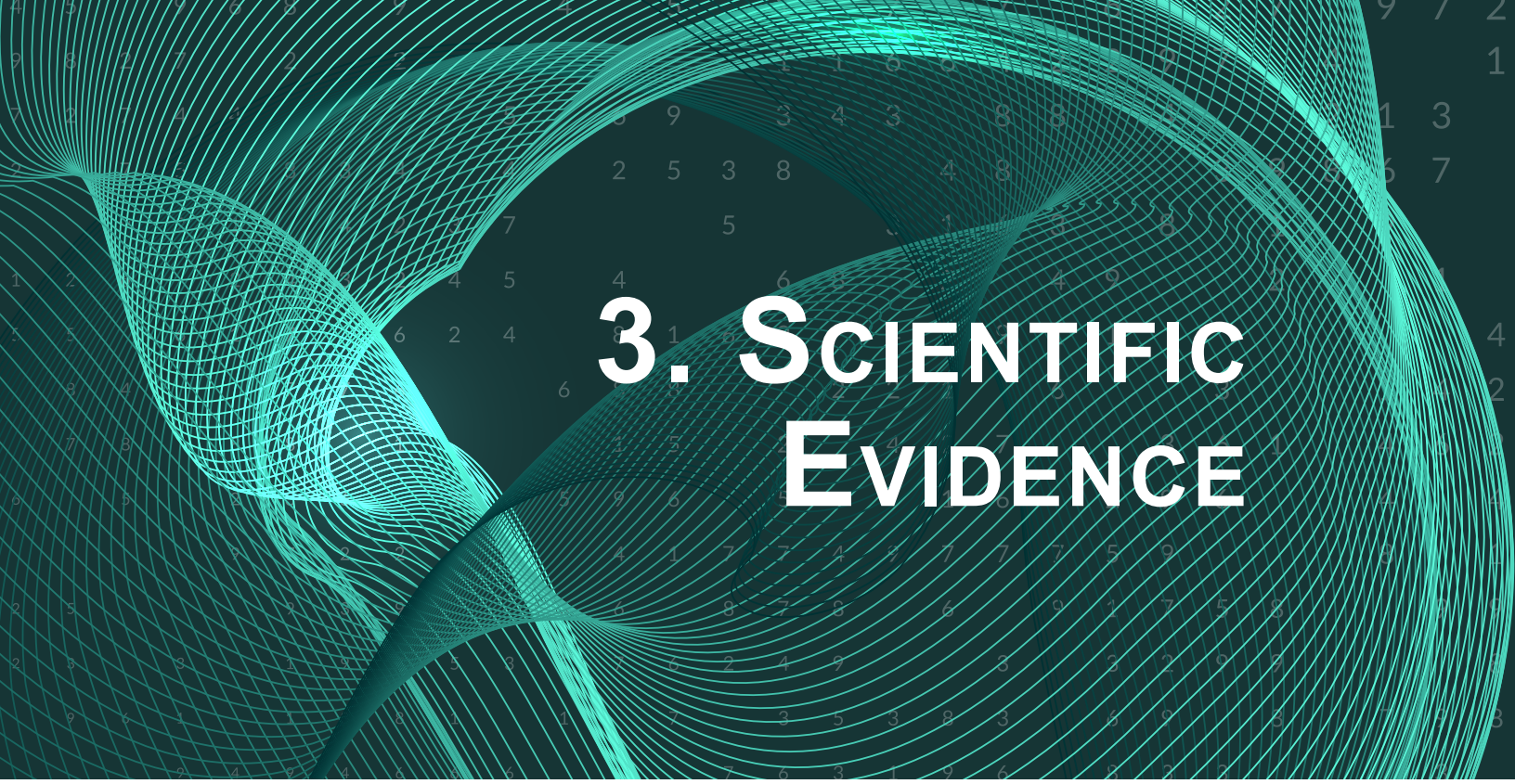

3. Scientific Evidence

Section 3.12
DNA Evidence

Hon. Ming Chin (Ret.)

3.12.1 Introduction

As the U.S. Supreme Court has recognized, "DNA testing has an unparalleled ability both to exonerate the wrongly convicted and to identify the guilty. It has the potential to significantly improve both the criminal justice system and police investigative practices."[1] But DNA testing also raises some unique concerns. This section provides a brief overview of the legal issues resulting from the collection, testing, storage, discovery and admissibility of DNA evidence.

3.12.1.1 What is DNA?

Deoxyribonucleic acid (DNA) is a large molecule coiled up tightly inside the nucleus of most cells in the human body.[2] It comprises two complementary strands of nucleotides held together by approximately three billion base pairs. The sequence of these base pairs, considered collectively in the form of a profile, are extremely useful as a forensic identifier because of the high degree of variability among individuals.[3] About one-tenth of one percent of human DNA (about three million bases) differs from person to person, which means that the order of the bases varies on average by one base in 1,000.[4]

DNA is a type of physical evidence that helps link an offender to a crime scene.[5] The first step in forensic use of DNA is typically collecting a sample of biological material from a crime victim or a crime scene.[6] The ability to use DNA as an identifier has expanded the types of biological evidence that is useful in litigation because all biological evidence found at a crime scene can be tested for DNA.[7] Scientists identify a limited number of genetic markers in the collected sample by deploying small pieces of manufactured chemical sequences (primers) that seek out and bind to complementary DNA sequences of interest in the sample.[8] A series of primers bound to a DNA sample permits amplification of the original sample to the point that the analyst can determine a DNA "profile" for the person who was the source of the sample.[9]

The next step is to compare a DNA profile of an unknown source to a profile of a suspect or to the millions of DNA profiles stored in computer databases of law enforcement agencies throughout the country.[10] To reduce the chance of misidentification, profiles are typically based on 20 or more DNA regions, or

loci, that vary from person to person.[11] A match between the profiles means that a single person could be the source of both DNA samples, a determination that is informed by the statistical rarity of the DNA profile at issue.[12] A finding of no match eliminates the known suspect as the source of the DNA collected from the victim or at the crime scene.[13]

3.12.1.2 Uses of DNA Evidence in Court

DNA evidence has been playing an important role in our legal system for some time. In criminal cases, DNA has dramatically affected questions of identity. Police, prosecutors, and defense counsel rely heavily on DNA evidence to do their jobs. Throughout the country, huge DNA databanks are being compiled with genetic information of convicted offenders, arrestees, suspects, victims and their family members, and even witnesses, for later comparison with DNA samples collected at crime scenes or from victims. These databases have enabled law enforcement authorities to make arrests in crimes that have gone unsolved for decades. Of course, DNA identity evidence may also aid the accused; all fifty states currently give inmates access to DNA evidence and testing that might not have been available at the time of trial. As of November 2018, there had been 362 post-conviction DNA exonerations in the United States.[14]

The impact of DNA evidence in criminal trials extends beyond matters of identity.

The impact of DNA evidence in criminal trials extends beyond matters of identity. In a 1998 death penalty case in Georgia, a defendant complained that his counsel conducted an inadequate mitigation defense by failing to pursue genetic testing that might have shown a genetic basis for his violent and antisocial behavior.[15] The highest state court in Georgia affirmed the death sentence, but not because it questioned this use of genetics as mitigation evidence.[16] In California, juries convicted two alcoholic lawyers in separate matters for embezzling money from clients. The attorney who claimed that a genetic disorder caused his alcoholism received a lighter sentence.[17] In another case, a jury found an accused murderer not guilty when her violence was linked to her Huntington's disease.[18]

Civil litigants also use genetic evidence in various new ways. Defendants in personal injury cases offer it on issues of both causation and damages. For example, in one toxic tort case, a chemical company whose toxins allegedly injured a child successfully sought a court order for genetic testing, hoping to establish that the child's condition was due to a genetic condition unrelated to the alleged exposure.[19] In other toxic tort cases, a defendant may offer DNA evidence of a plaintiff's genetic predisposition to a particular disease, and argue either that there was no causation — because that predisposition, not the defendant's product, caused the disease — or that damages should be reduced because the plaintiff would have developed the disease regardless of the exposure.[20] A defendant may also offer genetic evidence that the plaintiff was not exposed to the defendant's product, or does not have a susceptibility to disease as a result of the exposure, or has a particular sensitivity and was actually exposed to some other product that causes the same disease.[21] To reduce damages awarded for an exposure that causes a life-long disability, a defendant may even offer DNA evidence to show that the plaintiff, for genetic reasons, will have a shortened life.[22] Conversely, plaintiffs in toxic tort cases may offer DNA evidence on various issues, such as the fact and extent of exposure and predisposition to develop disease from a particular product.[23] This kind of evidence may be especially useful in "latent risk" cases, where plaintiffs assert they are at increased risk of developing disease in the future due to an exposure.[24] In short, genetic evidence has the potential to "transform toxic injury litigation."[25]

DNA may be introduced in civil and family law cases, not just criminal proceedings.

DNA evidence has also impacted family court judges. In family law cases, genetic evidence has traditionally been used to resolve disputes about paternity.[26] Today, it also may affect questions about parental rights. In South Carolina, for example, a judge deciding whether to terminate parental rights ordered a mother to be genetically tested for Huntington's disease.[27]

3.12.1.3 Procedures and Concerns in Handling DNA Evidence

However a litigant intends to use DNA evidence, safeguarding and preserving it is fundamental to success. Issues of admissibility may arise from the procedures

followed in gathering and testing DNA evidence from a crime scene, such as the risk of contamination from incidental activity. It is important for law enforcement personnel to avoid any action that could compromise the crime scene, including smoking, eating, drinking, and littering.[28] DNA evidence is more sensitive than other types of evidence, so law enforcement personnel should be especially aware of their actions in order to prevent inadvertent contamination.[29]

Procedures for collection of DNA and chain of custody issues may affect admissibility or weight of the evidence.

Documentation about chain of custody is another critical issue for those collecting DNA evidence. For example, where laboratory analysis reveals contamination of the evidence, chain of custody records will be required for identification of those who have handled the evidence.[30] In terms of processing DNA evidence, reducing the number of people who handle the evidence will lower the risk of contamination, simplify the proof required for admission, and eliminate avenues of cross-examination that could undermine the evidence's persuasive force. To check for processing errors, many laboratories compile "a staff elimination database" containing the DNA profiles of laboratory personnel, and run test results through it to identify contaminating DNA profiles.[31] It is also good practice to note in the documentation whether the DNA evidence was found wet or dry or includes blood spatters.

Direct sunlight and warmer conditions may degrade DNA, so the best way to preserve DNA evidence is to keep it in a cold environment. Therefore, officers transporting DNA evidence, in addition to maintaining chain of custody, should avoid storing the evidence in places that may get hot, such as the trunk of a car. Any probative biological sample that has been stored dry or frozen, regardless of age, may be considered for DNA analysis. Nuclear DNA from blood and semen stains that are more than 20 years old has been analyzed successfully using polymerase chain reaction (PCR).[32] Samples that have been stored wet for an extended period may be unsuitable for DNA analysis.[33]

Some biological samples are not considered suitable for DNA testing with current techniques, including embalmed bodies (with the possible exception of bone or plucked hairs), pathology or fetal tissue samples that have been immersed

in formaldehyde or formalin for more than a few hours (with the exception of pathology paraffin blocks and slides), and urine stains.[34] Other biological samples such as feces, fecal stains, and vomit can potentially be tested, but most laboratories do not routinely accept them for testing.

3.12.1.4 Data Analysis and Interpretation

After DNA evidence has been collected and properly tested, the next step is analyzing and interpreting the test results. If there is a "match" between the profile of the known individual and that of the unknown crime scene sample or the victim — meaning that the sequences in the sample from the known individual are all consistent with or present in the sequences in the unknown crime scene sample or the victim's sample — the result is considered an inclusion or non-exclusion."[35] This means that the known individual is included (cannot be excluded) as a possible source of the DNA found in the sample found at the crime or taken from the victim. Often, statistical frequencies regarding the rarity of the particular profile of genetic information observed in the unknown evidence sample and for a known individual are provided for various ethnic groups.[36] If the initial testing that produces the match involves comparison of only one or a few loci, then the possibility of including an innocent person as the source of the DNA increases, and comparison of additional loci should be done with remaining evidence. Also, there are circumstances in which a match is not legally meaningful, e.g., when the sequences are all consistent with those of the individual from whom the samples were collected (e.g., victim's sequences only on vaginal swabs taken from the victim; defendant's sequences only on a bloodstain on defendant's clothing).[37]

A DNA match has little significance without statistical information about the likelihood it occurred randomly.

A match has little significance without statistical information about the likelihood it occurred randomly. The lower the likelihood the match was random, the higher the likelihood the source of the matching profile was also the source of the DNA obtained at the crime scene or from the victim. To determine the rarity of a sample's genetic profile, experts use the "product rule," which involves selecting a set of genetic markers from the sample, estimating the frequency with which each marker

appears in the relevant population, and multiplying the frequencies together to produce the complete profile's frequency in the population. The resulting number may be described as the probability that the DNA of someone selected at random from the relevant population will match the DNA of the evidentiary sample.[38]

A match that results from running the DNA profile of a sample from an unknown source through a database of DNA profiles is called a "cold hit." Because these databases contain thousands, or sometimes millions, of profiles, and even unrelated people share, on average, two or three genetic markers, disputes may arise as to the significance of a cold hit. Defendants in cold hit cases sometimes challenge the use of the product rule, arguing that it fails to factor in the increased likelihood of a match that results when so many comparisons are done and thus does not accurately represent the probability of a random match. Appellate courts addressing this issue have held that, although the result of the product rule produces does not accurately express the probability of a random match in cold hit cases, it nevertheless is relevant and admissible because it accurately expresses the frequency with which a particular DNA profile appears in the general population.[39] These courts have also recognized, however, that a probability statistic reflecting the increased likelihood that a database search would produce a match may also be relevant and admissible.[40]

If testing fails to show a "match" between the profile of the known individual and that of the unknown crime scene sample or the victim — meaning that the sequences of the sample from a known individual are not all present in the sample obtained at the crime scene or from the victim — then the result is considered an exclusion, a nonmatch, or non-inclusion.[41] With limited exceptions, a nonmatch at any one loci of genetic comparison eliminates the provider of the sample as a potential source of the DNA found in the other tested sample.[42] However, in some contexts, additional testing may be necessary to make a nonmatch result meaningful, e.g., in a sexual assault case, when the suspect is excluded as the source but no samples are available from the victim and/or consensual partners.

A third possibility is that the testing is inconclusive. This can occur when the amount of DNA suitable for testing is too limited to yield more than partial results, or there are no samples from known individuals to compare with samples obtained at the crime scene or from the victim.[43]

3.12.2 DNA Databases

3.12.2.1 CODIS and NDIS

In 1990, the Federal Bureau of Investigation (FBI) started the Combined DNA Index System ("CODIS"), a pilot project to coordinate the DNA databases of 14 state and local laboratories.[44] Today, CODIS houses the National DNA Index System ("NDIS"), which allows more than 190 federal, state, and local law enforcement labs to exchange and compare DNA profiles electronically, greatly facilitating criminal investigations and searches for missing persons.[45] As of October 2018, NDIS contained over 13,566,716 offender profiles, 3,323,611 arrestee profiles, and 894,747 forensic profiles, and had produced more than 440,346 hits, assisting in more than 428,808 investigations.[46]

More than 190 federal, state, and local law enforcement labs exchange and compare DNA profiles electronically.

In criminal investigations, CODIS allows an analyst at a participating lab to upload an unidentified DNA profile created from crime scene evidence and to search it against two indexes: the Convicted Offender or Arrestee Index, which contains the DNA profiles of convicted or arrested individuals, and the Forensic Index, which contains unidentified DNA profiles from other criminal investigations.[47] If a match is identified, additional steps are taken to confirm the match. If there is a confirmed match with a DNA profile stored in the Convicted Offender or Arrestee Index, then the analyst working with the unidentified DNA profile may obtain the identity of the suspect from an analyst in possession of the known DNA profile. If there is a confirmed match with a DNA profile stored in the Forensic Index, then analysts and law enforcement personnel may share information about their investigations and possibly develop new leads.

3.12.2.2 Federal Privacy, Quality Assurance, and Expungement Requirements

(i) CODIS Privacy Measures

CODIS does not store names or other personal information, so no personal information is shared before confirmation of a match.[48] At the national level, only the following is stored and may be searched for:

- the DNA profile (the set of identification characteristics or numerical representation at each of the various loci analyzed);
- the Agency Identifier of the agency that uploaded the DNA profile;
- the Specimen Identification Number (a number assigned at the time of sample collection); and,
- the DNA lab personnel associated with the DNA profile analysis.[49]

Access to DNA samples and records is generally limited to participating federal, state, and local agencies and labs, and to defendants insofar as they may access samples and analyses performed in connection with their cases.[50]

(ii) NDIS Laboratory Participation Requirements

NDIS establishes quality assurance, privacy, and expungement requirements for participating labs, including the following:[51]

- compliance with FBI Quality Assurance Standards (QAS);[52]
- external audits every two years to demonstrate compliance with the QAS;
- accreditation by a nonprofit professional association of persons actively engaged in forensic science that is nationally recognized within the forensic science community;
- limiting access to DNA samples and records in accordance with federal law.[53]

Participating states must agree, by signing a Memorandum of Understanding, to abide by the DNA Identification Act's requirements as well as other record-keeping requirements and operational procedures.[54]

(iii) NDIS DNA Data Requirements

As of December 2018, NDIS only accepted DNA data generated through the Polymerase Chain Reaction (PCR) Short Tandem Repeat (STR), Y chromosome (Y-STR), and Mitochondrial DNA (mtDNA) technologies.[55] Additional requirements include:

- DNA data has been produced by a lab that meets the laboratory participation requirements (above) and follows expungement procedures in accordance with federal law;
- DNA data fall within an acceptable NDIS category, such as convicted offender, arrestee, detainee, legal, forensic (casework), unidentified human remains, missing person, or a relative of missing person;
- DNA data meet minimum CODIS Core Loci requirements for the specimen category;
- DNA PCR data generated using PCR accepted kits.[56]

A profile of a person whose conviction has been reversed must be expunged from data bases.

(iv) NDIS Expungement Requirements

Labs must expunge profiles of convicted individuals upon receiving a certified copy of a final court order documenting reversal of the conviction. Labs must expunge profiles of arrestees upon receiving a certified copy of a final court order documenting that no charges were brought within the applicable time period or that any charges were dismissed or resulted in acquittal.[57]

(v) FBI Quality Assurance Standards (QAS)

The FBI's QAS describe the minimum standards for labs performing DNA analysis and/or databasing, and cover the following areas: organization, personnel, facilities,

evidence or sample control, validation, analytical procedures, equipment calibration and maintenance, reports, review, proficiency testing, corrective action, audits, safety, and outsourcing.[58]

3.12.2.3 Local Databases

Police investigators increasingly rely on their own local DNA databases instead of the FBI's national DNA database network, because of federal restrictions regarding CODIS and NDIS.[59] These local databases largely operate outside of federal regulation, so they are not limited to convicted offenders and arrestees; they often also contain DNA profiles of suspects, victims and their family members, witnesses, and abandoned biological material.[60] Use of these local databases is controversial. Supporters argue that the practice "allows police to maximize the potential of genetic surveillance to solve crimes,"[61] but critics assert that it "has unleashed significant negative forces that threaten privacy and dignity interests, exacerbate racial inequities in the criminal justice system, and undermine the legitimacy of law enforcement."[62]

3.12.3 Fourth Amendment Issues

The Fourth Amendment to the United States Constitution protects the right to be free from "unreasonable" government "searches and seizures."[63] According to U.S. Supreme Court decisions, a search occurs when the government intrudes upon a reasonable expectation of privacy;[64] a seizure of property occurs when the government meaningfully interferes with a possessory interest;[65] and, a seizure of a person occurs when freedom of movement is restrained by means of physical force or show of authority, and a reasonable person would believe he or she was not free to leave.[66] A warrant supported by probable cause is generally required for a search or seizure, but there are exceptions to this requirement "because the ultimate touchstone of the Fourth Amendment is 'reasonableness'."[67] This section provides an introduction to some of the Fourth Amendment issues that arise in connection with collecting biological samples for DNA testing and creating, storing, and comparing DNA profiles.

3.12.3.1 Collecting Biological Samples for DNA Testing

(i) Collecting Biological Samples from a Person's Body without Consent

The U.S. Supreme Court has recognized that an "intrusion into the human body" by the government—such as swabbing the inside of a cheek, scraping fingernails, or withdrawing blood—constitutes a Fourth Amendment search.[68] Thus, without a warrant supported by probable cause, law enforcement officers generally may not collect a biological sample without consent.

Taking a DNA sample is a search for Fourth Amendment purposes.

The analysis changes, however, upon a person's arrest for or conviction of a serious crime. For example, the U.S. Supreme Court has held that when law enforcement officers, after making an arrest supported by probable cause for a serious offense, bring the arrestee to the station for custodial detention, they may swab the inside of the arrestee's cheek to collect an evidentiary sample for DNA testing.[69] The reasonableness of this "legitimate police booking procedure" is established by the government's significant interests in identifying persons taken into custody and solving crimes, the unique effectiveness of DNA identification, the minimal intrusion of a cheek swab, and the reduced privacy expectation of those in police custody.[70] Likewise, the government may, without a warrant and without consent, collect evidentiary samples for DNA testing from those convicted of felony crimes.[71]

(ii) Collecting Biological Samples from a Person's Body with Consent

Consent allows law enforcement officers to conduct a search and/or make a seizure without a warrant and without probable cause, provided that the consent is voluntarily given[72] and the search and/or seizure does not exceed the scope of consent.[73] Consent is "voluntarily given" when, under the totality of the circumstances, it is "not the result of duress or coercion, express or implied."[74] The scope of consent is determined by asking what a reasonable person—knowing what the officer knew at the time—would have understood the individual to have

consented to.[75] Both the voluntariness and the scope of consent are questions of fact entitled to deference upon appeal.

When a person provides a biological sample in cooperation with a law enforcement investigation, unique concerns may arise about the scope of consent. First, the person may not have known, at the time of consent, that the government would use the sample for DNA testing. This issue may arise because today's technology allows DNA analysis on samples that were taken before DNA testing was even available. When faced with this issue, an appellate court in Connecticut concluded that, because the defendant had consented to "a complete search" of his saliva samples without limiting when or how they could be tested, DNA tests performed over 20 years later did not exceed the scope of his consent. "[A] reasonably objective person," the court reasoned, "would understand that the police obtained the saliva sample with the intention of determining who committed the victim's murder and that they would continue their search until they found the person responsible."[76]

Second, the person providing the sample may not know that the government intends to use the resulting DNA profile in other law enforcement investigations. In a Maryland case presenting this issue, the appellate court concluded that, because the defendant signed a consent form acknowledging that "any evidence found to be involved in this investigation … can be used in any future criminal prosecution," running his DNA profile through state and county DNA databases, after testing showed he was the source of DNA collected in the case under investigation, did not exceed the scope of his consent.[77]

Cases like these suggest that when someone provides a biological sample for use in an investigation without expressly limiting the scope of consent, officers may use the sample for DNA testing and may use the resulting DNA profile in connection with other investigations.[78]

(iii) Collecting Biological Samples from Items Lawfully in Government Custody

Collecting biological samples for DNA testing from items lawfully in the government's possession generally does not constitute a search.[79] One court has

held, however, that when law enforcement officers have an item from the victim of one crime, and they suspect that the victim committed an unrelated crime, they need a warrant to collect a DNA sample from the item.[80]

(iv) Collecting "Abandoned" Biological Samples

The U.S. Supreme Court has held that there is no reasonable expectation of privacy in items abandoned in public.[81] This rule has been applied in cases where individuals have "abandoned" their biological material—or an item containing their biological material—in public.[82] Therefore, law enforcement officers do not need probable cause or a warrant to collect DNA from abandoned genetic material such as a straw, cup or cigarette.

3.12.3.2 Creating a DNA Profile from Lawfully Obtained Biological Samples

The U.S. Supreme Court has stated that the collection of biological material and subsequent forensic analysis of that material constitute separate Fourth Amendment searches.[83] But it has also held that, given the limited genetic information sought and revealed by the loci involved in identity testing, analysis of DNA that has been lawfully collected does "not amount to a significant invasion of privacy that would render the DNA identification impermissible under the Fourth Amendment."[84] At least one court has held, however, that the government needs a warrant to create a DNA profile from a victim's DNA sample where the government suspects that the victim committed an unrelated crime.[85]

3.12.3.3 Storing and Comparing DNA Profiles

Courts generally hold that retaining a DNA profile and comparing it to the profiles of later collected DNA samples does not constitute a Fourth Amendment search.[86] But Fourth Amendment concerns may arise when the government continues to store and use the DNA profiles of convicted persons after they have completed their sentences and any terms of parole or probation,[87] or of arrestees if no charges are brought within the required time period or after the charges have been dismissed or resulted in acquittal.[88]

3.12.3.4 Familial testing

A relatively new, but controversial, technique is familial database searching, which uses DNA to identify criminals through their relatives.[89] Investigators search databases for DNA profiles that closely resemble, but do not exactly match, the profile of DNA that an unidentified suspect left behind at the crime scene.[90] This technique is based on the scientific fact that a person's DNA is much more similar to the DNA of the person's biological relatives than to the DNA of unrelated persons.[91] Because of this fact, a partial match may, depending on its degree, suggest that the source of the DNA at the crime scene is a biological relative of the person identified from the database search.[92] Police can interview that person's relatives, hoping to identify and find the suspect.[93] Some claim that use of this technique could increase the yield of investigative leads by 40%.[94] The United Kingdom has been doing familial database searching since 2002, and has used it to solve several sensational crimes.[95] Maryland and the District of Columbia prohibit the technique, but as of 2018, ten states use it.[96]

The use of familial data bases are prohibited in Maryland and the District of Columbia.

Critics of this technique argue that it puts all family members under "genetic surveillance" for crimes they are not even alleged to have committed.[97] Others argue that "it turns family members into genetic informants without their knowledge or consent."[98] Some legal scholars assert that a familial database search constitutes an unreasonable, and therefore unconstitutional, search.[99] In a 2010 decision, a federal appellate court noted that the government's use of CODIS to discover partial matches "[a]rguably" raises unique "privacy concerns."[100] One constitutional law professor has warned that "if familial searching proceeds, it will create a political firestorm."[101] Because of such concerns, the FBI has so far declined to pursue familial database searching.[102]

In a related technique, investigators are using commercial, publicly available genealogical/ancestry websites (such as Ancestry and 23 and Me) to search for genetic relatives of the unidentified person who is the source of DNA found at a crime scene. Through this technique, detectives in California recently arrested a 72-year-old man whom they believe committed a string of rapes and murders in

the 1970s and 1980s.[103] They submitted DNA leftover from some of those decades-old crimes to a commercial ancestry website and identified the suspect's great-great-great grandparents. They then constructed about 25 distinct family trees of their descendants, located two descendants who were about the suspect's age and had ties to the locations of the crimes, surveilled one of those descendants, recovered an item he discarded, and performed DNA testing on the discarded item. The testing produced a match between DNA on the discarded item and DNA recovered at one of the crime scenes.[104]

In a criminal case, the statute of limitations does not begin to run until the DNA match occurs.

3.12.4 Procedural Issues

3.12.4.1 Statutes of Limitations

In the criminal context, statutes of limitations limit the time period within which the government may file charges for criminal conduct. They primarily reflect a legislative judgment that at some point, the benefits of prosecuting an old crime are outweighed by the costs, primarily due to concern about the defendant's inability to obtain sufficient and accurate evidence for a defense.[105] Under the general statute of limitations for federal crimes, the government must file charges within five years of the offense.[106] There are several exceptions to this statute, however, including for capital offenses, terrorism, white collar crimes, and crimes against children.[107]

Many legislatures, in recognition of the accuracy and reliability of DNA testing, have created special exceptions to statutes of limitations for cases that may be solved with such testing.[108] Under federal law, if DNA testing implicates a known person in the commission of a felony, then "no statute of limitations . . . shall preclude such prosecution until a period of time following the implication of the person by DNA testing has elapsed that is equal to the otherwise applicable limitation period."[109] In other words, the statute of limitations does not begin to run until the DNA match occurs.[110]

3.12.4.2 Doe Warrants and Indictments

Under federal law, if the DNA profile of an unidentified source implicates the source in a crime of sexual abuse, then the government may file an indictment against an "individual whose name is unknown, but who has a particular DNA profile" to effectively toll the statute of limitations.[111] At least one court has held that DNA-based "John Doe" indictments do not violate a defendant's constitutional right to notice.[112]

Likewise, several states authorize the filing of an arrest warrant based on an unidentified suspect's DNA profile, which allows prosecution to commence before the statute of limitations expires. The hope is that the suspect will later be identified through a DNA match. Provided that the DNA profile is sufficiently discriminating, state courts have upheld these DNA-based "John Doe" arrest warrants against federal and state constitutional challenges, including arguments that they violate the Fourth Amendment's particularity requirement and the Sixth Amendment's notice requirement.[113]

3.12.4.3 Pre-Indictment Delay

Even if a prosecution does not violate the applicable statute of limitations, the U.S. Supreme Court has stated that the Due Process Clause may require dismissal of charges upon a showing that an unreasonable prosecutorial delay actually prejudiced the defendant's right to a fair trial.[114] The high court has clarified, however, that unlike pre-indictment delay "to gain tactical advantage over the accused," "investigative delay does not deprive [a defendant] of due process, even if his defense might have been somewhat prejudiced by the lapse of time."[115] Consequently, claims of unreasonable prosecutorial delay have failed where the pre-indictment delay was due to DNA testing, such as when a defendant's DNA profile matches a stored DNA profile from crime scene evidence years after the crime was committed.[116]

3.12.5 Discovery Issues

3.12.5.1 Brady Duty to Disclose Material Exculpatory DNA Evidence and Information

In *Brady v. Maryland*, the U.S. Supreme Court held that the Due Process Clause of the Fourteenth Amendment requires the prosecution to disclose to the defense all material exculpatory evidence and information in the government's possession.[117] Courts have made clear that this *Brady* duty includes evidence and information possessed by the government's crime lab.[118]

Therefore, the government has a *Brady* duty to disclose any material exculpatory DNA evidence and any material exculpatory information about collection, testing, and storing of DNA evidence. This might include: flaws in the collection process or chain of custody; prior incidents of lab error; failed proficiency tests by lab technicians or analysts; inconclusive results; evidence of contamination; and DNA evidence from other crimes that might exonerate the accused in the case at hand.[119]

Brady requires disclosure of any material exculpatory DNA evidence.

The U.S. Supreme Court has also held, however, that *Brady* does not require the government to provide convicted defendants with access to the government's evidence so they may subject it to DNA testing.[120] In doing so, the high court noted that the federal government and forty-six States had already enacted statutes dealing with post-conviction access to DNA evidence.[121]

3.12.5.2 Government's Duty to Preserve Biological Evidence for Later Testing

In *California v. Trombetta*, the U.S. Supreme Court held that the that the Due Process Clause of the Fourteenth Amendments requires the government to preserve material exculpatory evidence "of such a nature that the defendant would be unable to obtain comparable evidence by other reasonably available means."[122] Later, in *Arizona v. Youngblood*, the court clarified that unless the defendant can "show bad

faith on the part of the police, failure to preserve potentially useful evidence does not constitute a denial of due process of law."[123]

Therefore, the government has a constitutional duty not to destroy any material exculpatory DNA evidence or any material exculpatory information about collection, testing, and storing of DNA evidence that the defendant may not obtain by other reasonably available means, but its failure to carry out this duty violates due process only if it acts in bad faith. Accordingly, courts have held that when government DNA testing would consume an evidentiary sample, the government is not required split the sample with the defense.[124]

3.12.5.3 Discovery in Criminal Cases Involving a NDIS DNA Match

In cases involving DNA matches through NDIS, criminal defendants are entitled to access the DNA samples and analyses that were performed in connection with their cases.[125] The "hit file" of the U.S. Department of Justice's DNA Data Bank Program generally includes:

- the hit notification letter that was issued by the database administrator to the DNA casework lab, including the name and state identification number of the offender whom the evidence profile matched;
- the specimen match detail report, specifying how many loci the profiles have in common and at which stringency;
- a photocopy of the offender's sample submission card that was submitted with the offender's buccal sample;
- chain of custody information, including the chronology of testing process;
- electropherograms for both the original and confirmation analyses;[126]
- procedural check sheets; and
- documentation of the technical and administrative review process.[127]

3.12.5.4 Discovery in Criminal Cases Involving DNA Evidence

Discovery is particularly important in cases involving DNA evidence because it may reveal concerns about the evidence's collection, transportation, storage, and testing. This section provides a brief overview of the items that are discoverable in most cases.

Rule 16 of the Federal Rules of Criminal Procedure establishes for prosecutors three disclosure responsibilities that may be relevant to forensic evidence:

1. the prosecution must permit a defendant to inspect and copy any results or reports of a scientific test that are (i) in the government's possession, custody or control, (ii) known or through due diligence could be known to a government attorney, and (iii) material to preparing the defense or intended to be used by the government in its case in chief at trial (rule 16(a)(1)(F));
2. the prosecution must provide, upon request, a written summary of any expert testimony the government intends to use during its case in chief at trial, including the expert's opinions, the bases and reasons for those opinions, and the expert's qualifications (rule 16(a)(1)(G)); and,
3. the government must produce, upon request, documents and items material to preparing the defense that are in the possession, custody, or control of the government, which may include records documenting the tests performed, the maintenance and reliability of tools used to perform those tests, and/or the methodologies employed in those tests (rule 16(a)(1)(E)).

Separately, the Quality Assurance Standards for Forensic DNA Testing Laboratories require participating labs to keep extensive records, which are subject to discovery.[128] For example, under Standard 11.2, a lab report must contain the following:

- case identifier;
- description of evidence examined;

- a description of the technology;
- locus or amplification system;
- results and/or conclusions;
- quantitative or qualitative interpretative statement;
- date issued;
- disposition of evidence; and,
- signature and title, or equivalent identification, of the person accepting responsibility for the content of the report.

Other required items that are subject to discovery include:

- documentation of the lab's quality system manual (Standard 3)
- documentation of the lab's evidence control system (Standard 7)
- documentation of the lab's standard operation procedures (Standard 9)
- records of proficiency testing (Standard 13); and,
- documentation regarding corrective action when casework errors are detected (Standard 14).

Finally, chain-of-custody records, which document all transfers of DNA evidence—from collection to testing to the courtroom—are also discoverable. At a minimum, these records should include the locations where the evidence was stored and the names of anyone who had custody of the evidence, including those who:

- collected the evidence;
- sent and received the evidence to and from the police department and/or the lab;
- transported the evidence to and from the police department and/or the lab;
- logged evidence into and out of the evidence room.

3.12.6 Admissibility Issues

3.12.6.1 Expert Testimony based on DNA Evidence: Frye[129] and Daubert[130]

An extensive discussion on these cases is found in *Section 7* in this Bench Book.

3.12.6.2 Confrontation Clause Issues

The Confrontation Clause of the Sixth Amendment to the U.S. Constitution affords criminal defendants the right to cross-examine witnesses who offer testimony that serves as substantive evidence against them.[131] In *Crawford v. Washington*, the U.S. Supreme Court held that "[t]estimonial statements of witnesses absent from trial [may be] admitted only where the declarant is unavailable, and only where the defendant has had a prior opportunity to cross-examine."[132] This holding raises two questions: whether DNA reports constitute "testimonial" evidence and whether the defendant has a right to cross-examine the analysts involved in production of the DNA report.

Crawford described "testimonial" evidence as "ex parte in-court testimony or its functional equivalent," such as "affidavits, custodial examinations, prior testimony that the defendant was unable to cross-examine, or similar pretrial statements that declarants would reasonably expect to be used prosecutorially."[133] Importantly, *Crawford* suggested that business records were not testimonial.[134] In *Melendez-Diaz v. Massachusetts* (2008) 557 U.S. 305, and *Bullcoming v. New Mexico*, 564 U.S. 647 (2011), the U.S. Supreme Court held that a lab's sworn affidavit identifying as cocaine a substance seized from the defendant and a lab's blood alcohol concentration (BAC) report of the alcohol content in a sample of defendant's blood were testimonial evidence for purposes of the Confrontation Clause.[135] Together, these decisions hold that if a scientific report and its conclusions are offered for the truth of the matters they assert, as substantive evidence against a defendant, the analysts involved in the subject of the report are subject to confrontation.

In *Williams v. Illinois*, however, a divided U.S, Supreme Court held that an expert witness's testimony about a non-admitted DNA report prepared by a non-testifying analyst did not violate the Confrontation Clause.[136] In that case, during the

defendant's trial for rape, one of the prosecution's expert witnesses testified that she had matched two DNA profiles: one produced by another testifying analyst from a sample of defendant's blood, and another produced by a non-testifying analyst at an outside lab. The trial court excluded the outside lab report in response to the defendant's objection that it had shown that the DNA profile provided by the outside lab was produced from semen found on vaginal swabs taken from the victim. Justice Alito, writing for a four-justice plurality, provided two, independent grounds for finding no constitutional violation. First, the testimony at issue was not admitted to prove the truth of the matters asserted, i.e., that the outside lab's report had shown that the DNA profile provided by the outside lab was produced from semen found on vaginal swabs taken from the victim.[137] Rather, it was offered to explain the basis for the expert's conclusion that the DNA profile produced from a sample of the defendant's blood matched the DNA profile provided by the outside lab.[138] Second, even if the other lab's report had been introduced for its truth, it would not constitute "testimonial" evidence for purposes of the Confrontation Clause, because unlike the forensic reports prepared in *Melendez-Diaz* and *Bullcoming*, it was not prepared for the primary purpose of creating evidence to use at trial to prove the guilt of a particular criminal defendant.[139] To this end, the plurality noted that lab technicians preparing DNA profiles "generally have no way of knowing whether it will turn out to be incriminating or exonerating--or both."[140]

Justice Thomas, writing only for himself, agreed with the plurality that the expert's statements were non-testimonial; in his view, the lab's report lacked the requisite "formality and solemnity."[141] Meanwhile, he agreed with the dissent that the expert's statements were offered for their truth and "share[d] the dissent's view of the plurality's flawed analysis."[142]

Therefore, it is unclear whether the prosecution is required call the analysts involved in the production of a DNA report in order to introduce it and its conclusions as substantive evidence against a defendant. In a recent dissent to a denial of certiorari, Justice Gorsuch, joined by Justice Sotomayor, noted, "This Court's most recent foray in this field, *Williams v. Illinois*, yielded no majority and its various opinions have sown confusion in courts across the country."[143]

3.12.6.3 Prejudice Concerns

(i) Presenting Evidence of DNA Database Matches

Under Federal Rule of Evidence 404(b), evidence of a "crime, wrong, or other act" is not admissible to prove a person's character in order to show that the person acted in accordance with that character on a particular occasion; but such evidence may be admitted for another, non-propensity purpose.

Concerns may arise when the prosecution presents evidence that a DNA profile created from crime scene evidence was matched to a defendant's DNA profile in a DNA database. From the fact that the defendant's DNA profile was stored in a DNA database, jurors may infer that the defendant was previously arrested or convicted of a crime and, therefore, has a propensity to engage in criminal conduct. Consequently, defense counsel have moved to suppress such evidence under rule 404(b) and its state equivalents.

Courts have rejected these motions on the ground that the evidence was introduced, not to show propensity, but to explain how the defendant became the suspect in the case and to avoid juror confusion.[144] It may be appropriate, however, for the trial court to issue a limiting instruction:

1. to prevent the prosecution from suggesting that the defendant's DNA profile was in the DNA database as the result of prior criminal activity, and/or

2. to require the prosecution to elicit testimony that the DNA database contains DNA profiles from individuals who were not arrested or convicted of a crime.[145]

(ii) Presenting Evidence of Inconclusive DNA Test Results

Under Federal Rule of Evidence Rule 403, evidence that is relevant and otherwise admissible may be excluded if its probative value is substantially outweighed by a risk of unfair prejudice and/or misleading the jury. Such risks arise when DNA test results leave questions as to whether the defendant truly was the source of the DNA evidence—for example, when the defendant may not be excluded as a suspect, when

there is a relatively low statistical probability that the defendant contributed to the sample, or a relatively high statistical probability of a random match.

Generally, courts have found that such DNA test results are admissible, because their probative value is not substantially outweighed by their potential to cause unfair prejudice to the defendant or to confuse the jury.[146] In these cases, courts have stressed the "ameliorative potential of cross-examination, counter-experts, and clarifying jury instructions."[147] But at least one court has reversed where inconclusive DNA test results were admitted without accompanying testimony explaining the statistical relevance of the results.[148]

3.12.7 Endnotes

1. District Attorney's Office for Third Judicial Dist. v. Osborne, 557 U.S. 52, 55 (2009).
2. MING W. CHIN ET AL., FORENSIC DNA EVIDENCE: SCIENCE AND THE LAW § 2.2 (The Rutter Group 2017).
3. *Id*.
4. *Id*. §1.1.
5. National Institute of Justice, *DNA Evidence: Basics of Identifying, Gathering and Transporting*, https://www.nij.gov/topics/forensics/evidence/dna/basics/pages/identifying-to-transporting.aspx (last visited Dec. 13, 2018).
6. CHIN ET AL., *supra* note 2, at § 1.1.
7. National Institute of Justice, *DNA Evidence: Basics of Identifying, Gathering and Transporting*, https://www.nij.gov/topics/forensics/evidence/dna/basics/pages/identifying-to-transporting.aspx (last visited Dec. 13, 2018).
8. CHIN ET AL., *supra* note 2, at § 1.1.
9. *Id*.
10. *Id*.
11. Before 2017, the FBI required that most profiles include 13 loci for inclusion its database. Effective January 1, 2017, the FBI increased the number of required loci to 20. (FBI, *Frequently Asked Questions on CODIS and NDIS*, https://www.fbi.gov/services/laboratory/biometric-analysis/codis/codis-and-ndis-fact-sheet (last visited Dec. 18, 2018)
12. CHIN ET AL., *supra* note 2 at § 2.3
13. *Id*. at § 1.1
14. Innocence Project, *Fast Facts: DNA Exonerations in the United States*, https://www.innocenceproject.org/dna-exonerations-in-the-united-states/ (last visited Nov. 15, 2018).
15. Turpin v. Mobley, 502 S.E.2d 458 (Ga. 1998).
16. *Id*. at 466-467.
17. CHIN ET AL., *supra* note 2 at § 13.10.

18. *Id*.

19. Lori B. Andrews, *Genetics, Reproduction, and the Law*, 35 TRIAL 7 (July 1999).

20. Gary E. Marchant, *Genetic Susceptibility and Biomarkers in Toxic Injury Litigation*, 41 JURIMETRICS JOURNAL 67, 68 (2000).

21. *Id*.

22. *Id*. at 101.

23. *Id*. at 68.

24. *Id*. at 84.

25. *Id*. at 68-69.

26. CHIN ET AL., *supra* note 2 at § 13.10.

27. *Id*.

28. National Institute of Justice, *DNA Evidence: Basics of Identifying, Gathering and Transporting*, https://www.nij.gov/topics/forensics/evidence/dna/basics/pages/identifying-to-transporting.aspx (last visited Dec. 13, 2018).

29. *Id*.

30. *Id*.

31. Mary McCarthy, *Am I My Brother's Keeper?: Familial DNA Searches in the Twenty-First Century*, 86 Notre Dame L. Rev. 381, 392 (2011).

32. *Id*.

33. *Id*.

34. *Id*.

35. *Id*.

36. *Id*.

37. *Id*.

38. People v. Nelson, 43 Cal. 4th 1242 (Cal. 2008).

39. *Id*.; *See also* U.S. v. Jenkins, 887 A.2d 1013 (App. D.C. 2005)

40. *Id*.

41. *Id*.

42. *Id*.

43. *Id*.

44. *Combined DNA Index System (CODIS)*, FED. BUREAU OF INVESTIGATION, CRIM. JUST. INFO. SERV. (Dec. 5, 2018), https://www.fbi.gov/services/laboratory/biometric-analysis/codis (last visited Dec. 13, 2018).

45. *CODIS and NDIS Factsheet*, FED. BUREAU OF INVESTIGATION, CRIM. JUST. INFO. SERV. (Dec. 5, 2018), https://www.fbi.gov/services/laboratory/biometric-analysis/codis/codis-and-ndis-fact-sheet (last visited Dec. 13, 2018).

46. FED. BUREAU OF INVESTIGATION, CRIM. JUST. INFO. SERV., *CODIS - NDIS Statistics*, (Dec. 5, 2018), https://www.fbi.gov/services/laboratory/biometric-analysis/codis/ndis-statistics (last visited Dec. 13, 2018)

47. *CODIS and NDIS Factsheet*, supra note 43.

48. *Id*.

49. *Id*.

50. 34 U.S.C. § 12592 (b)(3) (situations in which DNA samples and DNA analyses may be disclosed).

51. 42 U.S.C. § 14132(b).

52. See FED. BUREAU OF INVESTIGATION, QUALITY ASSURANCE STANDARDS FOR FORENSIC TESTING LABORATORIES (2011) [hereafter *QAS for Forensic Testing Laboratories*] (available at https://www.fbi.gov/file-repository/quality-assurance-standards-for-forensic-dna-testing-laboratories.pdf/view); FED. BUREAU OF INVESTIGATION, QUALITY ASSURANCE STANDARDS FOR DNA DATABASING LABORATORIES (2011) [hereafter *QAS for DNA Databasing Laboratories*] (available at https://www.fbi.gov/file-repository/quality-assurance-standards-for-dna-databasing-laboratories.pdf/view).

53. *CODIS and NDIS Factsheet*, supra note 43.

54. *Id*.

55. *Id*.

56. *Id*.

57. *Id*.

58. See *QAS for Forensic Testing Laboratories and QAS for DNA Databasing Laboratories*, *supra* note 50.

59. Jason Kreag, Going Local: The Fragmentation of Genetic Surveillance, 95 B.U.L.Rev. 1491, 1492-1494 (Oct. 2015).

60. *Id*. at 1497, 1499.

61. *Id*. at 1496.

62. *Id*. at 1493.

63. U.S. CONST. Amend. IV ("The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated . . . ").

64. U.S. v. Katz, 389 U.S. 347 (1967).

65. U.S. v. Jacobsen, 466 U.S. 109 (1987).

66. U.S. v. Mendenhall, 446 U.S. 544, 553-54 (1980).

67. Brigham City v. Stuart, 547 U.S. 398, 403 (2006).

68. Maryland v. King, 569 U.S. 435, 446 (2013) (collecting cases).

69. *Id*. at 465-66.

70. *Id*. at 461-62, 465.

71. *See id*. at 445 (noting that all 50 states require the collection of DNA from felony convicts).

72. Schneckloth v. Bustamonte, 412 U.S. 218 (1973).

73. Florida v. Jimeno, 500 U.S. 248 (1991).

74. *Schneckloth*, 412 U.S. at 248.

75. *Jimeno*, 500 U.S. at 251.

76. State v. Benefield, 103 A.3d 990, 1000 (Conn. App. 2014).

77. Varriale v. State, 119 A.3d 924 (Md. App. 2015).

78. *See* People v. Collins, 250 P.3d 668 (Colo. App. 2010), *cert. denied* No. 10SC223, 2010 WL 4400041 (Colo. 2010) (Colorado's matching of DNA sample from victim's rape kit to defendant's DNA profile did not exceed scope of consent where

defendant provided saliva sample in connection with robbery investigation in Missouri and then Missouri police sent defendant's DNA profile to Denver police because defendant did not place express limitation on his consent); Com. v. Gaynor, 820 N.E.2d 233 (Mass. 2005) (DNA testing did not exceed scope of consent where defendant provided blood sample with the understanding that it would only be used in comparison with blood samples from one crime scene and did not place explicit limitation on his consent); Pace v. State, 524 S.E.2d 490 (Ga. 1999), *cert. denied* 531 U.S. 839 (2000) (use of DNA profile in four separate investigations did not exceed scope of consent where defendant provided blood sample pursuant to consent form stating "for further use in this particular investigation" because defendant did not place explicit limitation on his consent). *But see* State v. Gerace, 437 S.E.2d 862 (Ga. App. 1993) (DNA testing exceeded scope of consent where defendant provided blood sample pursuant to implied consent law that limits the scope of implied consent to "determining alcohol or drug content").

79. Com. v. Arzola, 26 N.E.3d 185 (Mass. 2015), *cert. den*. 136 S.Ct. 792 (2016) (collecting unknown DNA sample from arrestee's item lawfully in government custody).

80. U.S v. Davis, 690 F.3d 226 (4th Cir. 2012), *cert. den*. 571 U.S. 829 (2013).

81. California v. Greenwood, 486 U.S. 35 (1988).

82. Williamson v. State, 993 A.2d 626, 633-637 (Md. App.2010), *cert. denied*, 131 S. Ct. 419 (2010) (collecting DNA sample from pretrial detainee's saliva on McDonald's cup that he left on the floor of his jail cell); Com. v. Perkins, 883 N.E.2d 230 (Mass. 2008) (collecting DNA samples from suspect's saliva on two cigarette butts and a soda can that he left behind in interrogation room of police station after a voluntary interview); State v. Athan, 158 P.3d 27 (Wash. 2007) (en banc) (collecting DNA sample from suspect's saliva on envelope sent by suspect to police officers posing as class action lawyers).

83. *See* Skinner v. Railway Labor Executives' Ass'n, 489 U.S. 602, 619 (1989) ("[T]he collection and subsequent analysis of the requisite biological samples must be deemed Fourth Amendment searches").

84. Maryland v. King, 569 U.S. 435, 465 (2013)

85. *Davis*, 690 F.3d 226.

86. Boroian v. Mueller, 616 F.3d 60, 67–68 (1st Cir. 2010) (collecting authority in support of this proposition).

87. Compare U.S. v. Kincade, 379 F.3d 813, 841-42 (9th Cir. 2004), cert. den. 379 F.3d 813 (2005) (noting that individuals who have "wholly cleared their debt to society" have "substantial privacy interest at stake") with Johnson v. Quander, 440 F.3d 489, 498-500 (D.C. Cir. 2006), *cert. den*. 127 S.Ct. 103 (2006) (rejecting argument that an individual's reasonable expectation of privacy in his DNA sample is restored upon completion of probation).

88. *See* State v. Blea, 425 P.3d 385, 393 (N.M. Ct. App. 2018) [rejecting claim that placing burden on arrestees to seek expungement violates the Fourth Amendment]; People v. Buza, 4 Cal. 5th 658, 680-681 [noting, but not addressing, potential Fourth Amendment issues with California's failure to provide for automatic expungement where charges do not result in felony conviction or convictions are overturned]; Center For Genetics and Society et al. v. Becerra et al., CPF-18-516440, filed Dec. 10, 2018, in San Francisco Superior Court [asserting that California's expungement procedures violate state constitutional right of privacy and prohibition against unreasonable searches and seizures].)

89. Maura Dolan & Jason Felch, *California Takes Lead on DNA Crime-Fighting Technique*, https://www.geneticsandsociety.org/article/california-takes-lead-dna-crime-fighting-technique (last visited December 27, 2018).

90. *Id*.

91. Religion & Ethics NewsWeekly, *Familial DNA Testing* https://www.pbs.org/wnet/religionandethics/2008/05/16/march-6-2009-familial-dna-testing/66/ (last visited Dec. 13, 2018)

92. *Id*.

93. *Id*.

94. *Id*.

95. *Id*.

96. *Id*.

97. *Id*.

98. Ellen Nakashima, *From DNA of Family, a Tool to Make Arrests*, Wash. Post, Apr. 21, 2008, at A01 (last visited Dec. 13, 2018) http://www.washingtonpost.com/wp-dyn/content/article/2008/04/20/AR2008042002388_pf.html; *see generally* Sonia M. Suter, All in the Family: Privacy and DNA Familial Searching, 23 Harv. J.L. &

Tech. 309 (2010) (arguing familial searching should proceed with caution because it implicates significant privacy concerns).

99. Dolan & Felch, *supra*, note 84.

100. Boroian v. Mueller, 616 F.3d 60, 69 (1st Cir. 2010).

101. *Id*.

102. Nakashima, *supra*, note 93.

103. Joseph James DeAngelo, the so-called Golden State Killer.

104. Justin Jouvenal, *To Find Alleged Golden State Killer, Investigators First Found His Great-great-great-Grandparents*, WASH. POST, (Apr. 30, 2018) https://www.washingtonpost.com/local/public-safety/to-find-alleged-golden-state-killer-investigators-first-found-his-great-great-great-grandparents/2018/04/30/3c865fe7-dfcc-4a0e-b6b2-0bec548d501f_story.html?utm_term=.92432f4d9eb9

105. *See* Stogner v. California, 539 U.S. 607, 615-16 (2003).

106. 18 U.S.C. § 3282(a).

107. *See* 18 U.S.C. §§ 3281 (capital offenses), 3283 (child abuse and kidnapping); 3286 (terrorism).

108. *See e.g.*, 18 U.S.C. §§ 3282(b), 3297.

109. 18 U.S.C. § 3297.

110. U.S. v. Hagler, 700 F.3d 1091, 1097 (7th Cir. 2012). U.S. v. Sylla, 790 F.3d 772, 775 (7th Cir. 2015).

111. 18 U.S.C. § 3282(b); *see* 18 U.S.C.A. §§ 2241-48 (sexual abuse offenses).

112. People v. Martinez, 52 A.D.3d 68 (N.Y.S. Ct. App. Div. 2008).

113. State v. Yonage, 321 P.3d 1127 (Utah 2013); State v. Burdick, 395 S.W.3d 120 (Tenn. 2012); People v. Robinson, 47 Cal.4th 1104, 1133, 1140-43 (Cal. 2010) (collecting authorities in support of this proposition); Com v. Dixon, 938 N.E.2d 878 (Mass. 2010). *C.f.* State v. Belt, 179 P.3d 443 (Kan. 2008) (agreeing "in the abstract" that DNA-based John Doe warrants may satisfy particularity requirements, but dismissing three John Doe warrants that did not include unique DNA profiles of their subjects).

114. U.S. v. Marion, 404 U.S. 307 (1971).

115. U.S. v. Lovasco, 431 U.S. 783, 795 (1977).

116. *See, e.g.*, Roberts v. State, 234 So.3d 1251, 1268-69 (Miss. 2017); Com. v. Dame, 45 N.E.3d 69 (Mass. 2016); People v. Cordova, 62 Cal. 4th 104, 118-20 (2015); U.S. v. Hagler, 700 F.3d 1091, 1098-1100 (7th Cir. 2012); State v. McGuire, 786 N.W.2d 227 (Wisc. 2010); Graham v. Com., 319 S.W.3d 331, 341-42 (Ky. 2010); People v. Nelson, 43 Cal. 4th 1242, 1249-57 (2008); State v. Montano, 65 P.3d 61 (Ariz. 2003); Clark v. State, 774 A.2d 1136 (Md. App. 2001).

117. Brady v. Maryland, 373 U.S. 83 (1963).

118. In re Brown, 17 Cal. 4th 873 (1998) (*Brady* violation where prosecution failed to disclose to capital defendant the positive results of a drug test, despite the fact that the crime lab did not inform the prosecution of such results); U.S. ex rel. Smith v. Fairman, 769 F.2d 386 (7th Cir. 1985) (*Brady* violation where prosecution failed to disclose to the defendant information that the defendant's firearm was non-operable, despite the fact that the crime lab did not inform the prosecution of such information).

119. U.S. DEP'T OF JUSTICE, OFF. OF JUSTICE PROGRAMS, NCJ 237975, DNA FOR THE DEFENSE BAR, at 31 (2012).

120. District Attorney's Office for Third Judicial Dist. v. Osborne, 557 U.S. 52 (2009).

121. *Id*. at 62-63.

122. California v. Trombetta, 467 U.S. 479, 489 (1984).

123. Arizona v. Youngblood, 488 U.S. 51, 58 (1988).

124. United States v. Kingsbury, 317 F.Supp.3d 476, 478-79 (D.D.C. 2018) (collecting cases); State v. Ferguson, 20 S.W.3d 485, 496 (Mo. 2000), *cert. denied* 531 U.S. 1019 (2000).

125. 34 U.S.C. § 12592 (b)(3)(C).

126. An electropherogram is a graphic representation of the separation of molecules by electrophoresis or other means of separation.

127. CHIN ET AL., *supra* note 2 at § 10:5.

128. See FEDERAL BUREAU OF INVESTIGATION, QUALITY ASSURANCE STANDARDS FOR FORENSIC TESTING LABORATORIES (2011), https://www.fbi.gov/file-repository/quality-assurance-standards-for-forensic-dna-testing-laboratories.pdf/view (last visited Dec. 13, 2018).

129. Frye v. United States, 293 F. 1013 (D.C. Cir. 1923).

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

131. U.S. CONST. Amend. IV ("In all criminal prosecutions, the accused shall enjoy the right … to be confronted with the witnesses against him.").

132. Crawford v. Washington, 541 U.S. 36, 59 (2004).

133. *Id*. at 51–52.

134. *Id*. at 56.

135. Bullcoming v. New Mexico, 564 U.S. 647 (2011) (blood alcohol concentration (BAC) report); Melendez-Diaz v. Massachusetts, 557 U.S. 305 (2009) (lab's sworn affidavit identifying substance as cocaine).

136. Williams v. Illinois, 567 U.S. 50 (2012).

137. *Id*. at 70-71.

138. *Id*. at 57-58.

139. *Id*. at 84-86.

140. *Id*. at 85.

141. *Id*. at 103 (Thomas, J., concurring in part and concurring in judgment).

142. *Id*. at 104, 108-09.

143. Stuart v. Alabama, 139 S.Ct. 36 (2018) (Gorsuch, J., dissenting) (citation omitted).

144. *See e.g.*, Scales v. State, 712 S.E.2d 555, 561-562 (Ga. Ct. App. 2011) (testimony was relevant to explain "why this fourteen year old case is now being prosecuted and how the investigation came to focus on the Defendant"); People v. Harland, 251 P.3d 515, 517 (Colo. App. 2010), *cert. denied* No. 10SC563, 2011 WL 51758 (Colo. 2011) (testimony was relevant because "it explained how defendant became a suspect after scores of leads had not panned out over several months, an important point because (1) absent the explanation, the jury would be left to speculate as to how defendant became a suspect, and (2) defendant's defense was mistaken identity"); Whatley v. State, 146 So.3d 437 (Ala. App. 2010), *cert. denied* 135 S.Ct. 90 (2014); State v. McMilian, 295 S.W.3d 537 (Mo. App. 2009) (testimony was "necessary to explain the significant passage of time between the offense and McMilian's identification"); People v. Jackson, 903 N.E.2d 338 (Ill. 2009) (testimony was "necessary to explain how defendant came to be identified as the

source of the DNA recovered at the crime scene"); Atteberry v. State, 911 N.E.2d 601, 609 (Ind. App.2009) (testimony was relevant "to show why Atteberry, living in St. Louis, was a suspect in an Indianapolis murder").

145. *See, e.g.,* Scales, 712 S.E.2d at 561; *McMilian*, 295 S.W.3d at 539; *Atteberry*, 911 N.E.2d at 609.

146. *See, e.g.*, State v. Lang, 954 N.E.2d 596, 618 (2011) (affirming admission of DNA test results where random match probability was 1 in 3,461); United States v. Graves, 465 F. Supp. 2d 450, 457-59 (E.D. Pa. 2006) (admitting results DNA test results re: DNA evidence on sneakers where random match probability of 1 in 2,900 to 1 in 3,600, but excluding DNA test results re: DNA evidence on an umbrella where random match probability was 1 in 2); Commonwealth v. O'Laughlin, 843 N.E.2d 617, 633 (Mass. 2006) (affirming admission of DNA test results where the random match probability was 1 in 2); U.S. v. Morrow, 374 F. Supp. 2d 51, 62-66 (D.D.C. 2005); (affirming admission of DNA test results where random match probability ranged between 1 in 1 and 1 in 12); U.S. v. Hicks, 103 F.3d 837, 844-47 (9th Cir. 1996), *cert. den*. 520 U.S. 1193 (1997), *partially overruled on other grounds by* U.S. v. W.R. Grace, 526 F.3d 499 (9th Cir. 2008) (en banc) (affirming admission of expert's testimony that DNA testing could not exclude defendant as a possible contributor to a DNA sample from a vaginal swab).

147. *Morrow*, 374 F. Supp. 2d at 68; *see also* Graves, 465 F. Supp. 2d at 459.

148. Commonwealth v. Mattei, 920 N.E.2d 845, 848 (Mass. 2010) (trial court erred in admitting "expert testimony that DNA tests could not exclude the defendant as a potential source of DNA found at the crime scene, absent testimony regarding statistical findings explaining the import of such a result").