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**PAPER**

**CRIMINALISTICS**

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# Touch DNA Collection Versus Firearm Fingerprinting: Comparing Evidence Production and Identification Outcomes*

**ABSTRACT:** A project by a metropolitan police agency in 2008–2009 had police use touch DNA kits to collect cell samples from seized firearms. To assess outcomes, results of touch DNA swabbing of firearms were compared to fingerprinting firearm evidence. The rationale was that fingerprinting, as the older technology, was the baseline against which to compare touch DNA. But little is known about ways to measure touch DNA productivity compared to fingerprinting. To examine differences between the two requires comparable measurements. Two measures were used: quantity of probative or investigative evidence produced and identification outcomes. When applied to firearms seized within an Indianapolis, IN police district, touch DNA produced a larger volume of evidence than fingerprinting, but identification outcomes for the two methods were equal. Because touch DNA was deployed by police patrol officers, there are implications for firearm forensics and the choice of forensic approaches used by police.

**KEYWORDS:** forensic science, touch DNA, firearms, fingerprinting, evidence collection, police forensics

Touch DNA technology is an evidence gathering approach that attempts to collect and produce viable DNA samples from small quantities of skin cells deposited after an individual has touched objects or places (1,2). Its use expanded in recent years, alongside growth of forensic DNA profiling (3,4). Touch DNA was first used in the United Kingdom around 1999 (5) and 2003 in the United States (6) and has had some success in both countries as a method of identifying suspects in burglaries and vehicle thefts (5,7–9). This success has created pressure on police and forensic agencies to use touch DNA methods for more specific offenses such as firearm crimes or other volume offenses (7,10–12), and touch DNA approaches have diffused widely (13). Touch DNA evidence collection kits are now deployed by a variety of operating police units (e.g., patrols, violent crime units, gun seizure units, auto theft, evidence collection officers, and detectives).

It is not surprising that the use of touch DNA has expanded, for several reasons. DNA analysis "has set the bar higher for other forensic science methodologies, because it has provided a tool with a higher degree of reliability and relevance than any other forensic technique" (14, p. 41) and has a demonstrated capacity to connect persons to evidence items and crime scenes. Considered from the perspective of technique, the collection of touch DNA samples is comparatively easy, involving the use of moist sterile cotton applicators, applied along specific surfaces (e.g., windowsills, firearm magazines, and steering wheels), and stored into evidence containers. Touch DNA samples can be collected by persons with otherwise little background in DNA collection. Collecting touch DNA samples does not necessarily require a fully trained evidence technician or crime scene specialist, and as shown here, rank and file police patrol officers have been asked to perform touch DNA evidence collection. Finally, police administrators can correctly characterize touch DNA evidence kits as tangible initiatives directed at focused targets such as burglaries or firearm recoveries (15).

But it is surprising that the widespread adoption of touch DNA techniques has occurred without much analysis and debate about its comparative effectiveness as an evidence gathering technique. Analysts have identified problems in touch DNA approaches linked to transference, contamination, and low copy number DNA samples (1,16–18). In touch DNA deployment, there is sometimes a marked change from the group traditionally tasked to collect DNA samples—reliance on evidence technicians or crime scene specialists has gradually given way to street patrol officers—which might increase the probability of transfer, contamination, or chain of evidence questions. As well, touch DNA approaches to firearm crime are in the earliest stages and have received few systematic evaluations. In addition to a lack of evaluation of the touch DNA method, there is an absence of studies comparing touch DNA approaches to other forensic methods (13). Further, DNA profiling in the criminal justice system is a comparatively expensive forensic tool, and long DNA testing backlogs are common in public forensic agencies. Assuming expanded use of touch DNA will add to these backlogs, it would be useful to know more about the comparative effectiveness of touch DNA approaches. Add to that the standard principle that new or retooled forensic technologies should be

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thoroughly tested in the field to be adopted or rejected, and it becomes less clear why touch DNA techniques have diffused rapidly when we know little about their effectiveness vis-à-vis other techniques. Even though it has been adopted widely, its effectiveness is untested in comparison with other possible methods of evidence collection.

So, it would seem prudent to identify situations in which touch DNA approaches can be examined to detail their various outcomes or in comparison with other established methods of evidence collection to determine whether touch DNA is demonstrably better than alternative approaches. During 2008–2009, a pilot project was implemented in Indianapolis, Indiana, in which police patrol officers used prepackaged touch DNA swab kits (called TriggerPro) to collect human cell samples from seized firearms. From July 2008 through August 2009, the Indianapolis Metropolitan Police Department (IMPD) East District patrol officers were supplied with TriggerPro kits for use in collecting possible DNA samples from firearms seized during field stops or other criminal incidents. Traditionally, if such samples were desired, evidence technicians or crime scene specialists from either the Indianapolis-Marion County Forensic Services Agency (IMCFSA) or IMPD had used sterile cotton applicators (swabs) and distilled water as the standard touch DNA collection mechanisms. TriggerPro was a self-contained unit of three swabs, moistened by cracking open a surrounding container of antimicrobial fluid, and was to be used by police patrol officers.

Evaluation of the TriggerPro pilot project compared two forensic methods: fingerprinting firearms versus collecting touch DNA samples from firearms. In effect, fingerprinting was the baseline against which TriggerPro was compared. Both methods were examined by comparing production of touch DNA evidence developed from TriggerPro swabs to fingerprint evidence harvested from firearms. Considering both methods, the pilot project focused on two research questions: how much potential forensic evidence was gathered and how useful was that information for suspect identification?

## Touch DNA and Fingerprinting in Firearm Forensics

When firearms are seized, they are processed in different ways by law enforcement and forensic personnel. Firearms can be:

- Photographed or imaged *in situ* (Firearms must be disarmed and rendered safe by police, so further forensic examination occurs after police personnel have handled the weapon.);
- Examined visually for visible fingerprints;
- Subjected to physical and chemical processes to raise latent fingerprint images;
- Swabbed by cotton applicators (i.e., "q-tips") to gather human cells containing DNA;
- Examined for serial numbers (which produce information about manufacturers, distributors, retailers, and owners linked to numbers; and information input into "crime gun" databases to see whether seized firearms are linked to previous cases); and/or
- Test fired, with the fired bullets and cartridge cases examined and submitted to local, state, and federal databases (which produce information on whether the firearm or bullet can be linked to Integrated Ballistics Information System cartridge case and bullet image databases).

Forensic firearm processing involves multiple techniques, and therefore, choices must be made about which techniques to use. The sequence of steps is somewhat fixed (although agency policies might affect the procedures used), but does involve possible decision-making points (which sometimes have high situational or circumstantial components) (19). For instance, a picture of the firearm in the crime scene has to be done at the time it is found. At this point, the police are actively involved due to their frequent contact with firearms in the street. They must confiscate and render firearms safe, but without transferring cells of their own, or otherwise disturbing latent or trace evidence. If responding officers have no camera and the crime scene must be cleared, they must either draw it or commit it to memory. Examining serial numbers could occur immediately or later. Test firing would likely come last, after the firearm has been processed through a police evidence room and transported to the forensic agency.

But before the firearm is test fired (if it is), decisions are required on whether to process the firearm for human cell samples or fingerprints—two procedures that, while not mutually exclusive, are not necessarily fully compatible (12,20). Fingerprint processing increases handling of the firearm by other persons, magnifying risk of cell transference and contamination (8,17,18). Using moist swabs to collect human skin cells can smear or damage latent fingerprint images (i.e., oil and perspiration deposits on the firearm). Studies have found that in cases where fingerprinting precedes DNA swabbing, "most fingerprinting development…techniques do not affect subsequent DNA analysis" (20, p. 732), although the quantities of DNA samples are often reduced (1,16–18). The question of what touch DNA processing does to fingerprint productivity remains open, so uncertainties about the order of forensic techniques have not been eliminated, even if the general practice is to attempt developing fingerprints first, followed by DNA swabbing.

In any event, there is no research on the comparative productivity of DNA swabbing versus fingerprinting for collecting evidence from firearms. Despite a long history of firearm fingerprinting, few studies have examined the productivity of fingerprinting firearm-related evidence items (21). The comparative analyses performed for the TriggerPro evaluation can provide information helpful in making choices about which technique to use and the circumstances conducive to one or the other evidence collection approach.

## Evaluation Terms, Research Questions, and Data

To isolate the impacts of touch DNA applied to firearms, this analysis uses a comparison group approach, in which identification outcomes of touch DNA firearm cases are arrayed against those of firearm fingerprint cases. How should the outcomes of the two techniques be compared? To examine differences between the two requires comparable measurements, yet specifying common identification outcomes is not straightforward, due to differences in the ways touch DNA and fingerprinting are measured. Two outcome measures were used: (i) quantity of probative or investigative evidence produced and (ii) identification results. The way these measures were developed is explained by examining the definition of terms used in the analysis.

### *Working Definitions*

Individualization is "the process of linking physical evidence to a common source … [it is the] assignment of a unique source for a given piece of physical evidence" (22, p. 128). Individualization of fingerprint evidence occurs when a latent fingerprint image is declared by a fingerprint examiner to be that of a specific person. Individualization of touch DNA evidence occurs when the evidentiary DNA profile is linked to an individual's DNA profile "to a reasonable degree of scientific certainty."

*Fingerprint-Related Definitions*

With fingerprints, images of visible or latent prints taken from firearm-related surfaces are examined to identify enough points of comparison to include or exclude an individual from having touched the evidence. Fingerprint analysis is based on comparisons of photographic or digital images of latent prints. Several forensic outcomes are possible. In the first place, fingerprint images obtained from firearms would be examined for suitability. An image is considered suitable when it has a sufficient quality and quantity of fingerprint ridge detail to permit comparison with other images. A more successful situation involves developing a suitable fingerprint image, but no subsequent success in matching it to other known fingerprint samples (no match); the unknown fingerprint image might or might not be uploaded to local, state, or federal data repositories, but it could be. Most successfully, a suspect identification (a match) would occur when the firearm fingerprint was matched to a known individual.

*DNA-Related Definitions*

No viable profile: a DNA sample might produce no viable profile, which yields no useful information.

Inconclusive: the U.S. government's DNA Initiative (23) states that "inconclusive" refers to "a situation in which no conclusion is reached regarding testing done due to one of many possible reasons (e.g., no results obtained, uninterpretable results obtained, no exemplar/standard available for testing)" (p. 5).

Single source: samples of DNA that come from a single source and which could therefore potentially be individualized to a specific person.

Mixture: this is a mixture of DNA samples from different individuals, in which multiple persons left biologic material on the evidence item. Mixtures can be problematic, but are not necessarily without value. Analysts have noted that "one of the most common complications in the analysis of DNA evidence is the presence of DNA from multiple sources… [B]y their very nature mixtures are difficult to interpret" (24, p. 21). Mixtures can produce partial and complete DNA profiles, but because they are products of more than one person, additional analyses are required to parse individual contributions. Mixtures can include major and minor contributors. The major/minor mixture is "a DNA profile where multiple individuals have contributed biologic material and one individual's DNA profile is more apparent" (23, p. 6) and can sometimes prove useful in excluding or including individuals as having contributed the evidentiary sample. Thus, there can be cases where mixtures are successfully used to determine an individual's inclusion or exclusion as contributor to the evidentiary DNA sample. In many other instances, however, individuals cannot be practically separated into distinct contributors, and in those cases, the DNA mixture offers inconclusive results of little or no value.

Complete profile/partial profile: The FBI's Combined DNA Indexing System (CODIS) defines a complete DNA profile as the detailed allele information at each of the 13 core genetic loci used for forensic identification (25). To develop a match, the alleles at each of the 13 core loci in DNA samples collected from the scene or evidence item are compared to the same chromosomal locations developed from a known reference or elimination standard. A complete profile would be composed of all allele information contained at each of the 13 core loci; anything less would be considered a partial profile. Technically, any profile developed from fewer than 13 core loci is by definition partial. Related to this, the FBI officially permits CODIS uploads and searches only on the basis of 13 loci profiles—but that does not mean that profiles with fewer loci have no value or that they contain no useful information. Matches on as few as six to eight (or less) of the core loci can determine that an individual cannot be excluded (or, in the case of nonmatches, can be excluded) as the source of a DNA sample. Unofficially, as practiced by the IMCFSA, CODIS searches are sometimes permitted on fewer than 13 loci, but the FBI will not run searches on fewer than nine loci. The Indiana state DNA database permits uploads for cases with as few as eight of the 13 loci. Thus, partial profiles can have investigative value under some circumstances. Nonetheless, the value of partial DNA profiles for investigations or trials is controversial and contingent on how many and which of the 13 core loci are involved (24,26–28).

The IMCFSA classified DNA identifications in one of three ways: (i) no match between the DNA sample and reference sample, (ii) the DNA sample cannot exclude the source of reference sample as a contributor, or (iii) a match between the two. The first classification has investigative value because it eliminates a suspect. The second classification also has investigative value, but is ambiguous and limited in its power of individualization; there might be some value added if it is used in other future DNA profile searches. The third classification has value because it definitively links the sample to a suspect. The IMCFSA DNA section referred to the ii and iii classifications above as, respectively, nonstats or stats identifications. In a nonstats identification, a partial match between the profiles from the evidence item and reference standard means the suspect cannot be linked uniquely to the DNA sample, but cannot be excluded as a possible contributor. In a stats identification, statistical calculations are provided once a match is established between a DNA profile from the evidence item and the DNA profile from a provided reference standard. According to the IMCFSA, an "identity-to-the-source statement" accompanies a match where calculations render statistical results that mean it is virtually certain that a suspect with a matching profile is the source of the evidentiary sample.

*Research Questions*

*Production of Forensic Evidence*—As different methods of collecting firearm evidence, what is the comparative effectiveness of touch DNA swabbing versus fingerprinting? For a given seized firearm, does it produce a viable latent fingerprint or a DNA profile? A viable DNA sample could be a partial or complete profile, while a fingerprint was either a suitable image or not. In effect, touch DNA has two possible successful outcomes and fingerprints only one. This can be shown by examining the outcome metrics used. The measure of success for fingerprinting is development of at least one viable fingerprint image (from firearm-related evidence) capable of being linked to a person or useful for further investigative or forensic purposes (e.g., searching a forensic database). The measure of success for touch DNA swabbing is production of at least one DNA profile capable of including or excluding an individual as having contributed DNA to the firearm. A complete DNA profile has the highest (potential) value. A partial DNA profile has value if it is at least capable of including (not excluding) an individual as a possible contributor.

*Use of Evidence for Identification*—If usable forensic evidence is collected, what is the effectiveness of touch DNA swabs compared to fingerprints to provide a positive identification? This question focuses on the frequency a viable DNA profile or fingerprint was obtained from firearms and used to link an individual to the firearm or fail to exclude an individual from having contributed to the sample. The comparison involves the probability a recovered firearm will produce some type of DNA profile that can be matched to a reference (suspect) sample versus the probability that a recovered firearm will produce a viable fingerprint that is matched to an individual. The identification outcome is confirmation or exclusion of a suspect as the sample contributor.

### *TriggerPro and Firearm Fingerprint Data*

Gun swab cases and gun fingerprint cases were drawn from the same operating field environment: the IMPD East District over a two-year period from July 2007 to August 2009. TriggerPro cases were developed from IMPD East District firearm incidents. During the July 14, 2008–August 31, 2009 period in the East District, there were 831 firearm cases, and of those, 164 became TriggerPro cases. Complete data on 160 of the TriggerPro cases were assembled from IMCFSA laboratory information management system (LIMS) reports.

Data on gun fingerprint cases were obtained from the IMCFSA and the IMPD latent fingerprint unit. To establish a set of gun fingerprint cases as a comparison group, IMPD East District firearm cases in the year preceding the TriggerPro project (July 1, 2007–June 30, 2008) were examined to identify cases that had gun-related evidence items and requests to process fingerprints from those items. During this period, there were 705 firearm cases in the East District, and of those, 147 cases had fingerprint-related requests recorded by IMCFSA. Data on latent fingerprint development and examination requests were extracted from the IMCFSA LIMS. For cases that produced viable prints, the IMPD fingerprint unit provided additional information regarding the use of those prints in identifying individuals.

## Analysis

### *Results of Gun Fingerprinting*

Of the 705 total firearm cases in the East District from July 1, 2007 to June 29, 2008 (Table 1), about 42% (299) were submitted for further evidence processing by the IMCFSA. Thus, less than half of gun cases had any additional forensic examination. There were 117 of these 299 cases that had no firearm-related evidence, leaving 182 cases with firearm evidence. However, fingerprint-related requests were not always made for an evidence item, so a smaller number of cases generated fingerprint-related requests. Among the 182 cases with gun evidence, latent fingerprint development or examination requests were submitted for 147 cases. These cases produced requests for processing 503 gun-related evidence items, which included 184 firearms.

In terms of firearm cases, given that a latent fingerprint examination was requested for gun-related evidence, what kind of potential forensic evidence was produced? Eighteen cases reported successful development of viable prints, and three additional cases produced print examination requests. This reflects 14.3% (21/147) of the cases for which print-related requests were made. When prints were developed, to what extent were they useful for purposes of suspect identification? From the 21 cases that reported viable prints for examination, four (2.7% of 147 gun fingerprint cases) produced identifiable prints individualized to a specific person. Another seven cases (4.8%) produced identifiable prints that could be used for investigative purposes or uploaded to local, state, or federal fingerprint systems. The remaining seven cases produced unidentifiable prints. Given that a gun-related fingerprint request was made for a case, the likelihood of positive results (fingerprint images of probative or investigative value) was 7.5% (11/147).

TABLE 1—*Summary of fingerprint requests and results, by cases.*

| Cases | *N* or % | Notes |
|---|---|---|
| Total gun cases in East District | 705 | Included in gun tracking files for East District, July 1, 2007 to June 29, 2008 |
| Gun cases with LIMS case number | 299 | Cases with IMCFSA LIMS number assigned |
| % Total gun cases | 42.4 | Percent of gun cases resulting in an IMCFSA case number (any evidence request) |
| Number with nongun-related evidence | 117 | These cases had other nongun-related evidence (excluded from this analysis) |
| LIMS cases with gun-related evidence items | 182 | Net number of cases with gun-related evidence requests |
| % Total gun cases | 25.8 | Percent total gun cases with gun-related evidence items (182/705) |
| Cases with latent print (LP) requests | 147 | Cases with gun-related evidence for which one or more LP requests were made |
| Cases reporting "viable prints developed" | 18 | Cases for which LP were found in response to an evidence request |
| Cases with LP examination requests | 3 | Cases with requests for latent fingerprint examinations only |
| % Cases with LP requests | 14.3 | Percent cases with LP requests that produced viable prints (21/147) |
| Cases with viable prints producing positive ID | 4 | Fingerprint images linked to an identified individual (individualized) |
| % Cases with LP requests | 2.7 | Percent cases in which fingerprints were individualized (4/147) |
| Cases with viable prints producing identifiable prints | 7 | Identifiable fingerprint images, not linked to individual (IAFIS uploadable) |
| % Cases with LP requests | 4.8 | Percent cases in which fingerprints could be (but were not) individualized (7/147) |
| % LP cases with probative/ investigative value | 7.5 | Percent cases with actual or potentially individualized fingerprints (11/147) |

Sources: Indianapolis-Marion County Forensic Services Agency (IMCFSA) laboratory information management system (LIMS), May–June 2009. IMPD firearm tracking files.

IAFIS, Integrated Automated Fingerprint Information System.

In terms of evidence items, among the 182 cases for which gun-related evidence items were submitted, there were 583 evidence items (e.g., cartridges, magazines, rifles, and pistols) (Table 2). Fingerprint requests were not submitted for all items, but fingerprinting was the most common technique used—there were 503 evidence items with latent print development or examination requests reported. From these 503 items, a total of 23 items (4.6%) produced viable prints. Only some of these items resulted in latent prints suitable for comparison: four items (<1%) produced prints that could be and were individualized and another 11 items (2.2%) produced prints suitable for comparison but were not individualized. After examination, the remaining eight evidence items had no prints suitable for comparison. Three percent (15/503) of gun-related evidence items for which latent print requests were submitted produced fingerprint images of probative or investigative value.

Some gun-related evidence items were more likely to produce viable fingerprints than others (Table 3). While cartridges or bullet casings represented the largest number of evidence items submitted for latent fingerprint analysis, <1% of the 201 items resulted in viable prints. In contrast, other gun-related evidence (e.g., holsters, ammunition cases) resulted in viable prints 25% of the time. Long guns (rifles and shotguns) and firearm magazines were more likely to produce viable prints (13.6% and 10% of evidence items, respectively). Automatic pistols and revolvers produced viable prints about 4–5% of the time. Based on the chi-square statistic, an association exists between the type of firearm-related evidence and viable print production.

TABLE 2—*Summary of fingerprint requests and results, by evidence items.*

| Evidence Items | *N* or % | Notes |
|---|---|---|
| Total gun-related evidence items | 583 | These were items submitted from the 182 LIMS cases with gun-related evidence |
| Gun-related evidence items with latent print (LP) requests | 503 | LP development requests were made for these items |
| Gun-related evidence items with viable prints developed | 23 | Items that produced "viable prints" |
| % Gun-related items with LP requests | 4.6 | Percent gun-related evidence items producing viable prints (23/503) |
| Identifiable and individualized | 4 | Fingerprints from evidence item were linked to a specific, identified individual |
| % Of evidence items with LP requests | 0.8 | |
| Identifiable, not individualized | 11 | Fingerprints could be identified, but were not linked to an individual (IAFIS uploadable) |
| % Of evidence items with LP requests | 2.2 | |
| Not identifiable or no examination request | 8 | No LPs of value for comparison |
| % Of evidence items with LP requests | 1.6 | |
| % LP evidence items with probative/investigative value | 3.0 | Percent evidence items with actual or potentially individualized fingerprints (15/503) |

Sources: see Table 1.
IAFIS, Integrated Automated Fingerprint Information System.

TABLE 3—*Summary of latent fingerprint development, by type of evidence items.*

| | Viable Prints Developed? | | | |
|---|---|---|---|---|
| Type of Gun-Related Evidence | No | Yes | Total | Yes Rate (%) |
| Cartridge or casing | 200 | 1 | 201 | 0.5 |
| Pistol | 115 | 4 | 119 | 3.4 |
| Magazine | 99 | 11 | 110 | 10.0 |
| Revolver | 41 | 2 | 43 | 4.7 |
| Rifle or shotgun | 19 | 3 | 22 | 13.6 |
| Other gun related | 6 | 2 | 8 | 25.0 |
| Total | 480 | 23 | 503 | 4.6 |

Sources: See Table 1.
$\chi^2 = 27.27$, df = 5, $p < 0.001$.

*Results of TriggerPro Cases*

TriggerPro gun swab kits were field implemented in the IMPD East District from July 14, 2008 through August 31, 2009. Based on IMCFSA summary reports, there were 164 separate cases developed that used TriggerPro kits. Complete information was available for 160 cases. The 160 TriggerPro cases involved 182 firearms and comprised about 20% of all 831 firearm cases occurring in the IMPD East District during the pilot period (Table 4). Of the 160 cases, the most frequent result (42%) was the collection of DNA mixtures from more than one individual. About 36% of the cases ($n = 57$) resulted in the creation of partial profiles from a single source. A complete DNA profile from a single source was the rarest outcome—this occurred in 8 (5%) of the 160 cases. Thirty-five percent of the TriggerPro cases ($n = 56$) did not produce enough DNA material for further processing and thus did not generate usable profiles.

The types of DNA profiles produced by the TriggerPro kits can be seen more clearly if examined in terms of the evidence items (i.e., gun swabs) (Table 5). Among all 160 cases, there were 529 TriggerPro gun swabs submitted as evidence. Of these swabs, nearly 70% ($n = 367$) were processed for DNA samples. Nearly one-half of the 367 processed TriggerPro swabs were either a single-source partial profile (24.3%) or a partial profile from a mixture (23.2%). Complete profiles from a single source were obtained from 13 swabs (3.5%), while complete profiles from a mixture were obtained 11 times (3%). Partial profiles from mixtures with major and minor contributors were produced from 12 swabs (3.3%). The remaining 157 swabs (42.8%) produced no results (e.g., inconclusive, zero results, not enough DNA). Later, it is shown that there is a relationship between the type of DNA profile and identification outcomes, so the types of profiles developed are important.

Considering TriggerPro on the basis of cases (Table 4), some of these DNA profiles obtained from processing TriggerPro kits resulted in useful identification outcomes. The IMCFSA review of the TriggerPro cases reported on whether, if produced, a

TABLE 4—*Summary of TriggerPro findings by case.*

| Cases | *N* or % | Notes |
|---|---|---|
| Total gun cases in East District | 831 | Firearm incident/cases in East District, July 1, 2008 to August 31, 2009 |
| TriggerPro (TP) cases completed | 160 | Processed as of May 1, 2010; four additional cases still under way |
| % Total gun cases | 19.3 | |
| TP cases providing | | |
| Complete single-source profile | 8 | Complete profiles developed from a single source |
| % Total TP cases | 5.0 | |
| Partial single-source profile | 57 | Partial profiles developed from a single source |
| % Total TP cases | 35.6 | |
| DNA mixtures (not single source) | 67 | TP cases producing DNA mixtures from two or more persons |
| % Total TP cases | 41.9 | |
| No usable DNA profiles | 56 | TP cases that produced no profiles |
| % Total TP cases | 35.0 | |
| Stats ID | 4 | Profiles that can be individualized to a specific person |
| % Total TP cases | 2.5 | |
| Nonstats ID | 15 | Profiles that cannot exclude a person as the sample contributor |
| % Total TP cases | 9.4 | |

Source: Data adapted from IMCFSA summaries.
A single case can produce multiple profiles. Therefore, % of no profiles, complete, partial, and mixtures will not sum to 100%. There were 13 TriggerPro cases that originated in other IMPD districts.

DNA profile resulted in any type of suspect identification—a stats ID in which the chances that anyone else contributed to the crime scene sample are miniscule or a nonstats ID in which an individual cannot be excluded as a potential contributor. Four cases (2.5%) produced stats IDs, and 15 cases (9.4%) produced nonstats IDs. Thus, nearly 12% of the TriggerPro cases provided profiles that had probative and investigative value.

Table 6 links the types of DNA profiles developed from TriggerPro cases with the suspect identification outcomes reported. Cases with various mixture combinations had a higher likelihood of producing stats or nonstats identifications than the cases that had various types of single-source profiles. Among the 42 cases from which gun swabs produced only mixtures, eight of the 15 nonstats identifications and three of the four stats identifications were developed (these mixtures generally had major/minor contributors). Based on the chi-square statistic, an association exists between the type of DNA profile developed and identification outcomes. This seems important because touch DNA methods like TriggerPro—especially if applied to firearm-related evidence items—will produce more DNA mixtures that, based on the pilot project data, can offer potentially useful identification information.

### *Identification Outcomes: Firearm Fingerprinting Versus TriggerPro*

Comparing gun-related fingerprint cases and evidence items to TriggerPro cases and evidence items suggests that touch DNA gun swab methods generate a more sizable quantity of potentially usable forensic evidence (Table 7), but this potential does not translate into an equally larger number of valued identification outcomes. Nearly two-thirds (104/160) of TriggerPro cases produced some type of DNA profile. Yet, the much larger number of TriggerPro cases with profiles did not result in a similarly larger number of the highest value individualized identifications (2.5% of gun swab cases vs. 2.7% of fingerprint cases). The TriggerPro cases produced nonstats identifications (i.e., could not exclude an individual as the contributor) at about twice the rate fingerprint cases produced identifiable (but not individualized) fingerprint images (9.4% vs. 4.8%, respectively, but not statistically different).

In the comparisons of evidence items, about 5% of gun-related evidence items produced viable fingerprint images, while 57% of the TriggerPro evidence items (gun swabs) resulted in DNA

TABLE 5—*Summary of TriggerPro findings by evidence items (swabs).*

| Evidence Items | N or % | Notes |
|---|---|---|
| Total gun swabs used in 160 cases | 529 | Sum of gun swabs reported in all TriggerPro (TP) cases |
| TP gun swabs processed | 367 | Sum of gun swabs processed |
| % Total gun swabs used | 69.4 | |
| Gun swabs providing | | |
| Complete single-source profile | 13 | Complete profiles developed from a single source |
| % Total swabs processed | 3.5 | |
| Partial single-source profile | 89 | Partial profiles developed from a single source |
| % Total swabs processed | 24.3 | |
| Complete mixtures | 11 | Complete profiles developed from mixtures |
| % Total swabs processed | 3.0 | |
| Partial mixtures | 85 | Partial profiles developed from a mixture |
| % Total swabs processed | 23.2 | |
| Partial mixtures (maj/min) | 12 | Partial profiles developed from a mixture (w/major + minor) |
| % Total swabs processed | 3.3 | |
| Other results | 157 | Inconclusive results, zero results, not enough DNA, etc. |
| % Total swabs processed | 42.8 | |

Source: Data adapted from IMCFSA summaries, March 11, 2010.
Maj/Min refers to major and minor contributors. % total swabs processed might not add to 100% due to rounding.

TABLE 7—*Comparison of fingerprint and TriggerPro findings.*

| Evidence Items | Fingerprint Cases | TriggerPro Cases |
|---|---|---|
| Total cases with forensic requests | 147 | 160 |
| Cases producing | | |
| Viable fingerprint images or DNA profiles | 21 | 104 |
| % Total cases | 14.3 | *65.0 |
| Positive ID or stats ID | 4 | 4 |
| % Total cases | 2.7 | 2.5 |
| Identifiable prints or nonstats ID | 7 | 15 |
| % Total cases | 4.8 | 9.4 |
| Total evidence items processed | 503 | 367 |
| Evidence items producing | | |
| Viable fingerprint images or DNA profiles | 23 | 210 |
| % Total evidence items | 4.6 | *57.2 |
| Positive ID or stats ID | 4 | 4 |
| % Total evidence items | 0.8 | 1.1 |
| Identifiable prints or nonstats ID | 11 | 15 |
| % Total evidence items | 2.2 | 4.1 |

DNA profiles include cases resulting in single-source or mixture-based profiles of any type. Positive ID refers to fingerprint images that are individualized.
*Difference in proportions $z$-score, $p < 0.001$.

TABLE 6—*Types of DNA profiles produced by TriggerPro cases and suspect identification outcomes.*

| | Suspect Identification | | | | |
|---|---|---|---|---|---|
| Profiles Produced in TriggerPro Cases | No ID Information | Nonstats ID | Stats ID | Total | % Total = Stats or Nonstats ID |
| Single-source complete + single-source partial | 3 | – | – | 3 | 0 |
| Single-source partial | 28 | 3 | – | 31 | 9.7 |
| Single-source complete | 3 | – | – | 3 | 0 |
| No profiles | 56 | | | 56 | 0 |
| Mixture + single-source partial | 19 | 4 | – | 23 | 17.4 |
| Mixture + single-source complete | 1 | – | 1 | 2 | 50.0 |
| Mixture only | 31 | 8 | 3 | 42 | 26.2 |
| Totals | 141 | 15 | 4 | 160 | 11.9 |

Source: IMCFSA summary reports, March 11, 2010.
A single case can produce multiple profiles. Table cells indicate the number of cases that produced one or more profiles of the types described in the first column on the left. For example, the first line shows that three cases produced at least one single-source complete profile and one single-source partial profile, but none of the three cases resulted in a stats or nonstats ID.
$\chi^2 = 38.74$, df = 12, $p < 0.001$.

profiles ($z$-score $p < 0.001$). However, the vast majority of those profiles had no identification value for the current cases, although it is possible that they could help with future DNA searches in forensic databases. As a proportion of total evidence items, the most valued identification outcomes were produced by 3% of gun-related fingerprint evidence and 5.2% of TriggerPro evidence, statistically insignificant differences.

## Discussion and Implications

This analysis focused on only two of the various approaches to firearm processing: touch DNA and fingerprinting. A full accounting of forensic firearm processing impacts would include outcomes linked to serial number reviews and test firing results to determine whether they produce hits from other firearm and ballistics databases. Setting those broader outcomes aside, the final sections discuss findings and their implications for forensic science.

### *Quantity and Use of Forensic Evidence Produced*

If considered as the baseline method, fingerprinting firearms had perhaps a higher rate of viable print production than originally suspected (mostly based on anecdotal stories, with few previous studies reporting the fingerprint productivity of firearm-related evidence). About one in five gun cases (147 of 705) resulted in requests for latent print development. If investigators asked for prints, viable prints were generated in 14.3% of the cases. Of the 147 gun cases with print requests, 7.5% (11 cases) produced suitable images that either were or could be individualized. TriggerPro produced more potentially useful evidence than firearm fingerprinting—but just because a DNA profile was developed did not mean it had any value for identification purposes. The TriggerPro kits collected a substantial amount of DNA material (i.e., the sum of single-source DNA samples and DNA mixtures). Measured this way, 57% of gun swab evidence items, or 65% of TriggerPro cases, generated DNA profiles.

### *Identification Outcomes*

The TriggerPro touch DNA cases fared only somewhat better than fingerprint cases when considering identification results. Despite the larger quantity of DNA material collected with TriggerPro gun swabs, identification outcomes between the two methods were similar. The higher volume of forensic evidence collected by TriggerPro kits did not translate into a larger number of identifications than gun fingerprinting. The incidence of positive identifications in the two groups was equivalent—fingerprinted items yielded a 0.8% rate (4/503 items), compared to a 1.1% rate for gun swabs (4/367 items)—not a significant difference. The sample of firearm fingerprint cases produced 11 identifiable (though not individualized) fingerprints, while the TriggerPro gun swab cases produced 15 additional DNA profiles capable of including or excluding the suspect's reference sample (i.e., nonstats IDs). The rate of success among fingerprint evidence items and DNA evidence items was not statistically different.

### *Implications for Forensics and Policing*

The TriggerPro evaluation raises various questions about police use of touch DNA, forensic processing of firearms, and the use of different evidence collection approaches. For example, who collects DNA—the responding police patrol officer or some other party? The TriggerPro kit was designed for deployment in the field by patrol officers and evidence technicians (sworn or civilian). This analysis offered little insight into the issue of whether prepackaged touch DNA kits should be utilized by a responding patrol officer or better left to evidence technicians or other crime scene specialists. Police patrol officers might be more effective if they are not asked to use touch DNA evidence collection kits and instead deployed more quickly to the next run. Police patrol use of touch DNA reflects an implicit decision that the marginal benefits of DNA collection are greater than that of additional patrol resources made available if touch DNA is not used by officers.

Nevertheless, if prepackaged kits such as TriggerPro were implemented routinely in police patrol, the pattern of their use would change, based on judgments about the circumstances under which touch DNA evidence is best acquired. As a pilot, one objective of the TriggerPro project was to swab as many guns as possible in as short a time as possible to assess the effectiveness of the kits in collecting human cell samples. Firearms might have been swabbed during the pilot that would not have been swabbed under normal circumstances (e.g., gun taken directly from an individual's pocket). It was also clear that many firearms recovered in the East District during the pilot period were not swabbed—TriggerPro cases were only about 20% of all East District firearm incidents during the time period of the pilot project. (In comparison, firearm fingerprint requests were about 20% of the IMPD East District firearm cases in the previous year.) Thus, the findings for this pilot cannot be broadly generalized.

Another question involves choices patrol officers or evidence technicians must make when processing crime scene evidence. What items should be submitted for further forensic processing? For fingerprinting requests, the type and amount of evidence mattered (e.g., cartridges vs. rifles vs. handguns), but this question was not examined in the TriggerPro cases. Trigger Pro evidence items were by definition swabs, and the locations from which swab samples were taken (e.g., barrel, grip, hammer, cartridge, holster, etc.) were not reported in the LIMS data. Some parts of a firearm might be more or less likely than others to produce viable DNA samples. A recent analysis of firearm DNA swabbing by the Illinois State Police found grips and slides to be the most productive sources (as measured by average number of loci profiled) (29).

A last set of issues concerns the comparative effectiveness of touch DNA swabs versus fingerprint approaches in terms of time required and costs involved to complete full forensic processing. The more complex scientific processing associated with developing and analyzing DNA samples—in comparison with developing or examining latent fingerprint images—means DNA-related evidence requests are likely to take longer to complete and be more expensive than fingerprint-related requests. In calendar year 2009, the IMCFSA turnaround time for latent fingerprint processing was 43.2 days, compared to 72 days for DNA processing (30). In an investigative sense, police and prosecutors would obtain fingerprint evidence back sooner than they would receive DNA evidence. If there is little difference in identification outcomes, the longer time period required and higher implied costs of touch DNA processing might suggest more emphasis on firearm fingerprinting as the most cost-effective technique. Accordingly, both the time element and costs associated with touch DNA evidence processing deserve more detailed analysis before widespread adoption. Overall, more analyses are needed of touch DNA use by police and forensic agencies within different operating environments to develop a better understanding of its effectiveness under different operating circumstances and in comparison with other forensic methods.

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