Expedited DNA Analysis and Demographic Comparison of Evidentiary Samples from 1,785 Property Crime Cases

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Abstract

Property crime cases from Miami-Dade, Florida, Charleston, South Carolina, and Huntington, West Virginia were sent to the Marshall University Forensic Science Center (MUFSC). DNA testing was performed and the CODIS hits were recorded. The forensic science community will be impacted by this poster because it will provide the community with patterns and trends noted in this property crime study.

At the time of submission of this abstract, this project included 1,785 cases for a total of 2,946 questioned samples. This on-going project currently includes 3,134 questioned samples as of October 1st, 2012. After DNA analysis, each questioned sample was analyzed; the resulting profiles and reports were sent back to the originating jurisdiction. The DNA profiles were uploaded into CODIS and the resulting hits were tracked.

As of September 1st, 2012, across the three sites, the 3,077 questioned samples were separated into blood, saliva, and touch samples. It is important to note that different presumptive testing for blood was utilized at each location; MUFSC did not perform any serological testing. Placement of samples into each category is based on those presumptive tests. In total, 34% of the samples were blood. Of those 1,038 blood samples, 982 or 95% of the samples produced DNA profiles. Saliva samples constituted 12% or 378 of the questioned samples. Sixty five percent of the saliva samples produced DNA profiles. The remaining questioned samples, making up 54% of the total questioned samples submitted, were touch samples. Of the 1,664 touch samples submitted, 31% resulted in DNA profiles. This number was higher than expected; an elevated percentage of touch samples resulting in DNA profiles may be due to the fact that many of the samples were that of contact DNA.

Introduction

In 2010, there were an estimated 9 million property crime offenses that occurred in the United States. The overall loss from the 2010 property crimes is estimated at 15.7 billion dollars[1]. The National Institute of Justice (NIJ) identified a need for additional research to be conducted regarding Property Crimes. This project sought to identify the best practices for sample collection, processing of samples and identification of perpetrators. It was developed to aid in the processing of property crimes, an often under-prosecuted category of crime. As a result, the intentions of this study also included examining the resultant data and extrapolate any apparent trends that occurred.

The definition of a property crime differs slightly based on location. The Uniform Crime Reporting (UCR) Program from the Federal Bureau of Investigation[1] includes the offenses of burglary, larceny–theft, motor vehicle theft, and arson. According to the South Carolina Legislative Council's Code of Laws[2], crimes against the property include, but are not limited to the following: arson, burglary, robbery, and robbery of a vehicle. West Virginia Legislature states in Chapter 61, Article 3 (Crimes Against Property[3]) that arson, burglary, and larceny are considered property crimes. Property crimes are defined in the Florida Statute under Chapter 812[4]. Total Criminal Defense, a website, stated burglary, robbery, larceny and theft, and arson are property crimes in Florida[5]. Regardless of the statute, it is clear that the definition differs. MUFSC did not attempt to define property crime and did not turn down any submitted cases. Each jurisdiction determined case submissions. Technical specifications and a Memorandum of Understanding (MOU) were in place prior to the start of this project and did not include modifications to the normal procedures to account for low copy number samples.

The Urban Institute produced a research report in April of 2008 titled, "The DNA Field Experiment: Cost-Effective Analysis of the Use of DNA in the Investigation of High-Volume Crimes[6]." Similar to that study, this study separated biological evidence by type, saliva, blood, and touch. The saliva category also included one sample believed to be vomitus. The blood category included two samples of skin tissue with hair. It was hypothesized that samples in this category would yield the highest percentage of DNA profiles followed by saliva and then touch, respectively.

Materials and Methods*

Miami-Dade, FL
- Extraction: Promega® DNA IQ™ on Beckman Coulter® Biomek® 2000
- Quantification: Applied Biosystems® Quantifiler® Human on 7500 Real-Time PCR System
- Amplification: Applied Biosystems® AmpFlSTR® Profiler Plus® and COfiler®on GeneAmp® PCR System 9700 Thermal Cycler
- Capillary Electrophoresis: Applied Biosystems® 3100 Genetic Analyzer, GeneScan® v. 3.7.1, Genotyper® v. 3.7

Charleston, SC
- Extraction: Promega® DNA IQ™ on Beckman Coulter® Biomek® 2000
- Quantification: Applied Biosystems® Quantifiler® Human on 7500 Real-Time PCR System
- Amplification: Applied Biosystems® AmpFlSTR® Identifiler® on GeneAmp® PCR System 9700 Thermal Cycler
- Capillary Electrophoresis: Applied Biosystems® 3100 or 3130xl Genetic Analyzers, GeneMapper® ID

Huntington, WV
- Extraction: Promega® DNA IQ™ Beckman Coulter® Biomek® 2000, Qiagen® DNA Investigator® on Biorobot EZ1
- Quantification: Promega® Plexor® HY, Applied Biosystems® Quantifiler® Human on Applied Biosystems® 7500 Real-Time PCR System
- Amplification: Promega® PowerPlex® HS and PowerPlex® 16 on Applied Biosystems® GeneAmp® PCR System 9700 Thermal Cycler
- Capillary Electrophoresis: Applied Biosystems® 3100 or 3130xl Genetic Analyzers, GeneMapper® ID

*According to MUFSC Procedures Manual

Results

Figure 1: Background Facts Regarding the Property Crimes Project Locations[7]

Miami-Dade, FL Facts	
Cases Received:	1,227
Questioned Samples:	1,752
County Population:	2,496,435

Charleston, SC Facts	
Cases Received:	382
Questioned Samples:	900
City Population:	418,052

Huntington, WV Facts	
Cases Received:	220
Questioned Samples:	482
City Population:	49,138

Figure 2: Pie Charts Representing Biological Evidence Categories

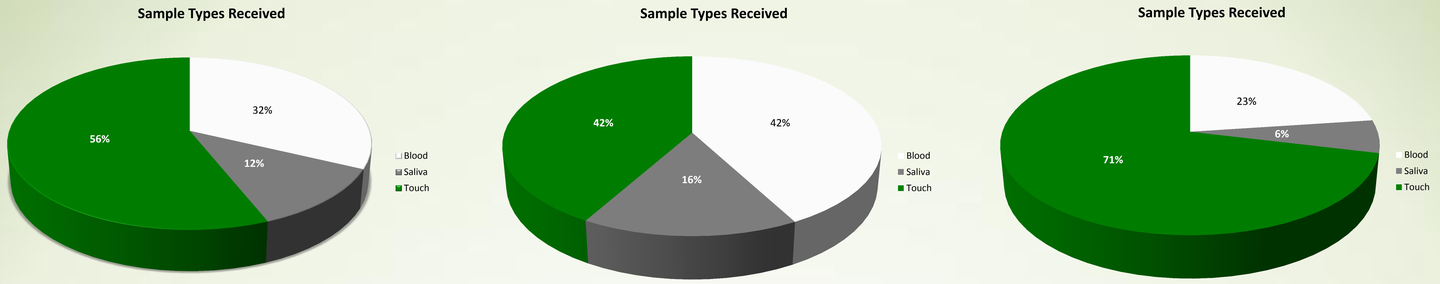
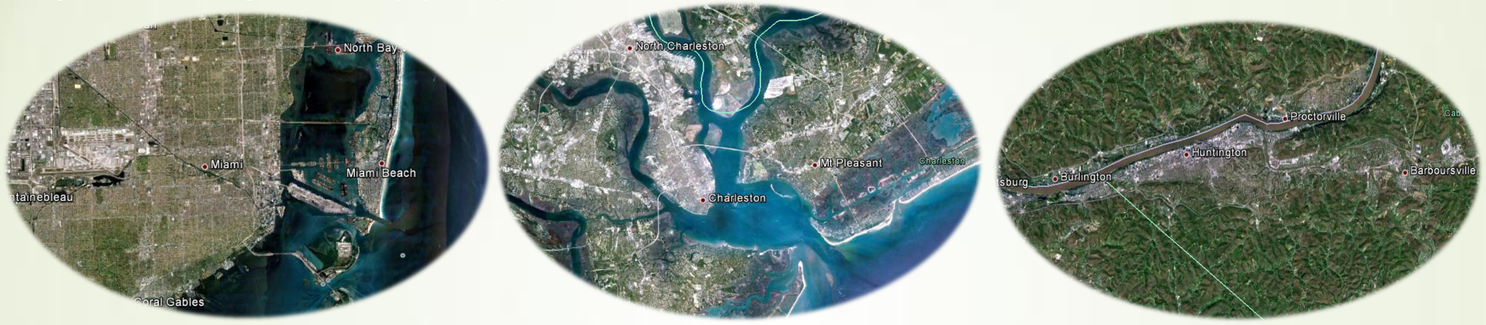
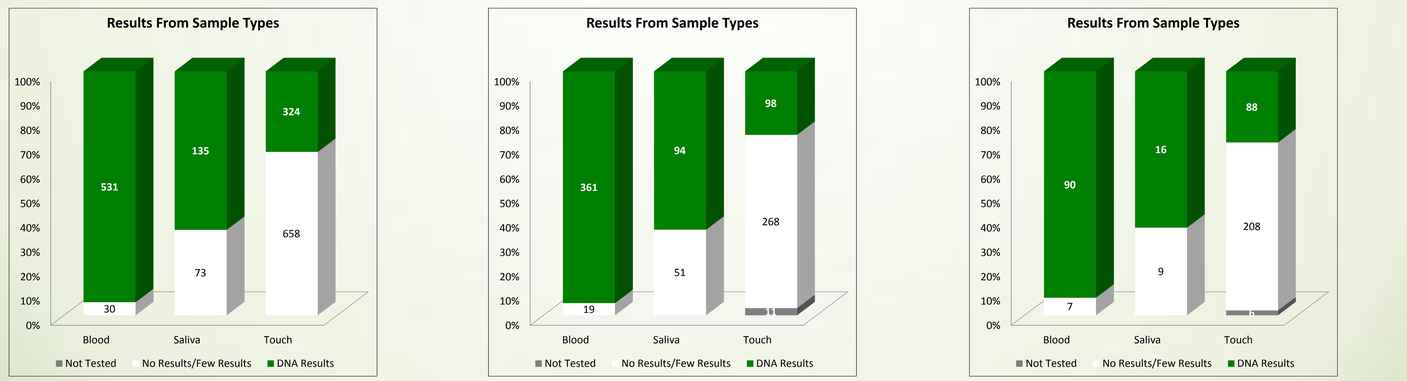


Figure 3: Aerial View of Each Region Involved in the Property Crimes Project



Miami-Dade, FL **Charleston, SC** **Huntington, WV**

Figure 4: Bar Graphs Depicting Percentage of Obtained DNA Profiles for Each Sample Type



Key: ☐ No Results/Few Results indicates ≤2 loci obtained; ■ DNA Results indicates ≥3 loci obtained; All results as of September 1st, 2012

Figure 5: Technical Specifications According to Site Location

Amplification Parameters	
Amplified With:	Profiler Plus®, COfiler®
Analytical Threshold (RFU):	150
Stochastic Threshold (RFU):	200

Amplification Parameters	
Amplified With:	Identifiler®
Analytical Threshold (RFU):	100
Stochastic Threshold (RFU):	200

Amplification Parameters	
Amplified With:	PowerPlex 16®, PowerPlex 16 HS®
Analytical Threshold (RFU):	100, 75 (respectively)
Stochastic Threshold (RFU):	200

DISCLAIMER: Although the authors acknowledge that the amplification chemistry as well as the analytical thresholds could alter the number of resultant profiles, the study was not created to compare amplification chemistries. At the Marshall University Forensic Science Center, our aim is to aid and support state and local laboratories. As a result, MUFSC uses the amplification chemistry of each site location. The circumstances in this study resulting in the use of three different amplification combinations were mere coincidence. This study does not recommend the use of one commercial product over that of another.

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Discussion

It was hypothesized that the number of blood, saliva and touch samples would be similar across each collection site. Figure 2 shows that both Miami-Dade, Florida and Huntington, West Virginia has the majority of their samples submitted belonging to the touch category, fifty six and seventy one percent respectively. Charleston, South Carolina had a different pattern; the blood and touch categories each contained forty two percent of the samples. Regardless of the location site, saliva samples represented the smallest category of biological evidence. Upon additional thought, the patterns that were seen in this study can be explained. Perpetrators often do not wear gloves when committing property crimes. Thus, touch evidence is more readily available. Also, since entry into the scene is often resultant of force, a suspect getting injured and bleeding can easily occur.

The three bar graphs in Figure 4 demonstrate a pattern that was expected and one that occurred across all three locations. At 95%, blood produced the largest amount of DNA profiles. Sixty five percent of the saliva samples produced a DNA profile. Touch samples resulted in 31% producing a DNA. Although it was expected that blood would produce the highest percentage of resultant DNA profiles followed by saliva and then touch samples, it was not expected that 31% of the touch samples would result in a DNA profile because the protocols were not modified for low copy number samples[8,9]. After additional examination of the samples present in this category, one could ascertain that the higher than hypothesized touch results were produced because many samples were not just mere touch samples. These samples include items like hats that are worn and in direct contact with a person's skin and may also contain sweat.

Each specific site location determined their own number of samples submitted for each case. Miami-Dade averaged 1.43 questioned samples per case. Charleston, South Carolina averaged 2.36 questioned samples per case submitted and Huntington, West Virginia averaged 2.19 questioned samples per case. No pattern was seen regarding the number of questioned samples submitted per case and the percentage of DNA profiles being produced. Submitting more or less samples was not as relevant to producing DNA profiles as the actual biological substances being sampled and submitted.

Out of the number of samples submitted, Miami-Dade, Florida has 56.54% of its submitted questioned samples result in DNA profiles. Charleston, South Carolina had the highest rate of DNA results at 62.07%. Huntington, West Virginia had the least amount of samples producing DNA profiles at 46.41%. When looking into the number of samples and types of samples submitted, Huntington has the lowest percentage of cases producing DNA results but it also had the highest number in regards to percentage of touch samples submitted.

Future Publications: A property crime project consisting of three thousand plus samples could in no way be depicted in one single poster. Instead, this poster is to be viewed as the first, an introduction, of a series of property crime posters. The next poster will discuss one site, South Carolina's Lowcountry Region, in great depth. Discussion will occur regarding samples submitted through the adjudication process and case results.

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Huntington, West Virginia:
West Virginia State Police Crime Laboratory, The Huntington Police Department, The Cabell County Prosecutor's Office, and The Wayne County Prosecutor's Office

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