have any significant effect on driving such as caffeine, nicotine, lidocaine, bupivacaine, venlafaxine, citalopram, and other SSRIs were not included in the totals for drug positive cases.

The mean (±SD) blood alcohol concentration (BAC) among the alcohol positive cases was 0.15 (± 0.07) g/100mL (median 0.15, range 0.01 – 0.44g/100mL). This is similar to the average blood alcohol concentration seen in DUI arrests in Washington State, where there is either no collision, or no serious injury.

Of the alcohol positive cases, 235 (51.3%) additionally had drugs which could have contributed to impairment. This is a significant finding since in many jurisdictions a positive blood alcohol result would preclude any further testing for drugs, meaning that the subject's drug use would go undetected. This is important for a number of reasons, including the ability

to fully prosecute the case, negotiations on a plea agreement, assessment or treatment for drug use, and allocation of law enforcement resources.

The data were also examined to assess relative rates of drug use among drivers with high BAC's compared to lower BAC's, and the data are presented in table 2.

Table 2. Drug positivity with respect to blood alcohol concentration.

	Drug Positive	Drug Negative	Totals
Alcohol ≥0.08g/100mL	192 (41.9%)	200 (43.7%)	392 (86.0%)
Alcohol 0.01–0.079g/100mL	43 (9.3%)	23 (5.0%)	66 (14.0%)
Totals	235 (51.3%)	223 (48.7%)	458

Of the alcohol positive cases 392 (86%) had alcohol concentrations of 0.08g/100mL or above. Among these high BAC drivers, 48.9% were positive for drugs. For the low BAC drivers (0.01 – 0.079g/100mL), 65% were positive for drugs. The combination of low levels of alcohol with other drugs having CNS depressant properties such as marijuana, benzodiazepines, opiates and muscle relaxants, can cause impairment in a synergistic manner. When circumstances suggest poor or inattentive driving, and the blood alcohol is less than 0.08g/100mL, further assessment of the drivers sobriety, and collection of a blood sample should be standard procedure.

The data were examined for evidence of any relationship between the drug classes detected as a function of BAC, and the data are shown in Table 3.

Table 3. Relative frequency of major drugs/classes identified as a function of blood alcohol concentration†.

	Alcohol Negative (n=242)	Alcohol 0.01 -0.079g/ 100mL (n=43)	Alcohol ≥0.08g/100mL (n=392)
Any impairing drug	47.5%	65.1%	48.9%
Cannabinoids	9.9%	58.0%	26.7%
Amphetamines	14.9%	6.9%	2.0%
Cocaine	2.4%	6.9%	4.8%
Opiates*	8.7%	27.9%	12.8%
Benzodiazepines*	4.1%	20.9%	8.9%

* Note: Opiates and benzodiazepines may be administered during emergency medical treatment prior to the collection of a forensic blood sample, therefore opiate and benzodiazepine rates should be interpreted with caution in this population.

† Columns will not total to 100% since many subjects were positive for more than one class of drugs.

Overall rates of drug positivity were high in all three groups. Therapeutic drug use was highest in the alcohol negative group with muscle relaxants, antiseizure medications, sleep aids and over the counter drugs being more frequently encountered than in the alcohol positive groups. These drugs can nevertheless cause driving impairment even when used according to directions. Rates of combined marijuana and alcohol use were dramatically higher in the alcohol positive groups, with cannabinoids being detected in 58% of low BAC drivers and 26.7% of high BAC drivers. Combined alcohol and marijuana use, particularly in young drivers has been demonstrated to cause synergistic impairment. Amphetamine use (principally methamphetamine) was highest among the alcohol negative drivers. Other studies have demonstrated relatively low rates of concomitant alcohol use among methamphetamine users.

In conclusion, this study documents the high frequency of combined drug and alcohol use among drivers suspected of impaired driving leading to vehicular assault or vehicular homicide. According to current practice, suspicion of drug use increases when a subject's low BAC is not consistent with their observed impairment, and these data validate that practice. In addition however, the data demonstrate that drug use is a factor throughout the range of BAC, and that investigators should be alert for indicia of drug use in any contact with a suspected alcohol impaired driver.

Toxicology, Impaired Driving, Drugs of Abuse

K28 She "Lost that Lovin' Feelin' " in the Arizona Dust: Angry Teen on Alcohol, Cannabis and Cocaine

Michelle A. Spirk, MS, Arizona Department of Public Safety, Central Regional Crime Laboratory, 2323 North 22nd Avenue, Phoenix, AZ 85009*

After attending this presentation, attendees will be exposed to a Case Study involving interpretive toxicology and drug impaired driving. This case provides valuable discussion material as it lacks many of the factors that would make for an "ideal" DUID case; thus forcing a discussion of how real-life drugged driving interpretations may be handled. Drug effects, DRE evidence, analytical issues, case strengths, weaknesses and summary statements will be covered.

This presentation will impact the forensic community and/or humanity by addressing the difficult challenges associated with drugged driving interpretations. Although many forensic toxicologists are asked to provide these interpretations and related expert testimony, they are rarely presented to colleagues in this type of case study format. Utilizing a detailed Case Study model as presented here, is an excellent way to share knowledge and promote discussion regarding challenging drugged driving interpretations.

Ideal drug-impaired driving cases include significant driving behavior, a DRE evaluation, psychoactive parent drug(s) quantitated in blood obtained close to the time of driving that corroborate the DRE opinion, and driver admissions supporting impairment. This case was *not* ideal as it lacked much of the information allowing an interpretive analysis of driving impairment; thus, it *was* a typical DUID case. A 16-year-old female presented with qualitative blood confirmations of Benzoylecgonine (BE), Carboxy-THC and a low alcohol concentration (0.015g/100mL), obtained two hours and 32 minutes after significant driving behavior resulting in a fatal collision causing the death of a seven-year-old child in a second vehicle. The collision occurred on the Tohono Oodham Reservation at approximately 9:41 pm as the teen drove with her boyfriend, and his two nephews (ages 3 and 7) in the back. An argument ensued resulting in her holding onto his shirt to restrain him as he tried to exit the moving vehicle; the 3-year-old was crying to leave. She then ran a stop sign, making a left turn into the opposing traffic lane and colliding nearly head-on with the second vehicle. She had the moderate odor of an alcoholic beverage on her breath, slurred speech and red bloodshot eyes. Confirmatory blood cutoffs for Cocaine/BE and THC/C-THC were 50ng/mL and 2ng/mL respectively, thus parent drugs may have gone undetected. Later additional quantitative analysis of Cocaine and THC was precluded by sample size and consideration of non-enzymatic hydrolysis of Cocaine during extended refrigerated storage. Alcohol concentration was too low to provide extrapolation evidence. No DRE was available. *Interpretation*: BE is detectable in blood for ~ 48 hours post ingestion; blood BE indicates that Cocaine was present at the time of, or prior to, the blood draw. Duration of effects for Cocaine is 2-4 hours and is dose dependent. Effects consistent with Cocaine influence were: self-absorbed; inattentive; decreased divided attention and increased risk taking. Cocaethylene, although not tested for, is a possible additional contributor to driving impairment. Carboxy-THC detection in blood is highly dependent upon dose and frequency of use; blood Carboxy-THC indicates that THC was present at the time of, or prior to, the blood draw. Duration of effects for THC is 3-6 hours with some complex divided attention tasks up to 24 hrs. Effects consistent with THC influence were: bloodshot eyes; decreased divided attention; difficultly thinking, problem-solving and processing information; decreased car handling performance; slow reaction times; decreased perceptual functions and significantly greater effects when combined with alcohol. The absence of Cocaine and THC in this case does not rule out their presence at the time of driving or sampling, or potential dysphoric effects of cocaine. Driver is a minor, with limited driving experience, thus drug-impaired driving would likely occur at a reduced threshold than for a more experienced driver. *Strengths*: inattentive, inexperienced driving resulting in a fatal collision; admission of recent prior alcohol use; confirmation of polydrug metabolites in blood that

could only come from prior use of potentially impairing and illicit drugs; documented poor judgment, decreased divided attention and increased risk taking. *Weaknesses*: driving distractions; absence of psychoactive drug(s); absence of DRE; minimal documentation of drug impairment at scene. *Summary*: focus on driver's diminished capacity to operate motor vehicle safely; includes her inability to focus on the complex task of driving and not become overly distracted by quarrels, etc. Her recent use of cocaine, alcohol and probable cannabis greatly increase the likelihood of her being a less competent and safe driver.

Cannabis, Cocaine, Drugged Driving

K29 Integrating a New DUI Toxicology Program – Trials and Tribulations

Fiona J. Couper, PhD, and Rory M. Doyle, MSc, Office of the Chief Medical Examiner, 1910 Massachusetts Avenue, SE, Building 27, Washington, DC 20003*

After attending this presentation, attendees will learn about a more coordinated effort in dealing with DUI cases in their local jurisdictions.

This presentation will impact the forensic community and/or humanity by facilitating improvements in public health and safety by increasing the likelihood of successful detection and prosecution of DUI cases.

This presentation primarily focuses on the recent changes to the DUI toxicology program in Washington, D.C. Although covering only 10 square miles, the District currently encompasses at least five different local and federal law enforcement agencies, two toxicology testing facilities, and two separate prosecuting agencies; all of which are responsible for the investigation, detection and prosecution of DUI cases. Over the past two years, representatives from several of these agencies have sought to improve overall coordination, communication, and training across the various agencies. This has included improvements in coordinated traffic stops, filing of police paperwork, sample submission, alcohol and drug testing protocols, preparation of court cases, coordinated training, and funding sources, in addition to extensive legislative changes.

DUI, Toxicology, Testing

K30 What's New in the Drug Evaluation and Classification Program?

Charles E. Hayes, International Association of Chiefs of Police (IACP), PO Box 4597, Salem, OR 97302

After attending this presentation, attendees will gain a better understanding of the Drug Evaluation and Classification Program's role in identifying drug impaired drivers and learn about the program's expansion and successes. They will also learn about the latest curriculum revisions.

This presentation will impact the forensic community and/or humanity by providing the forensic community with a better understanding of the DEC program successes and how the forensic community is a key player in this international program.

After attending this presentation, attendees will understand the role of the International Association of Chiefs of Police (IACP) and the National Highway Traffic Safety Administration (NHTSA) in coordinating, administering and facilitating the Drug Evaluation and Classification (DEC) Program. They will also learn about the program's expansion and successes, as well as learning about the most recent training curriculum changes that all Drug Recognition Experts (DREs) use in helping to identify persons under the influence of drugs. Toxicology is one of the key components of the DEC program and must be aware of revisions and new elements within the program.

This presentation will also update attendees on the DRE data collection tracking system that incorporates toxicology results from the various labs throughout the country. It will also address the DEC program expansion efforts into other states and how the program is expanding outside of the United States.

Drugs, Driving, Evaluation

K31 Application of Models for the Prediction of Time of Marijuana Exposure From Blood of Drivers Arrested for DUI

Ann Marie Gordon, MA, Jayne E. Clarkson, BS, and Barry K. Logan, PhD, Washington State Toxicology Laboratory, 2203 Airport Way, Seattle, WA 98134*

After attending this presentation, attendees will learn how clinically derived models for time of prediction of marijuana use in DUID cases was applied to data from actual driving under the influence cases. The model based upon THC concentrations, alone, was not predictive but the model based upon THC>carboxy-THC ratios had some predictive value.

This presentation will impact the forensic community and/or humanity by demonstrating how driving under the influence of marijuana is a major concern in traffic safety and forensic toxicologists are frequently asked to render opinions as to the subject's impairment. Since time of use is one of the determining factors used to evaluate impairment, the ability to predict the time of use from blood levels would be helpful. This paper discusses the use of a model presented by Huestis et al from clinical data and its application to DUI casework.

Forensic toxicologists are often asked to interpret THC and carboxy-THC levels detected in the blood of subjects arrested for driving under the influence of drugs (DUID). Marijuana has been shown to impair driving performance for up to 3 hours. Providing a reliable estimate for the time of use would help in the interpretation of such cases. In 1992, Huestis et al presented two mathematical models for the time prediction of marijuana exposure from plasma concentrations of THC and carboxy-THC based upon data obtained from participants in clinical studies. Model I utilized plasma THC concentrations and model II utilized carboxy-THC:THC ratios in plasma.

This study applied these models to blood data derived from DUI arrestees. Unlike the controlled clinical data, there are additional limitations to arrestee data. Blood, not plasma is the sample collected in DUI arrests; plasma:blood correlations are approximately 2:1. Second, validation of when THC was used and over what period of time in the driving population is not possible. Many of the arrested drivers admitted repeated use of marijuana over an extended periods of time. Since, both THC and carboxy-THC accumulate in chronic or repeat users, the variability of predicted time from the models would increase.

Driving under the influence of drugs is a major concern in traffic safety. Washington State had 2787 drivers arrested for DUID in 2004. The most frequent drug finding is THC and/or its major metabolite, carboxy-THC (28 % DUID cases). In 2004, 1135 drivers tested positive for THC and/ carboxy-THC; 668 (59%) had reportable levels of the pharmacologically active parent drug, THC (limit of quantitation is 1 ng/mL). From 1997 to 2004, the mean THC concentration decreased from 9.7 to 5 ng/mL, median 4 ng/mL, mode 2 ng/mL and the carboxy-THC levels were 54 ng/mL, median 40 ng/mL.

For this study, positive THC cases were selected in which a Drug Recognition Evaluation (DRE) was performed. DRE cases were selected because the reports are more complete. Of the 323 THC positive DRE reports obtained, the time blood draw on the blood vials was available in 191 cases. These cases were reviewed for a reliable source as to the time of last smoking, (n= 91). The criteria used included cases where the arresting officer visually saw the driver smoking marijuana, found a warm marijuana cigarette in the stopped vehicle, or cases in which the subject admitted to smoking within one hour of the stop. Cases were excluded when the subject cited an actual time of smoking as they were often confused actual time of day frequently stating use was after the stop. Admissions such as "thirty minutes before I was stopped" were included. In the 91 cases, the THC levels averaged 5.2 ng/mL, median 4 ng/mL, carboxy-THC levels 57.6 ng/mL, median 40 ng/mL.

Model I proved not to be useful. There was little correlation between the time of the stop and the predicted time of use the predicted time was always considerably less than the actual time. Model II proved more pre-

dictive for the time of use. The time of stated or observed use ranged from 50 to 233 minutes, average 131 minutes and median 127 minutes. The ranges were limited by the time required to stop and arrest, perform the DRE exam and obtain the blood draw. The average absolute time difference between the time of stated or observed smoking and time of blood draw was 43 minutes, median 30 minutes, standard deviation, 37 minutes. Further, Model II predicted the time of smoking to be within 30 minutes of the actual time in 50.5% of the cases, within 1 hour 73.6% of the time and within 2 hours 94.3% of the time. In 69% of the cases, the predicted value exceeded the actual time of use.

The data presented here is very promising for the usefulness of Model II in predicting the time of marijuana use but some caution must be used due to the limitations to this data. First, cases were pre-selected for short intervals between the time of smoking and the time of the stop. Second, the manner in which the cases were selected may have excluded more chronic smokers as these subjects may be less likely to answer the questions as to time of use or may purposefully misstate time of use. However, even in light of these limitations, it does appear that the time of use predicted by Model II may be useful when considered along with the context of the overall case, including the observed driving of the subject, the observed impairment of the subject during the physical exams and subject's statements when rendering an opinion as to the impairment of a subject arrested for DUID, marijuana.

46	0.505495	42.5736
21	0.230769	30.3341
19	0.208791	37.28421
4	0.043956	
1	0.010989	

Marijuana, Driving Under the Influence, Time of Driving

K32 Recommendations for Toxicological Investigations of Drug Impaired Driving Cases from the Joint SOFT/AAFS Drugs and Driving Committee and the National Safety Council Committee on Alcohol and Other Drugs

Laurel J. Farrell, BA, Colorado Bureau of Investigation, 690 Kipling Street, Denver, CO 80215*

After attending this presentation, attendees will learn about improved analytical protocols for DUID toxicological specimens.

This presentation will impact the forensic community and/or humanity by increasing standardization of analytical protocols in laboratories supporting the DRE program and increasing the effectiveness of DUID prosecution.

In May 2004, under the auspices of the National Safety Council's Committee on Alcohol and Other Drugs (NSC-COAD), a panel of toxicologists, prosecutors, and law enforcement officers trained as Drug Recognition Experts gathered to identify problems with the current system of prosecuting drug impaired driving cases, from the point of detection through adjudication. The panel in their report of the meeting sites lack of standardization of practices in toxicology laboratories supporting DUID programs as one of the major problems. The toxicology laboratory provides analysis of the biological specimen collected during the investigation. The labs need to test for the most frequently encountered drugs in these cases, and use an appropriate level of sensitivity. Along with comprehensive documentation by the DRE officer, good quality forensic toxicology is an essential part of the prosecution of a DUID case.

The Joint SOFT/AAFS Drugs and Driving Committee and the NSC-COAD were charged with identifying the laboratories performing DRE toxicology and to survey these laboratories to document their current practices. This was accomplished with the help of the International Association of Chiefs of Police (IACP). Once the survey was completed, the panel recommended that guidelines be developed to direct the development of more consistent procedures and protocols.

The presentation today will highlight results of the survey providing data on the scope and sensitivity of testing in practice today. Recommendations for Toxicological Investigations of Drug Impaired Driving Cases are being developed and the current status of these recommendations, to include drugs to be included in analytical protocols and appropriate analytical thresholds in blood and urine, will be provided.

DUID, Lab Survey, Laboratory Guidelines

K33 Ambien® - Drives Like a Dream? Case Studies of Zolpidem Impaired Drivers in Wisconsin

Laura J. Liddicoat, BS, and Patrick M. Harding, BS, Wisconsin State Laboratory of Hygiene, 2601 Agriculture Drive, PO Box 7996, Madison, WI 53707-7996*

After attending this presentation, attendees will gain knowledge of the zolpidem impaired driver.

This presentation will impact the forensic community and/or humanity by demonstrating An increased awareness of the growing problem of driving under the influence of drugs in the US.

Zolpidem is a non-benzodiazepine, sedative hypnotic prescribed for short term treatment of insomnia. It is available in strengths of 5 and 10 mg, with a recommended dose of 10 mg (5 mg in elderly) immediately before bedtime. Patients using the drug are directed to take zolpidem only when able to devote a full eight hours to sleep and are cautioned against operating heavy machinery or motor vehicles. There have been no reports of significant residual effect on memory or actual driving when subjects have been tested the morning after taking a single 10 mg dose.

However, .zolpidem produces severe deficits in psychomotor performance and cognitive abilities when driving is attempted within 5 hours of use. Erratic driving, confusion, dazed appearance, slurred speech, incoordination, poor balance and loss of memory are often used descriptors for the zolpidem-impaired driver. Drugged driving cases in Wisconsin have been steadily increasing over the last five years. Zolpidem cases have mirrored this trend, reaching a peak of 45 cases each in 2003 and 2004. Selected zolpidem-impaired driving cases will be discussed.

Zolpidem, Impaired, Driving

K34 Multiple Drug Intoxication in Impaired Drivers: Polypharmacy Challenges

Sarah Kerrigan, PhD, Sam Houston State University, College of Criminal Justice, Huntsville, TX 77341-2296*

After attending this presentation, attendees will be able to recognize some of the common challenges involved in polypharmacy DUI casework.

This presentation will impact the forensic community and/or humanity by facilitating the comprehension of interpretive limitations faced by toxicologists.

Despite the prevalence of driving under the influence of drugs (DUID), these cases often provide a number of unique challenges compared with alcohol-related DUI. Toxicology results are often interpreted within the context of driving behavior, signs, symptoms and other observations made by law enforcement personnel or witnesses. The quality of this supporting documentation can influence the interpretive strategy, and subsequently, the outcome in a court of law.

Interpretive issues may be further complicated by the presence of multiple drugs in a driver. Combinations of drugs or "polypharmacy" DUI

casework may pose additional challenges from a toxicological standpoint. Practitioners must go beyond the pharmacological classification of additive, synergistic and antagonistic effects when evaluating these cases. Laboratorians may overcome some of these challenges by appropriate choice of specimen, scope of testing and quantitative drug analysis. Although interpretation is rarely based upon quantitative drug results in isolation, quantitation may be particularly useful in polypharmacy casework to determine dominant drug factors or substances that are most likely to be responsible for the impairment. In some circumstances, quantitative analysis may also provide complementary information regarding approximate timeframe of drug use, history of drug use (habituation) or acute vs. chronic drug use based upon parent/metabolite concentration ratios. Caution should be exercised when classifying drug concentrations as sub-therapeutic, therapeutic, toxic or fatal in polypharmacy casework due to overlapping ranges, tolerance to the toxic effects of some drugs in habitual users and additive effects.

A series of ten cases involving drivers who tested positive for multiple drugs will be presented. Driving behavior, signs, symptoms and toxicology results will be discussed for cases involving combinations of central nervous system depressants, stimulants, opioids and cannabinoids. The series highlights some of the common challenges faced in polypharmacy casework such as additive and combination effects caused by drugs within the same or different drug classifications, the value of quantitative drug analysis to determine which drugs are most likely to be responsible for the observed impairment, the value of qualitative drug analysis for certain drugs, and the need for supporting documentation.

Drugs, Driving, Impairment

K35 Importance of Peer-Review and Publication for Admission of Expert Testimony in Civil and Criminal Litigation

Alan W. Jones, PhD, DSc, Department of Forensic Toxicology, University Hospital, Linkoping, 581 85, Sweden*

After attending this presentation, attendees will learn about the purpose, meaning, and proper use of peer-reviewed literature in specific reference to civil and criminal litigation.

Since the proliferation of scientific admissibility rules, e.g., *Daubert*, there has been a significant weight placed on peer-review. The effective use of peer-reviewed literature in the forensic setting can be abused and misused. A clear understanding of what "peer-reviewed" means as well as its relevant application will impact the forensic community and/or humanity by assisting in the proper use of this element within the scientific and legal arenas.

Much has been written about admissibility of expert testimony in the wake of the U.S. Supreme court decision in the case of *Daubert vs. Merrill Dow Pharmaceuticals.* The so-called *Daubert* principles or criteria for admission of expert testimony have gained wide acceptance not only in many U.S. states but also in other countries where an adversarial system of justice operates (e.g. UK and Australia). One of the *Daubert* principles asks whether a theory or technique has been subjected to peer-review and publication. However, publication should not be the *sine qua non* of admissibility. Publication of research is an integral part of the scientific process and a scientist publishes to spread information to colleagues, to gain credit for the work and to enhance his or her reputation. The vast majority of work published in mainstream scientific journals will never ever be used in civil or criminal litigation. On the other hand, many scientific articles are cited and used daily by both the defense and prosecution attorney to bolster their arguments. But does it really matter where a paper is published? Are some journals more reputable than others? How can scientific journals be compared and contrasted? Can peer-review uncover flawed work and/or plagiarism and thus avoid junk science seeing print? Flawed publications results in flawed expert testimony.

Most would agree that a scientific journal is only as good as its peer-reviewers. Peer-review of manuscripts submitted for publication enjoys a 250-year history although the peer-review process has come under attack from several quarters in recent years. Some maintain that the system is outdated and is in urgent need of overhaul. Allegations of bias, nepotism, competing or conflicts of interest have been raised. The advent of web-based journals many of which operate a completely open peer-review system might be something to consider for print-journals. On the web, the entire pre-publication history of an article is available for scrutiny, which is in stark contrast to the traditional "strictly confidential" peer-review reports of paper journals.

With peer-review and publication gaining so such importance in criminal and civil litigation, perhaps the time has come to disclose peer-review reports of manuscripts or make them open to discovery. Most journals operate a single-blind peer-review evaluation with the names of the reviewers not being reveled to the authors of the manuscript. However, some journals request that peer-reviewers now sign their reports and others would like to see the names of these individuals included as an endnote on the published article. Just because an article is published in a peer-review journal does not make the findings or conclusions gospel. What Sir Winston Churchill once said about democracy can be said about peer-review, namely *"it is the worst system in the world but better than all the rest."*

The purpose of expert evidence is to provide the court with information derived from scientific research and studies far removed from the experience, skill and knowledge of a judge and jury. Unlike an ordinary witness who provides factual evidence an expert witness can testify to opinion gleaned from his or her own specialized scientific, technical or medical knowledge. As a result of *Daubert* expert evidence has come under close scrutiny. Some recent high profile cases in UK involving complex and equivocal forensic-medical evidence has led to very serious miscarriages of justice. The backlash from these cases has called into question not only the reliability and admissibility of expert testimony but also the entire adversarial system. The notion of pre-trial hearings and the use of a single joint expert and even jury-free trials might be more appropriate in some cases, especially in civil litigation.

Peer-Review, Publications, Expert Testimony

K36 A Dog, a Lawyer, and a Toxicologist - Proving the Need for Pre-Trial Conferences

Robert A. Middleberg, PhD, National Medical Services, Inc., 3701 Welsh Road, Willow Grove, PA 19095*

After attending this presentation, attendees will understand the need for pre-trial conferences between lawyers and toxicologists is of paramount importance for the successful use of such testimony. Through case example, and without pre-trial conference, demonstration of how toxicological testimony was rendered useless and ineffective, and in fact, detrimental to the attorney's claim, even though he requested the scientific assistance.

This presentation will impact the forensic community and/or humanity by effectively using toxicological testimony in a helpful, time-effective manner.

Toxicological testimony can be of significant importance in both criminal and civil litigation. Toxicologists, unless specifically trained though law school, do not have the requisite knowledge to understand courtroom tactics, policies or procedures; on the other hand, attorneys do not, generally, have the knowledge base to understand the scientific principles behind toxicological analyses and interpretations. The successful melding of the two disciplines is necessary for the successful presentation of toxicological data in legal proceedings. One of the primary means of ensuring successful use of toxicological testimony is through extensive and intensive pre-trial conferences, with the emphasis on the plural. Remarkably, experienced toxicologists consistently testify with the

absence, or cursory forms, of such conferences, albeit not of their own choice. One case in point will demonstrate the ineffective use of a "pre-trial" conference and the ultimate effect on the case outcome. In this case, the attorney failed to recognize the lack of significance of the toxicological data, and subsequent interpretation, in the case, despite thinking the contrary. As a result, the courtroom presentation was farcical in nature, humorous and disastrous.

Pre-Trial Conference, Toxicologist, Lawyer

K37 Evaluation of Analytical Toxicology Test Data in Criminal Prosecutions and Civil Litigations

Alphonse Poklis, PhD, Medical College of Virginia, Box 98-0165 MCV Station, Richmond, VA 23298*

After attending this presentation, attendees will understand the significance and benefits of data review for all litigations involving toxicological analyses as well as the potential pitfalls of not having data reviewed.

So often, litigation involving toxicological issues focuses solely on the interpretive aspects of reported analytical results. However, the predicate is that the interpretation is based on good analytical data. Experience has demonstrated that this is not always the case. Thus, the independent review of analytical data is critical before any interpretive issues can be deduced. This presentation will impact the forensic community and/or humanity by highlighting the duality of the forensic toxicologist as both bioanalytical chemist and toxicologist and the importance and necessity of both roles.

The duties and responsibilities of the forensic toxicologist include: qualitative and quantitative analysis of drugs or poisons in biological specimens; and the interpretation of the analytical findings as to the physiological or behavioral effects upon the specimen donor, whether living or at the time of his death. It is most often in the role of interpreter of drug or poison effects that the toxicologist is subjected to adversarial questioning in legal proceedings. Usually, the actual analytical testing that gives rise to the basis of his interpretations is seldom questioned. This assumption of properly performed and documented analytical testing is well justified in certain areas of toxicology such as in the highly regulated urine drug testing industry or in blood and breath alcohol testing in cases of impaired driving. However, in many criminal cases or civil litigations, particularly those involving drugs or poisons not commonly encountered in toxicology testing, it is prudent for attorneys to obtain copies of the analytical testing data for review by an experienced forensic toxicologist. The significance and often surprising revelations of such a review will be highlighted by example cases.

Toxicology, Data, Analysis

K38 Gamma Hydroxybutyrate (GHB)-Related Deaths: Review of 194 Cases

Deborah L. Zvosec, PhD, and Stephen W. Smith, MD, Hennepin County Medical Center, 701 Park Avenue, Minneapolis, MN 55415, Quinn Stroble, MD, Midwest Forensic Pathology, PA, 3960 Coon Rapids Boulevard, Coon Rapids, MN 55433; Trink Porrata, Project GHB, PMB 434, 2753 East Broadway, Suite 101, Mesa, AZ 85204; and Jo E. Dyer, PharmD, California Poison Control System, UCSF Box 1369, San Francisco, CA 94143*

After this presentation, attendees will understand the nature/range of lethal risks posed by gamma hydroxybutyrate (GHB) and will be familiarized with toxicological/pathological findings on 194 GHB-related deaths. The presentation will raise awareness among law enforcement, clinicians, and the public regarding the lethality of GHB and aid in recognition and confirmation of GHB-related deaths and in harm reduction through public education.

GHB and its analogs, gamma butyrolactone (GBL) and 1,4 butanediol (BD), are drugs of abuse that have been sold as dietary supplements for purported health benefits. GHB/analogs have resulted in overdoses, addiction and lethal withdrawal, and have been used to facilitate drug-facilitated sexual assault (DFSA).

Medical Examiners and coroners across the U.S. and abroad were contacted to request searches for cases of GHB-related deaths and specific cases identified through the Project GHB website and media reports. Toxicology findings were requested and, whenever possible, autopsy reports with investigative summaries. GC/MS cut-offs of 50 mg/L in postmortem blood, 5 mg/L in antemortem blood, and 10 mg/L in urine were used for inclusion of cases.

194 GHB-related deaths were identified from 1995-2005; case identification is incomplete due to non-searchable records and confidentiality restrictions. Decedents included 133 men (69%) and 61 women (31%), ages 15-53 yrs (mean=27.9 yrs). 183 (94.5%) had cardiopulmonary arrest (29 with aspiration or asphyxiation), 6 (3%) drowned in hottubs/bathtubs, 4 (2%) died in lethal motor vehicle collisions, and 1 (0.5%) died of smoke inhalation from a fire started while GHB-intoxicated. One case involved DFSA, as supported by history and pathological findings.

179 had autopsy reports with toxicology, 2 had external exam findings with toxicology, and 13 had toxicology data only. Of 179 with autopsy findings, 150 had pulmonary edema/congestion. 59 had autopsies noting an enlarged heart; of these, 37 had LVH, 1 had RVH, 1 had LVH/RVH, and 20 had cardiomegaly without LVH/RVH noted. Analysis will be done to assess for correlation with chronic GHB use/dependence and histories of use of anabolic steroids, GHB, and other drugs including methamphetamine and cocaine.

Of 194 deaths, 177 had GHB confirmed with blood GHB levels, 16 with urine GHB levels only, and 1 with a chest fluid GHB level. Of 177 deaths with confirmatory blood GHB levels, there were 60 deaths (34%) with GHB as the sole intoxicant, 61 deaths (34.5%) with ≥1 depressant co-intoxicants, 25 (14% of total) with ≥ 1 stimulant co-intoxicant, and 31 (17.5%) with both stimulant and depressant co-intoxicants. See Table 1 for toxicology findings.

K 38 - Table 1. Toxicology findings for 177 deaths confirmed by blood GHB and/or BD levels

	#deaths (%)	# blood samples	Postmortem (PM) GHB mean and range	Antemortem (AM) GHB mean and range	Postmortem (PM) BD mean and range
GHB only	60 (34%)	71 total 69 PM, 2 AM	Mean 560.7 mg/L Median 319 mg/L Range 66-4400 mg/L	Mean 334.5 mg/L Range 159-510 mg/L	Mean 164.5 mg/L Range 7.6-220 mg/L
GHB and ≥1 depr. co-intox	61 (34.5%)	65 61 PM, 4 AM	Mean 442.5 mg/L Median 286 mg/L Range 59-2300 mg/L	Mean 262.2 mg/L Range 17-562 mg/L	None
GHB and ≥1 stim. co-intox	25 (14%)	28 26 PM, 2 AM	Mean 525.3 mg/L Median 346.0 mg/L Range 210-2900 mg/L	Mean 317.0 mg/L Range 190-444 mg/L	None
GHB and stim/depr co-intox	31 (17.5%)	33 31 PM, 2 AM	Mean 455.5 mg/L Median 259 mg/L Range 67-1550 mg/L	Mean 715 mg/L Range 700-730 mg/L	None

An additional 16 deaths were confirmed with urine GHB levels only (mean urine GHB 1544 mg/L, range 67-5950 mg/L). These included 3 deaths (19%) with GHB and no co-intoxicants, 7 deaths (44%) with ≥ 1 depressant co-intoxicants, 2 deaths (12%) with ≥ 1 stimulant co-intoxicants, and 4 deaths (25%) with both stimulant and depressant co-intoxicants. One death was confirmed with chest fluid GHB levels only (316 mg/L); this death occurred with a depressant co-intoxicant.

GHB concentrations exhibit unpredictable variability between collection sites. Heart/femoral blood ratios ranged from 0.6 to 1.93 in 11 cases. 31 vitreous samples contained an average GHB 280.6 mg/L, range 9-1300 mg/L.

In conclusion, data collection is ongoing and additional analysis will be performed on multi-site sampling data and to investigate correlations between pathologic findings and use patterns. The series demonstrates that GHB may be lethal, even without co-intoxicants, in a variety of ways, and the public, clinicians, and law enforcement must be made aware of these risks.

K39 Postmortem Tissue Distribution of Atomoxetine in Fatal and Non-Fatal Dosing Scenarios – Three Case Reports

Diana Garside, PhD, Office of the Chief Medical Examiner, 1001 Brink Hous Bullitt, Chapel Hill, NC 27599; Jeri D. Ropero-Miller, PhD, Research Triangle International, 3040 Cornwallis Road, Research Triangle Park, NC 27709; and Ellen C. Riemer, MD, JD, Wake Forest University School of Medicine, Department of Pathology, Medical Center Boulevard, Winston-Salem, NC 27157*

After attending this presentation, attendees will learn at what tissue concentrations to expect to find atomoxetine, and at what blood and tissue levels atomoxetine can be considered non-toxic. This data will be useful, since the presence of atomoxetine is already becoming prevalent in medical examiner cases, as the drug is an increasingly prescribed alternative to traditional stimulant therapy for Attention-Deficit/Hyperactivity Disorder (ADHD).

This presentation will impact the forensic community and/or humanity by educating forensic pathologists and toxicologists in the evaluation of atomoxetine levels in various postmortem fluids and tissues. This knowledge will be helpful, since atomoxetine is being used increasingly by prescribing physicians as a non-stimulant alternative to traditional drug treatment for Attention-Deficit/Hyperactivity Disorder

Atomoxetine (Strattera®, Lilly) is a selective norepinephrine reuptake inhibitor prescribed for the treatment of Attention-Deficit/Hyperactivity Disorder (ADHD) in children, adolescents and adults. It is the first non-stimulant drug-therapy option for ADHD. Three case reports are presented in which atomoxetine was detected in two individuals who died from causes unrelated to the drug and a third from the intentional ingestion of atomoxetine and other drugs. Postmortem blood levels of atomoxetine in the discussed cases ranged from 0.1 to 8.3 mg/L while the postmortem liver levels ranged from less than 0.44 to 29 mg/L.

Postmortem Fluid and Tissue Distribution of Atomoxetine

	Atomoxetine (mg/L or *mg/kg)						
	Aorta Blood	**Femoral Blood**	**Vitreous**	**Bile**	**Urine**	**Liver***	**Gastric***
Case 1	0.65	0.33	0.1	1.0	NA	3.9	0.54
Case 2	8.3	5.4	0.96	33	NA	29	860
Case 3	< 0.1	< 0.1†	NA	NA	< 0.1	< 0.44	NA

NA – not available; † - vena cava blood

Routine organic base drug screening detected presence of atomoxetine in the central blood of two cases presented. Screening analyses were performed on aliquots of blood using a liquid-liquid extraction. After the addition of alphaprodine (1 mg/L) as the internal standard, specimen aliquots were made basic by the addition of ammonium hydroxide (0.5 mL). Extraction was affected by the addition of *n*-butyl chloride:ether (4:1; 7 mL). The organic solvent was subjected to a back-extraction with 1 M sulfuric acid (2.5 mL). The aqueous phase was separated from the organic layer and was washed with hexane (2 mL). Removal of the hexane layer and further addition of ammonium hydroxide to the aqueous phase allowed the basic drugs to be drawn into *n*-butyl acetate (100 µL). The *n*-butyl acetate extracts were transferred to autosampler vials for analysis by gas chromatography (GC), equipped with a nitrogen-phosphorous detector (NPD), followed by definitive identification by full scan mass spectrometry (MS). Quantification of the original blood specimen and analysis of additional specimens collected in each case on the appropriate amount of specimen to fall with in the linear range of the assay followed the same extraction procedure with the addition of a standard curve and analyte-specific quality control, utilizing GC/NPD. Working methanolic spiking solutions of both standards (10, 100 µg/mL) and controls (10 µg/mL) were prepared by serial dilution from a 1 mg/mL stock solution prepared from the powder supplied from the pharmaceutical company. Calibration curves and quality control samples were created by spiking aliquots of drug-free blood with the working spiking solutions at the appropriate concentrations. Confirmation analyses utilized a 5-point calibration curve at concentration levels of 0.2, 0.5, 1.0, 2.0 and 4.0 mg/L, with a positive control sample at 0.5 mg/L. An aliquot of the drug-free blood was analyzed concurrently with each batch as a negative control. The assay was linear from 0.2 – 10 mg/L with a least squares linear regression analysis correlation coefficient (r^2) of 0.998 or better. The limits of quantitation and detection were 0.1 mg/L and 0.05 mg/L, respectively. Accuracy and precision studies conducted with a control spiked at 0.5 mg/L (3 x n=5) gave a mean within 8% of the target value (CV= 7%). GC/NPD was then performed; injections of 1 µL in the splitless mode were made with an inlet temperature of 275ºC. Helium was the carrier gas at a flow rate of 6.7 mL/minute with an initial oven temperature of 120ºC. This was followed by an increase of 15ºC/min until 300ºC, holding for 3 minutes. Drug confirmation by GC/MS was performed Split injections (3:1) of 1 µL were made with an inlet temperature of 275ºC. Helium was the carrier gas at a flow rate of 1.4 mL/minute with an initial oven temperature of 70ºC for 2 minutes. The oven temperature was then ramped at a rate of 15ºC/minute until 300ºC was reached where it was held for 7 minutes. Electron impact ionization was utilized in the scan mode, monitoring ions from 40-550 *m/z* ratio.

Atomoxetine is well absorbed after oral administration, with a bioavailabilty of 63% and is highly plasma protein bound (98% to albumin). Maximal plasma concentrations of atomoxetine occur 1-2 hours after dosing and its half-life is approximately 5 hours. Atomoxetine has a low volume of distribution (Vd) (0.85 L/kg) suggesting little tissue sequestration. Atomoxetine is metabolized primarily by cytochrome P450 (CYP) 2D6 to yield 4-hydroxyatomoxetine, which is subsequently glucuronidated. A second metabolite, *N*-desmethylatomoxetine is formed by the action of CYP2C19. 4-hydroxyatomoxetine has equipotent SNRI pharmacological activity to the parent drug but is only present in the plasma at very low concentrations. *N*-desmethylatomoxetine not only has less pharmacological activity than atomoxetine, but is also present in plasma at lower concentrations. The elimination half-life of the two metabolites is 6-8 hours. Greater than 80% of the dose of atomoxetine is excreted in the urine as 4-hydroxyatomoxetine-*O*-glucuronide with less than 17% of the dose appearing in the feces. Poor CYP2D6 metabolizers will display altered pharmacokinetic data.

Atomoxetine can be considered non-toxic at whole blood and liver concentrations below 1.3 mg/L and 5 mg/kg, respectively. Although the drug has a low volume of distribution, it appears to undergo postmortem redistribution with a mean central to peripheral ratio of 2.7 (range: 1.5 – 5.6).

Although this is a preliminary study, little is known through clinical trials or reports of the toxicity of atomoxetine in overdose; even less is known about postmortem toxicology. The presence of atomoxetine was considered an incidental finding in two of the cases presented while the third involved an intentional overdose. The corresponding postmortem fluid and tissue distribution of atomoxetine in addition to the significant anatomic findings autopsy are reported.

Atomoxetine, Postmortem, Forensic Science

K40 Postmortem Blood Concentrations Following the Oral Ingestion of Transdermal Fentanyl Patches (Duragesic®)

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The objective of this presentation is to describe the oral administration of transdermal fentanyl patches (Duragesic®) with resultant blood concentrations in seven deaths in the province of Ontario, Canada.

This presentation will impact the forensic community and/or humanity by alerting the forensic community to an unusual opioid abuse practice: the ingestion of fentanyl patches. Detailed case reports of seven deaths will assist forensic toxicologists in the interpretation of postmortem blood fentanyl concentrations that may arise following this route of administration.

Introduction: Fentanyl is a synthetic narcotic analgesic that is available in the form of a transdermal patch for the management of chronic pain. Transdermal patches contain 2.5-10 mg fentanyl and provide a dose of 25-100 µg/hr for 72 hours. Therapeutic serum concentrations following transdermal application have been reported up to 5 ng/mL. Since the introduction of the transdermal system to treat chronic pain, the patches are increasingly being found in the opioid-abusing population. There have been numerous reports of abuse of the transdermal delivery systems through the application of multiple patches or by intravenous injection of the patch contents. In addition, there are a limited number of reports where abuse of these transdermal patches was achieved via ingestion or inhalation.

Methods: Fentanyl-related deaths following the oral ingestion of transdermal patches were retrospectively identified from the files of the Toxicology Section of the Centre of Forensic Sciences, which provides the sole toxicology testing for coroner's investigations in the province of Ontario (approx. population 12 million). Inclusion criteria were: time period between 2002 and 2004 and the detection of fentanyl in postmortem blood. Further information pertaining to the circumstances of death, autopsy findings, and cause and manner of death was obtained from the Office of the Chief Coroner of Ontario. The route of fentanyl administration was classified as oral based on both observations of individuals chewing fentanyl patches prior to death or the finding of fentanyl patches in the oral cavity or pharynx during autopsy. Fentanyl was extracted from blood samples by liquid/liquid extraction and quantitation was performed using gas chromatography-mass spectrometry in the electron ionization mode.

Results & Discussion: A total of 119 fentanyl-related deaths were identified for the period of 2002 to 2004, of which there were seven cases where the route of administration was classified as oral. The seven decedents comprised three females and four males with ages ranging from 32 to 51 years. Postmortem blood fentanyl concentrations were determined in all cases and ranged from 7 to 97 ng/mL with a mean blood concentration of 28 ng/mL. There were two cases in which death was attributed solely to fentanyl overdose. The first was a 42-year-old male found dead in bed with numerous small pieces of a transdermal patch in the oral cavity and a heart blood fentanyl concentration of 22 ng/mL. The second case was that of a 20-year-old woman who had shared and ingested the contents of a 10 mg fentanyl patch the night before her death. Postmortem fentanyl was measured in a femoral blood sample at a concentration of 13 ng/mL. The blood fentanyl concentrations in these two cases are higher than those observed following therapeutic administration of transdermal patches and are comparable to concentrations in cases of fentanyl overdose following excessive transdermal application.

In three other cases, fentanyl was present in combination with ethanol and death was considered to have been the result of combined ethanol/fentanyl toxicity. The concentrations of fentanyl were 7, 8 and 28 ng/mL with corresponding blood alcohol concentrations of 209, 171 and 160 mg/100mL, respectively. The final two cases that will be presented comprise a case of mixed drug toxicity in which the fentanyl concentration was 97 ng/mL and a case in which administration was via both the transdermal and oral route of administration. In the latter case, a fentanyl concentration of 19 ng/mL was detected and the medical cause of death was due to a combination of fentanyl toxicity and a perforated duodenal ulcer.

Although oral ingestion accounted for less than 6% of the total number of fentanyl-related deaths in Ontario between 2002 and 2004, the seven deaths associated with this practice illustrate that toxic blood concentrations can occur following this route of administration. Detailed case reports of these cases will expand on this unusual means of Duragesic® abuse and illustrate the range of blood fentanyl concentrations that may be expected.

Fentanyl, Postmortem, Oral Abuse

K41 Toxicology of Deaths Associated With "Ecstasy"

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After attending this presentation, attendees will understand the interpretation of MDMA concentrations in postmortem toxicology.

This presentation will impact on the forensic community and/or humanity by demonstrating how MDMA concentrations in postmortem toxicology can only be interpreted in the context of other information. Considerable overlap exists between fatal concentrations and those seen in deaths from trauma.

3,4-Methylenedioxymethylamphetamine (MDMA), more popularly known as "Ecstasy" has been a widely used recreational drug in the UK since the beginning of the 1990s [1]. Deaths were first reported in the UK in the early 1990s at Raves and clubs, with deaths attributable to hyperpyrexia, water intoxication and cardiac dysrhythmias. Deaths from hepatic necrosis have also occurred. This study of deaths seen in Yorkshire in the North of England reports the toxicological findings where MDMA and related drugs have been found on post-mortem toxicology.

17 deaths were attributed to the effects of MDMA or MDEA (3,4-methylenedioxyethylamphetamine) alone. In 13 deaths collapse was rapid. Peripheral blood (femoral) analysis in these rapid deaths revealed MDMA concentrations of 0.478 mg/L – 53.9 mg/L. The mean concentration was 8.43 mg/L, median 3.49 mg/L. Two cases were also positive for MDEA with concentrations of 3.4 mg/l and 3.5 mg/L. 3,4-Methylenedioxyamphetamine (MDA) concentrations ranged from 0.012 – 8.5 mg/L (mean 1.5 mg/L, median 0.79 mg/L). Other drugs found were cannabinoids (6), amphetamine (5), ethanol (5), cocaine (1), LSD (1), benzodiazepine (1).

In 29 cases, death was attributed to polydrug use, MDMA (27), MDEA (1), MBDB (1). In 22 cases MDMA was recorded in blood, range

0.04 to 41.5 mg/L. The mean value in these deaths was 2.90 mg/L, median 0.76 mg/L. The other principal drugs in these cases were cannabinoids (16), ethanol (12), heroin (11), benzodiazepines (9), amphetamine (8), antidepressants (6), methadone (5), cocaine (5), GHB (2).

In 29 cases death was traumatic, homicide (8), vehicular collision (10), fall from height (6), drowning (4), hypothermia (1). In 24 cases MDMA was found in blood with concentrations ranging from 0.035 mg/L to 4.81 mg/L, mean 0.862 mg/L, median 0.483 mg/L. Other drugs found were ethanol (17), cannabinoids (10), amphetamine (5), cocaine (4), antidepressants (2), ketamine (1).

In conclusion, MDMA showed a wide range of concentrations. Higher concentrations were seen where death was attributed to the effects of MDMA alone, but considerable overlap exists between concentrations seen in drug related deaths and deaths due to trauma.

References:
1. Milroy CM. Ten Years of "Ecstasy." Journal of the Royal Society of Medicine. 1999; 92: 68-72.

Ecstasy, Death, Toxicology

K42 Suicide by Inhalation of Freons: Detection of in a Partially Decomposed Body

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The goals of this presentation are to present an unusual mechanism of suicide by freons inhalation and present a method for detection of freons in body fluids and tissues.

This presentation will impact the forensic community and/or humanity by demonstrating an unusual method of suicide and demonstrates that detection of volatile freons can still be achieved in a partially decomposed body.

This case describes a fatality due to suicidal inhalation of two widely available refrigerant gases: chlorodifluoromethane (HCFC-22) and 1,1,1,2-tetrafluoroethane (HFC-134a), a combination that has not been previously reported in forensic literature. A 51-year-old white man was found dead at home in the bathroom on the floor in a large plastic trash bag that covered the entire body. Two commercial 30-pound gas tanks containing the gases were suspended with two separate plastic tubes connected to the valves of the tanks that were running into the bag. The valves on both tanks were fully opened. The deceased was in an early generalized state of decomposition. There are no reports in forensic literature describing detection of refrigerants in a partially decomposed human body. Volatile gas analysis was performed using gas chromatography mass spectrometry. The chromatographic column used was a HP-5 MS capillary column (cross-linked 5% phenyl-methylsilicone, 30 meter length, 0.25 mm internal diameter, 0.25 um film thickness). Aliquots of the biological samples (1 gram of tissue, 1.0 ml of blood and bile) were sealed in 2 ml glass vials and heated at 30^{O}C for 30 minutes; 50 uL of the headspace gas was aspirated from each vial and injected into the GC/MS system. The retention times of HCFC-22 and HFC-134a were nearly identical, 1.76 and 1.78 minutes, respectively. A full scan of commercially purchased standards identified the ions unique to the compounds. A full scan of the peak showed all major ions of both compounds were identified in the following specimens: blood, bile, liver, spleen, heart muscle, thigh muscle, subcutaneous fat, brain, kidney, lung, pancreas, spinal cord, and thyroid. The relative amount of each gas in the samples was determined by comparison to the peak area obtained from injection of precise volumes of the 98% pure gas using the following ions in SIM mode (HCFC-22, 67, 85, 47, and HFC-134a 83, 63). The ratio of HCFC-22 and HFC-134a ranged from 1.4 in muscle to 4.0 in liver.

Freons, GC/MS, Suicide

K43 Absence of Elevated Carboxyhemoglobin Following Inhalation of Automobile Exhaust

Rebecca A. Jufer, PhD, Barry S. Levine, PhD, Deborah Green Johnson, BS, Mary Ripple, MD, and David R. Fowler, MD, State of Maryland, Office of the Chief Medical Examiner, 111 Penn Street, Baltimore, MD 21201*

After attending this presentation, attendees will become familiar with cases of asphyxia due to inhalation of automobile exhaust without an elevated carboxyhemoglobin concentration.

This presentation will impact the forensic community and/or humanity by providing information on cases of inhalation of automobile exhaust with atypical findings.

The objective of this presentation is to present three cases of suicide by inhalation of automobile exhaust that did not result in elevated carboxyhemoglobin levels.

Carbon monoxide is a colorless and odorless gas that is produced as a result of incomplete combustion of organic materials. It is a common component of automobile exhaust. Other components of automobile exhaust include nitrogen, carbon dioxide, water vapor, hydrocarbons, and nitrogen oxides. U.S. air pollution control programs that were initiated in the 1970s resulted in engine design changes and emission control devices that were designed to reduce carbon monoxide, volatile organic compounds, and nitrogen oxides, the more harmful components of automobile emissions. Additionally, changes in the formulation of gasoline have contributed to the reduction of these components of automobile exhaust. These changes may alter the typical findings in some cases of automobile exhaust inhalation, as illustrated by three cases received at the OCME in Baltimore, MD.

Cases 1 & 2: A husband and wife (aged 57 and 55 years, respectively) were found deceased in a running 2001 Chevy Tahoe that was parked in the backyard of a residence. A flexible dryer vent hose was attached to the car exhaust and inserted into the right passenger window, with towels placed into the open areas around the hose. The decedents were seated in the rear seat of the vehicle with two deceased Yorkie dogs between them. There were no signs of a struggle and neither victim showed signs of trauma. The position of the bodies was consistent with the victims dying while seated in the vehicle. Two suicide notes were recovered at the scene, one in the vehicle and one inside the residence. Blood was collected from the decedents and sent to the laboratory for analysis.

Case 3: A 52-year-old male was found unresponsive in a running 1983 Ford Ranger. A garden hose extended from the rear exhaust into a rust hole in the passenger floorboard. The hose was attached to the exhaust with tinfoil and medical tape. Two notes describing his intentions were located, one in the house and one on the seat of the truck. The subject had a history of heroin abuse and had discussed his desire to commit suicide with his father approximately six months earlier. He was resuscitated and transported to the hospital where he died one hour later. Blood was collected and submitted to the laboratory for analysis.

Blood specimens were analyzed for carboxyhemoglobin by gas chromatography. Two aliquots were prepared for each specimen. The first aliquot was sealed in a headspace vial. The remaining aliquot was saturated with carbon monoxide using a tonometer and then transferred to a headspace vial. Potassium ferricyanide was added to each sample to separate carbon monoxide from hemoglobin. A sample of the vial headspace was injected onto a 5A molecular sieve column, reduced to methane with a

nickel catalyst and detected with a flame ionization detector. Matrix blank and quantitative controls were included in each batch. Percent carbon monoxide saturation was calculated by comparing the response of the unsaturated sample to the saturated sample.

In cases 1 & 2, toxicological analysis indicated a blood carbon monoxide saturation of 3% for the female decedent and 4% for the male decedent. Other toxicological findings from a comprehensive drug screen and volatiles screen were unremarkable. The toxicological analysis did not include a cyanide screen. The medical examiner ruled that the cause of death was asphyxia due to inhalation of car exhaust and the manner of death was suicide in both cases.

In case 3, carbon monoxide saturation was less than 1%. In addition, ethanol and other volatiles were not detected at a cutoff of 0.01 % (w/v) and free morphine was not detected at a cutoff of 25 µg/L. The toxicological analysis did not include a cyanide screen. The medical examiner ruled that the cause of death was asphyxia due to inhalation of car exhaust and the manner of death was suicide.

The cases presented indicate that suspected carbon monoxide poisoning cases may present with atypical findings. In such cases, a comprehensive toxicological screen and scene investigation should be conducted whenever possible to rule out other causes of death.

Automobile Exhaust, Carbon Monoxide, Asphyxia

K44 Toxicological Testing of Emergency Responders Following the World Trade Center Attack

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After attending this presentation, attendees will learn of the specimen collection and analysis methods needed to quantify beryllium, mercury, and polychlorinated biphenyls (PCBs) in exposed workers; understand the toxicology of these substances, and their sources along with other toxic substances that were released from the World Trade Center collapse.

This presentation will impact the forensic community and/or humanity by providing results of toxicological testing of workers following exposure incidents such as this and may be useful in assessing the adequacy of the respiratory protection equipment to help improve safety equipment in the future. Results may also be used to predict the risk of subsequent potential health effects and to implement prevention programs and to reduce morbidity and mortality from exposure. Human biological monitoring results may also be useful in re-engineering building materials and reducing production of toxic aerosols in the event of fire or collapse.

Post-incident testing of workers for exposure to toxic substances is essential in order to determine whether or not such substances caused or contributed to morbidity or mortality of individual workers. Blood and urine specimens must be collected in an appropriate manner to avoid contamination and degradation. In an emergency action such as the second attack on the World Trade Center leading to collapse of the buildings, pre-shift specimens from emergency responders were not collected. Such specimens are important in determining workers body burden prior to the exposure event. Post-event specimens were collected for testing of specific analytes.

Specimen collection included 5,314 urine specimens that were tested for beryllium and mercury; and 5,312 serum specimens were tested for PCB's. Tests for specific gravity and creatinine were performed on urine samples to validate the samples and for calculating final concentrations of the metals using a creatinine correction algorithm. Beryllium and mercury were analyzed by inductively coupled plasma/mass spectrometry (ICPMS) and polychlorinated biphenyls were analyzed by gas chromatography using electron capture detection; calculation was based on Arochlor 1260. All three analytes may be found normally at low concentrations in the general population. Beryllium is elevated in tobacco smokers whose levels may be double the concentration of non-smokers. Smoking history and other factors need to be recounted for the final interpretation of test results.

A statistical analysis of test groups showed beryllium, mercury and PCB concentrations to be within that expected for the general population for almost all specimens tested. Only a few of the 5000 or so specimens tested demonstrated results that appeared elevated from reference ranges, yet not within the realm of where toxicity is expected.

Results of toxicological testing of workers following exposure incidents such as this may be useful in assessing the adequacy of the respiratory protection equipment to help improve safety equipment in the future. Results may also be used to predict the risk of subsequent potential health effects and to implement prevention programs and to reduce morbidity and mortality from exposure. Human biological monitoring results may also be useful in re-engineering building materials and reducing production of toxic aerosols in the event of fire or collapse.

Heavy Metals, PCB's, World Trade Center

K45 6-Acetylmorphine in Hair: Self-Reported Heroin Users Not Considered Positive Using Proposed Federal Guidelines

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After attending this presentation, attendees will learn the metabolic profile of heroin in hair specimens and understand the proposed Federal Guidelines for testing opiates in hair.

Guidelines and proposals are sometimes implemented without adequate regard for the relevant science. This presentation will impact the forensic community and/or humanity by showing that a significant number of admitted heroin users would not be considered positive under workplace testing rules if the proposed requirement for the presence of morphine is implemented.

Methods: Heroin abuse is associated with adverse health conditions, including fatal overdose, collapsed veins, and, when injected, infectious diseases, including HIV/AIDS and hepatitis. The central nervous system is depressed following heroin intake, and mental functions are generally impaired. Long-term effects include heart infections, abscesses and liver disease. Pulmonary complications may result from the poor health condition of the abuser, as well as from heroin's depressing effect on respiration.

This study was designed to determine whether the proposed Federal Rules for one of the "alternative" matrices, hair, would effectively identify heroin users. The proposed Federal guidelines for morphine, codeine and 6-acetylmorphine (6-AM) state that a hair specimen containing at least 200 pg/mg of 6-AM cannot be reported as positive unless it also contains at least 200 pg/mg of morphine.

The study enrolled 203 subjects, approximately half of whom admitted to opiate use, half who did not. Each subject provided a hair specimen taken from the head at the time of interview. Information on drug use, including time of last use, frequency of use, ethnicity, age, sex and hair color were recorded for each subject. The specimens were analyzed for morphine, codeine and 6-acetylmorphine using immunoassay and gas chromatography-mass spectrometry. While the analysis of various opiates in hair has been previously published, this is the first study where the positivity rate was determined according to proposed Federal guidelines.

Results: Mono-acetylmorphine (6-AM) was the major metabolite detected in hair following heroin use, and in all except three samples it was present in higher concentrations than morphine. Only one sample from an admitted heroin user did not contain 6-AM, and there were no samples containing only morphine. Overall, the mean morphine concentration detected in hair was 780 pg/mg; (median 407 pg/mg). The mean codeine level was1174 pg/mg; (median 481 pg/mg) and the mean concentration of 6-AM in the hair samples was 1904 pg/mg; (median 828 pg/mg). Morphine was present in 34 of the 52 positive samples from the self-reported group (65.3%); codeine in 46/52 (88.4%) and 6-AM in 38/52 (73%).

In the self-reported opiate using population, 45 hair samples confirmed positively for opiates under the proposed rules. However the other seven (15.5%) contained 6-AM at concentrations higher than 200 pg/mg, so would not have been considered positive under the regulations.

In the self-reported non-drug using population, 7 specimens (7%) were positive under the guidelines. Five of these contained codeine at levels higher than 200 pg/mg and the other 2 contained codeine, morphine and 6-AM.

Currently, the proposed Federal guidelines require morphine to be present as well as 6-AM in hair specimens in order to be reported as positive. The data shows that this will cause approximately 15% of heroin users to go undetected. Based on this study, and supported by the literature, morphine is not the predominant metabolite detected in hair following heroin use. Therefore, if the detection of heroin users is the focus of the Federal program, the presence of 6-AM alone in hair should be considered a positive result.

Summary: When specimens were analyzed according to the levels proposed in the Federal guidelines for alternative samples, hair failed to identify seven self-reported heroin users. Even though 103 subjects admitted opiate intake, not all were heroin users, some admitting to hydrocodone or oxycodone intake. However, of the seven who admitted frequent heroin use, all hair specimens contained measurable amounts of 6-AM, confirming their admission. Under the Federal Guidelines, these individuals would not have been reported as positive. It has been suggested that hair is a superior matrix to urine for the detection of drug users, however for this to be true, appropriate detection levels must be mandated, and the stand-alone presence of 6-AM must be considered a positive result.

6-Acetylmorphine, Federal Guidelines, Hair Analysis

K46 The Detection of 11-nor-Δ9-THC-9-Carboxylic Acid (THC-COOH) in Hair and Urine

Christine Moore, PhD, Sumandeep Rana, MS, Cynthia Coulter, BS, Michael Vincent, MS, and James Soares, PhD, Immunalysis Corporation, 829 Towne Center Drive, Pomona, CA 91767*

After attending this presentation, attendees will understand how to analyze 11-nor-Δ^9-THC-9-carboxylic acid (THC-COOH) in hair using a two dimensional gas chromatographic system coupled to a single quadropole mass selective detector

The detection of marijuana in hair at meaningful concentrations has currently been limited to analysis using triple quadrupole mass analyzers. This presentation will impact the forensic community and/or humanity by describing the application of two dimensional gas chromatography to a toxicological problem, allowing the analysis of drugs and metabolites at extremely low levels. The modifications can be applied for many different applications in toxicology

Methods: Tetrahydrocannabinol (THC) is the active ingredient in marijuana and is generally administered orally or by smoking, resulting in euphoria and hallucinations. Since its main metabolite, 11-nor-Δ^9-tetrahydrocannabinol-9-carboxylic acid (THC-COOH), is acidic, its incorporation into the hair shaft is not as extensive as that of more basic drugs such as cocaine or methamphetamine. Hence, the detection of marijuana metabolite, THC-COOH, in hair is extremely difficult, due to the very low levels incorporated and the sensitivity of detection. Even though the use of two-dimensional chromatography has been applied for many years in the oil and petroleum industry, its application to forensic toxicological problems was first described in 2003, and coupling to mass spectrometry for the detection of drugs of abuse was reported for the first time in 2004. The approach to the problem of inadequate detection levels using a single stage quadrupole mass spectrometer was to make sufficient small improvements over the entire assay, so that the final required detection limit could be routinely achieved.

Gas Chromatography - Two dimensional GC: The application of a prior separating column to the assay allowed the background associated with the hair extract to be spread out over a longer time frame. Once the analyte retention time on the first column had been determined, the pressure switch (Dean's switch) was turned on to divert the flow, and turned off 0.4 minutes later. This created a narrow "window" of the effluent from the first column containing the analyte to be passed to the analytical column with minimal background. The second analytical column was of a different polarity than the first and provided a further separation of the analyte from potential interferences.

Cryogenic Focusing: The fraction from the first column was selectively transferred to the analytical column where a cryogenic trap focused the peak of interest. The column was cooled as the analyte entered, effectively "cold-trapping" the drug. The focuser was then heated quickly allowing the peak of interest to advance through the analytical column and enter the mass spectrometer. This resulted in a much sharper chromatographic peak, producing an improved signal to noise ratio.

Mass Spectrometry: Chemical ionization provided a more specific and selective ionization of analytes than electron impact ionization, by enhancing the signal and lowering noise generated by potential interferences. The greatest potential gains were found in applying electron capture chemical ionization (ECCI) using ammonia as the reagent gas. The low gas pressure provided sufficient fragmentation to allow the monitoring of two ions for the drug and internal standard. The modifications described were necessary to in order to analyze samples at the proposed Federal guideline cut-off of 0.05 pg/mg.

Our study enrolled 156 subjects, all of whom admitted to recent marijuana use. Each subject provided a urine sample and a hair specimen taken from the head at the time of interview. Information on drug use, including time of last use, frequency of use, ethnicity, age, sex and hair color were recorded for each subject. Hair samples were analyzed at Immunalysis Corporation; urine samples were analyzed by a reference laboratory.

Results: Of the 156 specimens collected, 46 (29%) of the samples were positive using hair, urine or both. Eight (5.1%) were positive using urine only, nine (5.7%) were positive via hair only, twenty-eight (17.9%) were positive in both matrices, and the remaining 71% were negative. One sample (# 50) had no data for the urinalysis.

The frequency of use reported by the subjects ranged from as high as 10 times per day (subjects 50 and 151) to as infrequently as 3 times per week (subjects 19, 58, 134, 152 and 154). Overall, there appeared to be very little correlation between the self-reported use of marijuana and the concentrations detected in hair or urine.

Summary: The detection of THC-COOH in hair can be achieved at a similar positivity rate to urine when a low enough detection limit is used. Using a modified GC/MS system, THC-COOH was identified in hair at the level of 0.05 pg/mg, as mandated in the proposed Federal guidelines.

Sample ID	*Hair result (pg/mg)*	*Urine result (ng/mL)*
1	**Negative**	129
2	0.42	352
4	0.41	427
10	0.29	**Negative**
17	1.22	598
18	2.51	405
19	**Negative**	135
24	0.12	**Negative**
25	0.18	262
26	0.45	181
29	0.16	**Negative**
30	0.95	522
35	0.13	**Negative**
37	0.88	634
39	0.1	**Negative**
49	0.18	312
50	0.89	Data unavailable
51	0.62	407
57	0.24	489
58	**Negative**	297
65	**Negative**	307
69	0.68	613
72	0.49	505
79	0.45	**Negative**
81	0.12	**Negative**
96	**Negative**	465
97	1.12	592
99	0.11	**Negative**
100	0.52	397
103	1.04	686
109	0.15	500
110	0.44	299
114	**Negative**	136
122	0.99	530
125	**Negative**	463
126	**Negative**	200
129	0.56	810
130	0.59	772
131	0.3	472
134	0.2	**Negative**
138	1.08	621
139	0.23	70
146	0.35	277
151	0.95	586
152	0.22	149
154	1.16	234

THCA, Two-Dimensional GC, Hair Analysis

K47 Buprenorphine and Norbuprenorphine Concentrations in the Hair of Opiate-Dependent Pregnant Women and Their Newborn Infants

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After attending this presentation, attendees will have a better understanding of the application of hair analysis for the determination of buprenorphine and norbuprenorphine in women maintained on buprenorphine and their infants exposed in utero.

This presentation will impact the forensic community and/or humanity by addressing the usefulness of hair analysis as a tool for the determination of illicit and therapeutic drugs.

Accurate identification of in utero illicit and therapeutic drug exposure has important implications to mothers and infants. Buprenorphine, a partial μ agonist, is under investigation as a pharmacotherapy for treating opioid dependence in pregnant women. Hair testing may be a useful tool for the determination of drug exposure during pregnancy; however, data are limited on the disposition of buprenorphine and norbuprenorphine in maternal and infant hair.

This study examined buprenorphine and norbuprenorphine concentrations in hair obtained from nine (8 African-American, 1 Caucasian) buprenorphine-maintained pregnant women and four of their infants. Women received 4 – 24 mg daily sublingual buprenorphine throughout gestation, an average of 16.3 ± 2.8 weeks; 13 – 21 (mean ± SD; range). Mean total maternal buprenorphine dose was 1742.4 ± 385.3; (range, 1204 – 2270 mg). Mean cumulative third trimester maternal buprenorphine dose was 1347.6 ± 241.6 mg; (range, 920 – 1672mg).

Maternal hair specimens (N=52) were collected, root to tip, approximately every 4 weeks throughout enrollment and stored at -20°C until time of analysis. Specimens were analyzed at the Center for Human Toxicology, Salt Lake City, UT utilizing liquid chromatography-tandem mass spectrometry with limits of quantification of 3.0 pg/mg for buprenorphine and norbuprenorphine in hair. Prior to analysis, hair specimens were cut into 3 cm segments, representing approximately 3 months of hair growth. Hair specimens were washed twice with 5 mL of methylene chloride at ambient temperature. Of 52 washed maternal hair specimens, 40 were positive for buprenorphine (46.4 ± 33.74; 8.6 – 161.8 pg/mg) and 41 positive for norbuprenorphine (607.5 ± 496.9; 8.2 – 1733.7 pg/mg) in the first segment of hair (closest to the scalp). Ratios of buprenorphine to norbuprenorphine ranged from 0.04 to 0.70 (0.14 ± 0.17). When sufficient amounts of hair were available (N=20), specimens also were analyzed without washing. Of the 20 unwashed specimens, 18 were positive for buprenorphine (47.7 ± 35.6; 4.6 – 151.3 pg/mg) and 17 for norbuprenorphine (714.0 ± 554.3; 46.5 – 2018.6 pg/mg) in the unwashed first hair segment. There was no statistically significant difference between the concentrations of buprenorphine (p=0.64) or norbuprenorphine (p= .86) in the washed and unwashed hair specimens. Ratios of buprenorphine to norbuprenorphine in the unwashed specimens ranged from 0.04 – 0.49 (0.15 ± 0.14) and were not significantly different in washed hair specimens (p=0.89).

Infant hair specimens (N=4) were collected within 48 hours of delivery and were not washed prior to analysis. Neonatal hair was not washed because drug concentrations could have been lower than in the mother, and it was not known if washing would remove excess amounts of drug due to the fine texture of the hair, and there was an insufficient amount

of hair to test both washed and unwashed specimens. All infant specimens were positive for buprenorphine (54.7 ± 21.7; 36.8 – 82.1 pg/mg) and norbuprenorphine (785.6 ± 190.2; 579.9 – 1037.1 pg/mg). The ratio of buprenorphine to norbuprenorphine in infant hair ranged from 0.05 to 0.08 (0.07 ± 0.02). There was no correlation between maternal total buprenorphine dose and buprenorphine (r^2=0.05, p=0.95) or norbuprenorphine (r^2=0.18, p=0.82) concentrations in infant hair. There also was no correlation between 3rd trimester maternal buprenorphine dose and buprenorphine (r^2=0.29, p=0.71) or norbuprenorphine (r^2=0.09, p=0.91) in infant hair.

Higher concentrations of norbuprenorphine as compared to buprenorphine were found in maternal and neonatal hair following daily maintenance doses of buprenorphine to opiate-dependent pregnant women. Washing maternal hair with methylene chloride did not significantly decrease parent or metabolite concentrations in the specimens. Although buprenorphine pharmacotherapy offered the opportunity to evaluate dose-concentration relationships in this vulnerable population, no significant correlations were observed between maternal buprenorphine dose and buprenorphine or norbuprenorphine concentrations in maternal or neonatal hair. Research supported by NIDA R01-12220 and NIH DA 09096.

Buprenorphine, Hair, In Utero

K48 Three Gamma Hydroxybutyrate-Related Deaths

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The goal of the presentation is to identify and describe the characteristics of three, HCMEO Gamma Hydroxybutyrate (GHB) - related deaths occurring within the period of 2000- 2005.

This presentation will impact the forensic community and/or humanity by demonstrating how the interpretation of postmortem GHB can be a challenge to determine its significance in the cause and manner of death.

Gamma-Hydroxybutyric acid had been used clinically, beginning in the early 1960s, as an anesthetic and hypnotic agent. It is now classified as a Schedule I drug in the United States and has no currently approved medical use. This reclassification was made in 2000 as a result of its abuse as an alternative to anabolic steroids by body builders, and by others, for its central nervous system depressant effects: drowsiness, dizziness, visual disturbances, amnesia and loss of consciousness. GHB has become a popular drug of abuse in association with sexual assaults. Researchers have reviewed twenty-three Harris County Medical Examiner's Office (HCMEO) cases, from the five-year period between 2000 and 2005, in which GHB was detected. GHB was determined to be the cause of death in three of these cases.

Interpretation of postmortem GHB is a formidable challenge. GHB occurs endogenously in most mammalian tissues, as a product of postmortem degradation, or as a metabolic product of the inhibitory neurotransmitter, gamma-aminobutyric acid. It is generally not detected at significant concentrations in blood or urine from living persons and postmortem production can be reduced through use of preservatives. Peak plasma concentrations can occur within 20-40 minutes and peak urine concentrations occur within 4 hours of drug use. The half-life in blood is less than one hour and its duration of action are three to four hours. Less than 5% of a dose is eliminated unchanged in urine and it is generally undetected by twelve hours after administration. GHB may also be administered in the form of Gamma-Butyrolactone, (GBL) and this substance may be observed in urine, as evidence of the dosage form or as a product of spontaneous cyclization.

The three GHB-related cases from the Harris County Medical Examiner's Office are described in Table 1.

Table 1: Three Harris County Medical Examiner GHB Cases

Case Facts: **Age/Race/Gender**	Case 1 17 yrs. White Male	Case 2 25 yrs. White Male	Case 3 34 yrs. White Male
History of Illegal Drug Use	No	Cocaine & Ecstasy	Cocaine & GHB
Toxicology Results: **Blood GHB**	108 mg/L	328 mg/L	701 mg/L
Urine GHB	80 mg/L	5798 mg/L	761 mg/L
Urine GBL	<10 mg/L	50 mg/L	28 mg/L

The circumstances surrounding these three deaths were similar. In each case, the decedents had been partying with friends. Two of the decedents were later found dead at their residences and one was found at a friend's house. The time elapsed from last seen alive ranged from 5 to 12 hours. Case number 1, a seventeen-year-old male, had a history of depression and attention deficit disorder. Fluoxetine and diazepam were detected in the blood of this individual and were included in the cause of death. Alcohol or other drugs were not detected in any of these cases.

External or internal signs of trauma were not observed at autopsy. Congestion of organs was noted in all three cases and two had evidence of pulmonary edema.

GHB was detected and quantified in blood and urine by gas chromatography / mass spectrometry of liquid-liquid extracts after acid catalyzed cyclization to GBL. GBL, in urine, was determined by GC/MS, by extraction prior to acid treatment.

The cause of death in Case 1 was assigned as combined toxic effects of GHB, benzodiazepines, and fluoxetine. In cases 2 and 3, the cause of death was acute GHB toxicity. In all three cases the manner of death was accident.

Gamma-Hydroxybutyrate (GHB), Gamma-Butyrolactone, Cause & Manner of Death

K49 Prevalence of Carisoprodol, Methadone, Oxycodone and Zolpidem in Subjects Suspected of Driving Under the Influence of Drugs (DUID) by Enzyme Linked Immunosorbent Assay

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After attending this presentation, attendees will be aware of the prevalence of carisoprodol, methadone, oxycodone and zolpidem in the blood specimens from drivers in the state of Arizona.

This presentation will impact the forensic community and/or the public by demonstrating how the toxicological analysis for carisoprodol, methadone, oxycodone and zolpidem will significantly improve the safety of the population, particularly road-users in the state of Arizona.

Methods: Driving under the influence of drugs and/or alcohol is a major problem in public safety. Enzyme linked immunosorbent assays (ELISA) are currently used to screen for the presence of barbiturates, benzodiazepines, opiates, cocaine, methamphetamine and THC in whole blood. This study was designed to determine whether the prevalence of carisoprodol, methadone, oxycodone and zolpidem warranted their inclusion in the initial immunoassay screen performed in the subject population. The study evaluated 1109 consecutive cases submitted over a 5 month time period. Cut-offs were established which appeared to reflect a potentially impairing concentration, as well as a concentration which could be confirmed using gas chromatography-mass spectrometry (GC/MS). The established cut-off levels were carisoprodol 1000 ng/mL; methadone 100 ng/mL; oxycodone 25 ng/mL and zolpidem 25 ng/mL. The screening

prevalence was compared with the documentation supplied by the drug recognition experts or arresting officer, when available.

Results: Of the 1109 cases evaluated, 55 (4.9%) contained carisoprodol; 16 (1.4%) methadone; 51 (4.6%) oxycodone; and 9 of 946 cases (1%) were positive for zolpidem. Zolpidem was added to the panel at a later date; hence the number of specimens tested is lower. Not surprisingly, the most prevalent drug detected was marijuana, which was found in 47% of the cases. Methamphetamine was found in 30%. Benzoylecgonine and benzodiazepines each were detected in approximately 13% of the samples. The current opiate assay, the Immunalysis Opiates Direct ELISA Kit, is approximately 21% cross-reactive to oxycodone and in this study had 89 (8%) cases. The lowest class prevalence of drugs found was barbiturates at 2%. The GC/MS confirmation rates for these prevalence study assays are as follows:

Assay	Confirmation	Analytes found
Zolpidem	89 %	Zolpidem
Carisoprodol	96 %	Carisoprodol & meprobamate
	2 %	Meprobamate only
Methadone	100 %	Methadone
Oxycodone	25 %	Oxycodone
	18 %	Hydrocodone
	12 %	Codeine
	8 %	Morphine
	2 %	Codeine & morphine

15 (29%) of the presumptive positive oxycodone cases were not confirmed by the current GC/MS procedure and one case each for both carisoprodol and zolpidem. In many cases, multiple drugs were detected.

Summary: The additional ELISA screening has proven to be an effective approach to identify specimens for confirmation of prescription medications that have demonstrated impairing effects in the driving population. It has given this laboratory a preliminary screening test that is less labor intensive than and complementary to GC/MS. These results demonstrated that carisoprodol has a higher occurrence than the barbiturate class in the current screening set-up. The prevalence of methadone and zolpidem are not as high as expected. Zolpidem may be expected to rise based on the interest growing for this generation of drug type. Methadone has not increased as much as expected based on trends in other regions of the country. Oxycodone was not as prevalent as other parts of the country. It has not been decided to implement the use of the oxycodone assay because the majority of the positives were also identified by the current opiate assay. The differences between the two screening assays could be explained by the higher cutoff currently used for the opiate assay of 50 ng/mL. Several of the oxycodone positive samples were positive for opiates other than oxycodone.

Carisoprodol, Methadone, Zolpidem

K50 Detection and Quantification of Low Levels of Benzoylecgonine in Equine Urine

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After attending this presentation, attendees will understand some principles of testing race horses for cocaine and other drugs.

This presentation will impact the forensic community and/or humanity by providing understanding of a problem of so-called low level cocaine concentrations in horse urine.

Cocaine (COC) is a local anesthetic and psychostimulant plant alkaloid widely abused by humans by IV injections, snorting or smoking. After administration, COC is quickly and completely metabolized and excreted in urine. Benzoylecgonine (BE) is a primary COC metabolite detected in human and equine urine. COC has no accepted therapeutic applications in equine veterinary practice. Many horse racing toxicology laboratories in the United States and in other countries occasionally detect low concentrations of BE (<150 ng/mL) in urine samples collected from winning animals. It is known that these very low BE concentrations in horse urine are a result of an accidental transfer of COC from humans or environmental contamination rather than premeditated administration to increase a horse's performance during the race. In response to the controversy of very low BE concentrations in urine, in February 2005 the Illinois Racing Board issued new rules establishing the threshold level of 150 ng/mL for BE in urine. According to the new rule, the first three positive BE laboratory reports below 150 ng/mL are accompanied by increasing fines ($250, $500, and $1000, respectively). The presence of BE in urine at a concentration equal to or higher than the threshold level is treated as a Class 1 drug as defined in the Association of Racing Commissioners International Uniform Classification Guidelines for Foreign Substances.

Methods: A solid phase extraction method for extraction of BE from 2 mL of equine urine followed by EI-GC-MS analysis after derivatization with BSTFA with 1% TMCS was developed and validated. D_3-BE was used as an internal standard for quantitation of BE in equine urine samples. The following ions were monitored: for BE *m/z* 240 (used for quantitation), 256, 361, and D_3-BE *m/z* 243, 259, 364. The standard curve for BE in urine ranged from 5 – 300 ng/mL. In order to validate the method, two levels of controls prepared in naive horse urine were analyzed on different days (15 and 75 ng/mL).

Results: In this paper the results from analysis of horse urine samples collected at four race tracks in the Greater Chicago Area between July 1, 2004 and June 30, 2005 are presented. During that period of time a total of 15 samples (0.16%) were reported positive for BE, five collected from thoroughbred and ten from harness horses. Out of 15 samples, three were reported positive without BE quantification (July 2004 to February 2005) and none of the estimated concentrations exceeded 25 ng/mL. The concentrations of BE in the remaining 12 samples ranged from 5 – 57 ng/mL. The limit of quantitation for BE was 5 ng/mL and the limit of detection was 1 ng/mL. The intra-day accuracy and precision for the low control was 2.8% and 20.6%, respectively, and for the high control urine preparations 2.2% and –2.3%, respectively. The inter-day accuracy and precision for the low controls was 10.4% and 9.5%, respectively, and for the high controls was 6.8% and 2.9%, respectively.

Conclusions: None of the BE concentrations reached or exceeded the threshold level of 150 ng/mL. The authors then postulate that these low concentrations found in urine are most likely a result of the external contamination and not premeditated cocaine administrations to horses.

Race Horses, Benzoylecgonine, GC-MS

K51 Utilization of a Pyroprobe Coupled to GC/MS in Drug Analysis and Toxicology

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The goal of this presentation is to illustrate the potential of pyrolysis as a tool for detecting biomarkers of abused drugs. This presentation will discuss the usefulness of a pyroprobe in detecting pyrolytic products of single drugs as well as mixtures of cocaine and methamphetamine. Attendees will become familiar with potential applications of pyrolysis to toxicology as well as understand the effects of varying experimental conditions and how they may alter the resulting pyrolytic products.

This presentation will impact the forensic community and/or humanity by demonstrating how pyrolysis coupled to GC/MS has the potential to model metabolism, therefore, with this method, a broad range of drugs may be analyzed in order to quickly detect metabolites that can be used in forensic laboratory analysis. This technique may be a potential tool to complement metabolic studies.

Smoked illicit drugs are of interest in forensic toxicology because smoking may produce unique biomarkers as a result of metabolism. Metabolic conditions can be partially modeled via pyrolysis, a process that decomposes a chemical compound by extreme heat. A pyroprobe is a thermal preparation device used to heat samples at high temperatures in order to breakdown the compounds into oxidation products. The pyrolytic products are then introduced into a gas chromatograph coupled to mass spectrometry (GC/MS) for identification. The present work employed a pyrolysis experiment with a pyroprobe coupled to a GC/MS. Advantages of this analytical technique include rapid sample analysis (on the order of 30 minutes) and minimal sample preparation. Pyrolysis has been used in forensic science for analyzing fibers, paints, photocopier toners and polymeric material. However to date, pyrolysis has not been used widely for toxicological research. This project will focus on the analysis of cocaine and methamphetamine and more generally, potential applications of pyrolysis to forensic toxicology. Pyrolysis has been previously carried out by heating an aluminum boat in a reference pan or by using an apparatus to simulate smoking of a tobacco cigarette laced with the analyte drug. Using such techniques, the primary pyrolytic product of cocaine is anhydroecgonine methyl ester (AEME) and methamphetamine is 1-phenylpropene, respectively. These pyrolytic products have been analyzed using both high performance liquid chromatography (HPLC) and GC coupled to MS. However, no research has been directed at simulating the metabolic conditions by pyrolysis. The ability to differentiate between inhalation via smoking versus exposure by an alternative method of ingestion is useful to the investigatory information. This study focused on the more commonly smoked drugs, cocaine and methamphetamine, along with the addition of certain cutting agents including lidocaine, caffeine, mannitol, starch and dextrose. Data obtained by pyrolysis was compared to the products from metabolized cocaine and methamphetamine reported by literature. The goal was to correlate degradation via pyrolysis to metabolic degradation as was feasible and appropriate. Several such correlations were identified and will be discussed. The effects of each of the following conditions were also studied:

1) Mixing cocaine and methamphetamine in various alternating ratios.
2) Altering methanol and ethanol as solvents.
3) Varying pyrolysis temperatures and GC conditions.

Pyroprobes, GC/MS, Toxicology

K52 Exemplification of Continuous Quality Improvement by Quality Surveillance: Laboratory Incidents and Corrective/ Preventive Approaches

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After attending this presentation, attendees will be acquainted with examples of laboratory incidents that could be used as a basis to improve performance of a laboratory by taking incidence-driven corrective/preventive measures.

This presentation will impact the forensic community and/or humanity by exemplifying incidents that are commonly encountered in a laboratory. Upon the rectification of those incidents by taking appropriate corrective/preventive measures, the overall performance of a laboratory would be improved. Monitoring of laboratory incidents is a realistic and simple approach for quality surveillance, thereby for continuous quality improvement.

The Federal Aviation Administration's Civil Aerospace Medical Institute (CAMI) conducts toxicological evaluation of postmortem biological samples collected from victims involved in fatal civil aircraft accidents. The submitted samples are analyzed for the presence of primary combustion gases, alcohol/volatiles, and drugs. Throughout the entire evaluation process, a high degree of quality control/quality assurance (QC/QA) is maintained, and continuous quality improvement is always administratively sought.

Under this philosophy, as quality surveillance, an "Incident Reporting" module was instituted in the CAMI Toxicology Database in October of 2000. Any member of the CAMI Laboratory was allowed to report an incident, but it was evaluated by designated QC/QA scientists on an incident-by-incident basis. This process involved (i) categorization of types and severity of incidents, (ii) best-educated estimates of dollar amounts and labor hours ($20.00/hour) associated with the incidents, and (iii) corrective/preventive measures taken in response to those events. Incidents with a labor hour of < 0.5 were not included. To evaluate effects of the reporting on the laboratory performance, the Toxicology Database was searched for incidents that were reported during 2000–2004. Associated dollar amounts/labor hours and types/severity of incidents were retrieved from the Database. Information related to the corrective/preventive actions taken to rectify the incident-related deficiencies was also collected.

These findings revealed that incident types pertained to accessioning, analytical, clerical, procedural, report generation, security, and other deficiencies. Severity of incidents, categorized as major, moderate, minor, and undefined, varied from analytical-batch rejection to typographical, to power outage. Corrective/preventive approaches included proofreading, counseling, and repeating tasks. This aspect also included implementing modified or new procedures and providing training to the laboratory members. Taking these quality approaches reduced the number of incidents from 61 in 2001 to 8 in 2004, thereby reducing the laboratory cost from $4,400 in 2001 to $730 in 2004. The decrease in labor-cost hours was consistent with the decrease in the incidents and dollar cost. Clerical errors were the highest in number, followed by analytical and accessioning. Although incident severity was highly prevalent in 2001, the overall severity decreased during ensuing years. Major incidents were associated with analysis, followed by accessioning, which is consistent with the very nature of postmortem forensic toxicology since these are essential components of a toxicology laboratory. Based upon the incident reporting, corrective/preventive measures—such as peer review, proofreading, procedure modification, and new method implementation—were undertaken. Training through mentorship, attending workshops/meetings/symposia, and taking courses was also provided to the laboratory members. These approaches led to a decrease in incidents during the period, 2002–2004. For example, there was a drastic decrease in clerical errors—no such incidents were significant enough to warrant corrective measures after 2002. Average completion time per case decreased from 46 days in 2003 (199 cases) to 35 days in 2004 (180 cases) for positive cases and from 37 days in 2003 (283 cases) to 31 days in 2004 (269 cases) for negative cases, indicating a tendency in the decrease in case completion time.

Findings from this study suggested that the quality surveillance improved product quality, saved time and money, streamlined and implemented procedures, thus enhanced the overall performance of the laboratory. The "Incident Reporting" will continue to be an effective and important aspect for improving quality of laboratories.

Toxicology, Laboratory Incidents, Continuous Quality Improvement

LW1 The Great Fire of 1871 That No One Knows

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The goal of this presentation is to familiarize listeners with one of the first urban-wildland fire disasters in America.

This presentation will impact the forensic community and/or humanity by demonstrating how wildland-urban interface fires pose dangers to all communities, historical and modern. Practitioners should be aware of this threat.

The destructive urban-wildland fires of Oakland, San Diego, San Bernardino and Denver are well known, but they were not the first of their kind in America.

On October 8, 1871, the most devastating fire in American history in terms of lives lost took place on the western shore of Lake Michigan. Over 1200 people lost their lives in one terrible day and night as a firestorm raged Ashes fell in Michigan far to the east, but these were not the ashes of Chicago that also burned that cataclysmic time. Chicago burned – 100,000 buildings, 3 1/3 square miles of it, but that fire took "only" an estimated 300 lives. This fire took over 1200 lives, consumed three towns and countless acres of virgin fir forest. Except for local residents and some fire historians, few people remember the Great Fire of October 1871. This presentation will describe the dynamics and the destruction of that terrible day.

Fire, Wildland, Disasters

LW2 Forensic Science, the American Revolution, and the Mysterious Case of the "Bride of Fort Edward"

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After attending this presentation, attendees will be introduced to the deaths of Jane McCrea her friend Sarah McNeil and the potential impact these events had on the course of American history.

This presentation will impact the forensic community and/or humanity by reflecting on the ways in which modern forensic analytical methods can be utilized to address historical events.

Frequently, a series of seemingly unrelated actions can coalesce to form a crucial historical flashpoint. Given the unforeseen, and at first glance stochastic, nature of these events, society tends to retrofit them as causal factors. As time passes, subsequent generations typically assign specific roles to the people involved. A prime example of this is the near mythological accounts of the American Revolution. We are all familiar with the grand stories surrounding Benedict Arnold, the Continental Congress, and the long winter at Valley Forge. Yet these momentous events are often intertwined with less celebrated, though equally important, catalysts. It is here, at the intersection of the widely renowned and the largely unknown, that we find the case of two female "martyrs," Jane McCrea and Sarah McNeil. Ms. McCrea, who has become known as the "Bride of Fort Edward", was visiting Mrs. McNeil's home in upstate New York when the two were kidnapped by a Huron scouting party on July 27th 1777.

The passage of time and loss of primary source material has obscured the details surrounding what happened next. Nonetheless, every version of the story culminates in Jane McCrea's murder and eventual elevation to "martyrdom" following her scalping at the hands of the Huron. During this historical time period, the Huron were aligned with the British in their ongoing battles with the French for dominance in North America. Consequently, the local British leader, General John Burgoyne, made the ill-fated decision not to penalize the Huron for their role in the McCrea incident. The outrage felt by the colonists at the British decision to allow a woman to be brutally murdered by the Huron, without consequence, is believed to have been an emotional rallying point for the separatists in the early years of the American Revolution.

The unintended result of this British attempt to keep the peace in volatile New York State was the galvanization of early American patriotism, particularly in the northern colonies. Indeed, this brutal event may have inspired a similar kidnapping scene in James Fenimore Cooper's, The Last of the Mohicans. The powerful and long-lasting effect(s) of a random kidnapping served to eventually undermine British control over the colonies. It became the battle cry behind the unexpectedly decisive victory of Saratoga Springs, NY. This triumph brought an unlimited cash flow via the French to the nascent colonial militia. As a result the now well-outfitted and trained militia was able to turn the tide against the British, ultimately gaining their independence.

Today, her remains are interred at the Union Cemetery in Fort Edward, next to the body of Duncan Campbell, a relative of Sarah McNeil and a legend in his own right. Sadly, even in death Ms. McCrea cannot rest, having had much of her skeleton, including her skull, purloined as souvenirs by grave robbers. Jane McCrea's status as a revolutionary-era martyr and the possible mechanism (i.e., tomahawk v. gunshot wounds) of her death have recently inspired scientists to exhume and examine her remains.

Inquiry into the specific nature of her injuries can provide valuable insight into the true culprits behind her murder (i.e., Huron or New York minutemen). The results of this investigation, including mtDNA sequencing, revealed the presence of Ms. McCrea and Mrs. McNeil's remains, as well as a third, unknown individual. While no direct maternal descendent exists for McCrea, the team was able to identify Mrs. McNeil via DNA comparison with an eighth generation female descendent. Further, the argument over the cause of Ms. McCrea's death was explored. Here, then, forensic science plays a vital role in the interpretation of the murky and mysterious narratives surrounding the women's deaths, as well as the presence of the nameless third person. In conclusion, this paper will utilize modern forensic analytical methods to address the historical events that shaped such a crucial flashpoint in our collective history.

American History, Forensic Science, Facial Reproduction

LW3 Alfred Swaine Taylor, the Nursemaid and the Lord Chief Baron

A. Robert W. Forrest, MB, LLM, Office of HM Coroner, Medico-Legal Centre, Watery Street, Sheffield, South Yorkshire S3 7ES, United Kingdom*

After attending this presentation, attendees will gain an appreciation of the way in which the writings of the 19th century toxicologists can be highly relevant for 21st century practice.

This presentation will impact the forensic community and/or humanity by persuading colleagues that reading the text books and case books published by Victorian authors is both interesting and worthwhile. Their technology was limited but there was nothing lacking in their observational skills. They still have much to teach modern practitioners.

Alfred Swaine Taylor, arguably the most influential English toxicologist of the 19th century, was born in 1806, 200 years ago. One of his lesser known cases, *Reg vs. Vamplew,* still has important lessons for 21st century investigators.

Elizabeth Vamplew was only 12 years of age in 1861 when she first started work as a nursemaid in the village of Grimoldby, in North Lincolnshire. At least 2 of the children in her care had died in convulsions before she went to work for a moderately well to do farmer, Edwin Taylor, and his wife in 1862. Elizabeth's duties were to help care for the Taylor's infant daughter, Kate.

Some two weeks before her death, Kate was taken ill whilst in Elizabeth's care, but recovered. On the night of her death, 10th July 1862, she became fretful whilst in Elizabeth's care, was put to her mother's breast and began to "shriek fearfully", dying at 1 am.

A postmortem was carried out by a local surgeon, Dr Wroe, who found features suggestive of an irritant poison. Specimens were thus sent down to London for analysis by Dr Taylor. He found that the stomach content contained strychnine.

At the inquest evidence was given by one of the other household servants that Elizabeth had confessed to her poisoning Kate. A local shop keeper gave evidence that she had sold Elizabeth a packet of Battle's Vermin Killer, which Dr Taylor confirmed was a strychnine based product. Elizabeth's mother gave evidence which was unhelpful to Elizabeth. The coroner, who presided with a jury returned a verdict that Kate came to her death by being "Poisoned with Battle's Vermin Killer by Elizabeth Vamplew, Nursemaid aged 14 Years."

Elizabeth was committed for trial for murder at Lincoln Autumn Assizes before the Lord Chief Baron. The defense centered around intention but Elizabeth was found guilty of manslaughter. The similar fact evidence of the other two deaths did not form part of the evidence at the trial but the judge referred to them in passing sentence. She was sentenced to 12 years imprisonment.

There are many lessons in the death of Kate Taylor for those who have to investigate career associated killings today. "The thing that hath been, it is that which shall be; and that which is done is that which shall be done: and there is no new thing under the sun". Ecclesiastes 1:9. Alfred Swaine Taylor still has much to teach us.

Careers, Homicide, Poisoning

LW4 John Wilkes Booth: The Death and Posthumous Career of an "American Brutus"

Adrienne E. Segovia, MD, Office of the Medical Examiner, County of Cook, 2121 West Harrison Street, Chicago, IL 60612*

After attending this presentation, attendees will gain the knowledge of the historical events surrounding the capture and autopsy of the presidential assassin, John Wilkes Booth.

This presentation will impact the forensic community and/or humanity by examining the historical events surrounding John Wilkes Booth's capture and the findings of his autopsy. It will also discuss an alternate view held by some who disagree with conventional history and believe that John Wilkes Booth escaped.

The goal of this presentation is to inform the forensic community of the historical events surrounding the capture and autopsy of the presidential assassin, John Wilkes Booth.

This presentation will impact the forensic community and/or humanity by examining the historical events surrounding John Wilkes Booth's capture and the findings of his autopsy. It will also discuss an alternate view held by some who disagree with conventional history and believe that John Wilkes Booth escaped.

John Wilkes Booth assassinated President Abraham Lincoln on April 14, 1865 at Ford's theater in Washington, D.C.. Jumping onto the stage and fracturing his left fibula in the process, he cried "sic semper tyrannis," made his way through the back of the theater to a waiting horse, and rode into the night. He was later joined by David Herold. The two, with the assistance of Southern sympathizers, made their way through Maryland and into Virginia. The pair eluded capture for 12 days until their luck ran out in the early morning hours of April 26, 1865 in a tobacco barn on Garrett's farm outside of Port Royal, Virginia. Here, the pair, who had been locked into the barn by a cautious Garrett family, was surrounded by 26 soldiers from the 16th New York cavalry, under the command of Lt. Edward Doherty. Herold surrendered, but his companion Booth, who was armed with a pistol and a carbine, made it clear he did not intend to surrender and was willing to fight his way out. In an attempt to force him from the barn a fire was started. The fire spread quickly and a lone figure could be seen in the barn. A shot rang out and Booth fell. He had sustained a through and through gunshot wound of the neck. Sergeant Boston Corbett fired the bullet from his Colt .44 service revolver. Booth was eventually laid on the porch and after approximately two hours he died. Personal items recovered from Booth's pockets included a journal.

The body was sewn into a blanket and transported to the monitor USS Montauk, an ironclad warship. There on April 27th Army Judge Advocate General Joseph Holt held an inquiry and identification was confirmed. Later that day, Booth was autopsied by Dr. Joseph J. Woodward and Surgeon General Joseph K. Barnes. Dr. Barnes noted that the left leg was encased in splints and bandages. When these were removed, he identified a fracture of the fibula 3 inches above the ankle. Examining the gunshot wound of the neck, Dr. Woodward found that the bullet entered just behind the sternocleidomastoid muscle on the right side, avoiding the second and third cervical nerves, fractured the fourth cervical vertebrae, the pedicle of the fifth vertebra and involved its transverse process. The wound course next traversed the spinal canal almost horizontally, slightly downward and posteriorly, perforating the spinal cord. On the left side of the neck nearly opposite the point of entrance, there was a gunshot wound of exit. Dr. Woodward stated that immediately after sustaining the gunshot wound there was a "very general paralysis." His report also indicated that "The phrenic nerves performed their function, but the respiration was diaphragmatic, of course, labored and slow. Deglutition was impractical, and one or two attempts at articulation were unintelligible. Death, from asphyxia took place about two hours after reception of the injury." Despite the findings, several statements have been attributed to Booth as he lay dying.

Identification of the body had also been conducted on board the monitor USS Montauk. In all, 6 people identified the body as that of John Wilkes Booth. Identifying characteristics included a scar, from a fibroid tumor that had been removed on April 13 1863, by Dr. Frederick May who was called in to assist in the identification. Other characteristics included a tattoo of the initials "J W B" on the posterior aspect of the left hand and a recent 'dental plug'. Identification was also confirmed visually. Although Booth's appearance was haggard, he had shaved his mustache. The body, in the process of decomposition, was transported back to Washington, where he was buried in a locked room in the old Arsenal. In 1867, the body was exhumed and reburied. In 1869, the Booth family petitioned President Andrew Johnson for the return of the remains. These were exhumed and eventually reburied in an unmarked grave in Greenmount Cemetery in, or near, the Booth family plot in Baltimore, Maryland. The grave was left unmarked at the request of John's brother, Edwin Booth.

John Wilkes Booth died on the porch of Garrett's farm on April 26, 1865 from a through and through gunshot wound of the neck — or so conventional history tells us. There are many who believe that a loner/drifter, David George, who committed suicide by ingesting strychnine in 1903 in Enid, Oklahoma Territory, was really John Wilkes Booth. Revisionists and conspiracy theorists, believe Booth escaped and lived out his days in

Canada, India, Texas or the Oklahoma Territory. The body of David George was embalmed, claimed by a Memphis attorney and eventually sold to a carnival. The mummy had an active posthumous career traveling the carnival circuit, where it was presented as the mummy of John Wilkes Booth. In Chicago, in 1931, the mummy was autopsied. Those present claimed a ring with the initial "B" was found in the stomach. The mummy eventually disappeared from sight and today probably resides in a private collection.

In October 1994, a petition was filed in the Circuit Court of Baltimore for exhumation of the remains buried in Greenmount Cemetery. The petitioners believed there were compelling reasons for an exhumation. They alleged that the identification and autopsy were "equivocal and fraught with errors," that escape theories have persisted since 1865 and with the help of modern science these speculations could finally be proven or disproved. Their petition and appeal were unsuccessful. The court found that there was well-documented evidence that Booth did not escape and that the likelihood of reliable identification was inconclusive. DNA testing could not be done because there is no direct matrilineal link with surviving Booth relatives. The exhumation would likely disturb other graves, because the exact burial site is unknown. The remains could be in poor condition due to possible water damage, and the examination of the remains would take a minimum of 6 weeks, which the court found inappropriate.

Correct identification of an individual is of paramount importance in forensic pathology. Here identification was made visually by relying on several identifying characteristics: a tattoo ("JWB"), a scar, and a recent 'dental plug'. When the remains were turned over to the Booth family in 1869, several family members and friends, 19 in total, viewed the remains and the accompanying articles of clothing (a boot and a shoe). The skull, hair, teeth, and legs were examined. There was no doubt that the remains were those of John Wilkes Booth.

There appears to be a need among some Americans to believe that Booth got away: to reject the well-documented events and facts, and to believe that his mummy enjoyed a posthumous career with traveling carnivals and now resides in a private collection. Whether this need is based on romanticism, the mistrust of government or any other number of complex factors, it is like the tale of Booth's escape - a story not history.

John Wilkes Booth, Autopsy, Mummy

LW5 Kennewick Man: Nowhere Near the Last Word

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After attending this presentation, attendees will learn information on legal issues concerning skeletal remains found in archaeological sites.

The Kennewick Man litigation began as an effort to permit a thorough forensic investigation of the skeletal remains. The case resulted in a legal clash between science and politics in combination with religious fundamentalism. Resolution of this case has cost United States taxpayers well in excess of six million dollars. This presentation will impact the forensic community and/or humanity by providing an opportunity to study and learn from this important discovery.

This presentation will briefly explain the lawsuit required to study the remains known as Kennewick Man and the principles reinforced through this action. More extensively, the presentation will also reveal the scientific information acquired to date including the results of a detailed taphonomic analysis.

The accidental discovery of an exceptionally well-preserved human skeleton along the shoreline of the Columbia River in Washington led to a legal challenge of the U.S. Army Corps of Engineers' action. Not only did the skull show features uncharacteristic of modern Amerindians, but a spear point embedded in the right pelvic bone was determined to be of an ancient type. Radiocarbon dating revealed that the skeleton was approximately 9,000 years old, one of the oldest and best preserved found in North America. Five local Indian groups claiming affiliation demanded immediate reburial of the skeleton. Eight scientists filed suit in 1996 to enforce what they contended was a legal right to study the skeleton. The District Court and the United States Court of Appeals for the Ninth Circuit found in favor of the scientists. During the summer of 2005, formal study of the skeleton began. A second phase is scheduled to coordinate with the 2006 AAFS annual meeting.

Activities conducted to date include the use of industrial computed tomography technology to create dimensionally accurate replicas of the individual pieces of the skull and the right hip bone with the embedded projectile point. By examining the bones for postmortem fractures including propagation patterns, deposition of calcium carbonate, sediment infiltration of medullary cavities, and stain patterns, the position of the body in the ground and its orientation to the river can be determined. This important information cannot be obtained through other means because the remains were not examined or photographed *in situ* and the recovery site has been covered with rocks and trees.

Future investigations will include additional CT scans, pathology, hand and foot morphology, additional metric measurements and more complete skeletal observations.

The Last Word has not yet been written on Kennewick Man, but scientific investigation of one of the most important skeletons ever found in North America is in progress.

Kennewick, Anthropology, Taphonomy

LW6 The Crash of 13304: Investigation of the First Airplane Bombing

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After attending this presentation, attendees can expect to learn about accident investigation practices, in the historical context of a landmark airplane bombing in 1933.

This presentation will impact the forensic community and/or humanity by examining the facts of the first proven airplane bombing. This topic is of interest to forensics scientists, criminalists, and indeed anyone living in these days of increased air transportation insecurity.

The mention of airplane bombings calls up thoughts of Pan Am Flight 103 and Richard Reid. But an airplane bombing occurred early in the history of flight, only 30 years after the flight at Kitty Hawk.

At 9:15 pm on October 10, 1933, the quiet skies over Chesterton, Indiana were disturbed by an explosion. A Boeing 247, recently purchased by United Air Lines, erupted in flames, and crashed to the ground. Newspapers ran sensationalized accounts of the crash, which was witnessed by a number of local residents. Witnesses reported hearing an explosion. Upon rushing out of their houses they saw the plane "falling like a rock" with "flames shooting out". Several witnesses also reported hearing at least one engine still running and seeing the airplane spiraling towards the ground. The fire continued after a second explosion which occurred when the airplane impacted the ground. Although area residents rushed to

attempt rescue, the flames were too hot. The seven occupants, pilot, copilot, stewardess and four passengers, were all killed. The incident was the first fatal crash for United Air Lines in six years, and marked the first death of a stewardess in a crash.

In the early 1930's, air traffic was under the jurisdiction of the U.S. Department of Commerce, which, along with Boeing and United Air Lines, quickly sent investigators. They had few clues to work with, in addition to the eyewitness reports. The airplane was found in two pieces, the fuselage and the tail section. The tail section was located about one quarter mile from the body of the plane, along with the (unburned) bodies of two passengers, presumably seated towards the rear of the plane. The Chesterton Observer reported that following the crash, souvenir hunters cleared the area of loose debris and even removed pieces from the fuselage. This contamination of the debris field may have hampered the investigation.

The media immediately advanced various theories for the crash. The New York Times concluded that "it was apparent that one of the motors or a gasoline tank blew up". The Chesterton Observer reported possible causes including a broken gas line, a hot exhaust pipe, an impeller explosion, or a bomb. That the tail separated from the body of the plane during flight concerned Boeing and United Air Lines officials. The Boeing 247 was a new airplane, which had just gone into service six months earlier. Perhaps there was an undetected structural defect that might affect the entire fleet. Airplane crashes, while not frequent, were not uncommon. Frequently these were blamed on the weather or on pilot error. The single previous Boeing 247 crash had been caused by pilot error.

Five days after the incident, United Air Lines announced a bomb had caused the incident. Dr. E. W. Muehlberger, a toxicologist and director of the Northwestern University Crime Detection Laboratory, had examined debris from the wreckage including bottle fragments and a blanket. These showed gunpowder and nitroglycerine residues, indicating a bomb. The fuselage had numerous holes, specifically in the baggage compartment, which could have been caused by shrapnel. A porter for United Air Lines reported that a man carried a brown package onto the airplane in Newark, NJ. The man disembarked at a stopover in Cleveland. This mysterious passenger was never found.

Boeing 247, 1933, Bombing

LW7 Exit the Dragon: The Mysterious Death of Bruce Lee

James A. Filkins, MD, JD, PhD, Department of Law, City of Chicago, 30 N LaSalle Street, Suite 1020, Chicago, Illinois 60602*

After attending this presentation, attendees will understand the basic criteria and risk factors for Sudden Unexpected Death in Epilepsy or SUDEP.

This presentation will impact the forensic community and/or humanity by illustrating through the example of the death of Bruce Lee that individuals whose seizures are recently diagnosed or who have experienced only one seizure may still be at risk for SUDEP

Bruce Lee, the film star and martial arts legend, died on July 20, 1973 at the age of thirty-two. More than three decades later, both the cause of his death and the circumstances surrounding it remain uncertain.

On the afternoon of his death, Lee and Raymond Chow, his producer, drove to the apartment of Betty Teng Pei, a well-known actress in the Hong Kong film industry. The three discussed the script for Lee's current film project, "Game of Death." Lee and Chow planned to have dinner later that evening with George Lazenby, the actor best known for his one-time portrayal of James Bond in "On Her Majesty's Secret Service." The two hoped to persuade Lazenby to appear in "Game of Death." Chow left Betty's apartment about 7:30 p.m., but Lee stayed behind complaining of a headache. Betty gave him one tablet of Equagesic®, a prescription medicine consisting of aspirin and meprobamate. A short time later Lee said he felt ill and lay down in bed. At about 9:00 p.m., when Lee had not appeared at the restaurant, Chow telephoned Betty. She reported that she could not awaken Lee. Chow rushed back to the apartment, found Lee unresponsive and called a doctor. Lee was taken to Queen Elizabeth's Hospital, where he was pronounced dead after efforts to resuscitate him failed. The circumstances of Lee's death and his seemingly robust health led to various theories of foul play and conspiracy, which persist to this day. Following funerals in Hong Kong and Seattle, Lee was buried in Seattle's Lake View Cemetery.

Bruce Lee was born in San Francisco on November 27, 1940. In 1941, Lee's family returned to Hong Kong with their infant son. As a teenager, Lee began to study Wing Chun, a type of kung fu or Chinese boxing. He also became an accomplished dancer, winning the Crown Colony cha-cha championship in 1958. The following year Lee returned to San Francisco and then moved to Seattle. For the next four years he worked at Ruby Chow's restaurant in Seattle while majoring in philosophy at the University of Washington. During his Seattle years he began to teach martial arts and met his future wife, Linda C. Emery.

Nineteen sixty-four proved to be a pivotal year for Lee. He moved to Oakland, California where he continued to teach martial arts and began to develop his own style of fighting, which he called Jeet Kun Do (Way of the Intercepting Fist). Later that year he married Linda in Seattle. Most significantly for his evolution as a martial arts film star, he gave a demonstration of Wing Chun at the Long Beach International Karate Tournament. Lee's appearance there led to his being cast as Kato in the short-lived television series "The Green Hornet." After the series folded, Lee appeared in a couple of films and choreographed martial arts sequences in a couple of others. He also continued to teach martial arts and soon numbered among his clients stars such as Steve McQueen and James Coburn. After another short-lived television series in which he appeared, "Longstreet," was canceled, he and Linda moved to Hong Kong. In Hong Kong, Lee made three martial arts films and began work on "Game of Death" before completing "Enter the Dragon, " the film for which he is best known. The first Asian martial arts film to be financed by an American studio, "Enter the Dragon" was scheduled for an August 24, 1973 premiere when Lee died.

Lee's autopsy showed cerebral edema with a brain weight of 1575 grams. There was no trauma, tumor or vascular accident. The rest of the autopsy was unremarkable. Toxicology tests were positive only for cannabis and small amounts of aspirin and meprobamate. Cerebral edema was given as the cause of death, which was attributed to an allergic reaction to the aspirin and/or meprobamate. Although this explanation is reasonable, the possibility that Lee died from Sudden Unexpected Death in Epilepsy or SUDEP should be considered.

On May 10, 1973, while looping dialogue for "Enter the Dragon" at Golden Harvest Studios in Hong Kong, Lee collapsed. He then began gasping for breath, vomiting, and convulsing. By the time he arrived at Baptist Hospital, his temperature has risen to 105°F. He was intubated and placed on intravenous fluids. Lee was diagnosed with cerebral edema and given mannitol, which reduced the swelling of the brain. He began to recover within several hours. An evaluation two weeks later at U.C.L.A. Medical Center, which included an E.E.G., failed to find any explanation for the episode and Lee was diagnosed with an idiopathic grand mal seizure. Although he was prescribed the anti-seizure medication Dilantin®, none was found in his system at the time of his death.

SUDEP is defined as the "sudden unexpected, witnessed or unwitnessed, non-traumatic and non-drowning death in patients with epilepsy with or without evidence of a seizure and excluding documented status epilepticus, where necropsy does not reveal a toxicological or anatomical cause for death." SUDEP accounts for an estimated five to thirty percent of deaths in patients with epilepsy. The incidence of SUDEP in the general epileptic population ranges from 1 in 370 to 1 in 1100. Some investigators have suggested that SUDEP is under-reported. The mechanism of death is commonly thought to be a seizure-induced cardiac arrhythmia or respiratory arrest. Generalized tonic-clonic (grand mal) seizures represent the

most common seizure disorder in SUDEP. Predictably then, most witnessed seizures in SUDEP are tonic-clonic, but the absence of a witnessed seizure in SUDEP is not unusual. A specific etiology for the patient's seizures is often not identified. Non-specific post-mortem findings frequently include pulmonary and/or cerebral edema. SUDEP is more common in patients under 40 years old and in males. Patients are often found in bed. Even when patients survive long enough to reach an emergency room, they cannot be resuscitated. Poor compliance, or non-compliance, with anti-seizure medications is also a common finding. Other risk factors for seizures, such as alcohol abuse, sudden withdrawal from anti-seizure medications, lack of sleep, and stress, may also increase the risk of SUDEP.

The death of Bruce Lee correlates well with previously published studies of the factors associated with SUDEP. Although, the majority of cases of SUDEP occur in patients with a long-standing history of epilepsy, a handful of cases have been reported of patients, such as Lee, who had suffered only one seizure at the time of death or who had a first seizure within a few months prior to death. Thus, the absence of a more extensive seizure history should not preclude Lee's death from consideration as a possible case of SUDEP and should serve as a reminder that even patients whose seizures are infrequent or newly diagnosed are at risk for SUDEP.

SUDEP frequently claims young, active adults, who, but for their seizure disorder, are otherwise healthy. The death of a celebrity such as Bruce Lee, who passed away on the threshold of stardom and at the peak of his extraordinary physical prowess, illustrates this tragedy.

SUDEP, Epilepsy, Seizure

LW8 Mysterious Delusions: Witchcraft at Salem

Walter F. Rowe, PhD, Department of Forensic Sciences, The George Washington University, Washington, DC 20052*

After attending this presentation, attendees will learn about the theories that have been proposed to explain the witchcraft mania that broke out in Salem in 1692; he/she will also understand the limitations of these theories. The attendee will also understand the role that 17th Century science played in the Salem Witchcraft Trial.

This presentation will impact the forensic community and/or humanity by assisting the forensic community in understanding the limited value that science can have in explaining past events. The forensic community will also be made aware of the hazards of providing pseudo-scientific support for dubious testimonial evidence.

The Salem Witchcraft Trials are the most infamous series of criminal trials in the history of North America. Nineteen persons were condemned as witches and executed; one accused witch was pressed to death; and over a hundred accused witches were imprisoned for months in appallingly squalid conditions. This presentation will give a brief overview of the course of the trials and evaluate the various theories that have been advanced over the years to account for the witch-hunting mania in 16th Century Massachusetts. Theories of the cause of the Salem Witchcraft Trials fall into two broad categories: 'hard science' and 'soft science.' 'Hard science' explanations include Jimson weed poisoning, ergot poisoning and an outbreak of encephalitis lethargica. 'Soft science' explanations range from the psychiatric (e.g. mass hysteria or mass sociogenic illness) to the sociological (e.g. village factionalism and gender and age conflicts). This presentation will show how these theories all suffer from either a highly selective use of evidence or an overly narrow focus on the accusers and accused in Salem Village.

Almost all of the explanations of the Salem Witchcraft Trials focus on the accusers and the accused. This neglects the significant role of the justices of the Special Court of Oyer and Terminer that was established by Governor William Phips to try the witchcraft cases. Chief Judge William Stoughton frequently acted in a biased fashion. When one of the most prominent accused witches was acquitted, Stoughton recommitted the case to the jury (which then convicted the accused). Stoughton and his fellow judges may have been influenced by a belief in a conspiracy of New England witches with the Wabanaki Indians of northern New England and southern Canada. Witchcraft accusers and confessed witches frequently recounted encounters with a 'black man,' presumably a Wabanaki sachem or shaman. The goal of the conspiracy was the overthrow of the Puritan churches and the institution of the reign of Satan. This conspiracy theory gained credibility from the fact that New England was in the midst of a particularly violent war (King William's War or the Second Indian War). Raids by Wabanaki warriors had devastated settlements in Maine and killed villagers in Salem and Andover (the loci of the majority of witchcraft accusations). Military operations launched by Massachusetts had been conspicuous failures that consumed substantial blood and treasure. In this atmosphere of siege, both the judges and the general population may have been more willing to accept dubious evidence against the accused witches.

This presentation will also highlight the hitherto unrecognized role of 17th Century science in the Salem Witchcraft Trials. Proponents of the trials advanced a scientific explanation of the 'touch test,' one of the common tests of witchcraft employed during the trials. Accusers frequently went into fits when confronted in court by an accused witch; the fits would abate when the accused witch touched the victim. This was explained by claiming that when the witch looked at the victim malignant particles streamed out of the witch's eyes into the victim's body. When the witch touched the victim the poisonous particles flowed back into the witch's body. This theory gave a scientific veneer to the witchcraft trials. Thomas Brattle refuted this theory in a circular letter which harshly criticized the witchcraft trial. Brattle was the only empirical scientist in the British colonies: his astronomical observations had been published by the Royal Society and utilized by Isaac Newton in the *Principia*. Brattle was also a friend of the English chemist and atomist Robert Boyle. Consequently, his views would have carried considerable weight with the educated elite of Massachusetts but the jurors returned verdicts of guilty notwithstanding.

Salem Witchcraft Trials, Mass Hysteria, Ergot

LW9 The Psychic and the Murderer: Hype vs. Hope for Stalled Investigations

Katherine M. Ramsland, PhD, Department of Psychology, DeSales University, Center Valley, PA 18034*

After attending this presentation, attendees will gain an awareness of how psychics mislead both the police and the public with false publicity, as well as realizing that there are occasional experiences in which psychic impressions may be helpful to investigations without wasting time and resources. Criteria for making a correct judgment will be offered, along with red flags.

This presentation will impact the forensic community and/or humanity by educating investigators in how to make judgments about utilizing psychics as a last resort in stalled investigations.

Recently there has been a surge of media interest in psychics who claim to assist the police with solving cases and finding missing persons. But mediums and psychics have a long history of fraud, and some have hoodwinked the public into believing they've assisted when they've actually wasted resources and misled investigations. The presenter has examined a number of "psychic investigations" and of these will compare two cases in which famous psychics misled investigators: one was a 1901 murder in North Carolina and the other a triple homicide in 1982 in Waco, Texas that, while misled by an acclaimed psychic did benefit from "psychic flashes" from someone who claimed no psychic ability.

Psychics, Murder Investigation, ESP

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