



DNA Evidence: What Law Enforcement Officers Should Know

Proper use of DNA (deoxyribonucleic acid) evidence at trial can help to seal a conviction or obtain an acquittal. It is therefore very important that police officers know how to manage crime scenes in order to make sure DNA evidence is collected properly. If such evidence is to be useful in court, law enforcement personnel should employ specific procedures to protect and preserve this sensitive biological material.

At the Crime Scene

Violent crime scenes often contain a wide variety of biological evidence, most of which can be subjected to DNA testing. Although not always visible to the naked eye, such evidence often is key to solving a crime, obtaining a conviction, or exonerating the falsely accused. For example, during a sexual assault, the perpetrator may leave blood, hair, saliva, semen, and skin cells on the victim's body, clothing, or carpeting or elsewhere at the scene. Scientists compare the collected biological samples against the

DNA of the victim, the suspect, and any other potential suspects who may have had access to the scene. If no suspect exists, a DNA profile from the crime scene can be entered into the Combined DNA Index System (CODIS) to identify a suspect or to link serial crimes. (See "CODIS.")

Evidence Collection and Preservation

Responding officers and investigators should carry out their work at the crime scene as if it were the only opportunity to preserve and recover physical clues. Keeping DNA evidence untainted until it has been collected and recorded is the most important aspect of managing the evidence.

Proper collection is essential for successful DNA testing. Because prosecution of a case can hinge on the state of the evidence as it was collected, police investigators should take precautions, such as wearing disposable gloves and avoiding touching any other

objects while handling such evidence, to avoid contamination.

Contamination also can take place if someone sneezes or coughs over the evidence or touches his or her hair, nose, or other part of the body and then touches the area containing the sample to be tested. DNA left at a crime scene also is subject to environmental contamination. Exposure to bacteria, heat, light, moisture, and mold can speed up the degradation (or erosion) of DNA. As a result, not all DNA evidence yields usable profiles. (See “Safeguard DNA Evidence and Yourself.”)

Officers should not drink, eat, litter, smoke, or do anything else that might compromise the crime scene. They should remember that valuable DNA evidence may be present even though it is not visible. For example, since evidence could be on a telephone mouth- or earpiece, investigators should use their own police radios instead of a telephone located at the crime scene.

To further avoid compromising evidence, any movement or relocation of potential evidence should be avoided. Officers should move evidence only if it will otherwise be lost or destroyed. In sexual assault cases, it is especially important that officers explain to victims why they should not change clothes, shower, or wash any part of their body after an assault. Depending on the nature of the assault, semen may be found on bedding or clothing, or in the anal, oral, or vaginal region. Saliva found on an area where the victim was bitten or licked may contain valuable DNA. If the victim scratched the assailant, skin cells containing the attacker’s DNA may sometimes be present under the victim’s fingernails. Victims should be referred to a hospital where an exam will be conducted by a physician or sexual assault nurse examiner.

Potential evidence can become contaminated when DNA from another source gets mixed with samples gathered for a specific case. In those situations, laboratory analysts have to request samples from all persons with access to the crime scene, including officers and anyone who had physical

WHAT IS CODIS?

The Combined DNA Index System (CODIS) is an electronic database of DNA profiles administered through the Federal Bureau of Investigation (FBI). The system lets Federal, State, and local crime labs share and compare DNA profiles. Through CODIS, investigators match DNA from crime scenes with convicted offenders and with other crime scenes using computer software, just as fingerprints are matched through automated fingerprint identification systems.

CODIS uses two indexes:

- The Convicted Offender Index, which contains profiles of convicted offenders.
- The Forensic Index, which contains DNA profiles from crime scene evidence.

The real strength of CODIS lies in solving no-suspect cases. If DNA evidence entered into CODIS matches someone in the offender index, a warrant can be obtained authorizing the collection of a sample from that offender to test for a match. If the profile match is in the forensic index, the system allows investigators—even in different jurisdictions—to exchange information about their respective cases.

SAFEGUARD DNA EVIDENCE AND YOURSELF

Biological material may contain hazardous pathogens, such as the hepatitis A virus, which can lead to potentially lethal diseases. At the same time, such material can easily become contaminated. To protect both the integrity of the evidence and the health and safety of law enforcement personnel, officers should:

- Wear gloves and change them often.
- Use disposable instruments or clean them thoroughly before and after handling each sample.
- Avoid touching any area where DNA might exist.
- Avoid talking, sneezing, or coughing over evidence.
- Avoid touching one’s own nose, mouth, and face when collecting and packaging evidence.
- Air-dry evidence thoroughly before packaging.
- Put evidence into new paper bags or envelopes. Do not place evidence in plastic bags or use staples.

possession of the evidence while it was being recovered, processed, and examined.

Maintaining a precise chain of custody of all DNA materials collected for testing is critical,

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as it may at some point become an issue in court. (See “Identifying DNA Evidence.”) Every action officers take at a crime scene must be fully documented.

Improvements in analysis and interpretation of physical evidence recovered from crime scenes continue to develop. Properly documented and preserved DNA evidence will be given increased weight in court, so it is extremely important that an officer’s approach to gathering evidence be objective, thorough, and thoughtful.

Elimination Samples

The DNA of several individuals may be present at a crime scene. So, officers must ensure that technicians collect the victim’s DNA along with the DNA of anyone else who may have been present at the scene. These “elimination samples” help determine if the evidence is from a suspect or another person. The types of elimination samples to be collected depend on the details of the crime, but they are generally samples of blood or saliva.

IDENTIFYING DNA EVIDENCE

Evidence	Possible Location of DNA on the Evidence	Source of DNA
Bandanna, hat, mask	Anywhere (inside or outside)	Dandruff, hair, saliva, sweat
Baseball bat or similar weapon	End, handle	Blood, hair, skin, sweat, tissue
Bite mark	Clothing, skin	Saliva
Blanket, pillow, sheet	Surface area	Blood, hair, saliva, semen, sweat, urine
Bottle, can, glass	Mouthpiece, rim, sides	Saliva, sweat
Cotton swab, facial tissue	Surface area	Blood, ear wax, mucus, semen, sweat
Dirty laundry	Anywhere	Blood, semen, sweat
Envelope, stamp	Licked area	Saliva
Eyeglasses	Ear- or nosepiece, lens	Hair, skin, sweat
Fingernail, partial fingernail	Scrapings	Blood, sweat, tissue
Ligature, tape	Inside/outside surface	Blood, skin, sweat
“Through and through” bullet	Outside surface	Blood, tissue
Toothpick	Tips	Saliva
Used cigarette	Cigarette butt	Saliva
Used condom	Inside/outside surface	Rectal or vaginal cells, semen

For example, in a residential burglary where the suspect may have sipped from a glass of water, DNA samples should be obtained from every person who had access to the crime scene both before and after the burglary. The forensic technician will compare these samples with the saliva found on the glass to determine if the saliva contains probative evidence.

In homicide cases, the victim's DNA should be obtained from the medical examiner at the autopsy, even if the body is badly decomposed. This process may help to identify an unknown victim or to distinguish between the victim's DNA and other DNA found at the crime scene. (See "Thinking Solves Crimes.")

In a rape case, investigators may need to collect and analyze the DNA of every consensual sexual partner the victim had up to 4 days prior to the assault. Testing can eliminate those partners as potential sources of DNA suspected to be from the rapist. A sample should also be taken from the victim. It is important to approach the victim with extreme sensitivity and to explain fully why the request is being made. A qualified victim advocate or forensic nurse examiner can be a great help.

Evidence Transportation and Storage

When transporting and storing evidence that may contain DNA, the evidence should be kept dry and at room temperature. It should be placed in paper bags or envelopes and then sealed, labeled, and transported in a way that ensures proper identification and documents a precise chain of custody. Plastic bags should not be used because they provide a growth medium for bacteria that may degrade DNA evidence. Direct sunlight, heat, and humidity also harm DNA, so evidence should not be stored in an area that can get hot, such as a room or police car without air conditioning.

Evidence that is properly identified, preserved, and collected can be stored for years without risking extensive degradation, even

THINKING SOLVES CRIMES

Officers can collect DNA evidence from a wide variety of locations, and their thinking of unlikely places to look for DNA has been the catalyst for solving many cases. Examples of unusual sources of DNA evidence include the following:

- Saliva found on the flap of an envelope containing a threatening letter. The sample was analyzed and the suspect was apprehended.
- Spittle collected from the sidewalk where a suspect in a sexual assault case was under officer surveillance. Following DNA testing, the suspect was charged with the crime.
- Blood collected from a bullet that had passed through an assailant's body and lodged in the wall behind him. The assailant was identified and charged with the crime.

at room temperature. Check with a local forensic laboratory for more information on long-term storage issues.

DNA Testing

The most common methods of DNA analysis use the polymerase chain reaction (PCR) technique. Polymerase is an enzyme involved in the natural replication, or copying, of genetic material. By helping the replication process along through a series of chemical steps, the PCR process can copy very small amounts of DNA very quickly. PCR amplification can create enough DNA to enable a laboratory analyst to generate a DNA profile, which can then be compared to other profiles. The development of the PCR technique revolutionized the field of DNA testing by improving the success rate for analysis of old, degraded, or very small biological samples.

However, the quality or quantity of the DNA obtained from crime scene evidence may be inadequate to produce usable results, even using the PCR technique. Also, inconclusive results can occur if the sample contains a mixture of DNA from several individuals—for example, a sample taken from a victim of a gang rape. Because the PCR process copies whatever DNA is present in the sample, the contaminating DNA also is copied. Even if the suspect's DNA profile can be found in the evidence, the presence of DNA from other sources may prevent establishing either an

inclusion or exclusion. In such cases, the results will likely be reported as inconclusive.

Thus, the presence of DNA from other sources may prevent the inclusion or exclusion of one individual as the source of DNA. As with all DNA results, inconclusive findings should be interpreted in light of all the other evidence in a case.

Now and In the Future

DNA technology will continue to evolve. Some anticipated advances in its use include:

Broader implementation of the CODIS database. States will continue to enact legislation requiring DNA samples from more offenders, resulting in more crimes being solved and increased cooperation among the States. Procedures for making international matches are expected to be developed—especially with Great Britain, which has a well-developed convicted felon database.

Increased automated laboratory procedures and use of computerized analysis. Although these timesaving approaches are not expected to replace human judgments in the final review of data, automation of many of the more routine aspects of analysis is expected to result in significant cost savings.

Portable devices capable of DNA analysis. These devices, plus advances in communications technology, may permit DNA evidence to be analyzed closer to the crime scene.

Remote links to databases and other criminal justice information sources. Prompt determinations of the DNA profile at the crime scene could speed up identifica-

tion of a suspect or eliminate innocent persons from being considered suspects.

Such forecasts of the future are somewhat uncertain. However, the fact that private laboratories, Federal agencies, and universities are aggressively researching these and other new technologies raises expectations that more sophisticated innovations will be developed.

Even with the latest innovations, DNA testing alone cannot provide absolute answers in every case. The prosecutor, defense counsel, judge, and law enforcement should confer on the need for such testing on a case-by-case basis.

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For More Information

- Any State or local law enforcement laboratory that conducts DNA analysis should contact the FBI for CODIS software, training, and user support. Visit the CODIS Web site at <http://www.fbi.gov/hq/lab/codis/index1.htm>.
- CD-ROM interactive courses on collecting and preserving DNA evidence (NCJ 182992 Beginning and NCJ 184479 Advanced) are available from the National Criminal Justice Reference Service (NCJRS) at 800-851-3420 or <http://www.ncjrs.org>.
- A brochure entitled *What Every Law Enforcement Officer Should Know About DNA Evidence* (BC 000614) is available on the NCJRS Web site at <http://www.ncjrs.org/nij/DNAbro/intro.html>.
- *Understanding DNA Evidence: A Guide for Victim Service Providers* (BC 000657) is available on the NIJ Web site at http://www.ojp.usdoj.gov/nij/dna_evbro.

ADVANCING JUSTICE THROUGH DNA TECHNOLOGY

The massive demand for DNA analyses in recent years has created a significant backlog of casework samples in crime labs across the country. These delays in processing samples pose substantial barriers to effective law enforcement and deny justice to crime victims and the public. For example, many rape kits and other evidence were thrown away in Los Angeles because investigators believed that the statutes of limitations had passed. NIJ research estimates that the number of rape and homicide cases awaiting DNA testing is approximately 350,000.

On March 11, 2003, Attorney General John Ashcroft announced a 5-year, \$1 billion plan to eliminate the backlog of DNA evidence in crime labs. (See <http://www.ojp.usdoj.gov/nij/dnainitiative/welcome.html>.) If approved by Congress, the program would “not only speed the prosecution of the guilty, but also protect the innocent from wrongful prosecution,” the Attorney General said.

A number of factors contribute to the inability of labs to accept and process casework samples in a timely fashion. For one thing, most State and local crime labs lack sufficient numbers of trained forensic scientists and do not have the money to hire more. Even where funds are available, there is an insufficient pool of qualified forensic scientists to hire. In addition, many State and local crime labs lack the resources and lab space necessary to obtain and use state-of-the-art automated equipment and software that would speed up DNA analyses.

Aside from the backlog of DNA evidence collected through case investigations, there is also a backlog of DNA data from known offenders waiting to be input into searchable databases. Because DNA casework analysis often requires comparisons with offender DNA profiles, the effectiveness of any DNA casework reduction strategy will depend upon up-to-date offender databases. Furthermore, while many States have statutes authorizing the collection of DNA evidence from a variety of convicted offenders, substantial numbers of authorized samples have yet to even be collected, let alone analyzed.

In its report to the Attorney General, NIJ made six recommendations to address these and other backlog issues:

1. Improve the DNA analysis capacity of public crime laboratories.
2. Provide financial assistance to State and local crime labs to help eliminate casework backlogs.
3. Develop funding to eliminate convicted offender database backlogs, and encourage aggressive programs to collect owed samples from convicted offenders.
4. Support training and education for forensic scientists, to increase the pool of available DNA analysts.
5. Provide training and education on the proper collection, preservation, and use of forensic DNA evidence to police officers, prosecutors, defense attorneys, judges, victim service providers, medical personnel, and other criminal justice personnel.
6. Support the development of improved DNA technologies, set up demonstration projects to encourage the increased use of DNA testing, and create a national forensic science commission to help ensure that the latest DNA and other forensic technologies are used to the maximum extent by criminal justice systems.

For more information, visit NIJ's DNA backlog Web page at <http://www.ojp.usdoj.gov/nij/dnabacklog>. Get a free copy of *Report to the Attorney General on Delays in Forensic DNA Analysis*, Washington, DC: U.S. Department of Justice, National Institute of Justice, March 2003 (NCJ 199425), available online at <http://www.ojp.usdoj.gov/nij/pubs-sum/199425.htm> or from NCJRS at 1-800-851-3420.