Untangling the Helix: Law Enforcement and DNA

By Robin S. Wilson, Lisa Forman and Christopher H. Asplen

DNA evidence is one of the most powerful crime-fighting tools since the advent of latent fingerprint technologies. It has the ability to convict the guilty and free the innocent. The exoneration of 28 individuals whose cases are detailed in the National Institute of Justice (NIJ) publication, *Convicted by Juries, Exonerated by Science: Case Studies in the Use of DNA Evidence to Establish Innocence After Trial,* prompted U.S. Attorney General Janet Reno to establish the National Commission on the Future of DNA Evidence. The Commission will make recommendations to maximize the value of DNA evidence in the criminal justice system. After more than a year of meetings with criminal justice professionals, policymakers and scientists, the commission recognizes that, to fully realize the potential of DNA as criminal evidence, law enforcement will need to have the capability of using DNA evidence at every level, from the crime scene to the courtroom.

What is DNA?

DNA, or deoxyribonucleic acid, a double-helix molecule found in the nuclei of cells, is the basic building block of life. Based on the arrangement of four chemicals, called bases, our DNA determines each of our individual characteristics. The arrangement of the three billion pairs of bases in each DNA molecule is different for everyone (except identical twins). An individual's DNA is the same in every cell, from the moment of conception to death. A person's DNA in scraped skin cells will be the same as the DNA in his blood, saliva, organs, semen or hair.

Solving Crimes With DNA

Currently, the majority of criminal cases use DNA either to confirm or exclude a suspect as the source of evidence left at a crime scene. Because a person's DNA is the same in every cell, biological evidence from a crime scene can be compared to known samples from those involved in or suspected of a crime. Once a suspect is identified, a blood or cheek swab sample is collected and sent to the laboratory with the crime scene evidence for DNA analysis. The laboratory analyst compares the DNA profiles from the evidence and the suspect to determine if there is a match. Blood and semen are the traditional sources of DNA evidence, but law enforcement officers around the country are discovering that other evidence can be analyzed for DNA: saliva left on a rape victim, chewed tobacco or gum left behind at a murder scene, mucous on clothing or tissues, or skin cells left on the end of a weapon used to deliver forceful blows. DNA evidence must be properly identified, preserved and collected at the crime scene to maintain its integrity and to maximize its value as an investigatory tool. NIJ is trying to establish acceptable procedures for the safe handling of evidence. Additional training of law enforcement personnel may help to ensure that proper procedures are followed.

Traditionally, DNA has been used to develop criminal cases and, during the last 10 years, it has been used to successfully prove thousands of cases in court. The more crimes that are solved with DNA evidence, the more casework crime laboratories receive. Unfortunately, the workload of DNA cases with known suspects often expends laboratory capacities and creates casework backlogs. Efforts to manage backlogs have forced many crime laboratories to prioritize known suspect casework over casework without a known suspect (nonsuspect) and database profiling. Suspect casework backlogs not only create problems for delivering timely results, they compound the difficulties of populating and using DNA databases in criminal investigations.

DNA Database Systems

A DNA database is a computerized collection of certain DNA characteristics. DNA databases can be used for medical, statistical or other purposes. A database of DNA profiles of convicted offenders as well as profiles of crime scene evidence creates a searchable system that law enforcement can use to investigate and solve crimes. The information stored in DNA databases for use by law enforcement was designed to identify or link profiles: For privacy reasons, no personal genetic information can be determined.

Each state has mandated that convicted offenders of particular crimes surrender a DNA sample to be profiled in that state's DNA database system. Because offenders often commit more than one crime, a database system can be a useful resource in helping investigators identify suspects more quickly. Cases are strengthened significantly when a database search identifies a match between a stored offender profile and crime scene evidence. Investigations of serial crimes are aided when DNA profiles from multiple crime scenes match, linking the crimes to one another. As

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database systems become more populated, forensic and offender matches (or "hits") will become more frequent, enabling officers to solve more crimes.

CODIS: An Organized Database System

The Combined DNA Index System (CODIS) is the database software developed to help law enforcement, as authorized by the DNA Identification Act of 1994. CODIS allows crime laboratories to quickly compare convicted offender and crime scene DNA profiles across the nation. Free software, training and user support is provided to public laboratories that operate their databases on the CODIS system. A working group sponsored by the FBI selected 13 standard or 'core' DNA markers (or "loci") that the criminal justice system will use to produce DNA profiles for the CODIS database. These loci are highly polymorphic (variable), which reduces the possibility of a coincidental match, even though only 13 sites are being examined. On Oct. 12, 1998, the FBI officially unveiled the National DNA Indexing System (NDIS). NDIS enables public forensic laboratories using CODIS to compare and exchange DNA database information to solve crimes across state lines.

Many states have been collecting biological samples from convicted offenders for years, but have not had the manpower or equipment to analyze and enter offender DNA profiles into their databases, leading to a nationwide backlog of more than 500,000 collected but unanalyzed offender samples. In addition, an estimated one million probationers, parolees or released offenders still owe samples to be added to the databases. Many departments are beginning to outsource their forensic and offender samples to private laboratories for database profiling to reduce their massive backlogs. Automated systems that can rapidly analyze thousands of DNA database samples also are being developed to help ease the burden on laboratories. The criminal justice system must ensure that law enforcement not only has the technical resources to populate their databases, but the mechanism to use the power of DNA databases to investigate and solve criminal cases. As law enforcement succeeds in solving crimes through database hits, states are likely to expand the number of qualifying offenses that require database sampling. Changing offender statutes as they relate to DNA databases will require that collection strategies be both efficient and economical.

Implications for Corrections

Every state has laws that mandate DNA profiling of convicted offenders for a database system. Some states restrict sample collection to convicted sex offenders, while others include all offenders convicted of violent crimes. Although the laws mandate such actions, few states have developed comprehensive systems for sample collection. Several states have identified the correctional facility as the appropriate site for collection and have tasked their institutions with developing appropriate methods to handle the collection and transport of offender samples. Collection strategies considered by policy-makers range from sample collection upon conviction in court or upon being admitted to or released from a jail or prison. The task is to consider sample collection management in the context of potential additional burdens that may be placed upon the existing system.

The method used to collect samples has a significant impact on the efficiency of collections. Drawing blood is the most common procedure used to collect biological samples from convicted offenders. Although a vial of blood will yield a good sample for laboratory analysis, it is an invasive, costly procedure that is typically performed by a trained technician. Recent advances in technology have resulted in equipment that minimizes the need for technical personnel. For example, there now is a commercial portable laser device available to help perform painless finger pricks. With this method, a drop of blood is dripped on a special paper card instead of handling volumes of blood in test tubes. The buccal scrape is another relatively new procedure that uses a paper toothbrush or cotton swab to scrape cheek cells from the interior of the offender's mouth. As with any new equipment and procedure, if personnel are properly trained, using new technologies may save time and money. No matter what procedure is used to collect the sample, it must be done properly to yield a sufficient uncontaminated sample for laboratory analysis.

Once a sample is collected from an offender, it is sent to a laboratory for analysis. The storage and transport of the offender samples are issues that impact where the samples are collected and what method is used for collection. Cost, time and reliability are all considerations in selecting sample transportation. Vials of blood, for example, may be more expensive to transport because they can break or spill. If samples cannot be sent to a laboratory immediately upon collection, they must be properly stored. The method used for collection also will determine what type of storage facility is needed, as DNA is vulnerable to many environmental factors. Improper storage can affect DNA, rendering the sample ineffective for profiling analysis. Both whole blood and dried samples on paper can be stored at ambient temperatures, but large temperature fluctuations, especially heat, can destroy the cells and the DNA in them. As with any evidence, chain of custody and accurate records of procedures must be maintained for all DNA samples and is an additional storage issue for the large numbers of convicted offender samples.

Sample prioritization also may play a role in collection and storage. For example, to conserve resources, samples could be organized by severity of crime committed, release date or parole date. A consideration might be that those offenders who are soon scheduled for release should be entered into the database first because they pose the biggest risk of committing another crime. Sample prioritization requires exceptional recordkeeping and continual maintenance of samples to ensure that all samples are managed properly and eventually entered into the database system.

Collection, storage, transport and recordkeeping are practical issues that local, state and federal departments are considering to help develop and manage their DNA database systems, but economic factors will likely have the

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largest effect on the implementation of DNA-related policies. Recommendations can be made for how the criminal justice system could best use DNA technology to fight crime, but funding sources also must be identified to support the implementation of those recommendations. If funding is not available for states to reduce their current offender backlogs, databases will remain unpopulated and unavailable to aid law enforcement with criminal investigations. Similarly, if funding is available to reduce the backlogs but not to support the development of systems that can maintain current levels of offender collection and analysis, more backlogs will result. And if the criminal justice system is to realize the full potential of DNA evidence as a crimefighting tool, efforts must be made both to solve the database backlog of today and to promote DNA evidence use throughout all levels of law enforcement.

With more than 10,000 law enforcement jurisdictions throughout the country, there is no single best way to manage the processing of convicted offenders who owe DNA samples for databases. Management and practice of collection procedures will vary from the court in which an offender was convicted to the correctional facility in which the offender is housed. The common elements involved in collection, transport, storage and analysis of large numbers of DNA samples suggests that all jurisdictions will need systems that cross departmental lines to meet their state's mandate.

The Bottom Line

The success of using DNA as criminal evidence can be felt across the country, by a rape victim whose perpetrator was convicted, or an investigator who closed a haunting 10-year-old murder case of a child. During the last 10 years, DNA technology has advanced so rapidly that many departments have found themselves without the proper training and technical assistance to maximize the value of this technology. Battles have shifted from proving the reliability and integrity of DNA as criminal evidence to how funding will be appropriated through departments so officers can begin to use DNA in every capacity, not only as criminal evidence to convict a suspect, but as an investigative tool to identify suspects and link serial crimes. While the integration of new DNA technology into our criminal justice system requires innovative problem-solving, it is an invaluable tool that will give officers the power to solve more crimes and offenders less opportunities to commit crimes again.

Robin S. Wilson is executive assistant for the National Commission on the Future of DNA Evidence. Lisa Forman, Ph.D., is deputy director of the National Commission on the Future of DNA Evidence and a program manager in the Office of Science and Technology at the National Institute of Justice. Christopher H. Aspen is an assistant U.S. attorney in the U.S. Attorney's Office for the District of Columbia. He is currently detailed as the executive director of the National Commission on the Future of DNA Evidence.

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