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A Historical Review of the Demand for Forensic Evidence

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Introduction

There have been many significant improvements and dramatic growth of forensic crime laboratories capabilities in the past half-century. The number of facilities, size of laboratory operations, and the sensitivity and precision of scientific tests have all increased (Durose, Walsh, & Burch, 2012). The ability of forensic examiners to characterize biological evidence using DNA testing methods has been the most notable of many scientific breakthroughs; the speed and sensitivity of laboratory techniques to examine traces of DNA have improved dramatically (National Institute of Justice, 2013). Computerized databases to store DNA profiles, fingerprints, and firearms- and ammunition-related information have been established and continue to expand daily, enabling investigators to solve cold cases and identify offenders leaving behind crime scene evidence. Growing approximately fourfold in the past 50 years, the more than 400 publicly funded forensic crime laboratories in the nation offer improved scientific services to law enforcement, and important contributions to the overall system of justice. The profession has also instituted many improvements to raise standards of education, training, operations, and quality-control steps within these laboratories (Bashinski & Peterson, 2003). In addition, the criminal justice system has grown to expect forensic science results in major criminal investigations and prosecutions that has, in turn, increased the demand for scientific evidence.

Estimating the Demand for Forensic Evidence

Although demand for scientific services has increased over the years, there are various factors that also limit the demand for forensic evidence and the ability of the profession to respond to it. The crime laboratory field continues to be hit with periodic controversies that cause concern over the scientific integrity of individual analysts, crime laboratories, and the profession itself (Balko, 2011; Clark, 2012). The 1993 U.S. Supreme Court decision *Daubert v. Merrell Dow Pharmaceuticals*, which set new minimum standards for the admissibility of scientific evidence, continues to challenge the forensic field (see also *Kumho Tire Co. v. Carmichael*, *General Electric Co. v. Joiner*). The 2009 National Research Council report, *Strengthening Forensic Science*, has also raised serious concerns over the scientific foundation of laboratory examination and data interpretation practices employed in many areas of forensic science testing.

While research shows that resources devoted to forensic scientific testing have increased, actual budgets have not increased at a pace to examine all submitted evidence, let alone all available physical evidence at crime scenes. Recent data will be presented in this chapter that show that use of scientific evidence still occurs in only a small percentage of criminal cases, and only a fraction of physical evidence available at crime scenes is actually collected and examined. Available scientific evidence may be filtered out at the crime scene itself or, if collected, remains in police evidence rooms unexamined because investigators do not request testing. Investigator failure to request an examination of submitted evidence is common and a reflection of various factors: long testing turnaround times, poor investigator training, a belief that testing would not be helpful in a given case, and concern about placing added demands on limited laboratory resources. This chapter will explore the critical interface between investigators and crime laboratories, and examine the reasons why much available physical evidence goes unexamined.

The demand for forensic evidence test results, and the ability of the system to respond, is a complex issue that depends on various factors, ranging from limited laboratory resources to a reluctance of investigators and prosecutors to request testing be done. At base, parent police organizations do not allocate sufficient resources to the crime scene investigation units and crime laboratories to capture and analyze available physical evidence. This chapter will begin with a discussion of forensic evidence potential, will proceed through a historical review of physical evidence utilization rates, and present recent research results that show most available physical clues are filtered by different personnel before completion of laboratory analysis. The chapter concludes with results of a recent study that shows physical evidence affects arrest, charging, and sentencing. and asks the question, "Why don't agencies capitalize on such findings and allocate needed resources to forensic crime laboratories?"

What Is Physical Evidence and What Can It Tell Us?

Much of the technical literature of forensic science over the decades, in academic texts and training manuals, has centered on the "theoretical" types of assistance that the scientific analysis of physical evidence can provide to investigators, prosecutors, and other legal fact-finders (Fisher & Fisher, 2012). This literature clearly delineates the potential that physical evidence can offer but does not consider how related information in active investigations may inflate or deflate that potential. Guidance present in most forensic training texts stresses that it is of the utmost importance to collect all available evidence at scenes because these physical traces are perishable, and one never knows early in an investigation if particular evidence might prove critical in solving a case. Forensic science practitioners and authors advise that scientific evidence examinations have the potential to offer investigators the following types of information (see Johnson et al., 2012; Peterson et al., 2010).

IDENTIFICATION

The great bulk of physical evidence that is examined in the forensic crime laboratory focuses (initially, at least) on the identification of various materials. This can range from the identification of confiscated drugs and other controlled substances, the identification of alcohol and poisons in toxicological samples, and the identification of volatile liquids that can be identified in the debris collected from scenes of suspicious fires. The identification of controlled substances such as marijuana, heroin, cocaine, and methamphetamines make up the great bulk (as high as 70% of total caseloads) of evidence analyzed by crime laboratories. This drug caseload has remained remarkably high for the past 40+ years as drugs and narcotics became a major law enforcement and social problem in the late 1960s, and where a chemical identification of the substance is essential for a successful prosecution. Identifying the specific type of substance can be the starting point for many examinations and move the process forward.

CLASSIFICATION

Forensic crime laboratories will not only identify the unknown substance (e.g., blood, paint, or a synthetic fiber) but also place it in a more restricted category such as human blood, acrylic blue paint, or rayon. This additional classification may aid in determining the possible origin of the unknown material and thereby show that it could or could not have originated from a particular person, object, or crime scene. The more narrowly defined the classification is, the greater the likelihood that questioned evidence could have shared a common origin with a known sample of comparable evidence. If an item's class characteristics are clearly different from a known sample, the examiner may definitively conclude they did not share a common source.

INDIVIDUALIZATION/DETERMINATION OF COMMON ORIGIN

Such a finding means the examiner is able to conclude an item of evidence of unknown source originated from a particular perpetrator, victim, or tool/firearm used during the course of a crime. Such evidence transfer between an offender and victim or physical scene helps to place persons at particular locations and can be highly incriminating. Examiners will compare evidence of unknown origin (such as a latent fingerprint, spent bullet, or biological stain) with a reference sample of known origin (a set of fingerprints taken from a suspect, a projectile test fired from a suspect's weapon, and blood or DNA sample taken from a particular person of known identity). These findings are termed "individualizations" and have the potential to link a person, weapon, or tool to a crime. In practice, such individualizations that connect a suspect to a scene or victim are quite unusual and largely limited to latent fingerprints, biological stains, and firearms-related evidence. Examinations of other mass-produced synthetics, construction materials, and even botanical evidence can usually only show they are indistinguishable or similar in all measurable characteristics with evidentiary materials. Typically, a forensic examiner may offer a partial or potential association, but not a true individualization.

Individuality may be the "holy grail" of criminalistics, but DNA testing of biological fluids is one of the few types of physical evidence where scientific data clearly support the individuality of the evidence. In fact, the recent 2009 NAS *Strengthening Forensic Science* report concluded that most other types of pattern physical evidence—from latent fingerprints, firearms/toolmarks, shoeprints, and handwriting to bitemarks—lack a solid scientific foundation to form such conclusions. The long biomedical history of DNA testing, and the collection of extensive data on the uniqueness of DNA characteristics from populations around the world, affords it the scientific basis to form such individuality conclusions. Even latent fingerprint examiners must use caution in concluding a partial latent fingerprint found at a crime scene originated from a particular suspect, because the field lacks empirical data on the number and type of fingerprint minutiae needed to form common origin conclusions. Computerized databases of DNA, fingerprints, and bullet and shell casings have enhanced the ability of criminalists to narrow their search and to link questioned evidence to a small group of possible suspects or firearms. After a review of candidate matches, follow-up examination by knowledgeable experts can confirm the match.

Automated Fingerprint Identification System (AFIS), National Integrated Ballistic Information Network (NIBIN), and Combined DNA Index System (CODIS) databases holding digital information on fingerprints, firearms ammunition, and known DNA profiles have enhanced the ability of forensic laboratories and identification bureaus to use evidence from a crime scene to solve "whodunit" and cold cases, and identify an otherwise unknown offender. Before such digital reference collections, investigators needed known standards from one or more suspects with whom they could compare crime scene evidence. This greatly restricted the use of physical evidence to aid in the solution of these challenging cases. Now, digital evidence collections have the ability to assist with these investigations and sort through this evidence. Cold "hits" exploiting such crime scene evidence when querying these databases have helped investigations tremendously.

Crime scene investigators still have the daunting task of locating evidence at a crime scene that will link the actual perpetrator to a crime. Finding such evidence at a scene can be very challenging as the investigator is required to assess large quantities of physical materials in the environment, much left by victims or other persons who had legitimate access to the crime scene. Most physical materials at a scene do not implicate the perpetrator or have little bearing on the investigation. Through training and experience, and by focusing on entry, exit, and "target areas" of the crime scene, the skilled investigator can select the most viable evidence. Investigators must be discriminating and not "scoop up" everything they see; crime laboratories do not have the resources to accept and evaluate all such materials and must rely on crime scene search officers to make discriminating choices.

In recent years, many agencies have focused on potentially available DNA evidence at scenes of crimes that may identify or confirm the identity of suspects. The National Institute of Justice (NIJ), in particular, has encouraged the use of DNA techniques and databases in cold and unsolved case investigations, and encouraged coordinated approaches among investigators, prosecutors, and crime laboratory personnel. NIJ has also been active in promoting the use of DNA in property and minor offenses (in particular, see Roman et al., 2009). The growth of the national CODIS database is enhancing these procedures (now reinforced by the recent U.S. Supreme Court *King v. Maryland* decision upholding the collection of DNA from arrestees). A brief summary of these DNA efforts is included in Peterson, Hickman, Strom, and Johnson (2013).

RECONSTRUCTION

One of Peterson, Mihajlovic, and Gilliland's (1984) earlier studies detailed how scientific results from the crime laboratory occasionally result in reconstruction findings. This study of five jurisdictions nationwide reported how crime laboratory results typically provided insight as to how crimes unfolded. Physical evidence may be useful in reconstructing the criminal incident, showing point(s) of entry, activities surrounding the target of the crime, and point(s) of exit (if different) from entry. It may indicate where the offender gained access to the crime scene (breaking and entering); the relative positions of offender, victim, or other participants when the crime was committed; the order of crucial events; or how the offender gained access to items stolen. Establishing such "ground truth" of how the offender committed the criminal act helps build a helpful narrative for investigators in developing the offender's modus operandi.

DIFFERENT ORIGIN/NEGATIVE IDENTIFICATION

A negative identification results when the criminalist determines the substance in question is not what the investigator suspected it to be (the reddish substance was paint, not blood, or the residue was baking soda, not cocaine). Such findings may serve to eliminate a suspect from suspicion, close an investigation, or turn it in a completely new direction. Where comparisons show an evidentiary item and a standard are of different origin, they serve to dissociate persons, objects, and locations. Examples include when a biological stain did not originate from a prime suspect, a projectile was not fired from a particular weapon, or a latent fingerprint does not belong to a particular suspect. Such findings can be significant in excluding or exonerating a particular suspect and redirecting an investigation.

INCONCLUSIVE FINDINGS

Many examinations are not conclusive, and the examiner is not able to form a clear conclusion (unlike on television!). The evidence may be badly damaged, contaminated, or compromised in some fashion, and the examiner is prevented from developing definitive information or answers to investigator questions. Searches of databases may not yield the identity of a particular individual because the owner's fingerprint or DNA is not in the database or the questioned evidence is contaminated or does not contain clear points of identity. Inconclusive results are different from exclusions in that examiners can only report that evidence failed to establish a connection between principals and the crime scene.

Physical Evidence Presence—Historical Indicators

There have been few studies over the years that have attempted to document the presence and utilization of physical evidence in criminal investigations. Brian Parker's (1963) survey of forensic laboratories was among the first to find that scientific evidence was used in a very small percentage of cases—in his survey, he found that evidence was used in only about 1% of criminal violations. Later, Parker was funded by the National Institute of Law Enforcement and Criminal Justice (the predecessor to the

National Institute of Justice) to empirically determine the presence of physical evidence at the scenes of serious crimes (Parker & Peterson, 1972). Teams of criminalistics graduate students responded to the scenes of crimes reported to the police and found physical evidence present at about 88% of locations. The physical materials varied by type of evidence and offense category. Multiple forms of evidence were commonly present at scenes. This is the only study reported in the literature that documented the various types of physical evidence at crime scenes that didn't rely on surveys or police reports cataloging evidence that was collected after the crime scene was investigated.

Parker and Peterson's early research also found that most of this evidence was neither collected nor routed to a forensic laboratory for examination. This original research found that only about 0.1% of the offenses in the sample resulted in evidence being examined in the laboratory. Peterson's (1974) subsequent monograph accounted for how and why this evidence was neither collected nor examined. He identified a series of police "filters" that accounted for the exclusion of this evidence. It began with a patrol officer's or investigator's decision not to request a specially trained crime scene technician to respond to the scene to locate, collect, and preserve the evidence. Evidence technicians responded to crime scenes but often did not gather evidence that was present. These decisions were not solely based on evidence being present/not present, but often resulted from judgments on the part of technicians and investigators that available evidence did not merit collection or examination. Most of these (negative) decisions were based on an assessment of the seriousness of the crime, an evaluation of the legitimacy of victims, as well as the condition and potential usefulness of the evidence. Subsequent filters led officers (and supervisors) not to forward collected evidence to the crime laboratory for analysis. Even if the evidence was submitted for analysis, it often remained unexamined unless the investigator in charge of the case requested the laboratory to examine it.

Peterson's 1974 monograph described various styles of evidence technicians for responding to different types of crime scenes, interacting with victims (usually in property crimes), and deciding if physical clues were to be collected. On numerous occasions, he reported that technicians found their primary mission to provide "service" to the victim that sometimes involved misrepresentation of their activities by collecting materials they had no intention of submitting for analysis. Occasionally, investigators were even found to deposit, dust, and lift their own fingerprints if they thought it would impress the victim. Even at this time, long before the modern *CSI* era, crime scene officers were observed taking actions or offering commentary to victims so as not to disappoint them, leaving them with the impression that they received professional service.

Almost 40 years later, Makin (2012) contributed an article that described "simulated evidence collection" where investigators might "swab, powder, or collect nonviable samples to demonstrate that the victim received the full resources of the agency" (p. 126). He described "bagging and tagging" practices of crime scene officers where evidence was collected, documented, and returned to police evidence storage rooms, never to be analyzed, and sometimes discarded. Makin found that about 30% of law enforcement officers in his study knew of officers or technicians who had engaged in collecting "simulated evidence." Officers thought that the television inspired *CSI* effect was in part responsible for driving such practices, and that the PR value of such steps on (property crime) victims was a prime explanation. Makin proposes an interesting theory that such practices might, in part, explain the sizeable fraction of physical evidence that is backlogged in evidence storage rooms and not examined (discussed elsewhere in this chapter).

More than 10 years elapsed after the Parker study before NIJ funded additional studies to investigate the role of physical evidence in criminal investigations and prosecutions. The first study, *Forensic Evidence and the Police* (Peterson et al., 1984), reviewed almost 2,700 randomly selected case files stratified by offense type (homicide, rape, robbery, aggravated assault, and burglary) and controlled for the presence or absence of physical evidence in the instant case. The utilization of physical evidence varied widely by crime type, ranging from almost 100% of homicides and drug cases and 75% of rapes, to only about 15% of attempted murders, 33% of burglaries, and 20% of robberies. On reviewing paper case files, these figures primarily estimated percentages of evidence collected *and* examined, but did not account for evidence collected but not examined.

Apart from suspected drug cases, which constitute upwards of three-quarters of crime laboratory caseloads, blood, hair, firearms, and fingerprints were the primary forms of physical evidence collected and examined in the laboratory. Very little trace evidence (fibers, glass, paint, soil, etc.) was collected and examined. Suspected semen was also a primary type of evidence collected in sexual assaults, primarily via sexual assault kits taken from the victim in post-assault medical examinations. Its analysis and eventual utility was largely a function of the prior relationship between the victim and the offender. Cases involving an offender previously known (identified) by the victim usually resulted in a lower percentage of examined evidence. Violent, personal criminal investigations typically involved greater collection and analysis of physical evidence, and it was usually done earlier in the investigation.

A recent study addressed collected physical evidence stored in police property rooms that remains unexamined nationwide (Strom et al., 2009; Strom & Hickman, 2010). In a survey of 2,000 law enforcement agencies covering the years 2002–2007, agencies reported that they had not submitted collected evidence for examination in 14% of unsolved homicides, 18% of unsolved rapes, and 23% of unsolved property crimes. The study concluded that there may be good reasons why such evidence is not examined, as where defendants pled guilty or charges were dropped, but there were also situations where untrained personnel did not appreciate the full potential of the unexamined evidence in cases without suspects, where prosecutors had not requested an analysis, or where lengthy crime laboratory backlogs discouraged police personnel from making such a request.

Attention has also been paid of late to the substantial percentage of sexual assault cases where physical evidence, though collected by medical personnel in sexual assault kits from victims, is never examined. Ritter (2011) was one of the first to highlight this issue in her NIJ report that looked at the types and quantities of untested evidence contained in these kits, and efforts to understand the reasons cited by law enforcement and crime laboratories for this situation. The Strom et al. (2009) study described above found evidence collected but not examined in almost one in five rape cases. Human Rights Watch (Tofte, 2009) published a study in 2009 investigating the problem of sexual violence in Los Angeles and brought attention to the volume of untested sexual assault kits in the hands of law enforcement agencies. A study followed (Peterson et al., 2011) of the almost 11,000 untested sexual assault kits stored in Los Angeles city and county law enforcement freezers over the past 10 or more years. DNA profiles were determined in a high percentage (~60%) of these ~2,000 cases sampled that were uploaded into CODIS, but exams did not result in any added arrests and only two additional convictions. Current "action research" studies in Detroit and Houston (Ritter, 2011) are reviewing thousands of untested kits in police and laboratory storage areas to discover the reasons for non-testing, whether these kits should still be tested, the results of real time testing, and proper testing policies and practices for the future.

One might consider this backlogged sexual assault evidence against the research by Makin on symbolic evidence collection. It may be that historically, the collection of this sexual assault kit evidence from victims was not always for its analysis, particularly in cases where the victim knew the suspect. Was it "symbolic" from an investigator's standpoint, where they never intended for it to be examined? What criteria should be used in the future by investigators and criminalists to decide if this evidence is to be examined? The reader should note, however, that the parent law enforcement agencies in the Peterson (2011) study have directed crime laboratories to examine *all* sexual assault kit evidence that is collected.

Macro Forces Influencing Utilization Patterns

Any treatment of factors influencing the growth of forensic science services and the demand for scientific evidence needs also to take a broad overview of legal, social, and political factors affecting the use of forensic evidence. Peterson and Leggett (2007) prepared a 40-year retrospective of criminal, legal, and professional issues affecting the growth and utilization of forensic evidence in the United States. In this article, their beginning point was the steep rise in violent crime and the drug abuse explosion occurring in the late 1960s. Violent crimes are the source of most physical/biological clues submitted to crime laboratories, and drug cases mandate a chemical analysis of the controlled substance in question for successful prosecution. These two forces started the first real surge of physical evidence and forensic laboratories in the modern era.

U.S. Supreme Court rulings in the 1960s (*Escobedo*, *Miranda*, etc.) provided more legal protections for criminal suspects and encouraged the police to place greater reliance on "extrinsic" physical evidence to link offenders to crime scenes and victims. The President's Commission on Law Enforcement and the Administration of Justice (Institute for Defense Analyses, 1967) forecast that the successful solution of crime depended on the discovery and analysis of physical clues. In the 1970s, the federally funded Law Enforcement Assistance Administration (LEAA) also injected billions of dollars into the nation's criminal justice system and supported the construction of many more regional crime laboratories that were in closer proximity to state and local law enforcement agencies, and that, presumably, would result in better use of physical evidence. NIJ launched its first round of research projects to document the educational, technical, and professional development needs in the field of forensic science, sponsored proficiency testing projects documenting testing deficiencies in the field, and underwrote programs to accredit laboratories and certify forensic examiners (Peterson, 1975).

The 1980s saw continued growth in and demand for forensic services, and efforts to upgrade the level of professionalism in the developing forensic field gained momentum. The introduction of DNA typing demonstrated the promise of enhanced forensic biological testing, but also the need for standardized methods of analysis and regulation of the field. Still, these voluntary professional efforts lagged and there were further legal challenges to the reliability of laboratory testing and the need for more rigorous ethical standards for examiners. Proficiency testing studies and legal critiques drew attention to areas like questioned document examination (Jonakait, 1991; Risinger, Denbeaux, & Saks, 1989), its reliability, and whether the courts should routinely admit such testimony. Clearly, the justice system's demand for expanded forensic services was also accompanied by scientific and legal demands that the forensic profession get its scientific house in order and address the quality and fairness with which laboratory services were practiced.

While the early 1990s saw scientific and legal acceptance of DNA testing as a forensic technique to individualize biological evidence, the field instituted DNA methods standardization (Technical Working Group on DNA Analysis Methods, or TWGDAM) and formation of a national database of DNA profiles of convicted offenders. The Innocence Project (InnocenceProject.org) also demonstrated that DNA was a technique that could remedy prior injustices, where old physical clues could be reexamined and exonerate convicted defendants who had been falsely imprisoned. The fact that DNA was a highly reliable testing technique that had both the power to link and to exclude suspects with a crime created great interest in the police and the legal communities, as well as the public, and stimulated greater demand for forensic DNA testing.

Legal efforts also continued to strengthen standards for evaluating the judicial admissibility of scientific and technical evidence and as a means to exclude "junk" science (Giannelli, 1993). The U.S. Supreme Court decision *Daubert v. Merrell Dow Pharmaceuticals* (1993), and its progeny (*Kumho Tire* and *Joiner*), outlined steps that judges could consider when assessing the admissibility of scientific evidence. Judges were tasked to think more like scientists in determining if the reasoning underlying expert testimony was "scientifically valid." In considering the admissibility of the technique, judges could evaluate if the theory had been subjected to peer review and publication, if there were known error rates and the maintenance of standards, as well as general acceptance of the technique. Twenty years later, many judges are still uncomfortable in applying *Daubert* standards to scientific evidence presented to the court. In spite of that reticence, some courts today are reconsidering the admissibility of such venerable techniques as latent fingerprint comparison, hair examination, and firearms and toolmark testing that make up a large part of forensic evidence collected and examined.

The 1990s were also significant in that there were several investigations of improper forensic crime laboratory practices in which substandard procedures led to questionable findings and testimony. The U.S. Department of Justice Inspector General Michael Bromwich's (2006) investigation of charges, leveled by a disgruntled FBI crime laboratory scientist about its explosives division, underscored the importance of the laboratory practicing good science and maintaining independence from criminal investigator influences (Office of the Inspector General, 1997). And, as forensic science grew in popular culture through such television programs as *CSI*, the general public and professionals questioned if crime laboratories could possibly live up to unrealistic television standards. Investigative journalists also began to target forensic laboratories and increasingly found crime laboratories to be in "crisis." Individual scientists like Fred Zain, Joyce Gilchrist, and Arnold Melnikoff were targeted for falsification of findings and reading far more into their examinations than the science allowed. Journalists have continued their investigations into crime laboratory operations, sometimes focusing on errant examiners and at other times questioning if laboratories had sufficient resources to respond to their caseloads. Laboratories have been found not to have adequate resources to respond to submitted evidence, which has led to high examiner caseloads and lengthy testing turnaround times.

Articles in major city newspapers during the past decade have continued this theme. The growth in DNA testing and public awareness of the potential of forensic science have resulted in the creation of new and expanded laboratory facilities (Hertzberg Davis Forensic Science Center, Los Angeles, CA, in 2007) and to more scientists, but the rise in evidence submissions and casework seems to have outdistanced laboratory capacity. While DNA capabilities have been greatly enhanced, the ability of laboratories to develop and meet scientific needs in other forensic testing areas have fallen short. The profession has failed to undertake the necessary studies to lay the proper scientific foundation to support the individualization conclusions of firearms, trace, latent fingerprints, and other pattern evidence (Giannelli, Imwinkelried, & Peterson, 2011). Some forensic examiners have ventured beyond proper scientific boundaries and have been too quick to support criminal investigator and prosecutor theories in their interpretation of evidence, and even taking shortcuts to achieve definitive results (Swecker & Wolf, 2010). The pressure on examiners to practice good scientific procedures and maintain high ethical standards has sometimes given way to pressures placed on crime laboratories to secure convictions and satisfy unrealistic public expectations.

Crime Laboratory Census Results

Over the past decade, the Bureau of Justice Statistics (BJS) of the U.S. Department of Justice has surveyed publicly funded forensic science crime laboratories in the United States, gathering data on their workload, staffing, budget, and operations. Three periodic surveys have been conducted and published thus far, with the most recent data published in 2012 (Durose, Walsh, & Burch, 2012). Survey results offer some insight into the growth of forensic sciences and the demand for forensic services. Between 2002 and 2009, the number of crime laboratories identified by BJS increased from 351 to 411. The number of responding crime laboratories rose from 305 in 2002 to 377 in 2009, almost a 26% increase. The total number of requests submitted to responding laboratories increased from about 2.7 million in 2002 to about 4.1 million in 2009, over a 50% increase. Forensic biology (DNA) made up about a third of all such requests. So, while the number of laboratories supplying data to the survey increased by more than 25%, the demand for services (DNA testing) grew even faster.

Because backlogs have been such a problem for crime labs in recent years, the surveys asked for the number of backlogged requests for testing that laboratories had at the end of the calendar year. Total backlogged requests grew from 0.5 million to 1.2 million over that seven-year time period. Forensic biology cases accounted for about three-quarters of this backlog, and most of these requests were for the analysis of convicted offenders' and arrestees' DNA samples. This is understandable, as forensic laboratories have been attempting to build the number of DNA profiles within CODIS. It is also interesting to note that budgets for all laboratories responding to the surveys had grown from about $1.0 billion in 2002 to about $1.6 billion in 2009, and the number of full-time equivalent (FTE) crime laboratory personnel grew from about 11,000 FTE personnel to over 13,000 personnel.

Clearly, the demand for forensic services has increased, and resources have increased, but backlogs have grown at an even faster pace.

Up-to-Date Utilization Patterns From the "Role and Impact" Study

The Role and Impact of Forensic Evidence in the Criminal Justice Process Project was funded in 2006 by the NIJ to enable researchers at California State University, Los Angeles to track the collection, examination, and value of physical evidence data represented in official police, laboratory, and prosecutor records in five jurisdictions (Los Angeles County; Indianapolis, IN; and the Indiana State Police Laboratory System: Evansville, Fort Wayne, and South Bend). The project had multiple objectives:

1. To estimate the percent of crime scenes where one or more types of physical evidence were collected and the types of forensic evidence collected
2. To track the use and attrition of physical evidence from crime scene through laboratory analysis, and then through subsequent stages of the criminal justice process
3. To assess the contribution of forensic evidence to case outcomes

This section will focus on the first two areas of the study to estimate the presence and demand for forensic evidence in various offense types (Peterson et al., 2010).

These sites were chosen to represent city, county, and state forensic crime laboratory service configurations in the United States. Collected physical evidence data were based on a random sample of the population of reported crime incidents for the year 2003, stratified by crime type and jurisdiction. Aggravated assault, burglary, homicide, rape, and robberies files were randomly selected to represent a range of serious personal and property crimes. Cases were primarily selected from the year 2003 so that case files would be closed and files would hopefully contain complete data, through to final court disposition. A total of 4,205 cases were sampled including 859 aggravated assaults, 1,263 burglaries, 400 homicides, 602 rapes, and 1,081 robberies.

Data were collected from three primary sources: police incident and investigation reports, crime laboratory reports, and prosecutor case files (primarily for case disposition and sentencing data). Various forensic variables were used for descriptive analyses: location and type of crime scene, presence of crime scene evidence (i.e., biological, latent prints, pattern evidence, firearms, natural and synthetic materials, generic objects, drugs), whether the evidence was submitted to the laboratory, and whether it was examined. Police incident and investigation reports yielded information on different forensic, offense, and disposition variables. Information from crime laboratory reports gave information on the type of evidence submitted and examined, and the results of laboratory examinations. Laboratory reports that resulted in unique identifications (individualizations) of evidence and those that linked one or more suspects to a crime scene or victim(s) were noted. The presence and type of physical evidence present, collected, and examined were determined exclusively from reports contained in police incident, crime scene technician, and investigator files.

AGGRAVATED ASSAULTS

Physical evidence/substrates were collected in about 30% of incidents, with firearms/weapons (e.g., guns, bullets, shell casings) the leading category of evidence gathered. In only about 12% of cases where evidence was collected was the evidence submitted to the crime laboratory, and most of it was firearms/weapons and latent print evidence. Examinations in 79 cases (9.2%) conducted across all crime laboratories yielded 34 cases with identifications of evidence, most of them (21) involving firearms-related evidence. In terms of individualizations, there were 18 cases with firearms individualities and four other individualities involving latent prints.

BURGLARY

Police collected physical evidence and substrates in almost one-fifth (19.6%) of burglaries. Latent prints made up a high percentage (84%) of the evidence collected. Most collected latent print evidence was submitted to the laboratories (75%), and crime labs examined approximately 72% of submitted prints. Laboratories produced 52 cases with individualized evidence—mostly latent prints.

HOMICIDE

A very high percentage (97%) of homicides resulted in physical evidence/substrates being collected, primarily firearms/weapons and natural/synthetic materials (mostly clothing). The next most frequently gathered physical clues were biological and latent print evidence. Unlike other crime types, a very high percentage (88.5%) of collected physical evidence was submitted to crime laboratories, and most was actually examined (81%).

RAPE

Approximately 64% of incidents had physical evidence or substrates collected. Biological and natural and synthetic materials were the two primary types of physical evidence collected. Sexual assault kits were employed to gather physical evidence in about half the cases. The kits held samples of suspected blood, semen, saliva, and DNA. The data revealed that there was a dramatic decline of collected evidence that was submitted to labs. More than two-thirds of sexual assault kits (68%) were not submitted to the laboratory for analysis. While some submitted evidence likely came from sexual assault kits, seldom were complete kits noted as submitted to the laboratories. A high percentage of cases with submitted semen evidence were examined (86.2%). Vaginal, blood, and latent print evidence also were examined in most submitted cases (87.5%, 59.0%, and 74.1%, respectively). In terms of establishing the uniqueness of evidence, 19 cases had individualized biological materials, and nine had individualized latent finger or palm prints.

ROBBERY

Physical evidence and substrates were collected in less than a quarter (24.8%) of the robbery incidents, but rates of collection varied greatly by jurisdiction. Latent prints, natural and synthetic materials, and firearms/weapons were collected most frequently. After latent prints, materials (clothing) was the next major category of evidence/substrates collected, followed by firearms/weapons. The evidence was submitted to crime laboratories in 44% of cases where it was collected (only 10.9% of all robbery incidents). A high percentage of the evidence submitted was actually examined (90.7%) but, overall, less than 10% of all robbery incidents had examined evidence. Latent print examinations yielded individualizations in almost half (44%) of the 41 cases where evidence was submitted to the respective crime laboratories.

Conclusion

The growth of forensic science has been steady over the past several decades. Agencies have devoted added resources to forensic laboratories, but there have been comparatively few efforts to ascertain the effects of such evidence. While there have been a handful of prior efforts, a recent article by Peterson et al. (2013) has made a renewed attempt. The authors examined data collected from a probability-based sample of 4,205 cases from five jurisdictions nationally that was described in the previous section. Cases were randomly selected from the crime categories of homicide (400 cases), rape (602), aggravated assault (850), robbery (1,081), and burglary (1,262).

Even though utilization rates were low, regression analyses showed that forensic evidence played a "consistent and robust role" in case-processing decisions across all crimes, but effects were time and examination dependent. The collection of evidence predicted arrest and case referral to prosecutors' decisions; the examination of evidence predicted case referral, charging, trial conviction, and the severity of sentences. While forensic evidence did not play a major role in plea bargains, interaction effects revealed that evidence that linked an offender with a victim or crime scene played a role in guilty pleas for stranger offenses. Interaction effects also indicated that collection of forensic evidence played a role in particular types of offenses: In robberies, collection of evidence from the scene increased the likelihood of arrest, and in homicides, evidence that linked the suspect to the victim/scene was a predictor of sentence length.

This is not the final word on the value of forensic evidence on criminal case processing. As those authors recommended, criminal justice and forensic science researchers should continue to examine the contributions of various types of evidence—including forensic—to criminal justice decisions. Quantitative and qualitative approaches are needed to understand how these processes work to advance the progress of cases through the justice process. Scientific evidence is a complex variable, and its value may shift depending on the presence or absence of other characteristics and evidence in a case. As one prosecutor observed when asked about the value of scientific evidence, "It depends!"

This review has detailed the following:

1. A high percentage of crime scenes have extensive varieties of physical evidence present. While collected evidence and substrates are not as high as the original Parker and Peterson (1972) study, a substantial percentage of crime scenes have evidence that is collected.

2. Evidence is collected from those scenes ranging from a higher percentage of serious personal crimes and a lower percentage of property crimes.
3. Only a fraction of that evidence is routed to forensic crime laboratories for analysis: A high percentage of homicide and burglary evidence is routed for analysis, but a lower percentage of rape and assault cases.
4. An even smaller percentage of evidence submitted to crime laboratories is actually examined. Less than 2% of cases result in scientific evidence associating a suspect with the crime scene or victim. Robberies had the highest percent of collected evidence that was actually individualized.

This study showed that despite low rates of evidence analysis and individualization, physical evidence still played a substantial role on case processing decisions. If agencies were to devote greater resources to the collection and analysis of evidence, and improve the training of investigative and prosecutorial personnel in wiser use of that evidence, they should be able to strengthen case solution, charging, conviction, and incarceration rates. It is doubtful, however, that single studies like this one will persuade agencies to make major reallocations of resources. Agencies will need to undertake similar studies in their own jurisdictions, with their own unique blends of personnel and resources, to determine how forensic evidence influences decisions in their respective jurisdictions. Heads of key agencies need to formulate their own research hypotheses and to be personally invested in such studies to determine the effects of scientific evidence in their communities.

The relative importance of increasing solution and conviction rates in specific jurisdictions also needs to be considered. Compared with reducing crime rates, maximizing case solution, conviction, and sentencing rates may not command the same attention. Arrest, prosecution, and sentencing practices are important from a justice system perspective, but the police executive (who holds the purse strings of most crime laboratories) may not be as concerned with these "secondary" measures. Prosecutors and judges typically don't wield great influence over laboratory resources. Build in the fact, also, that the primary measure of forensic science laboratories is to find the "scientific truth" of the evidence, and is not to achieve high arrest and conviction rates.

There are other important research and policy questions that need to be kept in mind, as well. *Daubert* and the National Research Council's recommendations in the 2009 *Strengthening Forensic Science* report concerning the scientific underpinnings of forensic science and the strength of individualization conclusions must be addressed. There are a range of other research studies that are needed to resolve other key questions and controversies, such as proper allocation of resources and decision criteria to be used in prioritizing evidence for evaluation in the laboratory. The newly impaneled National Commission of Forensic Science needs to rigorously evaluate studies like those described in this chapter, to improve on and replicate them, and to recommend new projects to answer other nagging questions. While this commission will be primarily concerned with enhancing "quality assurance" practices in forensic laboratories, matters of policy and allocation of resources will of necessity address questions of the value of scientific evidence on the process of justice. Hopefully, the data presented in this chapter will inform other researchers, policy makers, and practitioners to develop future studies to assess the continuing demand for and analysis of forensic evidence, and determine its effects on criminal justice case decision making.

References

American Society of Crime Laboratory Directors, Laboratory Accreditation Board. (n.d.). About ASCLD/LAB. http://www.ascld-lab.org/about-ascldlab/

Balko, R. (2011, June 14). Private crime labs could prevent errors, analyst bias: Report. *Huffington Post*. http://www.huffingtonpost.com/2011/06/14/the-case-for-private-crime-labs_n_876963.html

Bashinski, J., & Peterson, J. (2003) Forensic sciences. In W. Geller & D. Stephens (Eds.), *Local government and police management* (4th ed., pp. 559–597). Washington, DC: International City Management Association.

Bromwich, M. (2006) *Fifth report of the independent investigator for the Houston Police Department Crime Laboratory and Property room* (HBD Crime Lab Independent Investigation). Retrieved from http://hpdlabinvestigation.org/reports/060511report.pdf

Clark, M. (2012, November 26). Forensic science falls short of public image. *Stateline*. Retrieved from http://www.pewstates.org/projects/stateline/headlines/forensic-science-falls-short-of-public-image-first-of-two-parts-85899431908

Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993).

Durose, M., Walsh, K., & Burch, A. (2012). *Census of publicly funded forensic crime laboratories, 2009*. Washington, DC: Bureau of Justice Statistics Bulletin.

Escobedo v. Illinois 378 U.S. 478 (1964).

Fisher, B. A. (2004). *Techniques of crime scene investigation* (7th ed.). Boca Raton, FL: CRC Press.

Fisher, B. A., & Fisher, D. R. (2012). *Techniques of crime scene investigation* (8th ed.). Boca Raton, FL: CRC Press.

General Electric Co. v. Joiner, 522 U.S. 136 (1997).

Giannelli, P. (1993). "Junk science": The criminal cases. *Journal of Criminal Law and Criminology, 84*(1), 105–128.

Giannelli, P., Imwinkelreid, E., & Peterson, J. (2011). Reference guide on forensic identification expertise. In National Research Council (Ed.), *Reference Manual on Scientific Evidence* (3d ed., Ch. 16). Washington, DC: National Academies Press.

Guillen, T., & Nalder, E. (1994, June 22). Overwhelming evidence: Crime labs in crisis. *Seattle Times,* p. A1.

Houck, M. (July 2006). CSI: Reality. *Scientific American, 295,* 84.

Huber, P. (1991). *Galileo's revenge: Junk science in the courtroom*. New York: Basic Books.

Institute for Defense Analyses. (1967). *Task force report: Science and technology: A report to the President's Commission on Law Enforcement and Administration of Justice*. Washington, DC: U.S. Government Printing Office.

Johnson, D., Peterson, J., Sommers, I., & Baskin, D. (2012). Use of forensic science in investigating crimes of sexual violence: Contrasting its theoretical potential with empirical realities. *Violence Against Women, 18*(2), 193–222.

Jonakait, R. (1991). Forensic science: The need for regulation. *Harvard Journal of Law and Technology, 4,* 109.

Kumho Tire Co. v. Carmichael, 526 U.S. 137 (1999).

Lassers, W. K. (1967). Proof of guilt in capital cases: An unscience. *Journal of Criminal Law, Criminology and Police Science, 58*(3), 310–316.

Makin, D. (2012). Symbolic evidence collection or "If all else fails, throw some dust around." *Forensic Science Policy & Management, 3,* 126–138.

McRoberts, F., Mills, S., & Possley, M. (2004, October 17). Forensics under the microscope: Unproven techniques sway courts, erode justice. *Chicago Tribune,* p. A1.

Miranda v. Arizona, 384 U.S. 436 (1966).

National Advisory Commission on Criminal Justice Standards and Goals. (1973). Standard 12.2: The crime laboratory. In *Task force report on the police* (pp. 299–304). Washington, DC: U.S. Government Printing Office.

National Institute of Justice (NIJ). (2013). *Forensic DNA*. Retrieved from http://www.nij.gov/topics/forensics/evidence/dna/pages/welcome.aspx

National Research Council (NRC). (2009). *Strengthening forensic science in the United States: A path forward.* Washington, DC: Author. Retrieved from http://www.nap.edu/catalog/12589.html

Office of the Inspector General. (1997). *The FBI laboratory: An investigation into laboratory practices and alleged misconduct in explosives related and other cases.* Washington, DC: U.S. Department of Justice. Retrieved from https://www.fas.org/irp/agency/doj/oig/fbilab1/fbil1toc.htm

Parker, B. (1963). Scientific proof. *Revista Juridica de la Universidad de Puerto Rico, 32*(2), 201–213.

Parker, B., & Peterson, J. (1972). *Physical evidence utilization in the administration of criminal justice*. Washington, DC: U.S. Government Printing Office.

Peterson, J. (1974). *The utilization of criminalistics services by the police: An analysis of the physical evidence recovery process*. Washington, DC: U.S. Government Printing Office.

Peterson, J. (1975). LEAA's Forensic Science Research Program. In G. Davies (Ed.), *Forensic science* (pp. 43–57). Washington, DC: American Chemical Society.

Peterson, J., Hickman, M., Strom, K., & Johnson, D. (2013). Effect of forensic evidence on criminal case processing. *Journal of Forensic Sciences, 58*(S1), S78–S90.

Peterson, J., Johnson, D., Herz, D., Graziano, L., & Oehler, T. (2011). *Sexual assault kit backlog study: Final report*. Washington, DC: National Institute of Justice.

Peterson, J., & Leggett, A. S. (2007). The evolution of forensic science: Progress amid the pitfalls. *Stetson Law Review, 36,* 621–660.

Peterson, J., Mihajlovic, S., & Gilliland, M. (1984). *Forensic evidence and the police: The effects of scientific evidence on criminal investigations*. Washington, DC: U.S. Government Printing Office.

Peterson, J., Sommers, I., Baskin, D., & Johnson, D. (2010). *The role and impact of forensic evidence in the criminal justice process: Final report*. Washington, DC: National Institute of Justice.

Risinger, M., Denbeaux, M., & Saks, M. (1989). Exorcism of ignorance as a proxy for rational knowledge: The lessons of handwriting identification "expertise." *University of Pennsylvania Law Review, 137,* 731–788.

Ritter, N. (2011). Solving the problem of untested evidence in sexual assaults. *NIJ Journal, 267,* 18–20.

Roman, J., Reid, S., Reid, J., Chalfin, A., Adams, W., & Knight, C. (2009). *The DNA field experiment: Cost-effectiveness analysis of the use of DNA in the investigation of high-volume crimes*. Washington, DC: Urban Institute.

Strom, K., & Hickman, M. J. (2010). Unanalyzed evidence in law-enforcement agencies: A national examination of forensic processing in police departments. *Criminology & Public Policy, 9*(2), 381–405.

Strom, K., Ropero-Miller, J., Jones, S., Sikes, N., Pope, M. W., & Horstmann, N. (2009). *The 2007 survey of law enforcement forensic evidence processing: Final report*. Prepared for the National Institute of Justice.

Swecker, C., & Wolf, M. (2010, August 18). *An independent review of the SBI forensic laboratory*. Retrieved from http://www.ncids.com/forensic/sbi/Swecker_Report.pdf

Tofte, S. (2009). *Testing justice: The rape kit backlog in Los Angeles city and county*. New York: Human Rights Watch.

U.S. Department of Justice. (2003, March 11). *Advancing justice through DNA technology*: Executive summary. Retrieved from http://www.justice.gov/ag/dnapolicybook_exsum.htm