Northeastern Association of Forensic Scientists

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Contents

Drug Chemistry Abstracts

"Identification and statistical analysis-facilitated classification of plant-based psychotropic substances by ambient ionization mass spectrometry," Rabi A. Musah*, Ashton D. Lesiak**,** Justine E. Giffen, Department of Chemistry, University at Albany-SUNY; Robert B. Cody, JEOL USA, Inc.

The United Nations Office on Drugs and Crime issued a list of 20 plant-based "drugs of concern" in its report on the world-wide emergence of new psychoactive substances. Since the crafting of legislation to address the use of these products is reliant on the presence of laboratory methods for their definitive identification, the development of suitable SOPs for their detection is imperative. However, the design of analytical methods that rely on hyphenated techniques such as GC- and LC-MS among others, is fraught with challenges that are peculiar to the analysis of complex plant matrices.

We demonstrate here that the unique and reliable mass spectral fingerprint profiles that distinguish one plant species from another, can be used to identify plants of abuse. The fingerprint can be acquired rapidly and in a high throughput fashion using direct analysis in real time-high resolution mass spectrometry (DART-HRMS). The use of this technique bypasses challenges presented by more conventional methods, as the material can be analyzed in its native form without resource to the creation of extracts, or sample derivatization, filtration and pH adjustment steps. The high throughput capabilities of the method, coupled with multivariate statistical analysis processing of the data, provide not only plant species information, but also a report of the statistical level of certainty. Several examples of the utility of this method using commercially available psychoactive plant products such as Kanna, Kratom, S. divinorum, Datura spp., Kava, Morning glory, Syrian rue, M. hostilis, and B. caapi, among several others, are illustrated.

"Identification of Heroin and Fentanyl in Seized Drug Samples using Direct Sample Analysis Time-of-Flight Mass Spectrometry," Jamie Foss*, Maine Health and Environmental Testing Laboratory

Maine has seen an increase in heroin use and overdose over the past three years, resulting in an increase in heroin samples submitted to the laboratory for identification. With the increase in heroin has also come an increase in exhibits containing fentanyl, heroin and fentanyl, as well as submissions of the fentanyl derivative acetyl fentanyl. Current methodologies lack sensitivity when it come to detecting fentanyl, especially in samples containing predominately heroin. Direct Sample Analysis (DSA) Time-of-Flight Mass Spectrometry provides a rapid and sensitive identification of heroin, fentanyl, and fentanyl derivatives. DSA is a direct ambient ionization source, requiring no chromatography and minimal sample preparation, which makes it particularly well-suited for rapid confirmation of low level opiates in seized street drugs. An overview of the instrumentation and use of DSA-TOF to rapidly generate exact mass data and fragmentation data from in-source CID will be demonstrated through a method validation study and analysis of seized street drugs.

"Separation of Cathinone Derivatives by Capillary Electrophoresis," Reena Patel*, Drug Enforement Administration, Northeast Laboratory

Many common illicit cathinone derivatives can be easily identified by common instrumental techniques such as GC/MS, GC/FID, HPLC and FTIR. GC/MS is often a useful tool but problems can arise when differentiating between compounds which are structural isomers because the spectra may exhibit very few distinguishing

characteristics. Issues can also arise when identifying cathinone compounds by infrared spectroscopy. Often spectra of illicit samples do not match known laboratory standards due to polymorphism. The availability of different instrumental techniques can be helpful in analysis of illicit samples. In this study, Capillary Electrophoresis was utilized to separate cathinone compounds. The initial focus was on Ethylone, Butylone, and bk-MDDMA due to their similar mass spectral fragmentation patterns and issues with identifying Ethylone by FTIR due to polymorphism. The same methodology was then applied to some commonly seen current illicit cathinones. This approach offers another option for separating cathinone derivatives.

"Scientific Working Group for the Analysis of Seized Drugs (SWDRUG) Update," Tiffany Ribadeneyra*, Nassau County Office of the Medical Examiner/Division of Forensic Services; Sandra E. Rodriguez-Cruz, Ph.D., DEA Southwest Laboratory

The Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) was formed in 1997 in a joint effort between the U.S. Drug Enforcement Administration (DEA) Office of Forensic Sciences and the Office of National Drug Control Policy (ONDCP). Historically, SWGDRUG recommended minimum standards for the forensic examination of seized drugs and to sought their international acceptance. There have been numerous inquiries as to how the formation of the Organization of Scientific Area Committees (OSAC) will affect SWGDRUG's future. SWGDRUG will continue to work as part of the international community to improve the quality of the forensic examination of seized drugs. In addition, the resources provided on the SWGDRUG website will continue to be updated and available.

This presentation will provide attendees with an update on SWGDRUG activities during the year 2014 and currently in 2015. Recent activities include Version 7.0 of the Recommendations, including guidance regarding new and emerging materials as well as supplemental documents addressing measurement uncertainty for cases of weight or count extrapolations and bylaw updates. Current issues being considered by the core committee include online resources for drug analysis training and qualitative method validation. The SWGDRUG mass spectral library remains an extensively utilized resource within the forensic community and current status as well as future plans will be reviewed.

"Kanna Chameleon-DART-HRMS Facilitated discovery of adulteration of psychoactive herbal supplements-The Case of *Sceletium tortuosum* aka "Kanna"," Ashton D. Lesiak*, Rabi A. Musah Department of Chemistry, University at Albany-SUNY; Robert B. Cody, Masaaki Ubukata, JEOL USA, Inc.

With the increasing regulation of psychotropic compounds, drug abusers and dealers are turning to plant-based drugs of abuse because they are much harder to track by law enforcement and because of the paucity of laws governing their use. These "natural alternatives" are widely available on the Internet, largely unregulated, and marketed as safe substitutes for other drugs of abuse including well-known narcotics and recently introduced synthetics. One example is Sceletium tortuosum, commonly known as Kanna. This psychotropic plant and various products derived from it remain unregulated and there is minimal oversight regarding the ingredients of these "supplements."

Here, we describe the use of direct analysis in real time-high resolution mass spectrometry (DART-HRMS) to monitor the active ingredient profile of commercially available Kanna products from different vendors. HR masses consistent with formulas of the mesembrine alkaloids that are characteristic of this species were observed for all five

products that were investigated. In-source collision-induced dissociation (CID) was used to confirm the presence of hordenine, which is a diagnostic alkaloid for the species. However, DART-HRMS analysis revealed that one product had been adulterated with an additive which consistently appeared as the most intense peak in its mass spectrum. In-source CID studies of various alkaloid standards in comparison with the in-source CID behavior of the Kanna product revealed the adulterant to be the regulated compound ephedrine. This finding was independently confirmed by GC-HRMS. DART-HRMS was shown to be a powerful tool that can be used to rapidly reveal the presence of scheduled adulterants.

"Drug Analysis of the Residue Content of Seized Syringes," Thomas A. Brettell PhD, F-ABC*, Forensic Science Program, Department of Chemistry and Physical Sciences, Cedar Crest College; Linda Burdick B.S. and Robyn A. Pyle B.S., M.S., Bucks County Crime Laboratory, PA

Drug paraphernalia is commonly submitted to forensic science laboratories for analysis of controlled substances. Paraphernalia seized by law enforcement often includes used syringes from drug abusers. The syringes are usually submitted to the laboratory with the needle intact. The proper submission of syringes should include a protective container labeled, as a biohazard, to protect anyone who must handle the evidence and laboratories should have procedures in place to safely handle this type of evidence. It is a known fact that the sharing of syringes by intravenous drug abusers is a primary cause of the transmission of HIV and hepatitis B and C. Anyone who handles this type of evidence, particularly forensic chemists and law enforcement, is at risk of exposure and acquiring these diseases. For this reason many laboratories choose not to analyze this type of evidence unless absolutely necessary.

There are a number of important reasons, however, to analyze syringes submitted to crime laboratories. Laboratories may chose to have syringes analyzed because (1) it is the only item in the case; (2) it may be the probable cause for arrest; (3) it may be essential for determining the cause of death in a death investigation; (4) possession of the contents of the syringe may be a significantly more serious offense than possession of other items in the case (e.g. a syringe with heroin vs. a bag of marihuana); (5) or other reasons specific to the case.

This presentation will report the results of analysis for controlled substances of over 450 syringes seized by law enforcement and submitted to the Bucks County Crime Laboratory during the period of January 2014 through July 2015. The syringes were extracted with methanol and analyzed by gas chromatography/mass spectrometry. 71% of the syringes analyzed were positive and the most common drug identified was heroin. Other drugs identified were cocaine, methamphetamine, fentanyl, morphine and buprenorphine as well as various cutting agents, heroin metabolites and naturally occurring opiate alkaloids.

"Synthetic Cannabinoid TNT: Trends, Names and Tools," Rob Schelkun*, Cayman Chemical, Forensic Chemistry Department

This presentation will focus on recent trends in the field of designer synthetic cannabinoids as viewed from the perspective of the reference material suppler. Topics to be discussed will include cannabinoid leads, new structural trends, and nomenclature issues including some new efforts toward developing a better systematic naming approach. Recently developed resources and web tools that facilitate the detection and confirmation of new designer drugs will also be covered.

"Measurement Uncertainty: Who stole the dope? (Maybe no one!)," Jim Wesley*, Monroe County Crime Laboratory, NY

Measurement Uncertainty has provided crime labs with a process that carefully evaluates all contributions to quantitative error and expresses that uncertainty in their reported results. M.U. is of limited value however if the drug lab reports drug weights or pill counts that appear to be at odds with the police report or the expectations of the district attorney. The result of this discrepancy can be the closure of the section or the entire lab.

We review news reports that resulted in employee dismissal and/or lab closure, compare police submission information with actual lab results and provide explanations and documentation which will help train your agencies and may save your lab! A summation police/lab weight chart will be provided. Ideas to prevent mishaps and changes to your weighing SOP will also be presented.

Forensic Biology Abstracts

"Use of Lean Six Sigma Methodology to Improve Laboratory Productivity and Reduce Backlog; Part 1 Define, Measure, Analyze," Lynn Schneeweis, M.S.*, Stefany Harman, M.S., Maureen McCabe, M.S., Kristen Sullivan, M.S., MA State Police Crime Laboratory (MSPCL)

In 2012, the MA State Police Crime Laboratory (MSPCL) secured grant funding to address backlogs in the Forensic Biology Section. As part of this initiative, the MSPCL completed a Lean Six Sigma (LSS) project that evaluated workflow and implemented changes to increase productivity and efficiency. The ultimate goal was to create a highly productive, quality driven environment capable of meeting current demand for forensic biology examinations and eliminating the backlog.

Employing the systematic DMAIC process (Define, Measure, Analyze, Improve, Control), the project team evaluated the laboratory's current state and developed baseline matrices to monitor progress. Using data collected from the Laboratory Information Management System, current case demand and output was calculated. A project charter was constructed outlining specific, measurable goals and a timeline to achieve them. Approximately six weeks was spent on the measurement phase eliminating all work in progress, mapping current processes to identify sources of process waste, and summarizing the current work and information flow. This data was then analyzed to determine what changes could most significantly improve the overall process.

This presentation will outline how a laboratory may increase productivity and reduce backlogs by implementing the workflow optimization method called Lean Six Sigma. While LSS provides effective tools to meet these goals, several operational challenges are also presented for laboratories to consider before undergoing this process. This presentation discusses the Define, Measure, and Analyze phases of the MSPCL project.

"Use of Lean Six Sigma Methodology to Improve Laboratory Productivity and Reduce Backlog; Part 2 Define, Measure, Analyze," Stefany Harman, M.S.*, Lynn Schneeweis, M.S., Maureen McCabe, M.S., Kristen Sullivan, M.S., MA State Police Crime Laboratory (MSPCL)

This presentation will discuss the Improve and Control phases of the MSPCL LSS project.

The Evidence Control and Case Management Unites focused on improving evidence intake procedures and the case activation process. This aided the Criminalistics and DNA units by improving collection of information, streamlining the movement of cases, and reducing the DNA backlog by 90%.

The Criminalistics Unit made improvements to the workflow by introducing a shorter schedule with dedicated days for certain tasks, and standardized worksheets for examination of common items. As of June 2015, the average analyst turn-around time (TAT) decreased 85%.

The DNA Unit implemented a dramatically shorter two week schedule, which introduced standardized work practices, specific daily tasks, and increased supervisor involvement. As of June 2015, the average case TAT

decreased 56%, and the average analyst TAT decreased by 87%. Case productivity increased an average of 33% despite transitioning 3 analysts to other duties within the unit.

The LSS process helped the MSPCL focus on teamwork and removing redundant work. Despite several challenges along the way, this has resulted in significant improvements to the Forensic Biology section.

"Validation of a High Throughput Forensic DNA Analysis Pipeline: Use of the Promega Powerplex 21 and Powerplex Fusion Systems with the Hamilton MicrolabSTAR Liquid Handling Platform," Danielle Lindgren B.S.*, Anna Moss B.S., Victoria Czabafy, Michael Marciano M.S., Syracuse University

The need for high throughput analyses in Forensic DNA laboratories can be addressed through the combination of the Hamilton MicrolabSTAR, a multifaceted liquid handling workstation; the Promega Powerplex Hamilton Setup software, version 4.3.0 and Promega's Powerplex 21 and Powerplex Fusion Human DNA amplification systems. This validation study evaluates the use of this high throughput analysis system through five studies: (1) reproducibility, evaluating the system's consistency across instrument runs; (2) cross contamination, ensuring the Hamilton MicrolabSTAR will accurately and precisely dispense and aspirate the appropriate reagents and samples in the user identified wells; (3) sensitivity, identifying the systems of the limit of detection; (4) accuracy and precision, confirming the consistent performance of the Hamilton-mediated PCR preparation procedure and (5) dilution and normalization, demonstrating the reliability of the Hamilton and Promega's software interface to provide accurate pre-amplification sample normalization. The Promega Corporation's proprietary software permits a seamless and user friendly interface with the Hamilton instrumentation. In addition, the system will provide high precision and accuracy with minimal variability between replicate runs. It will enable an effective workflow through a reliable software interface and robust instrumentation to produce reliable assays allowing increased efficiencies in forensic DNA analysis.

"The Effect of PCR Inhibitors on DNA Mixture Interpretation," Ashia G. Eckroth, BS*, Lawrence Quarino, PhD, Cedar Crest College, Forensic Science Program, 100 College Drive, Allentown, PA 18104

After attending this presentation, attendees will understand how PCR inhibitors affect the interpretation of two-component DNA mixtures of (1) low and recommended concentrations of starting template DNA and (2) varying mixture ratios.

This presentation will impact both the forensic science and legal community by providing evidence of how different PCR inhibitors alter the interpretation of DNA mixtures. The study also offers the potential to determine the concentration range that each inhibitor begins to alter DNA mixture interpretation.

Current research into the mechanism of PCR inhibitors has been extensively studied; however, how they affect deconvolution and statistical interpretation of DNA mixtures is not well understood. This is likely important in cases where a DNA mixture is suspected but results are consistent with a single DNA source or where low-template DNA samples show stochastic fluctuations. Therefore, the goal of this research is to determine the impact that PCR inhibitors may have on DNA mixtures.

In this study, two female individuals have provided buccal swabs that were used to extract and quantitate their DNA separately. The mixture resulted in loci with either three alleles (one shared allele at six loci; a heterozygote mixed with a homozygote at seven loci) or four alleles (no shared alleles at two loci). A total of 47 different alleles encompass the two-component mixture. Based on the quantitation results, two-component mixtures were made of varying mixture ratios of 1:9, 3:7, 5:5, 7:3 and 9:1 with starting template DNA quantities of 0.5ng and 0.06ng. Using the Promega Powerplex® 16 HS Kit, 15 autosomal loci were amplified in duplicate according to manufacturer specifications with no inhibitors present to provide a baseline. Genotyping results showed that with no inhibitor present, all mixture ratios showed the expected results of the two-component mixture ratio. The same mixture ratios were then amplified with PCR inhibitors hematin, calcium hydrogen phosphate, and indigo carmine. The concentration in the PCR reaction mix of calcium hydrogen phosphate and indigo carmine were 0.01uM and hematin was 0.1uM.

The results indicate that at 0.5ng of starting template DNA, inhibition was negligible for all mixture ratios with all three inhibitors. Only one allele from the minor component of the 1:9 ratio could not be detected. There was also no change in the ability to deconvolute a mixture due to the presence of an inhibitor at this concentration.

Inhibition was more significant at 0.06ng of starting template DNA. With no inhibitors, total alleles detected ranged from 30 (9:1) to 43 (5:5). With the exception of the 1:9 and 9:1 ratios, alleles not detected were from both the major and minor component of the mixtures. Those lost in the 1:9 and 9:1 were predominantly from the minor component. Indigo carmine and calcium hydrogen phosphate provided the most inhibition. PCR reactions incubated with indigo carmine produced a low of 7 alleles (1:9) and a high of 28 alleles (3:7, 5:5, and 7:3) detected. Similarly, calcium hydrogen phosphate produced total alleles detected ranging from 11 (1:9) to 29 (7:3 and 9:1). Alleles lost with these two inhibitors came approximately equal from both the major and minor components and varied across mixture proportions. Conversely, samples incubated with hematin produced little change from samples with no inhibitor. This is somewhat perplexing given that that both calcium hydrogen phosphate and hematin inhibit PCR by the same mechanism (they are both Taq polymerase inhibitors). Given the results of both the indigo carmine and the calcium hydrogen phosphate tested samples, it appears that PCR inhibitors can have a non-predictable effect on mixture interpretation and consequentially statistical analysis.

"STR genotyping of human DNA in soil beneath a decomposing body as a way of estimating time of body deposition," Heidi Campbell, B.S.*, Lawrence Quarino, PhD, Cedar Crest College, Forensic Science Program, 100 College Drive, Allentown, PA 18104

This study was designed to determine if human DNA can be detected in the soil beneath a decomposing body and whether the concentration and/or genotyping result quality can estimate the amount of time the body has been on the surface. This may help determine post-mortem movement of a body and perhaps help with time of death. Analyzed samples were obtained from soil beneath decomposing human bodies located at the University of Tennessee Forensic Anthropology Center. Samples were extracted utilizing a PowerSoil® DNA Isolation kit, spiked with bovine serum albumin before amplification, and genotyped using the Promega PowerPlex®S5 system. The PowerPlex®S5 kit allows for detection of five loci, including D8S1179, D18S51, Amelogenin, FGA and TH01. This kit was chosen because the loci detected are classified as mini-short tandem repeats, meaning these loci have a very small segment of repeating units that theoretically, should not degrade as rapidly over time. Results indicate that human DNA can be found and genotype profiles obtained up to four months after the bodies have exposed and allowed to decompose naturally. Overall, relative fluorescence unit (RFU) values and peak height decrease over

time. Approximately two weeks after placement, the peak heights spike once as the body decomposes, and then subside over time. Additionally, as time increases, other peaks appear that are likely attributed to microorganisms. Also, some allele peaks disappear over time. Discussion will center on overcoming PCR inhibition problems due to humic acid, DNA degradation problems due to microbial activity, and the importance of RFU values from genotyping results over time.

"Three Person Mixtures: Do They React as Expected?," Samantha Bender*, Binghamton University

This study is the initial step in developing guidelines for determining major and minor profiles in three person mixtures. The purpose of this study is to explore the reactivity of three person mixtures through peak height ratio imbalanced. Eight known DNA samples were extracted and three separate sets of three person mixtures were generated of different proportions of major, medium and minor donors. Resulting peak heights were compared to expected allele ratios. Loci containing allelic dropout and/or sister peak heigh ratios of less than 70% similarity were considered imbalanced. There were a total of 92 imbalanced out of 1200 total loci, a rate of 7.6%. As major donor ratios increased (i.e. 6:6:1) more imbalanced loci were observed. As locus size increases, there is an increase in the number of imbalanced loci. Increasing the number of alleles at a given locus decreases the occurrence of balanced peak height ratios.

"New Core CODIS Loci: HID Professional Services (HPS) Tips and Tricks for validations of the GlobalFiler™ Kit," Joanne B. Sgueglia, B.A., D-ABC*, Jennifer L. Elliott, B.S., ThermoFisher Scientific, 7335 Executive Way, Frederick, MD, 21704

This presentation will detail the benefits of the new CODIS core loci using the GlobalFiler Kit, including the transition to 6-dye chemistry and familiarization with the 3500 series instruments. The setting of analytical and stochastic thresholds on the 3500 instruments will be discussed with emphasis on how the dynamic range, increased signal, and pull-up artifacts may affect thresholds. An evaluation of increased sensitivity with the GlobalFiler™ Kit on the 3500 series instruments will be addressed. HPS 'magic tools' for data analysis and the generation of charts and graphs as part of report deliverables will be demonstrated. Information on how HPS services can help your laboratory with validation of emerging methodologies and technologies for future manual and robotic workflows will be presented.

"DNA transfer from spermatozoa and vaginal secretions during a machine wash may yield complete genetic profiles," Sarah Noel, Ph.D.*, Laboratoire de sciences judiciaires et de médecine légale (LSJML), Montreal

In cases of child sexual abuse, the alleged perpetrator is often a member of the nuclear family. In those intra-familial cases, the possibility that the suspect's DNA was innocently deposited onto the child's clothing without acts of sexual assault ever occurring, especially via secondary transfer within the washing machine, must also be considered. To assess the quantity and quality of DNA that may be transferred among the items of clothing during laundering, three series of experiments were conducted. First, we measured the level of spermatozoa transfer that occurs during laundering by washing pristine pairs of underwear with stained bed sheets containing a varying numbers of ejaculates. Secondly, we explored whether current genetic methods may detect the transfer of DNA

from vaginal secretions after a wash. Finally, our study included the analysis of background levels of DNA on children's underwear collected from control families, where no sexual abuse ever occurred.

For both spermatozoa and vaginal secretions, the results showed that sufficient amounts of DNA may transfer onto the clothing it is laundered with to yield complete genetic profiles. Analysis of children's underwear from control families revealed that small quantities of DNA from relatives living within the same household (i.e. father, mother and/or sibling) were commonly found on the underwear as well.

These findings have strong implications towards the interpretation of DNA results within cases of intra-familial sexual abuse, especially where presumptive tests are negative and only minute amounts of male DNA are found on pieces of clothing. In cases like these, the possibility that this DNA was innocently deposited onto the victim's clothing during laundering must definitely be considered.

"An introduction to probabilistic genotyping with STRmix™," John Buckleton*, ESR

Analysis of DNA mixtures especially low template (LT) mixtures or challenging mixtures including numerous contributors has become a large bottleneck in DNA analysis for labs worldwide.
Traditional mixture interpretation and related statistical best practices are being stretched to their natural limit by the exploding demand on the DNA forensic community.

In response to this heightened demand for novel analytical tools several software packages have emerged to increase options for DNA analysts to more confidently, accurately, and efficiently resolve increased volume of difficult DNA mixtures.

STRmix™ uses a fully continuous probabilistic approach to DNA analysis with powerful deconvolution features using number of contributors, degradation, amount of template, stutter, replicates, etc., called weights and uses these weights to calculate a Likelihood Ratio to resolve even the most difficult mixtures including accounting for traditional low template stochastic effects including heterozygote peak imbalance, allele drop-out, drop-in, and increased stutter products.

The weights are calculated using Markov chain Monte Carlo (MCMC) mathematics using a laboratory's own modeled data from their own instruments and kits. Laboratories can easily import any number of population frequencies, and load and search samples and profiles against any number of databases, or any size.

STRmix is the Australasian standard for DNA interpretation and is installed in over 20 forensic labs internationally including City, County, State and Federal laboratories and has been validated and in daily use at many laboratories.

Attendees will learn how STRmix™ has dramatically increased efficiency in DNA analysis, interpretation, documentation, and reporting while increasing the number of cases that can be confidently, accurately, resolved in labs worldwide.

"The very latest questions and answers on automated DNA analysis tools," Vic Meles*, Vice President Operations, Nichevision Forensics, LLC

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However, the speed and complexity at which the new DNA tools are evolving is simply too much for many laboratories who are trying to make well informed decisions about new technology while still fighting the challenges of day-to-day forensic DNA casework.

This presentation will address the most common questions forensic scientists are asking with regard to type of systems available (Binary, Probabilistic, Semi-continuous, Fully- continuous) the advantages and disadvantages of each, current trends in the forensic community, etc.) and specific detailed examples of various technologies and how each would immediately impact daily casework.

Attendees will be armed with specific, relevant, and easily understood information which will allow them to make fully informed decisions on what technologies may be most appropriate in their individual circumstances.

"Advanced DNA analysis tool for forensic casework," Vic Meles*, Vice President Operations, Nichevision Forensics, LLC

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ArmedXpert™ is a full DNA analysis case management tool with powerful deconvolution features using binary and semi-continuous approaches to DNA profile interpretation that empower analysts to resolve even the most difficult mixtures including accounting for traditional low template stochastic effects including heterozygote peak imbalance, allele drop-out, and increased stutter products.

The software allows each laboratory to consider using validated thresholds (Analytical, Stochastic, Peak Height percentage) or exclude thresholds as filters to determine potential genotypes in the evidence. Laboratories can

easily import any number of population frequencies, and load and search samples and profiles against any number of databases, or any size.

Armedxpert™ is installed in over 50 forensic labs internationally including City, County, State and Federal laboratories and has been validated and in daily use at many laboratories.

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"The enhanced sensitivity of the Applied Biosystems 3500 Genetic Analyzer and its utility in forensic DNA analysis," Stephanie Minero, M.S.*, Nassau County Office of the Medical Examiner, Division of Forensic Services

In New York State, approximately 89% of reported felonies are classified as property crimes, which include burglary, robbery, larceny, and auto theft. These crimes involve brief interactions with the suspect which results in a significantly less amount of DNA available for forensic short tandem repeat (STR) analysis. In the instrumental validation performed here, experimentation was completed to assess the potential enhanced sensitivity and capabilities of the Applied Biosystems 3500 Genetic Analyzer as compared to its predecessor, the 3130 Genetic Analyzer. Experiments performed included assessments of sensitivity, accuracy and precision, peak amplitude threshold, minimum interpretation threshold, National Institute of Standards and Technology (NIST) compliance, heterozygote peak imbalance, increased injection time, mixture samples, and non-probative casework samples using the AmpFISTR® Identifiler Plus® Kit. Through experimentation, a target DNA template concentration range of 1ng-0.062ng and analytical thresholds of 100RFU (amplitude) and 270RFU (interpretation) were established to provide reliable and accurate data interpretation. In addition, the results of each study were compared to manufacturer validation data as well as previous analyses using the 3130 Genetic Analyzer. As a result of these independent assessments, additional alleles were detected in low concentrations and non-probative casework samples. This suggests the 3500 Genetic Analyzer is more sensitive and may provide additional genotypic information than the 3130 Genetic Analyzer, which can result in more suspect inclusions or exclusions. Thus, the 3500 Genetic Analyzer has the potential to become invaluable in a field where low-level and mixture samples have become routine.

"Determining Detection Intervals for Seminal Fluid Markers and Exogenous Male DNA from Mock Post-Coital Samples," Masha Signeaevsky*, Catherine Brown, Arcadia University, 450 South Easton Road, Glenside, PA 19038

Sexual Assault backlog continues to grow due to cost, throughput and the result of unreliable or cumbersome screening techniques. Developing a true confirmatory method that is inexpensive and dependable is the change that the forensic science community needs to reduce the backlog of untested rape kits.

Biological fluids contain unique protein biomarkers that can be used to identify the fluid in question. For sexual assault screening, detection of these protein markers will indicate whether or not a sample contains a male component and will determine the necessity for DNA evaluation. Seminal fluid is no exception and can be

characterized based on the detection of Semenogelins 1 and 2, Prostatic Acid Phosphatase and Prostate Specific Antigent.

Historically, screening techniques include ABAcard® p30, Rapid Stain Identification of Human Semen and Microscopy, all of which can be cumbersome and can often show false positive results. This can be eliminated with the developed method. After confirmation of a seminal fluid marker, the sample is further tested for the presence of Male Short Tandem Repeats (Y-STRs). The DNA present can be compared to a known DNA sample from the suspect. Furthermore, the developed method will establish a post-coital interval which currently ranges from 8 to 72 hours, but can potentially allow for an even greater stretch of time, during which evidence can be collected from the victim. This new method is a significant step toward reducing the number of untested sexual assault kits across the nation and will considerably benefit the forensic science community.

"Transcription Factors and mRNA Increase for DNA Quantification," Katherine Ferrari*, Chelsea Thompson, Western New England University

Mast cells are consistently present in various allergic pathways, and play a critical role in the production of IL-13, IL-6 and TNF-alpha after activation through binding of IgE and it's high affinity receptor, Fc RI. Trichostatin A (TSA), an antifungal antibiotic was utilized to observe cytokine proliferation. This histone deacetylase inhibitor is known to interfere with the transcription process through altering the access of DNA. Transcription factors were noted to significantly increase the relative mRNA expression of IL-13, IL-6 and TNF-alpha after mast cell stimulation as compared to the unstimulated control group. With the DNA access interference and an increase in mRNA expression, the resulting data can aid in the understanding of metabolic pathways used to forensically identify suspects. If transcription factors increase through mast cell stimulation, cells found throughout a criminal investigation can be replicated and analyzed through genetic processes to more accurately predict the suspect. This can be utilized throughout the forensic field to enhance DNA quantification and lead to improvements in genomic research.

"Novel bioaffinity-based method for analysis of fingerprints and sweat samples," Crystal Huynh*, Erica Brunelle, Lenka Halámkova, Juliana Agudelo, Jan Halamek, SUNY Albany

The analysis of fingerprint and sweat samples is common in forensic science, but this area of study has become developmentally stagnated over the years. Fingerprint analysis still focuses only on the pictorial comparison of fingerprint images, while useful for identification purposes in particular situation, does not always result in a successful match. The analysis of the chemical composition of the fingerprint samples can then prove to be very useful to the investigation. Sweat, on the other hand, is often overlooked in the process of evidence collection and a method of detection is necessary.

The research presented here addresses the current limitations in fingerprint analysis by using a bioassay system that focuses on the components of fingerprints. A bioaffinity-driven cascade assay has been developed for the determination of gender from those components. A statistical analysis was first performed on 50 mimicked samples to determine the feasibility of this method. Further analysis was then performed on real fingerprint samples collected from volunteers. A different cascade has also been developed for the detection of sweat on a crime scene.

The developed assay has the potential to become a portable method that can be used for on-site analysis. Also, due to the ease at which the assay can be performed and interpreted, specialized training for the execution of the analysis is unnecessary, unlike most currently available techniques. This type of fast, easily interpretable on-site analysis of body fluids will revolutionize the field of forensic science.

"Analysis of biomarkers via bioaffinity cascades for forensic applications," Jan Halamek*, SUNY Albany

Biomarker analysis is a long standing discipline in forensic science, for instance, the analysis of blood for the presence of various substances can be performed along with DNA for identification purposes. The forensic science field has developed rapidly over the years, however, the methods that are currently implemented still need improvement. Most of the modern and routinely used forensic science techniques require the collection of the sample at the crime scene, followed by transportation to a laboratory facility for its analysis. Crimes are usually committed in high volumes, thus, improvement to these analyses is highly needed. The backlog in the analysis of serology samples has been recognized and addressed by the NIJ, but major improvements are still required, as full-scale investigations can take weeks or even months.

This project addresses the backlog problem by introducing the use of bioaffinity-based assays for quick and easily interpretable on-site analyses of blood and fingerprint samples. These bio-affinity based enzyme cascades use substrates present in the samples to identify various traits of the sample originators such as age, gender, ethnicity, and general health conditions. The bio-affinity based cascades are also versatile, and provide the possibility of being adjusted for the analysis of a large variety of substrates for the discernment of different physical traits.

Furthermore, this methodology has the potential to enrich the forensic science field by improving and contributing to the analysis of a number of samples, including body fluids and fingerprints, using an on-site method of detection. This quick, on-site analysis technique does not require specialized laboratory, and was not established with the intention of competing with the traditional laboratory-based methods. The main purpose is to revolutionize the forensic science field by accelerating criminal investigations.

Toxicology Abstracts

"A Comprehensive 'All Ions' Screening Method with Simultaneous Fragment Confirmation of Opiates, Opioids, Benzodiazepines, Amphetamines and illicit Drugs by High Resolution Accurate Mass LCMS," Dr. Julie Ann Cichelli*, Agilent Technologies

Recently many forensic laboratories have become interested in the employment of a comprehensive high resolution, accurate mass screen for compounds of forensic interest with a simultaneous confirmation of fragment ions in a single MS run as an alternative to the traditional screen and confirm model. High resolution, accurate mass LCMS techniques have become increasing popular and accepted in the forensic community due to the ease of use, quality of data and results, along with efficiency. Employment of several figures of merit, including accurate mass, retention time, theoretical isotope modeling, in addition to a personal compound database library (PCDL) match, are key qualifying parameters to confirming the identification of an analyte.

"Field Evaluation of new EIA reagent for Buprenorphine & Norbuprenorphine," Paul V. White*, Preferred Laboratory

Thermo Fisher is in the process of developing a new Buprenorphine Assay (Enzyme Immunoassay) that can measure Buprenorphine and Norbuprenorphine along with the glucuronide conjugates of both Buprenorphine and Norbuprenorphine in human urine. The assay is intended for the qualitative and semi-quantitative detection of Buprenorphine and its metabolites in human urine at a cutoff of 10 ng/mL on clinical chemistry analyzers. Currently available commercially immunoassays either detect only Buprenorphine and Buprenorphine Glucuronide or detect only Buprenorphine and Norbuprenorphine while this new Buprenorphine Assay detects all. The objective of this study was to perform an initial field evaluation of the proof-of-concept homogenous enzyme immunoassay that can detect buprenorphine, norbuprenorphine, buprenorphine-glucuronide and norbuprenorphine-glucuronide, with minimal cross-reactivity to other opiate compounds and structurally unrelated compounds. The assay uses CEDIA® Technology, with lyophilized reagents and liquid ready-to-use calibrators and controls.

"ELISAs for the screening of a broad range of synthetic cathinones, including alpha-PVP (flakka) in different matrices," Nathan Jones*, Randox Toxicology Limited

Introduction. Synthetic cathinones (i.e."bath salts") are "new psychoactive substances," abused and available on a global scale. They produce amphetamine –or cocaine-like subjective effects by activating monoamine systems in the brain and periphery. High doses or chronic exposure to these substances can lead to dangerous medical consequences. Immunoassays are antibody-based tests that provide high throughput screening. This study reports three Enzyme-Linked Immunosorbent Assays (ELISAs) for the screening of mephedrone, methcathinone, methylenedioxypyrovalerone (MDPV) and desmethyl pyrovalerone (alpha-PVP, flakka) in different matrices. Methodology. Competitive immunoassays were employed. The capture antibodies were immobilized and stabilized on the surface of 96-well microtitre plates. The analyte, if present in the sample, competes with the horseradish

peroxidase labelled conjugate for antibody binding sites on the microtitre plate. The signal is inversely proportional to the concentration of drug in the sample. Results. One ELISA (standardized to mephedrone HCl) also detected other compounds with cross-reactivity (CR)(%) values ranging from 43 (methcathinone) to 79 (methedrone). The limits of detection (LODs) were 0.40 ng/mL (urine), 0.57 ng/mL (blood) and 0.90 ng/mL (oral fluid). A second ELISA (standardized to MDPV) also detected naphyrone and 3',4'-methylenedioxy-□-pyrrolidinobutiophenone (MDPBP) with CR (%) values of 27 and 96 respectively. LODs: 20 ng/mL (urine, blood). A third ELISA (standardized to alpha-PVP) also detected other compounds with CR(%) ranging from 23.2 (4'methyl-□-pyrrolidinobutiophenone, MPBP) to 125.4 (pyrovalerone). LODs: 3.1 ng/mL (urine) and 1.8 ng/mL (blood).

Conclusion. The results indicate applicability of these ELISAs to the screening of mephedrone, methcathinone, MDPV, alpha-PVP and other related compounds in different matrices.

"*Variations on a theme: The detection of NBOMe designer drugs on blotter paper by high resolution time-of-flight mass spectrometry (TOFMS) with and without chromatography," David Barajas*, Boston University School of Medicine, Biomedical Forensic Sciences

Novel Psychoactive Substances (NPS) have been associated with the cause of death in a number of cases in the United States and have led investigators to rethink traditional drug monitoring protocols. Of particular interest to this investigation are the variable phenethylamine chemical structures known as NBOMes', which pose an emerging threat to public health with incidence steadily growing over the past decade. In the culture of abuse, NBOMes are commonly applied to blotter paper and administered sublingually to induce episodes of hallucinations (similar but more potent effects when compared to LSD). This study considers two approaches for screening confiscated blotter paper to determine the presence of NBOMes using high resolution mass spectrometry in forensic case studies. The first approach is an extraction prior to UPLC-ESI-TOFMS. The second is DSA-TOFMS, a direct measurement using ambient ionization mass spectrometry without chromatographic separation. The key advantage of the second approach would reduce the analysis time per sample from minutes to seconds. Additional value added considerations in the reduction of consumable cost and solvent waste should also be noted. Samples were prepared at Boston University-School of Medicine Department of Biomedical Forensic Sciences (Boston, MA). These samples were analyzed at PerkinElmer's Tech Center (Oakbrook, IL). Feasibility of both approaches will be presented.

"*Investigation into the Use of BioSPME for the Analysis of Illicit Substances in Urine," Kaitlyn E. Hess*, Cedar Crest College

LC-MS/MS is commonly used by forensic toxicologists for the detection of drug analytes in biofluids. Applications of SPME as a simple extraction procedure for drugs in biological fluids prior to LC-MS/MS have been reported. A new, BioSPME fiber has been engineered and has been investigated for the extraction of drug analytes from urine. The BioSPME fiber is stationed within a pipet tippet and is functional in a 96-well format. Each fiber is coated with either mixed mode hydrophobic and cation exchange, or C-18 (reversed-phase) stationary phase to extract drug analytes of interest. The fiber is directly placed into a biological fluid (urine) for extraction, desorbed into solution, dried, and reconstituted for analysis by LC-MS/MS. This method utilized an ABI Sciex 3200 QTRAP triple quadrupole mass spectrometer interfaced with a Shimadzu LC system. Extracted samples are run in positive-ionization mode using electrospray ionization (ESI). Chromatography was performed using an Ultra C18 column

(50 x 2.1mm, 3um) (Restek®, Bellefonte, PA). The strong mobile phase was 0.1% (v/v) formic acid in water and the weak mobile phase was 0.1% (v/v) formic acid in acetonitrile. Twelve drugs from different classes including morphine, methamphetamine, cocaine, nordiazepam, and methylone were studied for their extraction efficiency from urine using LC-MS/MS. This method eliminates lengthy extraction procedures typically used for biological matrices and can be used to simultaneously detect multiple substances from a biological matrix.

"*Validation of Neogen's Three Synthetic Cannabinoid ELISA Assays for screening Urine Samples for DUI Cases," Nick Laraia*, Scranton University - Intern project with NJSP Office of Forensic Sciences

Three synthetic cannabinoid ELISA kits currently available from Neogen; UR-144/XLR-11, JWH-250, and SPICE (JWH-018) were purchased from Neogen for validation at the NJSP Office of Forensic Sciences. These ELISA assays screen for synthetic cannabinoids (SYN CAN's) and metabolites in blood, serum, and urine. The OFS intends to use these kits primarily for screening urine samples. The kits have cross-reactivity with other SYN CAN's and would be used to screen a significant number of the SYN CAN's being abused. Drug reference materials were verified on GC/MSD by full scan prior to use. Interday/Intraday precision tests were performed using each kits target drug, and each kits sensitivity and specificity was verified with at least five SYN CANs. The validation was performed using a DYNEX automated liquid sampler (ALS) at the NJSP Office of Forensic Sciences - Central Regional Laboratory.

"*The Development of a Solid Phase THC Extraction Method from Whole Blood," Alexander Blanchette*, Western New England University

Delta-9-THC (THC) is a CNS depressant that is the major psychoactive component responsible for the "high" associated with smoking or ingesting marijuana. THC is metabolized to various forms including the major active metabolite 11-hydroxy-THC (THC-OH) which is further oxidized to an inactive carboxy form, 11-nor-9-carboxy-THC (THC-COOH). The detection of delta-9-THC and its metabolites in blood and other body fluids is indicative of recent marijuana use. Specifically, this research resulted in the development of a solid phase extraction method for THC and THC-COOH from whole blood. The success of the THC/THC-COOH SPE method was found to be contingent upon experimental conditions including: the type of glassware used; the solvents and solvent ratios employed; the quality of the standards; and multiple other factors. This presentation will focus primarily on the troubleshooting involved in the development of this successful THC/THC-COOH SPE method.

Trace Abstracts

"Chemometric Approaches in Forensic Mass Spectrometry," Matthew J. Pavlovich* and Adam B. Hall, Northeastern University.

Mass spectrometry is a widely used technique in forensic chemistry with applications in the analysis of drugs and drug metabolites, explosives, and ignitable liquids, among others. Forensic mass spectra are often complex and contain information about a large number of chemical species, particularly if they are created with ambient ionization techniques such as direct analysis in real time (DART). With these techniques, the lack of a chromatographic separation step decreases the analysis time and the complexity of the experimental method at the cost of producing spectra that are more difficult to interpret. Therefore, chemometric methods are often applied to draw quantitative, practical conclusions from such mass spectra.

The first part of this talk gives an overview of chemometrics as applied to forensic mass spectrometry. Several classes of problems are described where chemometric approaches are useful for analyzing chemical data, including positive/negative identification, classification, similarity analysis, and quantification problems. Specific chemometric techniques are briefly summarized, including both "supervised" and "unsupervised" approaches, although a full mathematical treatment of these algorithms is beyond the scope of this talk. Additionally, chemometric results are presented from recent publications that focused on mass spectrometry in the forensics, health, and security fields.

In the second part of the talk, chemometrics are applied to a specific area of forensic interest, improvised explosives. One emerging method of creating improvised explosives is to mix concentrated hydrogen peroxide or another oxidizer with spices, which act as finely divided, high-surface-area organic fuels. Forensic analysis of the concentrated hydrogen peroxide is difficult because hydrogen peroxide decomposes quickly (its half-life is on the order of tens of hours when exposed to sunlight at ambient conditions) and the presence of hydrogen peroxide may not be specific to an improvised explosive. However, analyzing the spices used as fuels can yield more useful information in an evidentiary context, including the biological nature, age, and origin of the spices.

DART-MS was used to analyze common powdered spices including cinnamon, black pepper, cumin, and turmeric. An optimal DART analytical method was developed by varying the extraction technique, source temperature, and detector polarity to achieve the greatest signal intensity with known spice compositions. Then, DART mass spectra were acquired for spices of different ages and brands. Finally, various chemometric models were constructed with commercial software to differentiate the mass spectra based on the type of spice and to determine if the model could identify other factors such as age or brand. A comparison of the models, including training, cross-validation, and blind testing errors, is presented. The talk concludes with a discussion of which characteristics of the spices could be successfully distinguished based on the developed models and the relevance of the models to forensic chemistry.

"Non-Chromatographic and Chemometric Approaches for the Analysis of Forensically Relevant Samples," Adam B. Hall*[1], Matthew Pavlovich[1], Ashley Davis[2], Fred Li[2], Drew Horsley[2], Joseph LaPointe[3] and

Brian D. Musselman[3]. [1]Northeastern University, Boston, MA; [2]Boston University School of Medicine, Boston, MA; [3]IonSense, Inc., Saugus, MA

Current methods for the extraction and analysis of ignitable liquids, smokeless powders and drugs of abuse suffer from lengthy chromatographic separations prior to MS analysis. In an effort to decrease case submission to reporting turnaround times, we have evaluated higher throughput methods for use by the forensic science community. DART ionization prior to mass spectral detection has been utilized for the evaluation of chemical attribute signatures generated from forensically relevant samples. These signatures were then interrogated utilizing chemometric approaches in an effort to further classify and determine whether or not two samples could have originated from a common source.

For several applications we demonstrate the use of statistical analysis models that can discriminate analyzed samples in a fraction of the time in comparison to traditional chromatographic methods. In order to evaluate the robustness of such an approach for use in forensic casework, predictive models were constructed using machine-learning techniques and evaluated for their performance in classifying forensically relevant samples. The models generated were able to accurately predict the presence or absence of targeted analytes with error rates between 0 - 4%. Predictive classification models were developed using a combination of pre-processing steps, cluster analysis and machine-learning techniques.

Predictive modeling has advantages over current mass spectral libraries, which are limited to the identification of pure compounds. The ability to employ chemometric approaches for the analysis of the generated data demonstrates an attractive and viable alternative to conventional techniques for ignitable liquids, smokeless powders and adulterated drugs of abuse in forensic casework.

"Direct Thermal Extraction of Volatiles from Black Electrical Tapes," Emily E. Prisaznik, B.S.* and Thomas A. Brettell, Ph.D., F-ABC, Forensic Science Program, Cedar Crest College, Allentown, PA 18104

Black polyvinyl chloride (PVC) electrical tape is often used in the construction of improvised explosive devices (IEDs) as a means of securing its components. Consequently, black electrical tape is often submitted as evidence to crime labs. IEDs often utilize PVC tape for sealing, insulating, or securing parts to the device; important information can be gained from analysis of the components of IEDs, either intact or fragmented. New alternative methods to compare and differentiate black electrical tapes are needed. Direct thermal extraction gas chromatography/mass spectrometry (DTE-GC/MS) was investigated as a method to differentiate black electrical tape. DTE-GC/MS is a thermal desorption method used to extract volatiles from the electrical tape onto a gas chromatographic column for analysis by mass spectrometry. This thermal extraction technique is a dynamic process that can be used to analyze both solid and liquid samples. Under a continuous flow of inert gas and heat, volatile and semi-volatile organics are extracted from the sample matrix into the gas stream and transferred to the vapor phase and then onto the carrier gas of a gas chromatograph (2). DTE-GC/MS was used to examine and evaluate the potential to differentiate several PVC tape samples from the National Forensic Tape File (NFTF) maintained by the Federal Bureau of Investigations (FBI).

1. Scientific Working Group for Materials Analysis. SWGMAT Tape Group Survey. Spring 2012. http://swgmat.org/tape%20survey%20presentation%20for%20website.pdf (03May2015).
2. Bart JC. Polymer/Additive analysis by thermal methods. Plastics additives: advanced industrial analysis. Amsterdam: ProQuest ebrary. 2006, 155-324.

"The Determination of Preservatives in Cosmetic Foundation by Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS)," Emily A. Myers, B.S.*, Thomas H. Pritchett, M.S., and Thomas A. Brettell, Ph.D., F-ABC, Forensic Science Program, Department of Chemistry and Physical Sciences, Cedar Crest College, 100 College Drive, Allentown, PA 18104

A LC-MS/MS method has been developed which identifies and quantifies multiple preservatives in cosmetic foundations. LC-MS/MS data was acquired using an ABI Sciex 3200 QTRAP triple quadrupole mass spectrometer interfaced with a Shimadzu LC system. The instrument utilized electrospray ionization (ESI) and all samples were run in positive-ion mode monitoring. Chromatography was performed on a 5.0 cm x 3.0 mm x 2.7 μm Raptor® biphenyl capillary column (Restek®). The strong mobile phase used was 0.1% (v/v) formic acid in 2-propanol and the weak mobile phase used was 0.1% (v/v) formic acid in HPLC grade methanol.

Twenty-six different cosmetic foundation brands were prepared by adding 100 mg to 5 mL of methanol:acetonitrile (1:1, v/v) and sonicated for 10 minutes. Each individual cosmetic solution was then placed into a micro-centrifuge tube and centrifuged for 5 minutes at 800 G. After centrifugation the supernatant was carefully removed, filtered using 0.2 μm Millipore filters, and 1 mL of the filtered supernatant was added to an autosampler vial along with 60 μL of the internal standard (BHA). Lastly, 2.0 μL of sample was injected onto the LC column.

Separating and identifying six parabens as well as other preservatives proved to be simple and quick. The method is capable of identifying which preservatives are present in a cosmetic sample with a limit of detection of 0.5 μg/mL. Cosmetic foundations analyzed were differentiated by analysis of the preservatives in the samples using the LC-MS/MS method. This method can be used in a forensic setting to compare and differentiate evidential cosmetic samples.

"Making the right choice for improved assay results- How tips, tubes and plates can affect your experiments," Kayla Hager-Wilson*, Lars Borrman, Matt Leiber, Rafal Grzeskowiak, Daniel Wehrhahn, and Natascha Weiss; Eppendorf North America

Leachates are an important part of everyday life in the home and in the lab. It has been known for several years that chemicals (e.g., Bisphenol A and phlalates) can leach out of the plastic, such as toys and baby bottles. The impact of these chemicals on human health is well known. Recent scientific reports have now noted that chemicals used in the manufacturing of disposable plastic labware, such as slip agents or plasticizers, can leach out of the plastic and affect laboratory experiments leading to erroneous results. This presentation will discuss the current scientific findings on leaching and the impact they can have on lab experiments. In addition, benchmarking data from several different tubes available on the market will be shown to support the scientific findings. Eppendorf has eliminated the use of several common additives during the manufacturing of their tubes, tips, and plates, to minimize the impact on scientific assays.

"The Effect of Walking On the Evidentiary Value of Soil Taken From Footwear," Heather Moody* and Dr. Quarino; Forensic Science Program, Department of Chemistry and Physical Sciences, Cedar Crest College, 100 College Drive, Allentown, PA 18104

This study examines this question of whether the particle size distribution of soil in footwear is altered while walking or running on an asphalt surface as a function of distance.

Soil was collected from along a tree line, mixed, and homogenized. Particle size distribution was performed on five samples of the soil using a previously published method (1). Cumulative weight graphs were generated from size fractions weighed at sieves with mesh sizes measuring 2000 μm, 500 μm, 250 μm, 125 μm, and 63 μm. Results served as the zero mile trial, representative of the point of origin or site of casting. Soil from the same sample was moistened and applied to the grooves of sneakers (by stepping into the soil) from four volunteers weighing 110, 130,160 and 200 pounds respectively and collected after each of five trials at four walked distances (0.5, 1, 1.5, and 2 miles) and two ran distances (0.5 and 1 mile) on dry asphalt. The same type of sneaker was worn by all volunteers. After each trial, soil remaining on the treads of the sneakers was collected from four regions: right heel, right toe, left heel, and left toe and approximately 1.2 g of the soil was analyzed using the particle size distribution method and compared against the zero mile trial. Mean cumulative weight graphs were converted to semi-log graphs from soil collected from each region of the sneaker from both volunteers at each distance and compared to mean semi-log graphs generated from the zero mile trial. The Kolmogorov-Smirnov test, a non-parametric statistical test, was used at the 95% confidence interval to determine differences between the semi-log graphs from the zero mile samples and the distance trials. This test showed that all twenty of the 0.5 mile walking trials, eighteen out of twenty 1 mile walking trials, nine out of ten 1.5 mile walking trials, ten out of ten 0.5 mile running trials, and ten out ten 1 mile running trials were indistinguishable from the zero mile samples. Of the two differing 1 mile trials, only one region out of eight was found to be indistinguishable from the zero mile samples. Of the single differing 1.5 mile trial, one-half of the regions were found to be indistinguishable from the zero mile samples. The 1.5 mile walking trials for the volunteers weighing 160 and 200 pounds and the 2 mile trials for all volunteers did not yield enough soil for analysis.

Although several other parameters are being examined (volunteers of different weights, running, different surfaces), results of the present study show that false exclusions are not likely to occur when comparing soil from footwear from a point source after walking up to a distance of 1.5 miles.

1. Johnson WH. Soil Particle Size Analysis. UNLV Health Physics Program Laboratory Operating Procedure. 1996:1-16.

"UPDATE FROM OSAC SUBCOMMITTEES: Materials, Fire Debris/Explosives, Gunshot Residue and Geological Materials," Vincent Desiderio*, Susan Gross, Diana Wright, Cheryl Lozen, Michael Martinez, and William Schneck

The Organization of Scientific Area Committees (OSAC) Chemistry and Instrumental Analysis Specialty Area Committee (SAC) oversees the work of the Toxicology, Seized Drugs, Materials, Fire Debris/Explosives, Gunshot Residue (GSR), and Geological Materials subcommittees. Each of these groups is currently working on the development or revision of standards and guidelines related to the examination and interpretation of their respective forms of physical evidence. Specific task groups have been established within each subcommittee to address several of the key issues facing the forensic community including but not limited to document development, interpretation and reporting of results, training, outreach, quality assurance, research, and terminology.

This presentation will provide an overview of the OSAC structure and update the audience as to the progress of the Chemistry/Instrumental Analysis SAC with an emphasis on the trace evidence related subcommittees (Materials, Fire Debris/Explosives, GSR, and Geological Materials). To this end, the progress of the various task groups will be discussed and an overview of the documents currently under consideration will be provided.

"Infrared Analysis and Microanalysis of Forensic Evidence," Fred Morris* and Thomas J. Tague Jr., Ph.D.
Bruker Optics, Inc., 19 Fortune Drive, Billerica, MA 01821

Infrared spectroscopy and microspectroscopy have become important components of a complete forensic investigation. The highly specific nature of infrared chemical analysis greatly facilitates the identification of unknown compounds. Infrared microanalysis works great for drug and trace identification as well as identifying small unknown compounds. Optical microscopy can be an important compliment to the spectroscopic analysis. Optical analysis provides the physical properties of the samples in question, such as color, shape, morphology, etc. Contrast enhancement tools like visible polarizers and darkfield illumination are used to facilitate the visualization and characterization of fibers, multilayer laminates, paint chips, gun-shot residues, and other evidence.
After archival of the optical properties of the evidence, the infrared spectra are collected using in the appropriate transmission, reflection, or ATR mode of acquisition. Fibers are typically analyzed via transmission or ATR. Library searching of the resultant spectra yields rapid and accurate identification utilizing ATR synthetic and natural fiber reference libraries. Drugs and gun powders are analogously identified quickly and easily by ATR infrared spectroscopy.

"The Screening of Arson Accelerants by APCI-MS/MS and Flow Injection," Clare Fried* and Thomas H. Pritchett, M.S., Forensic Science Program, Cedar Crest College, Allentown, PA 18104

Every year in the United States, millions of dollars and thousands of businesses and private properties are lost due to intentionally set fires. The forensic fire debris field is a continuously shifting one, which presents constant challenges to those who are involved with the investigations. Arson investigations depend largely on quick detection and determination of accelerants.

An APCI-MS/MS method has been developed which has been used to screen common arson accelerants. A passive headspace sampling technique, along with activated charcoal strips, were used to collect samples. A carbon disulfide reagent was added to each strip once the headspace was collected. The carbon disulfide extract was injected into the MS/MS using a flow injection technique. The MS/MS, an ABI Sciex 3200 QTRAP triple quadrupole mass spectrometer, utilized an atmospheric pressure chemical ionization (APCI) source and positive-ion mode scanning. A Q1 scan and precursor scans were run for each accelerant sample. Prominent molecular ion peaks provided indications that each accelerant presented a different profile.

This method could potentially be used in forensic fire debris analysis to screen for accelerants. This method could shorten analysis time considerably. According to the ASTM Standard, GC-MS methods include a total run time of 25.0 minutes. This method cuts down run time to less than three minutes, with no cool down time.

"Performance and Ricochet Characteristics of Frangible Ammunition," Peter Diaczuk*[1,2], Jack Hietpas[2], and Xiao Shan Law[1]. [1]John Jay College of Criminal Justice, CUNY; [2]D&H Criminalistics Agency

Frangible bullets are designed to minimize the dangers from ricochet by breaking up or fragmenting upon impact with hard unyielding substrates. The energy of these smaller post-impact fragments or powder is so minimal that they cannot travel very far from the initial impact site. To perform this way, these bullets are made of various formulations of powdered metals held together by compression, adhesives, resins or polymer materials. In contrast to the formulations that are bonded together, at least one manufacturer has developed a line of frangible ammunition that instead incorporates a jacket to encase a complex frangible core. Because of this novel design, the manufacturer claims that their bullets will also behave on soft organic targets as they behave on hard unyielding materials, i.e. by breaking up into small pieces.

Using high-speed photography, the impact dynamics of selected brands of frangible bullets are compared to each other and to traditional full metal jacketed bullets to determine their performance characteristics on common yielding and unyielding materials. Post-impact bullet or jacket fragments were recovered and examined microscopically to determine if stria from passage down the firearm's barrel were present and if so, were the stria useful for comparison purposes to determine common origin.

"A Comparison of Propellant Deposition by a Suppressed and Unsuppressed Firearm for the Purposes of Distance Determination," Peter Diaczuk*[1] and Lt. Sean Quinn[2]. [1]John Jay College of Criminal Justice, CUNY; [2]Glen Ridge Police Department, NJ

The discharge of a firearm can produce a pattern of unburned and partially burned propellant particles on target substrates relatively close to the muzzle. These patterns may be interpreted to determine a muzzle to target distance for the purposes of a shooting reconstruction. As the muzzle to target distance increases, the density of this propellant pattern decreases while its diameter increases. Eventually, the distance will exceed the ability of the propellant particles to overcome the resistance of air and they will succumb to the forces of gravity, never reaching the substrate. Factors commonly taken into account when assessing the propellant pattern include barrel length, propellant morphology, ambient air and environmental conditions, and type of substrate.

Suppressors can be attached to the muzzle of a firearm to reduce the sound of discharge by allowing the escaping gases to slow down before exiting. Slowing down the escaping gases has the concomitant effect of reducing the ability of propellant particles to travel to the substrate. This research compares the propellant patterns from a firearm with and without a suppressor to assess the muzzle to target distances. With the suppressor attached, propellant patterns were less dense than firing without the suppressor, keeping all the other conditions the same.

"Assessing the utility of automated image analysis for the characterization of small arms propellants," Jack Hietpas*[1], Peter Diaczuk[1], Alexandria Anstett[2] ; [1]D&H Criminalistics Agency; [2]NIST-Department of Homeland Security STEM summer intern

Pipe bombs are the most common improvised explosive device (IED) in the United States, with the majority containing small arms propellant (smokeless powder (SP) and black powder (BP)) as the main explosive charge (1). Thus there is a need to develop robust metrics for comparisons between exemplar and recovered explosive residues.

Smokeless powder micrometry (length and width measurements) has been shown to help reduce the number of possible manufactured brands, thus providing fast valuable investigative information1. We investigated the potential to use automated image analysis software to characterize small arms propellants. Approximately 50 samples of SP and BP were acquired. For each sample at least 100 kernels of powder were placed on transparent adhesive backings. Transmitted light was used to produce high-contrast "masks" of the individual kernels. Photomicrographs were captured at 10-30x magnification using stereomicroscopy. Open-source image analysis software was used to process the propellant kernel images, thus allowing thousands of particles to be quickly characterized. Canonical discriminant analysis was used to separate the sample classes. These classes were treated as a database of known standards. Next an independent set of kernels were processed (from the original stock propellant samples). These were treated as "unknown" samples. These "unknowns" were assigned to the class (database entry) that had the smallest Mahalanobis distance. Seven samples were incorrectly assigned to the specific database entry. However, two of these were simply assigned to replicate entries (same brand, different lot or distributor). In addition, two of the incorrect samples were assigned to database entries that have been reported to be the same propellant just sold under different brand names. The remaining three samples were true false positives. The results from this study show that there is potential for using automated image analysis for the characterization of small arms propellants. By using automated methods, the time required for particle measurements is dramatically reduced in comparison to manual methods.

1. Moorehead, W. Characterization of smokeless powders. In: Blackledge, RD, editor. Forensic Analysis on the Cutting Edge. Wiley-Interscience, 2007:241-268.

Criminalistics/Crime Scene Abstracts

"OSAC Bloodstain Pattern Analysis Subcommittee Report and Update," LeeAnn Singley*, Grayson Singley Associates, LLC

This presentation will report on the development of the Organization of Scientific Area Committees (OSAC) and particularly the work of the Bloodstain Pattern Analysis Subcommittee.
The OSAC was formed under the "umbrella" of the National Institute of Standards and Technology (NIST), in part, as a response to concerns presented in the National Academy of Sciences Report "Strengthening Forensic Sciences in the United States: A Path Forward". An open membership application process resulted in committee members being selected in the latter part of 2014. The first meetings of the subcommittees took place in Norman, Oklahoma in January of 2015.

Outcomes of the BPA subcommittee meeting along with on-going task group work will be discussed in this presentation. Future tasks and membership selection will also be discussed. Time will be set aside to answer audience questions and receive comments.

"Investigating The Use Of MicroRNAs For The Identification of Forensically Relevant Body Fluids," Kelsie R. Weir*, Department of Forensic Science, Henry Lee College of Criminal Justice and Forensic Science, University of New Haven; Claire L. Glynn, Ph.D., University of New Haven

MicroRNAs (miRNAs) are small non-coding single stranded RNA molecules, typically 19-25 nucleotides in length. Previously they were assumed to have no function and were referred to as 'Junk DNA'. However they are now known to be highly robust under chemical and physical conditions and they have also been shown to have high tissue specificity. Due to these qualities, it is proposed that miRNAs could be ideal for the identification of forensically relevant body fluids. The aim of this research was to investigate the ability to extract miRNAs from body fluids using multiple methods, and then to validate miRNAs previously identified to show specificity for particular body fluids using RQ-PCR.

Following informed consent, 5 body fluids were collected from 10 volunteers (n=50), including venous blood, menstrual blood, semen, saliva and vaginal secretions. Each sample was extracted using three different methods including; mirVana (Ambion), miRNeasy (Qiagen), and a modified mirVana method with Trizol. The extracted miRNA was quantified using an EON spectrophotometer (BioTek®). RQ-PCR was performed using a 9700 Thermal Cycler and 7900HT Real Time PCR System.

Quantifiable miRNA was detected in every sample, however remarkable variation was observed in the yields obtained depending on the methods used for each body fluid. Each miRNA of interest was detectable in the relevant body fluid with significant dysregulation observed across the body fluids for each miRNA.

This study has identified the optimal method for extraction of miRNAs from body fluids and highlights the potential of miRNAs as biomarkers for the identification of forensically relevant body fluids.

"Investigating the Ability of Raman Spectroscopy to Differentiate Body Fluids in Mixed Samples,"
Tyler Schlagetter*, University of New Haven ; Brooke Kammrath, Ph.D., University of New Haven; Claire Glynn, Ph.D., University of New Haven

During an investigation, biological stains discovered at a crime scene may be a combination of different body fluids. While there are several methods to resolve DNA mixtures, there has been little research to determine effective means of resolving body fluid mixtures. Many current strategies for body fluid identification consume the sample. The non-destructive nature of Raman spectroscopy has led to an increased focus on it in the field of forensic science. This study aims to demonstrate Raman spectroscopy's ability to differentiate between body fluids in a mixed sample.

After obtaining informed consent, venous blood, saliva, semen, and urine, were collected from volunteers (n=20). Under controlled laboratory conditions, Raman spectroscopy was performed at a constant wavelength of 780 nanometers, first on the individual body fluids, then on mixtures of varying ratios. Testing was also performed on different substrates (aluminum slides, black cotton, and white cotton). DNA profiling was then performed on a selection of scanned samples to confirm the non-destructive nature of Raman spectroscopy.

The results showed the individual body fluids each produce their own unique spectra. Of the six mixture combinations, four gave positive identification of both fluids present (blood and semen, saliva and semen, saliva and urine, semen and urine). Substrate analysis gave indefinite results for all samples tested except blood, which was only identified on white cotton. Full DNA profiles were obtained from the selected samples tested.

"Estimating the Age of Bloodstains by Comparing Oxidized and Reduced Hemoglobin Absorption Spectra," Sagar S. Shah B.A*. Cedar Crest College, Marianne Staretz PhD

After attending this presentation, attendees will be aware of a novel method for estimating the age of bloodstains utilizing pre- and post-reduction hemoglobin absorption spectra.

This presentation will impact the forensic science community by providing a new mathematical method to estimate the age of a bloodstain using hemoglobin absorption spectra and a better understanding of the effect of environmental conditions on hemoglobin.

Age determination of a bloodstain may play a vital role in solving a crime. Knowing the approximate time when a blood stain was produced could help narrow an investigation, and provide leads for future investigation. Forensic science has progressed to where a bloodstain can be individualized and the mode of deposition ascertained, but determining the age of a bloodstain remains a vexing problem. Published methods for determining the age of a bloodstain vary in methods of analysis, and in overall reproducibility and accuracy. This is one of the primary reasons why there is no consensus method among the scientific community. The need for an accurate, precise and validated method for bloodstain age estimation still lingers.

Hemoglobin is an iron containing oxygen transport protein present in the blood. Upon exiting, the principal hemoglobin species present in the blood are carboxy-hemoglobin, oxy-hemoglobin, and hemoglobin. Over time hemoglobin can be oxidized into met-hemoglobin, and met-hemoglobin can be further oxidized to hemichrome. The amount of oxidized hemoglobin derivatives increases over time [1]. Oxy-hemoglobin, met-hemoglobin, and

certain hemichromes can be reduced to hemoglobin using a reducing agent such as sodium dithionite. The change in absorbance spectra upon reduction should be related to the extent of oxidized species present. The goal of the current experiment is to measure the absorbance spectra of an extracted portion of a blood stain before and after reduction and to analyze how the changes in the spectra correlate with age of the bloodstain.

Bloodstains were created by applying 4mL of human blood evenly onto a white cotton T-shirt. The bloodstains were stored under several environmental conditions: a) room temperature, b) window lighting (room temperature, c) refrigerator (3ºC, dark), d) oven (36ºC, dark) e) humidity (99%), f) humidity (85%). At various time intervals, sections approximately 1cm by 1cm were cut out and placed into a cuvette containing 1.5mL of 0.4% ammonium hydroxide. The absorbance spectra were measured from 480-610nm using a Beckman Coulter DU® 800 Spectrophotometer. The pre-reduction spectra had two max peaks known as alpha (540nm) and the beta (575nm) and a minimum between the two peaks (559nm) in the 480-610nm region [2]. The reduction spectra was obtained by adding 75mg sodium dithionite into the same cuvette and measuring the spectra again. The hemoglobin peak max is at 554nm in the 480-610nm region [2].

Results were analyzed by calculating the absorbance ratio at 608 nm ratio before and after reduction and plotting the values in a regression curve with relation to time. The pre-reduction/post-reduction absorbance ratios were calculated at each wavelength. The absorbance ratio at 680 nm showed the greatest change and good correlation with time. Logarithmic curve equations along with R^2 values are as follows thus far; 36°C $y = 0.1522\ln(x) + 0.8152$ $R^2 = 0.7965$, 3°C $y = 0.1277\ln(x) + 0.3463$ $R^2 = 0.7416$, 85% humidity $y = 0.157\ln(x) + 0.2919$ $R^2 = 0.6679$, 99% humidity $y = 0.0172\ln(x) + 0.2553$ $R^2 = 0.4243$, window lighting $y = 0.1779\ln(x) + 0.6557$ $R^2 = 0.8875$, and room temperature $y = 0.1659\ln(x) + 0.5634$ $R^2 = 0.8885$. Results demonstrate that an increase in temperature increases oxidation while increased humidity decreases the rate of oxidation. Oxidation under all conditions is most rapid during the first 48 hours. Logarithmic curves, based on data obtained to date, indicate age can be estimated up to 1 month from deposition, with the first 48 being more rapid.

In conclusion, this research presents a different method that may prove useful in the age estimation of bloodstain. The mathematical approach of the current study utilizes the pre- and post-reduction absorbance spectra of hemoglobin. The current study will also contribute to a better understanding of how environmental conditions can affect hemoglobin oxidation in bloodstains

[1] R. Bremmer, et al. Biphasic oxidation of oxy-hemoglobin in bloodstains. PLoS ONE, 2011 Jul; 6(7)
[2] W. O'Hare, Islam. The age estimation of blood stains up to 30 days old using visible wavelength hyperspectral image analysis and linear discriminant analysis. Science & justice: journal of the Forensic Science Society, 2013 Sep; 53(3): 270-277

"A Raman 'Spectroscopic Clock' for Bloodstain Age Determination: The First Week After Deposition,"

Kyle C. Doty*, Gregory McLaughlin and Igor K. Lednev Department of Chemistry, University at Albany, State University of New York

Knowing the time since deposition (TSD) of an evidentiary bloodstain is highly desired in forensics, yet it can be extremely complicated to accurately determine in practice. Although there have been numerous attempts to solve this problem using a variety of different techniques, currently no established, well-accepted method exists. Here, a Raman spectroscopic approach was developed for determining the age of bloodstains up to one week old. Raman

spectroscopy, along with two-dimensional correlation spectroscopy (2D CoS) and statistical modeling, was used to analyze fresh bloodstains at ten time points under ambient conditions. The 2D CoS results indicate a high correlation between several Raman bands and the age of a bloodstain. A regression model was built to provide quantitative predictions of the TSD, with a cross-validated root mean squared error of 0.13 and R2 of 0.97. It was determined that a 'new' (1 hour) bloodstain could be easily distinguished from bloodstains at other ages, which is very important for forensic science in helping to establish the relevant association of multiple bloodstains. Additionally, all bloodstains were identified as blood by comparing the measured spectra to multidimensional body fluid spectroscopic signatures. These results demonstrate that Raman spectroscopy can be used as an analytical tool for discriminating between bloodstains on the scale of hours to days. This approach shows promise for immediate practical use in the field to predict the TSD of a bloodstain with a high degree of accuracy.

"Handprints - what to expect," Dr. John Allison*, The College of New Jersey (TCNJ); Allison Zumwalde, Kendall Ciriaco, TCNJ

It is a substantial step up from dealing with fingerprints to entire handprints, and obviously we've yet to collect handprints for databases. When a handprint is discovered, the questions posed are often not related to identification of the owner, but instead: 1) how were they formed? and, 2) are they real? Handprints have been found on windows, and are often reported on home mirrors. Should a handprint on the outside of a window be reported to the police, indicative of an attempted break-in? How does one even begin to explain such evidence when found on a the outside of a fifth-floor window? Does a handprint on a home mirror indicate a possible break-in? Often, handprints have very unusual shapes, which require explanation. Interestingly, there are a number of reports on the internet which suggest that unusual handprints in unexpected places are from aliens or ghosts! We have investigated a number of unusual handprint shapes/physical details and will show how they can be formed. We have also investigated the chemical composition of some questioned handprints and show that, often, latent handprints can become visualized with the appropriate lighting or under certain environmental conditions. Finally a case will be discussed in which a handprint on a double-pane window was discovered in which the handprint was on the inside of the window.

"A Novel Method for Visualizing Fingerprints on Absorbent Surfaces - Contact Ninhydrin," Howard A. Harris PhD*, J.D. University of New Haven, Professor Emeritus

The Presentation summarizes the development of a novel method for rapidly visualizing fingerprints on absorbent surfaces (paper). The method is highly portable, rapid and produces high quality fingerprints on absorbent surfaces and involves no solvents. This is a one-step procedure that uses a treated paper containing Ninhydrin and additives that is placed in contact with the fingerprint containing substrate and is enclosed in a sandwich containing a moisture source. A simple piece of diaper can be used as a, dry to the touch, source of sufficient moisture to heat the contents of the sandwich. The boards that contain the package must freely pass microwave energy. The sandwich holds the reactant materials together under pressure to facilitate the two phase reaction. This "sandwich is placed in simple microwave oven and microwaved for two to six minutes, then allowed to cool for a few minutes. Prints are visualized on the substrate with no darkening (purple) of the substrate background. This Contact Ninhydrin method does not run most ballpoint pen inks. This new method has significant advantages of speed and portability over the solution methods currently widely used. All the necessary materials, except the microwave oven, can be easily carried in a briefcase and it is suitable for use at a crime scene, if there is a microwave in the van.

"Cobalt Chloride as an Enhancement Reagents for Footwear Prints Made in Ice Melt Products," Kevin Karakkat*, Saint Peter's University; Ted Schwartz, Westchester County (NY) Forensic Science Laboratory; Lawrence Quarino, Cedar Crest College

Many transition metals can serve as a Lewis acid or an electron pair acceptor. Polyatomic or monoatomic ions that can serve as an electron pair donor (Lewis base or ligand) can form coordination complexes with the transition metal. Examples of common ligands are ammonia (NH_3), simple anions (Cl-, F-, Br-, OH-) and complex anions (CO_3^{2-}, SO_4^{2-}, SO_3^{2-}). Cobalt is an example of a transition metal that is suitable to form coordination complexes and is most commonly found in cobalt chloride hexahydrate. Cobalt chloride hexahydrate has a pink color which can be changed to blue-purple when the compound is converted to the anhydrous state upon heating.

Given that cobalt chloride displays colors and can form coordination complexes with chloride anions, it is being studied as a possible enhancement reagent for footwear prints made in ice melt products commonly found on outdoor surfaces during the winter in climates producing snow and ice. A review of the literature showed that only silver nitrate has been reported as an enhancement reagent for salt crystals and is recommended only as a last resort (Nause, L. Forensic Tire Impression Identification. Canadian Police Research Centre, Canada, 2001; Loveridge, F.H. Shoe Print Development by Silver Nitrate. Fingerprint Whorld, 1984).

Ice melt products such as rock salt is normally composed of a chloride salt, most commonly sodium chloride or calcium chloride although products containing magnesium chloride and potassium chloride are commercially available. Some "pet and vegetation safe" ice melt products are not composed of chloride salts but rather urea or a carbamide resin.

Eight commercial ice melt products were obtained. SEM/EDX determined that six of the eight contained sodium chloride and one contained calcium chloride. The composition of the eighth is proprietary although it is likely a carbamide of some variety since a strong nitrogen x-ray peak was detected in the EDX spectrum and a carbonyl stretch was found under infrared microspectrophotometry.

Samples of each were placed on the tread of a sneaker, placed on a volunteer who then walked five steps on a particular substrate. Each of the products were applied to the sneaker in three ways: ground to a powder and applied to the sneaker by brushing, stepping into a tray of product completely dissolved in water, and stepping into a tray of product partially dissolved in water. Substrates tested included materials made of ceramic, laminate, vinyl, and wood (finished and unfinished). Several different types of each substrate were tested. Wet sneaker prints were allowed to dry prior to enhancement.

To each sneaker print, a 20% (weight/volume) $CoCl_2 \bullet 6H_2O$ solution was sprayed evenly. A heated blow dryer was then applied over the imprint to turn the color of the enhancement from a lighter pink to the darker blue-purple (this was not needed with the calcium chloride sample which is exothermic in aqueous media) which typically yielded better contrast.

Enhancements were obtained with all three product compositions. It is hypothesized that nitrogen moieties on the proprietary product serves as an electron pair donor. Although somewhat substrate specific, the best enhancements occurred on either the third or fourth step. The better enhancements yielded excellent class characteristic detail but individual characteristics were not observed in any enhancement. The quality of enhancements varied depending on specific substrates rather than specific material. For instance, vinyl carpet runners yielded better enhancements than vinyl tile. In addition, the ability to enhance imprints on ceramic tile varied from product to product. All three methods of sample deposition on the sneaker yielded probative results. Essentially, if the material could transfer to

the substrate and adhere, an enhancement was likely. Porous materials (such as untreated wood) yielded poor enhancement.

"The Lindbergh Baby Kidnapping - Investigation of the Ransom Letters," Dr. John Allison*, The College of New Jersey (TCNJ); Tim Castor, Courtney Amster (TCNJ)

One of the most highly publicized crimes of the 20th century involved the kidnapping of Charles Lindbergh's young son, on March 1,1932. While Richard Hauptmann was found guilty and executed, many questions remain, and dozens of books have been written since that time on aspects of the case. We discuss here the fifteen ransom notes, focusing on the unusual "signature" on each. We were fortunate to get limited access to them, obtained UV/Vis reflectance spectra of the "inks" involved, and have been investigating materials used to create the multi-colored figures that are the signatures. Various aspects require analysis and consideration. What was used to create the red, and blue colors? What were used to create the shapes (combination of large and small circles), and how were the three holes, present in each signature, reproducibly formed? A true "cold case", investigators must take care to "go back to the 1930s" and understand what materials might have been available then, to identify appropriate comparators.

While the story is a long and complex one, with many individuals involved, most of the "information" available contained in books and "Lindbergh hobbyist's" blogs is not refereed, so many facts must be questioned. We will show spectra obtained from the original letters, compare them to dozens of possible materials available at the time, consider unusual approaches to creating the shapes involved in the symbolic signature, and discuss implications of the results to finding the real kidnapper(s).

"Biological Fluid Testing Cassettes - A False Positive Study," Michelle Levasseur Massachusetts State Police

Detection of body fluids such as semen, saliva and blood is an invaluable investigative tool in forensic cases. Immunochromatographic strip tests are commonly used in the field of forensic science to detect such body fluids, of which many are advertised as being confirmatory for the body fluid tested.

Unexpected positive results on diaper samples from casework prompted the incentive to re-evaluate the specificity of these immunochromatographic tests. The initial direction of the study focused on diapers that were clean, soiled with urine and/or fecal matter, and ones that appeared to have mold contamination. The results indicated that the soiling of the diapers alone could not have been the source of the positive results which prompted further investigation of other substrates that appeared to be contaminated with mold.

Samples were also spiked with semen to evaluate the performance of the test in the presence of the suspected contaminate. Dilution strategies and pH variability's were also evaluated.

"An Expansion of the Griess Test for Nitrites in Gunshot Residue," Erin Noval*, BS and Jeanne Berk, PhD Cedar Crest College

The current Modified Griess Test method detects the nitrites present in gunshot residue (GSR) by reacting them with sulfanilic acid to form a diazonium ion. This then reacts with alpha-naphthol to form an azo dye on the paper

substrate. The item suspected of having GSR on it is processed by laying it over the dried paper substrate. Cheesecloth soaked in acetic acid is then laid over the top of the item and the stack is ironed without steam. If nitrites are present an orange color dye will be visible on the paper substrate.

The new method that will be presented tested m-nitroaniline and aminoanthracene in place of alpha-naphthol and sulfanilic acid, respectively. These changes resulted in a purple dye when reacted with nitrites. The literature limit of detection for Griess is 2.5μM. Our results show that using m-nitroaniline and aminoanthracene as the reagents detecte nitrites at a concentration comparable to Griess, but is easier to discern due to its darker purple color.

Traditionally photographic paper was used as the reagent substrate, but due to decreased availability labs are using commercially available papers and lab filter paper. This study conducted a survey of several paper types and found that high gloss photographic paper is the most durable after spraying with reagents and shows the most visual detail after being processed. Filter paper showed the greatest diffusion of the dye due to its porosity. The photopaper gave the best detail for the GSR pattern.

"Analysis of Change in Nitrite to Nitrate Ratios in Gunshot Residue over Time using Ionpairing HPLC," Anusha Rankoth* Cedar Crest College; Marianne Staretz, Cedar Crest College; Peter Diaczuk, John Jay College; Thomas Prichett, Cedar Crest College; Elana Conant, Cedar Crest College

There is a high level of nitrites and nitrates present in GSR due to the high nitrogen content of the propellant used in smokeless powder cartridges. After discharge these components are left behind within and on the firearm.

This study has developed an HPLC method which can be utilized to measure the nitrite to nitrate ratios within the barrel of a firearm after it has been discharged and determine if there is any change in this ratio over time that may prove useful for estimating the time frame in which this discharge occurred. This method consisted of an ion pairing system using the ion pairing agent tetrabutylammonium hydrogen sulfate. Successful separation of the target analytes is possible in less than 5 minutes. The HPLC data was collected using an Agilent®1100 HPLC system. The system utilized a diode array detector and absorbance was monitored at 205nm. Separation was accomplished using a 100mm x 2.1mm x 2.6□m Kinetex® C18 column. The mobile phase consisted of 95% 10 mM tetrabutylammonium hydrogen sulfate in a 2.0 mM sodium phosphate buffer adjusted to a pH of 8.4 and 5% HPLC grade acetonitrile. Sample injections of 20□L were made using an autosampler at a flow rate of 0.20 ml/min.

The retention time of nitrite and nitrate present in GSR using this method is 2.4-2.5 minutes and 3.9-4.0 minutes, respectively. Starting ratios of nitrite to nitrate at time zero range from 1 to 0.92. After 24 hours the ratios decreased to a range of 0.45 to 0.49. After an additional 24 hours the ratios decreased again to approximately 0.27. These results indicate that nitrite to nitrate ratios decrease approximately 50% over a 24 hour period. With this type of data it may be possible to construct a calibration curve which will be an important tool in determining the approximate time firearms were last discharged.

"Collecting Evidence from a Sexual Assault Patient; A Forensic Nursing Perspective," Karen Hazard, RN,BS, SANE, Massachusetts Sexual Assault Nurse Examiner Program

The Massachusetts Sexual Assault Nurse Examiner (SANE) Program is nationally and internationally recognized as a model of quality, compassionate, forensic nursing care which provides services for sexually assaulted/abused patients of all ages. MA SANEs provide a trauma-informed approach to care that incorporates the concepts of patient empowerment, control and choice. Each sexual assault patient has unique medical, emotional and forensic needs. The MA SANEs follow standardized protocols but also tailor sexual assault care and forensic evidence collection to the patient's assault history and clinical presentation. This workshop will discuss the role of the MA Adult/Adolescent SANE and Pediatric SANE - their training and credentialing and how the SANE determines priorities for care and collection of evidence. Case reviews will be used to demonstrate how SANEs employ critical thinking when determining which evidence to collect and the methods to use for evidence collection. Participants will gain unique insight into how MA SANES provide expert trauma-informed care to sexual assault patients utilizing evidence based protocols combined with critical thinking and focus on the overall well being of their patient.

"From Crime Scene to Conviction: A Case Presentation," Stephanie Waite, Massachusetts State Police

I will present a non-fatal stabbing/sexual assault case from 2010 where I performed both Crime Scene and Criminalistics (biological fluid identification) work. I will also touch upon the crime scene examinations, fingerprint analysis results, and DNA testing results from other analysts.
At approximately one in the morning, an unknown male gained entry into an apartment where a father and son were sleeping. The son alleged that the unknown male sexually assaulted him. The father was stabbed at least fifteen times.

I processed the interior of the apartment, where there were several bloodstain patterns. I also examined the sexual assault evidence collection kits from the father and the son and processed several red-brown stained swabs collected from the scene as an expedited Criminalistics assignment. I did additional Criminalistics work on articles of clothing believed to have been left at the scene by the suspect, additional red-brown stained swabs from the scene, weapons left at the scene, and the suspect's boots.

Poster Session Abstracts

"Blood markers to identify personal characteristics through biocatalytic cascades," Julianna Agudelo*; Crystal Huynh; Erica Brunele; Jan Halámek, SUNY University at Albany - Department of Chemistry

The analysis of biological samples left at crime scenes is routinely achieved by biochemical and chemical techniques leading to the elucidation of criminal investigations and subsequent prosecutions. Because of its genetic material, unique composition of proteins and low molecular compounds, blood is a major contributor to crime investigations. Biomarkers found in blood can be used to reveal characteristics of the donor by performing enzyme based biocatalytic cascades. Aspects that dictate the different levels of the markers include but are not limited to age, gender, health condition, race, somatic type, presence/absence of diseases, and injuries. The fundamental study of the use of biomarkers in forensic investigations is outlined in this project. The age of a blood spot found at a crime scene and the age of the blood spot originator was the latest accomplishment with this technique. The bioanalytical assays of human blood can help to build a profile of suspects or victims based on age, gender and ethnicity. The simplicity and robustness of this system aims to be adapted as a component of a forensic field kit.

"Variations on a theme: The detection of NBOMe designer drugs on blotter paper by high resolution time-of-flight mass spectrometry (TOFMS) with and without chromatography ," David Barajas*; Sabra Botch-Jones, Boston University School of Medicine – Biomedical Forensic Sciences; Frank Kero; Noelle Elliott; Bogdan Bogdanov; Craig Young; Jason Weisenseel, PerkinElmer

Novel Psychoactive Substances (NPS) have been associated with the cause of death in a number of cases in the United States and have led investigators to rethink traditional drug monitoring protocols. Of particular interest to this investigation are the variable phenethylamine chemical structures known as NBOMes', which pose an emerging threat to public health with incidence steadily growing over the past decade. In the culture of abuse, NBOMes are commonly applied to blotter paper and administered sublingually to induce episodes of hallucinations (similar but more potent effects when compared to LSD). This study considers two approaches for screening confiscated blotter paper to determine the presence of NBOMes using high resolution mass spectrometry in forensic case studies. The first approach is an extraction prior to UPLC-ESI-TOFMS. The second is DSA-TOFMS, a direct measurement using ambient ionization mass spectrometry without chromatographic separation. The key advantage of the second approach would reduce the analysis time per sample from minutes to seconds. Additional value added considerations in the reduction of consumable cost and solvent waste should also be noted. Samples were prepared at Boston University-School of Medicine Department of Biomedical Forensic Sciences (Boston, MA). These samples were analyzed at PerkinElmer's Tech Center (Oak Brook, IL). Feasibility of both approaches will be presented.

"Biocatalytic cascades as a tool for the evaluation of fingerprint samples," Erica Brunelle*; Crystal Huynh; Lenka Halámková; Juliana Agudelo; Jan Halámek, SUNY University at Albany

The analysis of fingerprint samples via pictorial comparisons has been largely accepted by the scientific community as a reliable method of identification. While this method is fairly dependable and well established, it is not applicable for all situations. For instance, when only partial or smudged fingerprints are collected, a match is unlikely to be found. In cases such as those, the chemical composition of the samples would be of more use than the image of the fingerprint pattern.

The research displayed in this poster presents various newly developed bioassay systems that focus on the analysis of the chemical components in fingerprints. These systems utilize enzyme cascades that are driven by different markers known to be present in fingerprint samples to provide information on the sample originator's gender and the sample's age. There is also the potential for developing other systems that are capable of determining additional physical attributes. To insure that the methods presented here are practical and can be used on samples left on more than one particular surface, research showing the performance of one of the systems on samples collected from various surfaces is also presented in this poster.

The developed bioassays also have the potential to become a portable method that can be used for on-site analysis. In addition, due to the ease at which the bioassay can be performed and interpreted, specialized training for the execution of the analysis is unnecessary, unlike most currently available techniques.

"Development of an Allelic Ladder to Analyze the Overall Precision of the NMI01 Region of Cannabis DNA," Ryan Clarke*; Dr. Heather Coyle, University of New Haven

The NMI01 STR region of Cannabis sativa DNA is currently used for source attribution of seized Cannabis by law enforcement. As part of an extended study on stability of plant DNA on evidence collection cards, FTA cards with seized Cannabis from 2009 and 2012 and fresh samples were amplified using CS1F and CS1R primers. Overall, the alleles 2, 16.1, 22.1, 23, 26, 28, and 30.1 were chosen to include in the proposed custom NMI01 allelic ladder in this study. The current NMI01 bin set is calibrated to the GeneScan 500 ROX size standard, which contains a possible sizing gap due to its temperature dependent 250 bp peak. The GeneScan 500 size standard had more precise fragment sizing than the GeneFlo 625 in the inter-run analysis and similar sizing precision in the intra-run analysis. Despite the high precision (+/- 0.5bp), the GeneScan 500 standard displayed an average sizing quality of 0.8714 across the inter- and intra-run analysis versus the GeneFlo 625 standard sizing quality of 0.9937. Further, including the temperature dependent 250 bp peak in sizing with the GeneScan 500 increased the sizing quality to 0.9777 while decreasing overall precision. Despite the fact that most of the alleles were called above 90% accuracy with the GeneScan 500 standard, the allele 28 was only accurately called 77.38% of the time. This research highlights the need for the development of an allelic ladder for the NMI01 region of Cannabis DNA as well as a joint recalibration of the sizing bin sets to approach 100% accuracy in automated software assignment of correct allele peaks.

"Identification of Methampehtamine in One-Pot Reaction Vessels by Direct Sample Analysis Time -of-Flight Mass Spectrometry," Jamie Foss*, Maine Health and Environmental Testing Laboratory

The One-Pot or "Shake & Bake" synthesis of methamphetamine that appeared in the United States nearly ten years ago is now one of the most common methods used to manufacture methamphetamine. The One-Pot synthesis of methamphetamine is a single step reduction method utilizing a pseudoephedrine precursor, in which all ingredients are mixed in one container. Not every clandestine lab scene has finished product and, due to the simplicity of this process, production evidence can be limited. If a reaction has occurred, methamphetamine can be detected in the liquid from the reaction vessel. Typical analytical techniques can be utilized, such as GC-MS and TLC; however there are limitations to these techniques. Detection of methamphetamine can be complicated by the components of the reaction medium (typically camping fuel), which have similar volatility and GC retention indices to methamphetamine, and can require additional sample preparation. TLC can also be utilized, but is often time-consuming and lacks sensitivity. An alternative to these techniques is Direct Sample Analysis (DSA) which uses a modified atmospheric pressure chemical ionization source coupled to time-of-flight mass spectrometry, leading to dramatically improved sensitivity. DSA is a direct ambient ionization source, requiring no chromatography and minimal sample preparation. Methamphetamine and its precursor can be detected in a small amount of liquid taken

directly from One Pot reaction vessels and analyzed without any sample preparation. Liquid from several different One Pot reaction vessels from seized clandestine laboratories in the State of Maine were analyzed using DSA/TOF MS. In all liquids, methamphetamine was identified using exact mass and the generation of fragment ions from in-source CID. Pseudoephedrine was also identified in some of the liquids. The use of DSA offers a rapid solution to potentially problematic analysis analyses of evidence seized from clandestine "One Pot" laboratories.

"Investigation into the Analysis of Benzodiazepines in Dried Blood Spots using LC-MS/MS," Andrea Jones*, Cedar Crest College

Drug impaired drivers harm or kill thousands of people each year in the United States. Benzodiazepines are CNS depressants that are one of the most common medications that are prescribed in the country today. Therefore, a selective and sensitive analytical method for the detection of benzodiazepines in small blood samples would be exceedingly beneficial to the field of Forensic Toxicology.

The use of dried blood spots (DBS) as a substrate for collection of blood for the purpose of detecting drugs in DUI cases has many advantages. The technique uses less blood, typically 10 – 50 uL of capillary blood which can be obtained through minimally invasive procedures. The cards are easy to handle, easy to transport, and can be stored at ambient temperature in the laboratory with minimal analyte loss. This makes sampling simpler, faster, and less invasive.

A LC-MS/MS method was developed for the analysis of ten benzodiazepines from 10 uL of blood spotted on untreated FTA®DMPK-C cards (GE Healthcare). The analysis was performed using an ABI Sciex 3200 QTRAP triple quadrupole mass spectrometer interfaced with a Shimadzu LC system consisting of two Shimadzu LC-20AD Prominence liquid chromatography binary pumps, two Shimadzu DGO-20A_3 Prominence degassers, and a Shimadzu SIL-20AC Prominence auto sampler. Chromatographic separation was achieved using an Ultra® Biphenyl LC Column (5.0 cm x 3.0 mm i.d., 2.7 □ m particle size). The HPLC method was isocratic with 30:70 0.1% (v/v) formic acid/methanol and the total run time was 9.50 minutes. It was possible to detect benzodiazepines at a concentration of 50 ng/mL in 10 uL of blood spotted on DBS.

"Evaluation of Microscopy and Vibrational Spectroscopy for the Discrimination of Blue and Purple Nail Polishes," Brianna Kroon*; Elaine Pagliaro; Brooke Kammrath, Henry C. Lee College of Criminal Justice & Forensic Science

After attending this presentation, attendees will understand the discriminating power of microscopic and spectroscopic analytical methods for the analysis of blue and purple nail polishes. This presentation will impact the forensic science community by evaluating the discriminating potential of microscopic and spectroscopic methods for the analysis of blue and purple nail polishes. A total of 21 different polishes were analyzed using three types of microscopy (stereomicroscopy, brightfield and polarized light microscopy) and two types of spectroscopy (Raman and attenuated total reflection Fourier Transform infrared microspectroscopy) in order to determine whether these methods could provide discrimination between the 21 bottles of blue and purple nail polish and/or brand identification. All 21 bottles of nail polish could be discriminated microscopically, based on various pigment characteristics. Raman spectroscopy was successful in identifying some pigments in the polishes, specifically Pigment White 6 (anatase) and Pigment Blue 27; however, fluorescence prevented pigmentation identification in several samples. Infrared spectroscopy was used for brand identification, with principal component analysis-canonical variate analysis (PCA-CVA) hold-one-out cross validation proving to have a 1.9% error rate. The results from this research provide valuable information about cosmetic evidence for criminalists to use in investigations and adjudications.

"Morphological Classification of Dorsal Fins and its Application to Forensic Science," Amina Kunovac*; R. Christopher O'Brien, University of New Haven - Department of Forensic Science and Center for Wildlife Forensic Research

Rapidly declining shark populations are having a negative effect on the overall marine ecosystem. Shark populations are exploited for their fins, which are used for shark fin soup, a Chinese delicacy. The United States government enacted several laws including the Magnuson-Stevens Fishery Conservation Act and the Shark Conservation Act of 2011. However, these laws are difficult to enforce due to the lack of an inexpensive and discriminatory method of differentiating the shark species after the fins have been processed. The reason that shark fins are difficult to differentiate is because some sharks, such as the Shortfin Mako and the Porbeagle, have a similar appearance to their fins, especially in the processed form. Many sharks are morphologically similar due to comparable feeding habits, migratory patterns, and the pelagic zone they inhabit. This can inevitably lead to misidentification of the fins. A method of differentiating the species is imperative because there are different levels of protection for the assorted species. In order to determine if there are diagnostic differences between various shark species, this research project involved investigating the cross-sectional morphology of dorsal shark fins. The three shark species used were the Common Thresher shark, Shorfin Mako, and Blue shark. When studying the cross-sectional morphology, each fin was sliced into five pieces. Measurements that were considered to possibly have diagnostic differences included proximal-distal lengths, caudal-cephalic lengths, thickness of platelet cartilage, fibrous cartilage, and platelet count at percentages of fifteen, fifty, and eighty-five of each slice. Rapidly declining shark populations are having a negative effect on the overall marine ecosystem. Shark populations are exploited for their fins, which are used for shark fin soup, a Chinese delicacy. The United States government enacted several laws including the Magnuson-Stevens Fishery Conservation Act and the Shark Conservation Act of 2011. However, these laws are difficult to enforce due to the lack of an inexpensive and discriminatory method of differentiating the shark species after the fins have been processed. The reason that shark fins are difficult to differentiate is because some sharks, such as the Shortfin Mako and the Porbeagle, have a similar appearance to their fins, especially in the processed form. Many sharks are morphologically similar due to comparable feeding habits, migratory patterns, and the pelagic zone they inhabit. This can inevitably lead to misidentification of the fins. A method of differentiating the species is imperative because there are different levels of protection for the assorted species. In order to determine if there are diagnostic differences between various shark species, this research project involved investigating the cross-sectional morphology of dorsal shark fins. The three shark species used were the Common Thresher shark, Shorfin Mako, and Blue shark. When studying the cross-sectional morphology, each fin was sliced into five pieces. Measurements that were considered to possibly have diagnostic differences included proximal-distal lengths, caudal-cephalic lengths, thickness of platelet cartilage, fibrous cartilage, and platelet count at percentages of fifteen, fifty, and eighty-five of each slice.

"Investigating the Simultaneous Extraction of miRNA and DNA from Forensically Relevant Body Fluids," Sarah Markland*; Kelsie Weir; Claire Glynn, PhD., Department of Forensic Science, Henry C Lee college of criminal Justice and Forensic Science, University of New Haven

It was recently recognized that microRNAs (miRNA) may serve as potential biomarkers for body fluid identification, thereby providing tissue source information in addition to DNA profiling. This study investigated simultaneous extraction of both DNA and RNA from forensically relevant body fluids.

Following ethical approval from the Institutional Review Board and informed volunteer consent, venous blood, semen, saliva and urine were collected from 5 volunteers (n=20). Two commercially available kits were investigated namely; ZR-Duet™ DNA/RNA MiniPrep kit (ZYMO) and AllPrep™ DNA/RNA Mini Kit (Qiagen). The

manufacturer's guidelines were followed using 200µl of sample. A series of dilutions of each body fluid were co-extracted for their RNA/DNA content. The quality/quantity of each extract was analyzed using a Biotek EON Spectrophotometer. RQ-PCR was performed on a selection of the RNA samples targeting miR-16 to determine if a miRNA signal was present. In parallel, STR analysis was performed on a selection of the DNA samples.

The results showed that quantifiable amounts of both DNA and RNA were obtained from all body fluids using both kits. The results were variable depending on the body fluid and the kit used. The diluted samples produced varying concentrations at much lower levels, as expected. Overall, the Zymo Kit provided higher concentrations of both DNA and RNA when compared to the Qiagen Kit. Finally, miRNA signals and full DNA profiles were obtained from all samples profiled. This research highlights the potential of miRNAs in forensic investigations with the ability to extract both miRNA and DNA from a single sample.

"A Comprehensive Comparison of Nicotine and Other Minor Components in Tobacco Products,"
Kassandra McCarthy*; Andrew S. Dutton, Suffolk University

Nicotine, a component of tobacco products, is a stimulant with addictive properties. A comprehensive analysis of different tobacco products was carried out in order to quantify the amount of nicotine in these products by developing a GC/MS method. A multi-analyte extraction in methanol was performed on cigarettes, cigars, moist snuff, Swedish snus, and several types of tobacco leaves in order to determine relative differences in nicotine concentrations between them. Using GC/MS analysis, it was determined that the uncut burley and dark fire cured tobacco leaves contained the most nicotine per gram of tobacco product, with 1.72 ± 0.11 mg and 1.63 ± 0.02 mg of nicotine respectively, while the Canadian flue cured tobacco leaves contained the least amount of nicotine per gram of tobacco product, 0.36 ± 0.01 mg. The extraction solutions were then concentrated using rotary evaporation in order to identify other compounds that were present in the tobacco products. Among the compounds that were detected were other minor tobacco alkaloids, such as cotinine and anabasine, flavor compounds, and caffeine. Future research will involve modifying the protocol in order to be used in the introductory forensic science module at Suffolk University.

"Elemental Profiling of Gunshot Residue Using TXRF," Amanda Morgan*; Dr. LIng Huang, Hofstra University

Gunshot residue (GSR) occurs as a result of firing a gun and is deposited on the suspect, victim, or at the crime scene, thus making it a useful tool for forensic analysis in weapons cases. This project is aimed to differentiate GSR based on inorganic elements present using total reflection x-ray fluorescence spectroscopy (TXRF). This method is relatively new but it is superior to other methods thanks to its high sensitivity, ability to get quantitative results, and ease of use. This means it can be used for the trace amounts of GSR deposited at a scene and the analyst can get relatively quick results. For this project four types of bullets were shot at distances of 6 inches with a Smith and Wesson .38 special caliber revolver through a white cotton cloth. The samples were cut into rounds with 12 cm diameters and digested with acid and then diluted and run 6 times each with a 100 ppm internal standard of Gallium. It was shown that TXRF can be used to generate an elemental profile based on bullet type, including titanium, lead, barium, silver, and potassium. The results for each bullet type demonstrated significant differences in the amounts of the listed elements per bullet. In the future the TXRF method can potentially be used to qualitatively and quantitatively determine the type of bullet found at a crime scene.

"Stability of Heroin in Various Solvents," Melanie Schade*; Thomas A. Brettell, Ph. D., F-ABC, Cedar Crest College - Forensic Science Program

The stability of heroin in four different solvent: acetonitrile, chloroform, methanol, and a 1:9 mixture of methanol:chloroform was studied. The degradation of heroin in the different solvents under various storage conditions was monitored for thirteen weeks. Samples of heroin in the four solvents were stored at different conditions including at room temperature, in the refrigerator, in the freezer, and on the autosampler of a gas chromatograph. The samples were analyzed by gas chromatography-mass spectrometry (GC/MS). Relative concentrations of the degradation products to the heroin concentration were measured semi-quantitatively using the ratio of area counts of the respective chromatographic peaks. Degradation products were identified through spectral analysis and comparison to known certified standards. It was found that heroin breaks down into 6-monoacetylmorphine in methanol. No breakdown products were observed in acetonitrile, chloroform, or the 1:9 mixture of methanol:chloroform at any of the storage conditions. The percent concentration of heroin in methanol decreased as the temperature of the storage condition increased. For the most part, no breakdown was observed for the heroin in methanol stored in the freezer (-4°C). The samples stored on the autosampler and at room temperature (26°C) had the lowest percent heroin concentrations and respective highest 6-monoacetylmorphine concentrations. The samples stored in the refrigerator (6-8°C) had higher percent heroin concentrations than the samples stored at room temperature and on the autosampler of the gas chromatograph.

"Investigation of Forensic Cleaning Methods for Bullet and Cartridge Case Evidence," Cassie Shuherk*, Boston University School of Medicine

Forensic pattern analysis of bullets and cartridge cases relies on the clarity of the toolmarks on evidence. These patterns may be distorted by debris such as blood and cyanoacrylate. This study examined the effects of several cleaning solutions and application methods on copper and brass bullets and cartridge cases, as well as the efficacy of these cleaning protocols on evidence contaminants blood and cyanoacrylate.

No cleaning method was universally effective on both contaminant types and nondestructive to the metal surface. Ultrasonication was the most efficient application method when used with an appropriate cleaning solution. The bloodstained bullets retained most or all of the underlying brown tarnish, regardless of the cleaning method employed. Ultrasonication with sulfuric acid was successful at removing some blood-initiated tarnishing; however, the removal of residues was not complete, making it difficult to visualize the full toolmark pattern. Acetone and sulfuric acid were successful at removing heavy cyanoacrylate deposits from cartridge cases; however, ultrasonication in sulfuric acid caused the nickel-plated primer caps to turn black. Etching occurred when sulfuric acid was allowed to dry on the metals. Citric acid, salt-flour-vinegar paste, Tergazyme®, and water were safe to use, but did not effectively remove the cyanoacrylate or the brown tarnish.

Flitz® Instant Brass and Copper Tarnish Remover caused etching to occur to both sample types. Additionally, the Flitz® tarnish remover caused the brass cartridge cases to turn black over time. The use of the Sunshine Polishing Cloths left light scratches on the surface of the samples, demonstrating they are not suitable for cleaning toolmark evidence.

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"Forensic Applications Through the Use of an Osmometer," Karoline Sperber*; Colleen Walsh*, Western New England University

Osmometers over the years have become more prevalent in the forensic science world. In previous years, osmometers were primarily used for clinical applications, but today the need for them in forensic science is increasing. Osmometers measure the amount of dissolved particles in a fluid in units of mOsm/kg. In this specific study, using a Model 3250 osmometer, a database was created to measure the osmality of various commercially available drinks, which include but is not limited to a variety of sodas, sports drinks, energy drinks, and bottled waters. From this established database, a level of uncertainty can be determined to prove the precision of the instrument. This generated database was then compared to a database previous established by the Monroe County, NY, Crime Lab to observe the deviations of each specific drink over the years. Furthermore, this database can be utilized by forensic laboratories to analyze liquids that may have been tampered with or adulterated. If the values obtained are outside the database values, then the sample can be further analyzed to determine how it was tainted. Osmometers have also recently shown to aid in sexual assault cases to determine if a victim's drink has had any substances added to it, which was also observed in this study.

"MP 609-New Algorithms Using All Ions MS for the Identification of Isobaric Drugs in Blood Samples Using LCMSMS High Resolution Mass Spectrometry," Agilent Technologies

This poster describes a new algorithm for the collection of MSMS spectra using low medium and high energy collision spectra. The acquire spectra are merged into a composite spectrum that contains molecular ion species, adducts, as well as fragments with associated isotopes. These composite spectra can be used to create libraries, which, when combined with UHPLC separations can be used to identify isobaric drugs in blood samples.

"TP 513- New Algorithm Utilizing All Ions MSMS Data on TOF/QTOF and Accurate Mass MSMS Libraries for Rapid Development of Qual/Quan Methods," Agilent Technologies

This poster describes an algorithm and workflow which allows for easy setup of qual/quan methods for MSMS data acquisition, data analysis and results review.

"Analysis of Heroin Samples By High Resolution Accurate Mass GCMSMS," Agilent Technologies
This poster describes the design and use of a purpose-built GCMSMS QTOF instrument that utilizes conventional 70 ev analyte ionization, while producing exceptional high resolution accurate mass spectra.

Educator's Forum

"Future Forensic Scientists, a Path to Success," Scott Rubins*, New Rochelle High School/Syracuse University

Forensic science is one of the most common professions portrayed in the media. Flashy, sexy CSI like shows fill high school Forensics classes and inspire students to want to become Forensic Scientists. Students who enter Forensics programs are often surprised to find out that they will end up as Chemistry, Biology or Biochemistry majors and it is not as TV portrays.

The Forensic Science program at New Rochelle High School has been around for three decades. Partnered with Syracuse University in a concurrent enrollment program, some students earn college credit for the course. Twenty years of teaching Forensic Science have provided me the tools to guide my students to understand the leap they are taking and the commitment they are making. This ensures students are set up for success in their journey and they don't think they are off to CSI Miami. That is **not** to say that Forensic Science in high school is a must nor does it make a Forensic Scientist. It provides a solid background in the field and the support a student needs for success.

A number of former students have entered FEPAC accredited programs and are successfully employed. One at our local lab in Westchester County NY!

This presentation will take you through our journey providing insight into what high schools are doing to prepare students for these programs. Hopefully this will inspire educators who teach in these programs to partner with high schools to ensure the highest caliber students are admitted to their schools.

Evening Session

Kerry Gilmore, 24 Trauma

This biohazard safety course was designed specifically for police officers, investigators, and first responders. Law enforcement officials have the potential to encounter biohazardous situations on a daily basis. You should be knowledgeable on how to protect yourselves. Walking into a biohazardous scene may not only be harmful to you, but also to your co-workers and families. The stories we tell are from speaking to officers who have been exposed throughout the years while on the job. The pictures we show are from real scenes we had to clean up, and pertain to the safety precautions you should be taking when faced with brain tissue, blood, and other harmful elements. Did you know Hepatitis can live in dried blood for 45 days? This course teaches you about the proper personal protective equipment to wear upon entering crime and death scenes. The diseases we go over pertain to specific scenes law enforcement officials walk into all the time. We cover everything from Hepatitis, HIV, MRSA, Tuberculosis, CJD or "mad cow" disease, feces, bed bugs and scabies to sick houses, meth labs, Ebola, suicide by hazmat, motor vehicle accidents and how to process a crime scene safely.

This seminar will be facilitated by 24 Trauma which is a dedicated crime scene and biohazard cleaning company that is committed to helping families, property owners and businesses during emotional situations. Attendees will be offered donated gym bags full of personal protective equipment (PPE).

General Session

Dr. Itiel Dror, Cognitive Consultants International

In the past 10 years issues relating to 'bias', 'cognition', and 'human factors' moved from basically non-existance to central stage. Now that they are accepted as having an important role in forensic science, how do we move forward? How can we use them to enhance forensic work? To answer such questions we need to adopt practical procedures and best practices. However, for these to work we must understand the human cognitive system and how it relates to forensic work. Making such a bridge is critical in developing and implementing ways to minimize bias and utilize human cognition in everyday case work in forensic laboratories. This talk will introduce elements of human cognition, show how they are relevant to forensic work, and then suggest practical ways to move forward.

Plenary Session

Andrew Rivas and Vincent Desiderio, United States Postal Inspection Service

Maricopa County Sheriff Joe Arpaio Mail Bomb Case Study:

This case involved an investigation by Postal Inspector Andrew Rivas of the on-going harassment and interstate stalking of William Bradstreet Stewart by his former business partner, Gregory Lynn Schrader. The actions undertaken culminated in the mailing of an explosive device to Maricopa County Sheriff Joseph Arpaio on April 11, 2013 near the Grand Canyon in Arizona. The investigation took approximately 17 months, spanned numerous states and involved over a hundred agents from numerous federal, state and local agencies. Extensive use of the United States Postal Inspection Service Forensic Laboratory, along with the ATF, FBI and Arizona State Laboratory was essential in the successful outcome of the case. The investigation came to a head in March 6, 2014 after the search warrant execution of Schrader's residence in Jay, Oklahoma and subsequent arrest.

Author Index

The presenting author index can provide a quick reference to find when and in what section presenting authors were scheduled to present at the 2015 Annual Meeting. The reference table below assists you in finding the section in which the presentation was given. Letters correspond to the scientific discipline/section in which the presentation was made while the number corresponds to the page number of the abstract in this booklet.

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