Evaluating the Success of DNA Analysis and Latent Print Examinations on Submitted Firearms

SUMMER 2016

Karlee J. Rock B.A. | Marshall University Forensic Science
Victor M. Murillo B.A., Criminalist | Iowa Division of Criminal Investigations – Criminalistics Laboratory
Season E. Seferyn MSFS, Parentage DNA Analyst II | Marshall University Forensic Science Center
Dr. Terry W. Fenger PhD, Program Director | Marshall University Forensic Science Graduate Program

IOWA DIVISION OF CRIMINAL INVESTIGATIONS – CRIMINALISTICS LABORATORY
FIREARMS AND TOOLMARKS SECTION
2240 SOUTH ANKENY BOULEVARD, ANKENY, IA 50023

Abstract

A request for multiple examinations on firearms evidence has become more and more common across the country. The development of latent prints is a reliable method of human identification for decades; touch DNA is a newer investigative tool that is employed in forensic casework. Latent print examinations date back to the early 20th century, while touch DNA dates back to 1999 in the United Kingdom, 2003 in the United States. Nationwide, laboratories have seen approximately a 10-15% success rate with both latent print examinations and touch DNA analysis on firearms. Other studies have shown that latent print and DNA methods have even lower success rates on ammunition.

This review analyzes the types of cases that were submitted to the Iowa Division of Criminal Investigation – Criminalistics Laboratory. Included in the review are 104 closed cases from 2015 that submitted firearms evidence, and also requested other analyses be performed. First, cases were sorted into the type of crime that was committed (crimes against a person, weapon offenses, drug related crime, and property crime) and whether latent print examination, DNA analysis, or both were requested in addition to the firearms examination. It was found that out of the 104 cases, 58% went to latent prints only, 26% to DNA only, and 16% had both examinations performed. Crimes against people constituted for 45% of the total cases; property crimes had the least amount of case submissions.

One hundred pieces of firearms-related evidence were sent for latent print examination. The majority of the evidence was either a pistol or a magazine from a pistol. Fifty latent prints were developed, and thirty-nine were considered suitable for identification on twenty-four firearms, good for a 24% success rate. Blood was found on eight firearms and one bullet; the

DNA analysis resulted in nine complete profiles suitable for identification, resulting in a 100% success rate for DNA analysis on blood-related firearms evidence. Sixty-seven swabs from forty-one firearms and four ammunition types were analyzed for touch DNA. From the sixty-seven swabs, eleven profiles resulted in the identification of a person, giving a 16% success rate for touch DNA analysis. The most common outcome was a mixture/DNA factors too weak to interpret, happening almost 50% of the time.

The authors suggest similar studies be performed over several years to determine if the success is maintained throughout, and also to determine if the percentages are consistent in a larger data set. Studies like these are imperative since there is an increasing demand on turnaround time due to backlogs nationwide; therefore, laboratories need to be aware of and use the most efficient methods available.

Introduction

When a crime occurs, there is always some type of evidence left behind that can be used to identify suspects, corroborate alibis, and support or refute an eyewitness's story. This evidence comes in many forms, such as a blood stain, a computer hard drive, a baggie containing a white powdery substance, or a shoeprint in the mud. This evidence is typically sent to a forensic laboratory, where that evidence is examined to determine if it was used in a particular crime. In some circumstances, evidence can be examined by multiple forensic sections in the laboratory, and this practice has become more and more routine in the examinations of firearms.

If a firearm is used during the commission of a crime, some kind of firearms evidence is likely to be recovered for examination in the crime lab. The firearm itself is the best piece of evidence, but fired bullets, cartridge cases, and live rounds are often submitted as evidence as well. If a firearm is submitted, it is test fired into a water tank and the bullets and cartridge cases are compared to the evidence to see if the marks from the evidence were made by the submitted firearm using a comparison microscope. The Association of Firearms and Tool Marks Examiners (AFTE) suggest using a two level approach when comparing evidence to test fires. The first level includes searching for class characteristics, such as caliber, twist of rifling, number of lands and grooves, etc. The second level includes searching for individual characteristics, which involves lining up striae to ensure that they are continuous across both objects. Identification occurs when there are sufficient class and individual characteristics to say that two objects were fired from the same gun (1).

Cartridge cases are useful for connecting cases and providing investigative leads into the caliber and type of firearm. Cartridge cases from pistols (not revolvers, rifles, or shotgun shells) are eligible for entry into the National Integrated Ballistic Information Network, or NIBIN. The computerized microscope captures images of the firing pin impression, breech face, and ejector marks which are all unique to a specific firearm. The photos are uploaded to a database where they are stored and searched against previously entered cartridge cases from crimes or test fires. The best “matches” are generated and analyzed by a criminalist. If a match is suspected using NIBIN, it must be confirmed with a match using a comparison microscope.

Bullets are also useful for examiners if they are not badly damaged. A bullet that is intact will show the rifling characteristics of the barrel it was fired from, as well as a range of the caliber based upon its dimensions and weight. Bullets are often damaged from objects they contact during flight, but might still bear some surfaces suitable for comparison.

Although a firearm itself can give an investigator ample information, there is often a request for latent print examination, DNA analysis (touch DNA or blood/tissue), or both. Touch DNA is an attempt to recover small amounts epithelial cells from a simple touch of an object or place. Touch DNA dates back to 1999 in the United Kingdom and 2003 in the United States, and recently has gained attraction in the field of forensic DNA analysis (2). It had some early success in producing leads in property crimes, and as a result, more emphasis has been placed on its use in major crimes, especially crimes involving firearms. In addition, DNA has long been referred to as the "gold-standard" in forensic testing, therefore heightening the overall influence of DNA on a case. DNA testing is very accurate and has proven to be a reliable tool, but it is also very expensive, so testing low yield samples with an expensive and time-consuming method is a drawback, among other complications involved with touch DNA analysis (2). While DNA analysis is the current trend in forensics, latent print analysis has been a long-standing forensic technique used for human identification purposes. When compared to DNA, it has been scrutinized in the past as lacking statistical backing for the results of analysis, but the science is sound when a properly trained and experienced examiner is performing the work.

Since latent print and DNA examinations could potentially interfere with one another, it is important that investigators evaluate which processes are going to provide the most probative evidence in a case. Completing a latent print examination requires more handling of a firearm, which in turn can increase the number of skin cells transferred to that weapon. More handling increases the chance of contamination, and thus a more complex DNA mixture to analyze. Collecting DNA involves rubbing a moist swab across the surface of the firearm, which can distort the fingerprints that are present. Studies have shown that doing fingerprint examinations first does not lead to complete loss of DNA; it just severely lowers the quantity of DNA present. For these reasons, agencies may often only request one or the other, but it is possible to perform both. Typically, latent print examinations are quicker and are more cost effective; therefore, agencies will request latent prints more than DNA analysis, unless there is blood or tissue visually present on the firearm (2).

There are several factors that can affect these examinations in a negative way, leading to nationally low success rates for both examinations. In DNA analysis, there are problems with touch DNA in regards to contamination, low copy number samples, as well as transfers of profiles (2). Contamination can occur either at the crime scene, such as touching a firearm without gloved hands or improper packaging, or at the lab during analysis. Low copy numbers are attributed to the fact that when a person touches an object, they do not leave behind much DNA, and transfer of profiles can occur when multiple people handle a firearm. A key to keep in mind is that not all identifiable DNA profiles or latent prints left behind may be from a perpetrator; there may be factors from other people present on the firearm, but that does not necessarily mean that they were involved with the crime. For example, if the suspect used the victim's firearm during the crime, we could see latent prints or DNA from both people present.

As with DNA analysis, many factors can inhibit latent prints from developing on a firearm. The ability to lift prints off a firearm is dependent on not only the analyst, but also everything that happens to the firearm before it reaches the analyst's bench. Barnum and Klasey list eight main factors that can determine whether a visible, identifiable latent print will develop on a firearm. The first factor involves the life of a latent print. Circumstantially, it can be determined when a latent print was deposited if an eyewitness saw a suspect handling a weapon, but it cannot be determined scientifically. There is also a lot of variability in the ability for a latent print to survive under harsh conditions, further complicating the attempt to date a latent print. Tying into that are the atmospheric conditions including the air, temperature, and water. A firearm left out on a breezy day will result in gradual evaporation of the water portion, where if it is a hot or humid day, the water will evaporate much faster. Rain will wash away the water portion left behind. Further, the environment in which the firearm is subjected to will also alter the latent print. If a gun is placed in a holster, between car seats, or in someone's waistband, the latent prints may rub off. The same thing can happen if a gun is thrown from a vehicle and lands in a body of water or a dusty field.

Next the source of the fingerprint itself, the friction ridge skin of the fingers and palm, is considered. The skin can be damaged permanently (scarring or disease) or temporarily (superficial burn, wart, continuous hand washing, or working in construction). As a result of the damaged skin, the fingerprints may be very poor and sometimes unidentifiable. One of the main factors is the amount of perspiration that is actually transferred to the weapon during the commission of the crime. If there is not enough perspiration, the developing agents used will not adhere, and no prints will develop (3).

Although latent print examinations are often successful, processing firearms is a difficult task due to the materials used to produce the firearm and the sheer fact that there are not a lot of smooth areas on a firearm. More gun manufacturers have stopped producing the frames with metal and have started using polymer parts, such as GLOCK® (GLOCK, Incorporated, Smyrna, GA). These polymer parts usually have textured surfaces, which do not lend themselves to retaining latent prints. Also, consideration must be given to the manner in which the firearm was handled during the crime and how it was handled during recovery. The finishing of the metal parts on a firearm are often covered with non-stick materials advertised to inhibit latent prints from being left behind (3).

The last major source of issues for obtaining latent prints off of firearms comes from the evidence collection itself. Investigators may touch the areas that have viable latent prints while they are collecting them, which cannot always be avoided, but should be minimized. An important note is that all evidence, including firearms, should be collected using gloved hands. As with all evidence, proper collection and storage is imperative to ensure the best chance of accurate results, especially in latent prints and DNA. Firearms should be packaged in a box, tied down with zip ties to prevent movement. Under no circumstance should more than one firearm be in the same packaging. Bags should be avoided, if possible, in order to reduce the chance of distorting a print due to rubbing or shifting during movement (3).

Touch DNA is relatively new to the field of forensics, so there hasn't been as much research done to determine if it is an effective tool (due to lower success than traditional DNA analysis). A few studies have been done to determine what the best method for swabbing firearms is, where to swab on a firearm, as well as analyzing fired cartridge cases. Firearms can be swabbed either as individual components (such as one swab for the trigger, one for hammer, one for grips, etc.) or as a whole (using two swabs and running them over the entire firearm) (4). Multiple studies found that the grip is the area most likely to leave a profile and it is suggested that law enforcement agencies swab the firearm continuously as a whole rather than swabbing each component separately (4). There was also an interest in whether DNA could be transferred from the cartridge to the chamber of a firearm during firing. Live cartridges were hand loaded into a firearm, and after firing, the breech face, ejection port, and chamber were swabbed and analyzed for DNA. Although there are a few concerns that would inhibit the transfer, such as the high heat in the chamber during firing and multiple people handling a firearm or ammunition, some success occurred in obtaining amplifiable DNA from the interior of the firearm itself (5).

A case study from Italy found a latent print on the trigger of a firearm after cyanoacrylate fuming, which is extremely rare. The importance of not swabbing the trigger for DNA is imperative when latent print processing will be performed since the trigger is one of a few smooth surfaces on a firearm that the user will touch (6). Studies have also found that the identifiable latent print recovery rate is approximately 13% for firearms. Ammunition fares even worse, with a 0% recovery rate for fingerprints in some agencies. From these results, it seems that ammunition is better suited for DNA analysis rather than latent print examination (although the rate for DNA may not be significantly higher) (7). A study completed at the Denver Police Department found a 0% success rate for spent ammunition, and 0.25% success from live cartridges. The most success noted was 10% from magazines (8). Similarly, a 12% recovery from firearms and magazines and 0% from unfired cartridges was noted from a study at the Minneapolis Police Department (9). Additionally, a 13% success rate for firearms was found at the Bureau of Alcohol, Tobacco, Firearms and Explosives Forensic Science Laboratory in San Francisco (10).

The most important matter dealing with multiple examinations is to compare the methods side by side. One law enforcement agency began using TriggerPro ID™ (Forensic ID, Indianapolis, IN) gun swab kits (swab with anti-microbial liquid designed to maintain touch DNA) for the collection of touch DNA samples. The most common result was a mixture from more than one person, which happened 42% of the time. 36% of the cases resulted in partial profiles from a single source, 5% produced a full profile, and 35% did not produce a profile at all. Overall, roughly 12% of the cases provided profiles that were probative and provided investigative information. As far as latent print examinations, 7.5% resulted in prints suitable for identification. If the data is compared side by side, the rates of identification are statistically similar for both methods (0.8% for latent prints, 1.1% for touch DNA) (2).

Studies have published data in regards to the success obtained with latent print and DNA analysis regarding firearms, it sparked a question as to where the Iowa Divison of Criminal Investigation-Criminalistics Laboratory stacks up against the other agencies across the nation.

The research involved identifying cases that involved DNA analysis and/or latent print examination on firearms-related evidence. The type of firearm, crime, and results of analysis were documented and statistical analysis of data was performed to determine trends in outcomes. The expected outcome will be similar to data collected from other forensic agencies. In addition, the author predicts that percentage of success to be somewhere between 10-15%. The research will benefit the forensic science community by allowing agencies to look at their standard operating procedures compared to the procedures the DCI uses with these types of evidence, and possibly consider looking into newer or different methods of analysis to increase success in their own casework.

Materials and Methods

2.1: Data Collection

Data was obtained using the Laboratory Information Management System (LIMS) database from the DCI Laboratory in Ankeny, Iowa. Included in this study are closed cases from the calendar year 2015. In that calendar year, the Firearms and Toolmarks Section saw 1011 cases. Information was extracted from the case files, including the type of crime (robbery, homicide, etc.), weapons or ammunition submitted as evidence, and if any other examinations were requested. As data was collected, the research focus was narrowed to include only cases where DNA Analysis, Latent Print Examination, or both were requested.

Once the latent print and DNA cases were separated, they were sorted into four different types of crime: crimes against people (CAP), weapon offenses (WEA), drug related crimes (DRUG), and property crimes (PC). The crimes against people category include homicide, suicide, kidnapping, officer involved shootings, assaults, among others. Weapon offenses include, but are not limited to, felon in possession cases, firearms that were recovered, found, or confiscated, or simple possession. Drug related crimes simply are any crimes that involve drugs, such as possession or delivery of a controlled substance. Lastly, property crimes include robbery, theft, and property damage. If a weapon was used in the commission of multiple crimes, for example, if a felon was in possession (weapon offense) and committed an assault (crime against a person), it was classified as the more serious offense. The rankings used included crimes against people being the most serious; any crime involving drugs was placed into the drug related crimes except for property crimes with drugs.

Once it was determined what classification of crime a case fell into, the evidence submitted, examinations performed, and outcomes of those examinations were documented. Outcomes were used to determine the success of the examinations performed during the calendar year 2015. Success was measured using the number of identifiable latent prints and if an investigative DNA profile was produced. An investigative profile was defined as a profile that was of good enough quality for comparison to known victim or suspect profiles, entry into CODIS, or a major contributor profile could be determined. This definition was set because the profiles obtained could be used for comparative purposes.

2.2: Latent Print Processing-not performed by author

All evidence underwent procedures validated in the Iowa DCI Criminalistics Laboratory Standard Operating Procedures (11). Cyanoacrylate fuming was performed using a Foster + Freeman® MVC 3000 (Foster + Freeman, Worcestershire, England). Also utilized is a

LatentMaster™ 16MP Workstation, which includes a Reflective Ultra-Violet Imaging System (RUVIS) Full Spectrum Camera (Syntronics, LLC®, Fredericksburg, VA). The RUVIS is a non-destructive method used primarily for guns that are in pristine condition, per communication with the case agent. After cyanoacrylate fuming, the firearm was inspected to see if any latent prints were visible; if none were present, chemical processing was utilized. Typically, a combination of Rhodamine 6G, Ardrox, and MBD (RAM) is utilized with petroleum ether as a carrier. Sometimes Rhodamine 6G is used alone, but more often RAM is used. The fluorescent orange dye was sprayed on the firearm surface, allowed to dry, and then visualized using a Foster + Freeman® Crime-lite® ML2 under blue light (420-470 nm) with an orange filter. If a print developed, it was photographed and documented, examined to see if it is suitable for identification, and proceed to comparison if it was. In cases where DNA and latent prints were requested, DNA swabs were obtained prior to latent print analysis. Swabs collected by criminalists at the laboratory are taken from rigid areas on the slide and the grips in order to leave the smooth areas on a firearm for latent print examination.

Per section policy, ammunition is only examined for latent prints in cases including robbery, homicide, assault, etc. Ammunition is not examined in drug related cases or simple weapon violations, such as felon in possession. This policy is in place to decrease the workload and save time and resources, since latent print recovery off of ammunition is rarely successful.

2.3: DNA Analysis-not performed by author

All samples underwent procedures validated in the Iowa DCI Criminalistics Laboratory Standard Operating Procedures (11). Extractions were performed using the QIAGEN® DNA EZ1®

DNA Investigator® Kit and QIAGEN® EZ1® Advanced XL Instrument (QIAGEN®, Hilden, Germany). Under Standard 9.4 from the FBI Quality Assurance Standards for Forensic DNA Testing Laboratories, all forensic samples are required to be quantified (12). Quantitation is performed using Applied Biosystems® Quantifiler® Duo quantification kit (ThermoFisher®, Carlsbad, CA), and samples are run on an Applied Biosystems® 7500 Real-Time PCR System. The lab uses the Promega® PowerPlex® 16HS System (Promega®, Madison, WI) on Applied Biosystems® GeneAmp® PCR System 9700, followed by capillary electrophoresis on Applied Biosystems® 3130 Genetic Analyzer. Data analysis is performed using Applied Biosystems® GeneMapper® *ID*-X Software.

Results

Crime Breakdown

In the calendar year of 2015, there were 104 total firearm cases with DNA analysis, latent print examination, or both requested. This made up 10% of the total cases worked by the Firearms and Toolmarks section during the year. Of the 104 cases with other examinations, 60 were sent to latent prints (58%), 27 to DNA (26%), and the remaining 17 had both DNA and latent print examinations performed (16%). Crimes against people made up the majority of the 104 cases, representing 45% of them. Weapons offenses were the next highest, making up 23% of the cases, followed by drug crimes with 18% and property crimes with 14%. This data is represented in **Table 1**.

Table 1: Crime type breakdown

Crime Type	# of Cases	% of Cases
CAP	47	45%
WEA	24	23%
DRUG	19	18%
PC	14	14%

A comparison was done to determine what kind of case types are submitted for each analysis. **Figure 1** shows the breakdown for each crime type and where those cases went for analysis. As shown in **Table 1**, nearly half of the firearms cases that requested additional analysis are crimes against people. It was also mentioned that over half of the cases were sent for latent print examination only. The chart shows that for all crime types, the majority of the cases are sent for latent print examination only. For cases that went for both latent print and DNA analysis, 71% of them were in cases of crimes against people. Property crimes had the least amount of submissions.

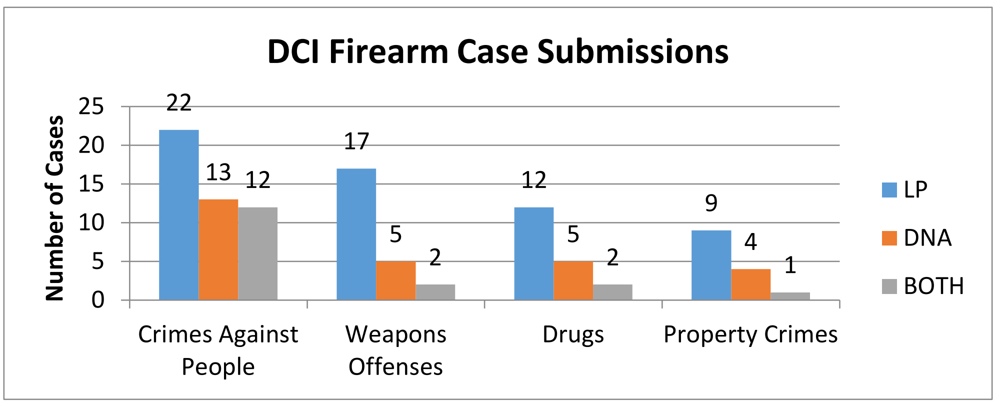

Figure 1: Comparison of case submissions and requests for analyses

Data was also reviewed to see if there was consistency among the percentage of the case types assigned to latent print examination, DNA analysis, or both. For example, crimes against people accounted for 45% of the total cases, but made up 37% of the latent print cases, 48% of the DNA cases, and 70% of the cases that requested both. Weapons crimes had slightly more consistency with 28% of the latent print cases, 19% of the DNA cases, and 12% of the cases with both, shown in **Table 2**.

Table 2: Distribution of crime type and analysis requested

Crime Type	LP Only	DNA Only	LP and DNA	Total % of Cases
CAP	37%	48%	70%	45%
WEA	28%	19%	12%	23%
DRUG	20%	18%	12%	18%
PC	15%	15%	6%	14%

Latent Print Examinations

A total of 100 firearms related evidence was examined for latent prints in 2015. The breakdown of the types of evidence submitted is shown in **Table 3**. Over 50% of the evidence submitted was pistols or magazines from pistols, with the other half coming from revolvers, shotguns, rifles, and ammunition.

Table 3: Evidence submissions for latent print examination

Type	# of Items	# of Developed LP	# of LP Suitable for ID
Pistol	53	20	15
Revolver	14	8	4
Shotgun	13	14	13
Rifle	8	7	6
Ammunition	12	1	1

50 latent prints were developed on the evidence, mostly of firearms, magazines, and one cartridge case. Of those 50 developed latent prints, 39 were considered suitable for identification, meaning that they were of good enough quality that they could be compared to known ten-print cards or uploaded into the Integrated Automated Fingerprint Identification System (IAFIS); a national database maintained by the Federal Bureau of Investigation (FBI). Of the 39 latent prints suitable for identification, 17 were matched to the suspect, 1 to a victim, 1 to a laboratory staff member, 10 were deemed unknowns, 5 were entered into IAFIS and hits

were generated, and 5 were entered into IAFIS without any hits. The data is displayed graphically in **Figure 2**. **Table 3** also shows the breakdown of where the most latent prints were developed from, and how many of those were identified for each evidence type. Other interesting notes to make are that 13 (33%) of the latent prints were from magazines, and 19 (53%) came from long guns (rifles and shotguns). Overall, the success rate per firearm is 24% with a total of 39 prints developed from 24 firearms.

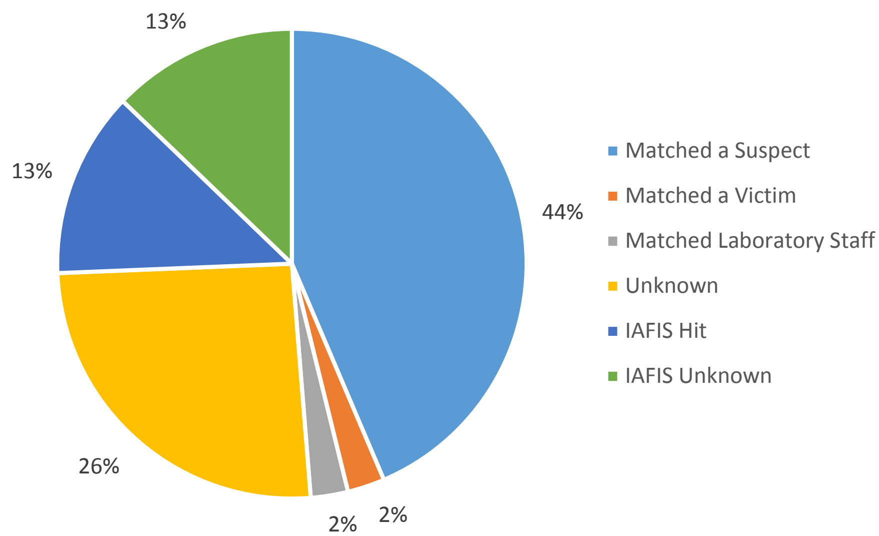

Figure 2: Outcomes of latent print examinations (n=39)

DNA Analysis: Blood

In this research, if blood was detected on a firearm, touch DNA was disregarded due to the fact that blood is often better evidence, in the sense that it will result in a probative profile more often than touch DNA would. Eight firearms and one bullet were found to have blood evidence present, and DNA testing on all nine produced full profiles. Four stains matched a victim, three stains matched a suspect, and two were from unknown persons.

DNA Analysis: Touch

A total of 41 firearms and four types of ammunition were tested for touch DNA including 33 pistols, 6 revolvers, 1 shotgun, and 1 BB gun. From the 41 guns, 67 swabs were taken and DNA analysis was performed. 11 of the swabs produced profiles that were either identified to a suspect or victim, a major contributor was determined, a partial profile was developed, or were eligible for CODIS entry. The remaining 56 either resulted in a mixture that was too mixed for conclusive interpretation or did not produce a profile. These results, shown in **Figure 3**, are good for a 16% success rate. Success was deemed if a case developed an investigative profile. The ammunition failed to produce a profile in each instance, resulting in a 0% success rate (n=4). Ammunition tested included a live .45 caliber round, a .270 Winchester cartridge case, a shotgun shell, and either a 357 Magnum or 38 Special +P round.

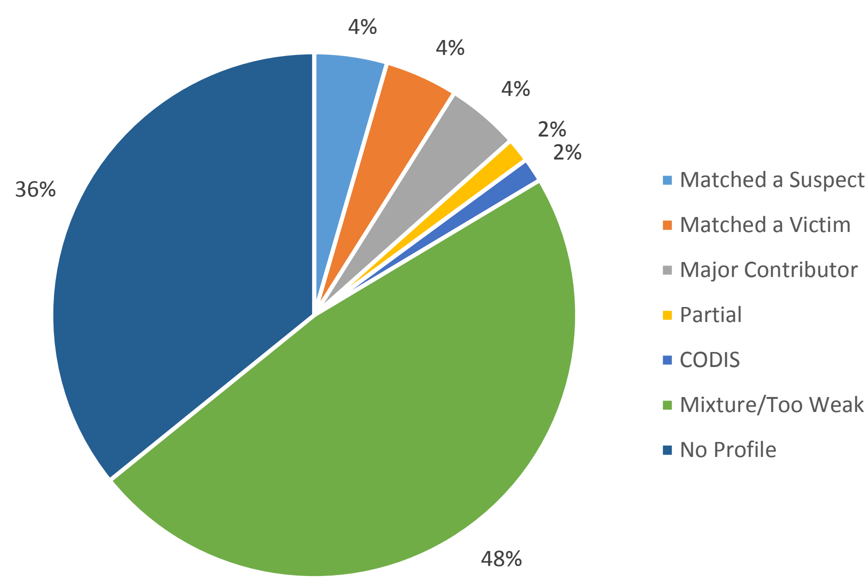

Figure 3: Outcomes of touch DNA analysis (n=67)

The areas of the firearms that were swabbed were also noted, shown in **Table 4**, with special attention being paid to whether a component was swabbed individually, or if the swab was from multiple components of a firearm. Studies have shown that there is better success among swabbing multiple areas, but in the DCI cases, one out of ten swabs with multiple areas resulted in an investigative profile (10%). The most success was noted with swabs from barrels, with two out of six swabs resulting in an investigative profile (33%). Other areas investigated included the grips, magazines, unknown (the location of the swab was not listed), ammunition, and other (areas on a firearm other than ones listed). The most common outcome was a mixture/DNA factors were too weak for conclusive interpretation at nearly 48%.

Table 4: Firearm component swabs and DNA analysis results

Area Swabbed	# of Swabs	# No Profile	# Mixture	# ID	Success Rate
Grips	10	4	5	1	10%
Barrel	6	2	2	2	33%
Magazine	7	4	2	1	14%
Unknown	18	3	10	5	28%
Multiple	10	0	9	1	10%
Ammunition	4	4	0	0	0%
Other	12	7	4	1	8%

Discussion/Conclusion

The majority of the cases are sent for latent print examination over DNA analysis; there is a faster turnaround for their evidence being processed. Fingerprints may also be more cost effective since DNA is expensive and time consuming, especially if they have similar success rates. The parallel is clear as to why CAP is the most represented crime type. If a crime occurs and a human life is harmed or killed, investigators are going to want to use every tool in their arsenal to help solve a crime. This also explains why it accounts for 71% of the cases that had both latent prints and DNA analysis performed. When touch DNA first started being used as an investigative tool, it was typically reserved for property crimes, and we think of latent prints being used commonly in property crimes as well. Over the years, the trend has made a complete reversal, where now there are significantly less property crime case submissions utilizing either latent prints or touch DNA. There were not any consistencies noted in the case type and what analysis method(s) were requested. A reason for this imbalance could be due to the low number of cases evaluated and possibly could be weighted for the fact that latent prints are faster than DNA, and therefore DNA is only used in cases where latent prints are not possible or if there is blood or tissue visible on the firearm.

The most common weapon submitted for latent print analysis was a pistol, which is consistent with the fact that most crimes are committed using handguns, specifically pistols. It is important to note that although 53% of the evidence items submitted were pistols, 33% of the identifiable latent prints came from shotguns. The numbers are skewed partly because shotguns have a larger surface area, and with more surface area comes more smooth surfaces for latent prints to be left behind. In addition, handguns are more commonly going to a textured grip in order to prevent slippage during use, which in turn hinders latent print examination. A 24% success rate is higher than other laboratories are reporting across the country, and was higher than hypothesized by the author.

Every submitted firearm that had blood or tissue present resulted in the development of a full, single source profile. Blood is a great source of DNA, so we would expect to see full, single source profiles from a blood stain unless there is blood from more than one person in a stain. If there was more than one contributor to a stain, the analysis would be more difficult for a criminalist to decipher.

Touch DNA from firearms was successful 16% of the time, which was just above the average reported from other laboratories. With DNA analysis, there are so many variables that can be changed slightly and will determine the quality of the profile obtained after capillary electrophoresis, such as the kits used or instruments used. Different kits have different sensitivities and different instruments have tendencies to create artifacts, so there are several more challenges when comparing DNA methods to different laboratories. It is not surprising that the most common outcome is a mixture, due to the fact that many people may handle a gun and deposit trace amounts of DNA. One study in particular found that secondary DNA transfer is possible and can alter the interpretation of DNA analysis. Two subjects shook hands for two minutes, then one person handled a knife. DNA testing on the knife handle found there to be a mixture in 85% of the samples (13). Therefore, it is possible that this could happen with firearms. Some studies say that swabbing multiple areas is advantageous over swabbing one component at a time. The advantage is that in theory, more DNA will adhere to the swab, but the disadvantage is that more DNA will adhere to the swab. More DNA will lead to a higher order mixtures and complicates analysis. The most successful area found was the barrel, but there were only six swabs analyzed and two produced profiles. Ammunition had a 0% success rate (n=4), which aligns closely to the literature. In this study, it was deemed that the number of samples was too small for true data conclusions to be drawn.

Future Needs

In the future, studies with more cases would be beneficial to create a more accurate representation of the trends. In addition, trends monitored over several years would be useful to track the progression of the fields to see how newer methods may or may not be more successful for the types of firearms evidence a laboratory receives. Continued studies would not only benefit the laboratory, but the forensic science community as a whole.

This research was intended to inform the DCI Criminalistics Laboratory of how the analysis of firearm evidence for latent prints and DNA compared to other labs across the country. A success rate for latent prints was found to be 24%, which was higher than the other reports across the nation, which were closer to 10-15% success. DNA analysis on blood from firearms produced full, identifiable profiles 100% of the time, and touch DNA analysis was successful 16% of the time. From this data, it was found that more cases are requested to be examined for latent prints rather than DNA, and that the internal success in the laboratory was higher for latent print examination. The success rates were also found to be higher than what other laboratories have reported across the nation. The best methods determined from this study were the DNA analysis and latent print examination methods mentioned previously due to no other methods being utilized in this laboratory. Comparisons of methods are suggested to be performed if another method is utilized in the future.

Backlogs demand that analysts do casework day in and day out, but if nobody takes the time to collect and analyze the data, there is not a way to determine how procedures and outcomes compare to other labs across the nation. Time is valuable to an analyst, so it is important that data like presented in this paper are analyzed and results are made known to the analysts. It is important to evaluate the procedures used daily and make changes to improve the product the laboratory puts out daily, and studies like this aim to do exactly that.

Acknowledgements

The research presented in this paper would not have been possible without the help of numerous individuals both from the Iowa Division of Criminal Investigation – Criminalistics Laboratory and the Marshall University Forensic Science Program. The author would like to thank Bruce Reeve, the Laboratory Administrator for all of his help arranging the internship and research project, as well as Gary Licht who is the supervisor of the Firearms and Toolmarks section for providing the author with research materials. In addition, the author thanks Victor Murillo, Carl Bessman, Steve O'Brien, and Mike Tate from the Firearms and Toolmarks Section for offering their time and expertise in firearms and for all of the help they gave me over the course of the internship. Information provided about DNA analysis and latent print processing procedures at the laboratory was greatly appreciated from Brenda Crosby and Richard Crivello, respectfully. Review from DNA Criminalist Supervisor Paul Bush was also appreciated.

Lastly, the author thanks the three reviewers: Victor Murillo, Season Seferyn, and Dr. Terry Fenger. The time you spent overlooking the research, as well as reviewing and giving feedback on this paper was greatly appreciated and it would not have been possible without you.

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