An International DNA Database: Balancing Hope, Privacy, and Scientific Error

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AN INTERNATIONAL DNA DATABASE:
BALANCING HOPE, PRIVACY, AND
SCIENTIFIC ERROR

Allison Puri*

Abstract: The discovery of DNA technology is considered one of the most revolutionary and beneficial contributions to the modern industrialized world. Not only has it led to formidable advances in medicine and genetic biology, but, in the past ten years, DNA technology also has become an important tool to law enforcement personnel and the legal community. Since 1986, police officers and lawyers have used DNA to find, apprehend, convict, and exonerate criminals ranging from burglars to murderers. The creation of the first DNA criminal investigative database in 1995 in Britain further enabled law enforcement to better exploit the uses of DNA technology and effect more acts of justice. As many more countries develop similar databases and seek to create one international databank, however, legislatures must ensure that the advancement of this tremendously powerful tool will not overshadow the fundamental right of privacy.

INTRODUCTION

Approximately twenty-eight years ago a baby girl was welcomed into this world with a future full of possibilities.¹ Twenty-two years later, on July 11, 1994, this same girl lay nude and slain in her Petersburg apartment.² Hope Denise Hall’s life never could have been la-

* Allison Puri is the Senior Managing Editor of the Boston College International and Comparative Law Review. She dedicates this Note in loving memory of her grandmother, Mary G. MacLeod (1914–2001), whose kindness and intelligence will continue to inspire for years to come.


beled easy or privileged. At only eighteen months old, Hope gave her family its first glimpse of the strength she possessed when she managed to fight off a serious bout of pneumonia that threatened to take her life. Hope’s next obstacle and opportunity to display her inner steel came years later at the age of nine. At an age when a girl’s only worry should be what to wear to her best friend’s birthday party, Hope had to grapple with the possibility of death yet again. She was diagnosed with kidney cancer and given only eleven months to live if she did not seek treatment. The young Hope, true to her name, survived surgery and chemotherapy with patience and prayers, crying only once when the treatment claimed her thick, beautiful hair.

Hope persevered and went on to build a promising future as her cancer went into remission. She graduated from a Fairfax County high school in 1989 as a National Merit Scholar and went on to George Mason University with a scholarship to study journalism. It finally looked as though the girl who had encountered such tragic hurdles so early in life was finally making a name for herself.

Unfortunately, the good times didn’t last long. In her sophomore year, Hope became pregnant. Despite her dubious health, she decided to take a year off from school and give birth to her son. After giving birth, Hope moved to Petersburg to be closer to her son’s father and to go back to school. The steadfast single mother resumed her studies at Virginia State University while working part-time as an associate producer at Channel 12 in Petersburg.

4 Barnes, supra note 1.
5 Blackwell, supra note 3; Barnes, supra note 1.
6 See Blackwell, supra note 3; Barnes, supra note 1.
7 Blackwell, supra note 3; Barnes, supra note 1.
8 Barnes, supra note 1.
10 Barnes, supra note 1; JUC Article, supra note 2.
11 See Barnes, supra note 1; JUC Article, supra note 2.
12 See Barnes, supra note 1.
13 Id.
14 Id.
15 Id.
16 E.g., Barnes, supra note 1; Maribeth Brewster, Losing Hope, STYLE WEEKLY (July 19, 1994), http://hope-dna.com/articles/ha_styleweekly_940719.htm; Pope, supra note 2.
again proved that steely determination and hard work pay off as she graduated magna cum laude with a degree in mass communications.\textsuperscript{17}

It was her dedication, dependability, and perfectionism that led her co-workers to become worried when Hope did not report to work on time on day during in the summer of 1994.\textsuperscript{18} After making a series of unsuccessful phone calls to her apartment, a few reporters from the news station traveled to Hope's apartment only to be confronted with horrific news.\textsuperscript{19} Maintenance workers for the apartment complex had found Hope lying lifeless in her apartment bedroom.\textsuperscript{20} She had been raped, stabbed across her body a total of fifteen times, and her throat had been slit three times with a steak knife.\textsuperscript{21} It became clear that finally Hope had been confronted with an obstacle that all her strength could not get her through.\textsuperscript{22}

As her family struggled with the tragic death, the police were having their own difficulties handling the murder.\textsuperscript{23} Grieving neighbors were not able to supply much information.\textsuperscript{24} Some said that they thought they had heard someone running down the stairs in the early morning hours but had thought nothing of it in such a busy apartment complex.\textsuperscript{25} A few others thought they had seen a male acquaintance of Hope's leave her apartment the day she was murdered.\textsuperscript{26} After arresting him, however, the police released him because his DNA did not match the samples found at the crime scene.\textsuperscript{27} For two years, family, friends, and the police became more and more discouraged as

\textsuperscript{17} See Barnes, supra note 1; Brewster, supra note 16; Pope, supra note 2.
\textsuperscript{18} See, e.g., Barnes, supra note 1; Pope, supra note 1; Pronko, supra note 1.
\textsuperscript{19} See Barnes, supra note 1; Pope, supra note 1; Pronko, supra note 1.
\textsuperscript{20} Barnes, supra note 1; Pope, supra note 1; Pronko, supra note 1.
\textsuperscript{22} See Blackwell, supra note 21; Sorokin, supra note 21; Grossman, supra note 21.
\textsuperscript{24} Id.
\textsuperscript{25} Pronko, supra note 1.
\textsuperscript{27} Id.
they began to lose hope that they would ever discover who took Hope’s life on the lonely day in July.\textsuperscript{28}

Finally in August 1996, a scientific miracle occurred that was responsible for finding Hope’s murderer.\textsuperscript{29} The Virginia DNA databank, developed by Virginia lawmakers in 1989, got a “cold hit.”\textsuperscript{30} The databank, which was the first of its kind in the United States, is made up of blood samples that are collected from convicted felons and various unsolved crime scenes from across the state.\textsuperscript{31} The databank routinely compares the samples of the felons with the crime scene information looking for potential matches.\textsuperscript{32} A “cold hit” occurs when the database makes a match between a felon and a particular crime scene when the felon was never a suspect in the case.\textsuperscript{33} A “cold hit” means that, without the match, the suspect likely never would have been found.\textsuperscript{34}

In Hope’s case, a nineteen-year-old man, who was serving a one hundred year prison sentence for abduction and multiple rapes, was matched to Hope’s murder via his DNA samples.\textsuperscript{35} After an emotional trial and sentencing hearing, Shermaine Ali Johnson was convicted of the murder of Hope Denise Hall and was sentenced to death.\textsuperscript{36}

Since Hope’s case, almost all states in the United States have developed similar DNA databanks that have led to several other convictions for previously unsolved crimes.\textsuperscript{37} In addition, the FBI recently developed a national DNA databank that links the information in all the participating state databanks.\textsuperscript{38} Hope Hall’s parents have set up a memorial project with a mission to create an international DNA databank.\textsuperscript{39} Although such a databank has not been implemented yet, it is not all that far off on the horizon.\textsuperscript{40} Several other countries have or

\textsuperscript{28} See, e.g., Trial, supra note 23; DNA Database, supra note 23; Grossman, supra note 9.
\textsuperscript{29} See Trial, supra note 23; DNA Database, supra note 23; Grossman, supra note 9.
\textsuperscript{30} Trial, supra note 23; DNA Database, supra note 23; Grossman, supra note 9.
\textsuperscript{31} Trial, supra note 23; DNA Database, supra note 23; Grossman, supra note 9.
\textsuperscript{32} Trial, supra note 23; DNA Database, supra note 23; Grossman, supra note 9.
\textsuperscript{33} E.g., Trial, supra note 23; DNA Database, supra note 23; Grossman, supra note 9.
\textsuperscript{34} See Trial, supra note 23; DNA Database, supra note 23; Grossman, supra note 9.
\textsuperscript{35} Trial, supra note 23; DNA Database, supra note 23; Grossman, supra note 9.
\textsuperscript{38} E.g., WEEDN, supra note 37; Sievers, supra note 37; Heeger, supra note 37.
\textsuperscript{39} Sievers, supra note 37.
\textsuperscript{40} See WEEDN, supra note 37.
are beginning to develop similar databanks, and former Attorney General Janet Reno showed great interest in the future of DNA as an investigative tool. Although an international databank undoubtedly would bring the potential for more acts of justice similar to Hope's case, many are concerned with privacy, constitutionality, and other issues that such a system raises. This Note analyzes the possibility for an international DNA databank.

First this Note provides a basic background on what DNA is and its revolutionary growth over the past twenty years. Next, this Note compares the uses of DNA databanks across the world by highlighting the growth in the United States and the constitutional issues raised, the British experience and the recent worries over incorrect matches, and the privacy issues currently being raised in the Far East. Finally, this Note analyzes how well the databanks from these countries could work together and the potential problems that such a compilation could cause.

I. BACKGROUND

A. DNA and Sampling Procedures

DNA is the commonly known abbreviation for deoxyribonucleic acid, the genetic material found in the nucleus of all cells in living organisms. It is often referred to as the "blueprint of life" because it contains the information needed to give us our physical characteristics and functional abilities.

Each strand of DNA contains a chain of chemical subunits for the coding and expression of genes. These subunits direct the cells to

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41 E.g., WEEDN, supra note 37; NAT'L COMM'N ON THE FUTURE OF DNA EVIDENCE, U.S. DEP'T OF JUSTICE, NCJ 177626, POSTCONVICTION DNA TESTING: RECOMMENDATIONS FOR HANDLING REQUESTS iii (1999); Heeger, supra note 37.


43 NAT'L COMM'N ON THE FUTURE OF DNA EVIDENCE, supra note 41, at 21.

44 Id.


construct proteins that provide structure and chemical reactions within the cells.\textsuperscript{47} The proteins, therefore, determine the characteristics of the cells and the cells determine the characteristics of the person.\textsuperscript{48} Likewise, faulty DNA sequences have been known to cause genetic defects, abnormalities, and diseases.\textsuperscript{49}

The double helix or twisted ladder shaped strand is made up of four organic bases called adenine, cytosine, thymine, and guanine.\textsuperscript{50} Pairs of these bases make up the rungs of the ladder.\textsuperscript{51} Adenine can only be matched up with thymine, and cytosine can only be paired with guanine.\textsuperscript{52} Each DNA molecule consists of over three billion base pairs arranged in particular sequences.\textsuperscript{53}

Forensic scientists are able to "read" the DNA sequences and find differences among species.\textsuperscript{54} They reduce the base names down to letters, namely "a," "c," "t," and "g."\textsuperscript{55} Then scientists read the sequence of these letters by looking at one-half of the ladder.\textsuperscript{56} Although the majority, 99.9\%, of the letter sequence on a human DNA strand is identical, there are portions on each strand that differ from individual to individual.\textsuperscript{57} Thus, in a DNA strand with three billion letters, one tenth of one percent difference translates into three million separate spelling differences.\textsuperscript{58} These are the differences that scientists examine in the process known as DNA fingerprinting to determine identity and heritage.\textsuperscript{59}

\textsuperscript{47} Burk \& Hess, supra note 42, at 4.
\textsuperscript{48} Id.
\textsuperscript{50} E.g., Dodson, supra note 46, at 227; Schumacher, supra note 46, at 1638-39; Burk \& Hess, supra note 42, at 3-4.
\textsuperscript{51} See Schumacher, supra note 46, at 1638-39.
\textsuperscript{52} Id.
\textsuperscript{53} Id.
\textsuperscript{55} E.g., Schumacher, supra note 46, at 1640; Lander, supra note 54.
\textsuperscript{56} E.g., Schumacher, supra note 46, at 1640; Lander, supra note 54.
\textsuperscript{57} E.g., Lander, supra note 54; Schumacher, supra note 46, at 1639; Dodson, supra note 46, at 227. It is important to note, however, that identical twins have identical DNA and do not differ at any point along the molecule. Dodson, supra note 46, at 227.
\textsuperscript{58} Lander, supra note 54.
Unfortunately, for purposes of forensic DNA fingerprinting, scientists do not read all three billion letters. Instead, to save time and money, scientists look at a very small handful of sites of variation. Along the DNA strand, or genome, there are regions where the base pair sequences repeat themselves. For instance, one person could have the sequence of “t-a-c-t-g” repeat three times and another person could have that same sequence repeat twice or appear only once. Thus, these normally biologically insignificant sequence repetitions create spelling differences in particular areas. In general, forensic scientists cut the DNA strands with an enzyme at these points of repetition. They then record the repetition variations by reducing the data into a bar code type expression. When comparing DNA samples from crime scene evidence to a suspect’s DNA sample, scientists will compare the “bar code” information from each site of variation. If the bar code differs between the evidence and the suspect’s DNA at any point, that particular suspect is usually ruled out as a possible source of the DNA evidence. However, if the bar codes are the same along all points of variation tested, the suspect is considered more likely to have left the evidence. It is important to note, however, that this does not mean the suspect committed the crime or even left the DNA evidence. Because scientists do not read the entire DNA, looking for any and all variations, two samples conceivably could appear as

60 See Lander, supra note 54.
61 Id.
62 Id.
63 See id.
64 Id.
66 See Lander, supra note 54.
67 See id. Samples can come from a number of sources and, as the technology develops, even more plausible sources may develop. See NAT’L COMM’N ON THE FUTURE OF DNA EVIDENCE, U.S. DEP’T OF JUSTICE, WHAT EVERY LAW ENFORCEMENT OFFICER SHOULD KNOW ABOUT DNA (1999). Currently, samples can be taken from traditional bodily fluids such as blood, saliva, or semen. See id. However, they also can be taken from hair, bones, clothing, organ tissue, and even skin cells that have rubbed off onto inanimate objects such as glass, fabrics, or even dirt. See id.
68 Lander, supra note 54. When the samples do not match, however, it does not mean that the suspect did not commit the crime. Id. For instance, the DNA sample taken from the crime scene could be from an innocent person or a co-conspirator. Id.
69 Id.
70 Id.
exact matches but actually differ in some other portion of the strand.71

Thus, two main concerns always must remain at the forefront of the scientific and legal community's conscience when conducting such sample comparisons.72 First, laboratories must remain unadulterated and impeccable because careless mistakes and sloppiness easily can create paramount errors.73 Second, scientists need to make clear to the legal community exactly what these tests do and do not prove.74 For example, before using samples to determine the likelihood of guilt, the proper weight must be applied to apparent matches.75 Some sequences are more rare than others and, therefore, some matches are more common than others.76 Usually the frequency of different DNA sequences varies across the population.77 Thus, some results of DNA comparisons or DNA fingerprinting can be inconclusive while others can be conclusive with no evidentiary value and still others can be conclusive and relevant to innocence or guilt.78

71 Id.
72 See id.
73 See Lander, supra note 54.
74 See id. There has been a great deal of controversy among the scientific and legal communities surrounding these issues. See id. Currently there are no mandatory standards for forensic testing. Id. In fact, there are higher standards for the laboratory practices of someone who will diagnose strep throat. Id. In addition, people are worried that the statistical significance applied to DNA evidence is either over or underestimated. See id. Therefore, the National Research Council Committee from the National Academy of Sciences has taken important steps in defining standards for laboratory and statistical calculations. Id. One significant contribution has been the creation of a mandatory proficiency test for laboratories conducting DNA sampling and analyses. Id.
75 See id.
76 Id.
77 Id. In addition to statistical probabilities, other concerns must be addressed when determining the appropriate weight to be given to matches. See Nat'l Comm'n on the Future of DNA Evidence, supra note 41, at 21–29. For instance, identical twins are known to have exact DNA matches and therefore, must always be considered in identity issues. Id. at 21. In addition, scientists indicate that some samples from one individual could show multiple DNA sources due to recent blood transfusions. Id. at 22. Finally, the need for control samples is important, especially in sexual assault cases, to ensure that no one is improperly included or excluded as a suspect. Id. at 22.
78 Richard Zitrin, DNA Expert Retained for Decades-Old Murder Case, APB News (Oct. 15, 1999), http://www.apbnews.com/newscenter/breaki...ws/1999/10/15/0ldcase1015_01.html?sl=en. A result can be inconclusive for a number of reasons, such as an inadequate sample or the lack of a control sample. Nat'l Comm'n on the Future of DNA Evidence, supra note 41, at 29. A sample is considered conclusive if it matches along all tested points of variation and is compared to a control sample. Id. at 28. A sample can be considered irrelevant if it comes from a source that could be present legally, such as a consensual sexual partner. Id. at 29.
Technology has developed three main types of DNA testing that are widely used for both science and legal identification purposes. Each testing protocol differs slightly and each has its own pros and cons. Therefore, circumstances, such as the age, size, and handling of the sample, determine what type of testing is used.

1. Restriction Fragment Length Polymorphism Testing

The first type of testing that has been widely used by forensic scientists for legal identification purposes is known as Restriction Fragment Length Polymorphism Testing (RFLP). This procedure was developed by Professor Sir Alec Jeffreys and was first reported in 1985. RFLP testing is generally accepted by the courts in the United States and has resulted in a number of post-conviction exonerations.

The RFLP testing process generally follows the guidelines discussed above but it does not actually “read” the sequence repetitions. Instead, it isolates certain areas of repetition and essentially measures the length of these sections. The lengths are then recorded as bar codes and compared between samples as discussed above.

RFLP testing is best used on large, unadulterated or untarnished samples. Many samples collected from crime scenes, therefore, are too small for such testing. In addition, samples that are too old can

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80 See, e.g., Nat’l Comm’n on the Future of DNA Evidence, supra note 41, at 26–28; Schumacher, supra note 46, at 1640–46; Thompson, supra note 59, at 26–30.
81 See Schumacher, supra note 46, at 1640–46.
82 Nat’l Comm’n on the Future of DNA Evidence, supra note 41, at 26–27. RFLP testing also has been used frequently in the area of familial testing, such as paternity tests. See id.
83 Id. at 26.
84 Id. There are approximately 300 appellate rulings regarding RFLP testing in the United States. Id.
85 See id. at 27; Schumacher, supra note 46, at 1640–41.
86 See Schumacher, supra note 46, at 1640–41. It follows that a sample fragment that repeats a sequence three times will be longer than a fragment that only repeats twice. See id.
87 See id. For a more in depth analysis, see Nat’l Commission on the Future of DNA Evidence, supra note 41, at 27.
88 Nat’l Commission on the Future of DNA Evidence, supra note 41, at 26. A “large” sample would contain at least 100,000 cells, e.g., a dime-sized or larger saturated bloodstain. Id.
89 See id.
start to decompose and become less pristine.\textsuperscript{90} Thus, older or smaller samples are better suited to other types of testing.\textsuperscript{91} When RFLP testing is plausible, however, it is very discriminate.\textsuperscript{92} Thus, samples appropriately subjected to RFLP testing can result in statistically strong exclusions and inclusions even when only testing a few DNA regions.\textsuperscript{93}

2. Polymerase Chain Reaction Testing—Nuclear DNA

Because of the sample limitations of RFLP testing, another type of testing, known as Polymerase Chain Reaction Testing (PCR), has become the most widely used technique in the field of molecular biology.\textsuperscript{94} PCR was first developed by Dr. Kary Mullis at Cetus Corporation in 1984.\textsuperscript{95} It was first used in the area of criminal identification in 1986.\textsuperscript{96} Like RFLP testing, PCR is also accepted by the courts and has resulted in a number of post-conviction exonerations.\textsuperscript{97}

Unlike RFLP testing, however, PCR testing can be done on smaller and less pristine samples.\textsuperscript{98} Small samples can be subjected to PCR testing because sample amplification is part of the process.\textsuperscript{99} Essentially specific regions of DNA are copied using an enzyme called \textit{Taq} polymerase and then are compared in a type of bar code format.\textsuperscript{100} Like RFLP testing, an exclusion is generally considered dispositive, however an inclusion is less discriminate.\textsuperscript{101} Therefore, in

\textsuperscript{90} \textit{Id.;} Schumacher, \textit{supra} note 46, at 1642.
\textsuperscript{91} See Schumacher, \textit{supra} note 46, at 1642.
\textsuperscript{92} \textit{NAT'L COMM'N ON THE FUTURE OF DNA EVIDENCE, supra} note 41, at 27; Schumacher, \textit{supra} note 46, at 1641–42.
\textsuperscript{93} See \textit{NAT'L COMM'N ON THE FUTURE OF DNA EVIDENCE, supra} note 41, at 27. This statement assumes that the testing was conducted correctly and that other considerations previously mentioned were taken into account. \textit{See id.} at 21–24.
\textsuperscript{94} \textit{Id.} at 27.
\textsuperscript{95} \textit{Id.}
\textsuperscript{96} \textit{Id.}
\textsuperscript{97} \textit{Id.}
\textsuperscript{98} See \textit{NAT'L COMM'N ON THE FUTURE OF DNA EVIDENCE, supra} note 41, at 27; Schumacher, \textit{supra} note 46, at 1642. A “smaller” sample only needs to contain fifty to one hundred cells, e.g., a visible dot of blood or a single hair root. \textit{NAT'L COMM'N ON THE FUTURE OF DNA EVIDENCE, supra} note 41, at 27. A less pristine sample is one that may have degraded because of improper storage or old age. \textit{Id.}
\textsuperscript{99} See \textit{NAT'L COMM'N ON THE FUTURE OF DNA EVIDENCE, supra} note 41, at 27; Schumacher, \textit{supra} note 46, at 1642–43.
\textsuperscript{100} \textit{NAT'L COMM'N ON THE FUTURE OF DNA EVIDENCE, supra} note 41, at 27.
\textsuperscript{101} \textit{Id.} at 27–28; Schumacher, \textit{supra} note 46, at 1643.
order to have a more statistically strong inclusion, PCR testing needs to be conducted at a number of sites along the DNA strand.\footnote{See Nat‘l Comm’n on the Future of DNA Evidence, supra note 41, at 27; Schumacher, supra note 46, at 1643.}

3. Polymerase Chain Reaction Testing—Mitochondrial DNA

Finally, a third type of testing has emerged that can be used on extremely old or damaged samples.\footnote{See Nat‘l Comm’n on the Future of DNA Evidence, supra note 41, at 28; Schumacher, supra note 46, at 1643–44.} Traditional RFLP and PCR testing is done on DNA found in the nucleus of the cell.\footnote{Schumacher, supra note 46, at 1643.} However, PCR testing can also be done on DNA found in the mitochondria of a cell (MtDNA).\footnote{Nat‘l Comm’n on the Future of DNA Evidence, supra note 41, at 28. The mitochondria is a cell organelle involved in producing cellular energy. Id.} Because the DNA does not come from the nucleus, this testing can be done on samples from dried bones, teeth, hair shafts, or any other sample that contains very little or highly degraded nuclear DNA.\footnote{See id.}

PCR testing on MtDNA is not as widely used as traditional nuclear DNA testing and only a limited number of laboratories are able to conduct such tests.\footnote{See id.} MtDNA testing has, however, been used in a number of court cases in the United States.\footnote{See id.} Usually MtDNA testing is used to link a sample to a particular family since mitochondria is passed from a mother to her offspring.\footnote{See, e.g., Nat‘l Comm’n on the Future of DNA Evidence, supra note 41, at 1; Weedn & Hicks, supra note 37; Betty Anne Bowser, Strands of Justice, ONLINE NEWSHOUR (July 10, 1998), at http://www.pbs.org/newshour/bb/law/july-dec98/dna_7-10.html.}

B. DNA Revolution

Given the tremendous power and versatility of DNA technology, DNA has become not only an important discovery to the scientific and genetic biology world, but it also has provided great advances in the legal community.\footnote{See Higgins, supra note 42, at 64–65; Weedn & Hicks, supra note 37.} Law enforcement officers and lawyers quickly realized that DNA could become a useful complement to or even replacement for traditional fingerprint evidence.\footnote{See Higgins, supra note 42, at 64–65; Weedn & Hicks, supra note 37.} It even has been suggested that over the past ten years DNA technology has been one
of the most revolutionary changes in law enforcement.\textsuperscript{112} The first known use of DNA testing in the area of criminal identification was in 1986.\textsuperscript{113} In this landmark case, Colin Pitchfork's DNA was matched using RFLP testing to the DNA of semen collected from two rape-homicides in Narbourough, England.\textsuperscript{114}

Moreover, public law enforcement agencies and criminal lawyers are not the only ones who have become involved in the investigative use of DNA technology.\textsuperscript{115} Within five years of the notion of DNA spelling differences being used for medical purposes, private companies entered the business and began to provide DNA typing services to law enforcement officials.\textsuperscript{116} Shortly thereafter, in 1989, the FBI had its own DNA typing lab in the Hoover Building in Washington.\textsuperscript{117} In 1995, Britain developed the first known DNA criminal investigative database that allowed for a completely new type of criminal investigation.\textsuperscript{118} Instead of simply using DNA sample evidence on a case-by-case basis, DNA databanks allow investigators to use the information on a grand scale and use the samples for multiple ongoing investigations.\textsuperscript{119} Now countries all over the world, including the United States, have begun to model similar databases after the British example.\textsuperscript{120}

With the obvious possibilities that such a technology creates for criminal investigation and law enforcement, the courts have been forced to address the admissibility of DNA data as legal evidence.\textsuperscript{121} The courts generally have applied two different tests to determine whether scientific evidence, such as DNA, should be admitted in a given case.\textsuperscript{122} The original test for the admissibility of DNA and other

\begin{itemize}
\item \textsuperscript{112} Higgins, \textit{supra} note 42, at 67.
\item \textsuperscript{113} \textsc{Nat'l Comm'n On the Future of DNA Evidence}, \textit{supra} note 41, at 1.
\item \textsuperscript{114} \textsc{Nat'l Comm'n On the Future of DNA Evidence}, \textit{supra} note 41, at 1. Before the DNA identification, a seventeen-year-old mentally handicapped kitchen porter had been incarcerated for several months after confessing to one of the murders. \textit{Id}.
\item \textsuperscript{115} See Lander, \textit{supra} note 54.
\item \textsuperscript{116} \textit{Id}.
\item \textsuperscript{117} \textit{Id}.
\item \textsuperscript{119} See, e.g., Hibbert, \textit{supra} note 49, at 767; Weedn & Hicks, \textit{supra} note 37; Burk & Hess, \textit{supra} note 42, at 10–11.
\item \textsuperscript{121} See Thompson, \textit{supra} note 59, at 30–33.
\item \textsuperscript{122} See id.
\end{itemize}
scientific evidence was developed in *Frye v. United States*\(^{123}\) and is commonly known as the *Frye* standard.\(^{124}\) The *Frye* standard asks a court to determine whether the scientific evidence in question has "gained general acceptance in the particular field in which it belongs."\(^{125}\)

After the development of the *Frye* standard, most federal and state courts attempted to apply it to scientific evidentiary questions.\(^{126}\) When applying the *Frye* standard, however, courts did not inquire into the reliability of the particular piece of evidence in question. Instead, they had to determine the general reliability of the scientific test as a whole.\(^{127}\) Because this type of analysis is so vague, many became concerned with the reliability of such a standard.\(^{128}\) One major concern that was particularly relevant to the area of DNA testing was that the *Frye* standard tended to unfairly discredit relatively new tests and principles.\(^{129}\) Given the fast rate of change that often occurs in scientific communities, such as the constant changes among types of available DNA testing, the *Frye* standard could create an unfortunate roadblock to admissibility.\(^{130}\) For instance, the development of PCR DNA testing easily could have been considered not "generally accepted in the scientific community" when many were still using RFLP testing.\(^{131}\) Moreover, as discussed earlier, there are still relatively few labs that are able to conduct MtDNA PCR testing and, therefore, under the *Frye* standard such testing may not be admissible because it is too new.\(^{132}\)

Thus, many thought that the birth of a new test for scientific evidentiary admissibility was greatly needed.\(^{133}\) In 1993, the Supreme Court developed such a test in the landmark case, *Daubert v. Merrell Dow Pharmaceuticals*.\(^{134}\) The Supreme Court concluded that the *Frye*

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\(^{123}\) *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923).


\(^{125}\) *Frye*, 293 F. at 1014.

\(^{126}\) See Edward Connors et al., U.S. Dep't of Justice, NCJ 161258, *Convicted by Juries, Exonerated by Science: Case Studies in the Use of DNA Evidence to Establish Innocence After Trial* xii (1996).

\(^{127}\) *Id.*

\(^{128}\) See *id.* at xxii.

\(^{129}\) See *id.* at xii.

\(^{130}\) See *id.*; Thompson, *supra* note 59, at 31.

\(^{131}\) See *supra* text accompanying notes 82–102.

\(^{132}\) See *supra* text accompanying notes 103–109; Thompson, *supra* note 59, at 31.


\(^{134}\) *Id.*
standard had been superseded by the enactment of the FED. R. EVID. 702. FED. R. EVID. 702 simply states:

If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.

Therefore, the court in *Daubert* concluded that in order for scientific evidence to be admissible it must (1) be shown to be scientifically valid and (2) must be relevant to at least one issue in the case. In order to make these determinations the courts can look at (1) whether the principle or technique has been or can be reliably tested, (2) whether it has been subjected to peer review or publication, (3) its known or potential rate of error, (4) whether there are standards or organizations controlling the procedures of the technique, (5) whether it is generally accepted by the community, and (6) whether the technique was created or conducted independently of the litigation. Therefore, the *Daubert* test still allows for the consideration of the *Frye* standard, however, the “generally accepted” prong has become only one factor rather than the only factor in the analysis. This change has somewhat increased the admissibility of DNA procedures because now newer tests still will be given consideration. The *Daubert* case, however, was decided on statutory rather than constitutional grounds. Consequently, each state court remains free to fashion its own standard for admitting scientific evidence, including continued use of the *Frye* standard. According to a Department of Justice report, as of 1995, twenty-two states remained essentially committed to the *Frye* standard. Whether under the *Frye* or *Daubert* standard, as of 1998, forty-six states admit DNA evidence in criminal proceedings.

135 Id. at 588–89.
136 FED. R. EVID. 702.
137 *Daubert*, 509 U.S. at 592.
138 Id. at 593–94.
139 See CONNORS ET AL., supra note 126, at xii. In *Daubert*, Justice Blackmun stated that judges still have the power to limit scientific evidence admissibility under FED. R. EVID. 403. *Daubert*, 509 U.S. at 595. He further stressed that caution is important because such evidence can have a very powerful and mystifying effect over jurors. Id.
140 See CONNORS ET AL., supra note 126, at xii.
141 See id.
142 Id.
143 Id. at 6.
In forty-three states the courts have ruled on the admissibility of the technology while the remaining three states require compliance with statutes for admission.\textsuperscript{144} Recently it has become clear that DNA is not only useful to police officers and lawyers in strengthening cases against suspects.\textsuperscript{145} In fact, DNA has become extremely helpful to suspects and their defense attorneys in proving innocence.\textsuperscript{146} The FBI has stated that nearly one-third of people are exonerated as suspects immediately upon DNA testing.\textsuperscript{147} They further state that before DNA testing, they never could have excluded the same people using other test results such as standard blood markers.\textsuperscript{148} In addition, DNA testing has provided a unique, non-investigative opportunity for convicts that no other type of evidence has been able to provide to the same extent.\textsuperscript{149} Many convicts are now filing for post-conviction relief based on previously unavailable DNA testing.\textsuperscript{150} In 1996, the National Institute of Justice under the guidance of former Attorney General Janet Reno issued a report on this subject entitled \textit{Convicted by Juries, Exonerated by Science: Case Studies in the Use of DNA Evidence to Establish Innocence After Trial}.\textsuperscript{151} The report opened with an introduction written by Reno stressing the importance of the use of DNA evidence to exonerate the innocent.\textsuperscript{152} The report then provided twenty-eight case studies where the use of previously unavailable DNA technology proved the innocence of convicted felons.\textsuperscript{153} The twenty-eight men in the study had served an average of seven years in prison before exoneration.\textsuperscript{154} One case involved a man, Kirk Bloodsworth, who had been convicted twice of

\begin{enumerate}
\item[144] \textit{Id.} The four states that have not admitted DNA evidence are Maine, North Dakota, Rhode Island, and Utah. \textit{id.} at ex. 1. The three states that have statutes requiring admission are Nevada, Oklahoma, and Tennessee. \textit{Id.}
\item[145] \textit{See Nat’l Comm’n on the Future of DNA Evidence, supra note 41, at 2.}
\item[146] \textit{See id.}
\item[147] \textit{Lander, supra note 54.}
\item[148] \textit{Id.} Blood marker tests, such as the Lattes test, allow scientists to identify certain substances, such as ABO blood group substances, from a biological stain. \textit{See Connors et al., supra note 126, at xv.} Although these tests are capable of narrowing down the possible source of the evidence, they often fail to yield usable results because they are less discriminating and more susceptible to deterioration. \textit{See id.}
\item[150] \textit{See Sealey, supra note 149; Connors et al., supra note 126.}
\item[151] \textit{Connors et al., supra note 126.}
\item[152] \textit{See id.} at iii.
\item[153] \textit{Id.} at 34-76.
\item[154] \textit{Id.} at iii.
\end{enumerate}
beating, sexually assaulting, and strangling a nine-year-old girl.\textsuperscript{155} Witnesses, who said they saw Bloodsworth with the girl earlier in the day, identified him as the likely murderer.\textsuperscript{156} In addition, Bloodsworth's statement about a bloody rock\textsuperscript{157} and a comment about doing something "terrible" on the day of the murder\textsuperscript{158} were entered as evidence against him.\textsuperscript{159} After his second conviction, his lawyer requested DNA testing that was previously unavailable.\textsuperscript{160} After three separate tests were done,\textsuperscript{161} it was concluded that Bloodsworth was not the murderer.\textsuperscript{162} After serving approximately nine years on his second sentence, two of which were on death row, the prosecutor joined the defense in petitioning for a pardon that was granted by a Baltimore County Circuit judge on June 28, 1993.\textsuperscript{163} Finally, in December 1993, Maryland's governor officially pardoned Bloodsworth.\textsuperscript{164}

Three years after the initial report, the National Commission on the Future Use of DNA Evidence issued another report entitled \textit{Post-conviction DNA Testing: Recommendations for Handling Requests}.\textsuperscript{165} The report is aimed at highlighting the legal and scientific issues involved in post-conviction testing.\textsuperscript{166} It further provides recommendations for prosecutors, defense counsel, the judiciary, victim assistance groups, and laboratory and law enforcement personnel.\textsuperscript{167} The report states

\begin{enumerate}
\item \textsuperscript{155} \textit{Id.} at 35. The Maryland Court of Appeals overturned Bloodsworth's first conviction because the police had withheld evidence regarding a possible other suspect from his defense attorneys. \textit{Id.} at 36.
\item \textsuperscript{156} \textit{CONNORS ET AL., supra} note 126, at 36.
\item \textsuperscript{157} During a police interrogation, Bloodsworth mentioned a "bloody rock." \textit{Id.} This statement was considered significant because the murderer had beaten the girl's head with a rock. \textit{Id.} It was later revealed, however, that there was a bloody rock placed on the table next to Bloodsworth during the interrogation. \textit{Id.}
\item \textsuperscript{158} The prosecution provided evidence that Bloodsworth had told acquaintances that he had done something "terrible" on the day of the murder that would affect his marriage. \textit{Id.} It was later revealed, however, that he was referring to the fact that he had forgotten to buy his wife a promised taco salad. \textit{Id.}
\item \textsuperscript{159} \textit{Id.}
\item \textsuperscript{160} \textit{Id.}
\item \textsuperscript{161} \textit{CONNORS ET AL., supra} note 126, at 36. The first test conducted by the Forensic Science Associates revealed Bloodsworth's DNA did not match any of the evidence received for testing. \textit{Id.} at 37. A second test was requested, however, due to the possibility of improper sample labeling. \textit{Id.} The second test affirmed the findings of the first. \textit{Id.} Finally, the FBI conducted a third test, which confirmed the findings of the first two. \textit{Id.}
\item \textsuperscript{162} \textit{Id.}
\item \textsuperscript{163} \textit{Id.} Because courts in Maryland only allow new evidence to be presented within one year of the final appeal, Bloodsworth could not have been granted a new trial. \textit{Id.}
\item \textsuperscript{164} \textit{Id.}
\item \textsuperscript{165} \textit{NAT'L COMM'N ON THE FUTURE OF DNA EVIDENCE, supra} note 41.
\item \textsuperscript{166} See \textit{id.}
\item \textsuperscript{167} See \textit{id.}
\end{enumerate}
that since the 1996 report, more than forty additional convicts have benefited from post-conviction testing.\textsuperscript{168} Similar post-conviction relief cases also have occurred in other countries all over the world.\textsuperscript{169} Courts in Canada, Hong Kong, and New Zealand all have reversed convictions based on subsequent DNA testing results.\textsuperscript{170} Moreover, many of the countries that have allowed such post-conviction testing, especially Canada and the United States, have expressed concern over the problems that these cases have unveiled.\textsuperscript{171} With DNA testing highlighting more and more mistaken convictions, many are questioning the traditional forms of law enforcement identification such as eyewitness testimony.\textsuperscript{172} Therefore, these post-conviction cases highlight yet another important reason for the use of DNA, and more specifically DNA databases, as an investigative tool.\textsuperscript{173}

II. DISCUSSION

A. DNA Databanking and the Constitution of the United States

In 1989, Virginia became the first state to implement a criminal DNA database.\textsuperscript{174} Originally, the database called for the inclusion of samples from certain classes of violent crime and sex offenders.\textsuperscript{175} Shortly afterward, however, the legislature expanded the database to include all newly convicted felons and was applied retroactively to current felons who were required to submit samples upon release.\textsuperscript{176} After passing constitutional muster in 1992, according to the Fourth Circuit of the United States Court of Appeals in Jones v. Murray,\textsuperscript{177} the legislature further expanded the database in 1996.\textsuperscript{178} The new data-

\textsuperscript{168} Id. at iii.


\textsuperscript{170} See id.


\textsuperscript{172} See id.

\textsuperscript{173} See id.

\textsuperscript{174} Hibbert, supra note 49, at 774.

\textsuperscript{175} Id.

\textsuperscript{176} Id.

\textsuperscript{177} 962 F.2d 302 (4th Cir. 1992).

\textsuperscript{178} Hibbert, supra note 49, at 774.
base demanded the inclusion of certain juvenile offenders over the age of fourteen.\textsuperscript{179}

The other forty-nine states quickly followed suit.\textsuperscript{180} Less than a decade after Virginia’s first implementation, all fifty states had enacted some form of a criminal DNA database.\textsuperscript{181} Every state currently collects samples from certain convicted sex offenders, however, beyond that point the states differ greatly.\textsuperscript{182} Some states require collection of samples from all felons both violent and non-violent.\textsuperscript{183} Furthermore, other states require collection from some classes of misdemeanors.\textsuperscript{184} In addition, a few states have or still require collection of blood from arrested suspects before conviction.\textsuperscript{185} In addition, certain states have a type of “two strikes and you’re out” type of legislation in which a person who was previously convicted of certain crimes will have to submit to testing upon the conviction of any other later crime.\textsuperscript{186} Moreover, an increasing number of states have seemingly gone against the general ideal of juvenile reform and required inclusion of juvenile offenders as well.\textsuperscript{187}

Not only do states differ in the types of offenders included in the databases, but they also differ in the allowed uses of the databases themselves.\textsuperscript{188} Most states allow the databases to be used for criminal investigations of any kind.\textsuperscript{189} Some states, however, restrict the types of criminal investigations allowed.\textsuperscript{190} In addition, other states allow for the use of the data upon court order; therefore, these samples could be used in civil cases such as paternity suits.\textsuperscript{191}

In addition to the individual state DNA databases, the FBI has created a national DNA database.\textsuperscript{192} In 1994, the DNA Identification

\textsuperscript{179} Id. at 774–75. Juveniles offenders are required to submit samples if they committed crimes that would constitute felonies if they had been tried as adults. See id.

\textsuperscript{180} See id. at 775.

\textsuperscript{181} See id.

\textsuperscript{182} See id. at 775–78.


\textsuperscript{188} See Hibbert, supra note 49, at 779–81.

\textsuperscript{189} See id. at 779.

\textsuperscript{190} See id.

\textsuperscript{191} See id. at 788.

\textsuperscript{192} Schumacher, supra note 46, at 1646.
Act authorized the FBI to establish the Combined DNA Index System (CODIS). Essentially, CODIS consists of three tiers of DNA data. The first level is called the Local DNA Index System (LDIS) and consists of information installed by the laboratories of local police and sheriff departments. The next level is the State DNA Index System (SDIS) and allows the individual local laboratories to exchange information throughout the state. Finally, the third level is the National DNA Index System (NDIS) that allows states to share information between each other on a national scale.

With the development of CODIS and the expansion of state DNA databases, many critics, especially civil libertarians, have become concerned with privacy and abuse issues associated with such databases. The primary legislative purpose given to support DNA databases is related to recidivism rates. Database supporters state that statistics show that many offenders of particular types of crimes, e.g. sex offenses, have a high incidence of repeat offenses. Therefore, supporters state that a DNA database will help law enforcement identify suspects of new crimes who were previously convicted of earlier crimes. In addition, proponents hope that DNA databases will provide a deterrent effect to counteract recidivist tendencies. They reason that a released convict will be less likely to commit additional crimes if he knows that his DNA is on file with the government. Critics claim, however, that this is a violation of our society’s commitment to reform, especially with respect to juvenile offenders, and the presumption of innocence. Furthermore, opponents fear that with

193 Id.
194 See id.
195 Id. at 1646 n.88.
196 Id.
197 Schumacher, supra note 46, at 1646 n.88.
201 Id.
202 Hamblett, supra note 199.
203 See id.
a centralized system, DNA data easily could get into the wrong hands. In addition, legislatures and law enforcement agencies are working to set laboratory standards and confronting tremendous backlogs of data created by database expansion.

1. Possible Constitutional Violations

Currently, the major concern that most database critics have is that DNA database sampling statutes allow for the mass screening of individuals without individualized suspicion or probable cause. The general justification given to support such sampling is the notion that a certain class of people, i.e. certain convicted felons, are more likely to pose a danger to society than others. Thus, critics claim that such a justification undermines both the Fourth Amendment's protection against unreasonable searches and seizures and the Fourteenth Amendment's Equal Protection Clause. Thus, a few courts have been forced to address these issues and to determine whether DNA databases pass constitutional muster.

One of the most recent and controversial cases that addressed this precise issue is Landry v. Attorney General. In Landry, plaintiffs challenged the validity of a Massachusetts DNA database statute, which requires involuntary collection of blood samples from all persons convicted of thirty-three different types of offenses. The given legislative purpose of the statute is to "assist local, state and federal criminal justice and law enforcement agencies in: (1) deterring and discovering crimes and recidivistic criminal activity; (2) identifying individuals for, and excluding individuals from, criminal investigation...

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205 See Mark Hansen, Banking on DNA, at http://www.abcnet.org/journal/au99/08NDNA.html (last visited Feb. 22, 2000); Higgins, supra note 42, at 64--64.
207 Hamblett, supra note 199; Keehn, supra note 204.
208 See Niezgoda, supra note 200.
209 See, e.g., Hamblett, supra note 199; Higgins, supra note 42, at 86; Burk & Hess, supra note 42, at 18--21.
210 See, e.g., Hamblett, supra note 199; Higgins, supra note 42, at 86; Burk & Hess, supra note 42, at 18--21.
213 Landry, 709 N.E.2d at 1085. An attempt or conspiracy to commit an enumerated crime also falls under the challenged statute. See id. at 1087.
or prosecution; and (3) search[ing] for missing persons.”214 The statute states and regulates the use of the database for primarily criminal investigative purposes.215 The statute, however, also allows for the use of the database for other court proceedings and “advancing other humanitarian purposes.”216 The plaintiffs argued that the statute allowed for an unconstitutional search and seizure under both the federal and state constitutions.217 The Massachusetts Superior Court agreed and issued a preliminary injunction against the statute.218 The Massachusetts Supreme Judicial Court, however, disagreed with the lower court’s reasoning and reversed the decision.219

The Supreme Judicial Court agreed that the taking of a DNA sample constitutes a search and seizure, but decided that it is not unreasonable.220 The court explained that a prisoner’s reasonable expectation of privacy in his identity is diminished,221 and that there is a strong governmental interest in a “particularly reliable form of identification.”222 Finally, the court weighed the strong state interest and the reduced expectation of privacy with the level of intrusiveness of the test.223 Citing other cases that dealt with blood tests in different contexts, the court stated that a blood test is only minimally intrusive.224 Thus, the court concluded that the search and seizure passes both federal and state constitutional requirements.225

In September of 1999, the Second Circuit of the United States Court of Appeals reached a similar decision in Roe v. Marcotte.226 The plaintiffs argued that a Connecticut statute,227 which requires all convicted sexual offenders to submit a blood sample for a DNA database, violates the Fourth Amendment’s prohibition against unreasonable searches and seizures and the Fourteenth Amendment’s guarantee of

214 Id.
215 See id. at 1088.
216 Id.
217 Id. at 1089.
218 Landry, 709 N.E.2d at 1089.
219 Id. at 1090.
220 Id.
221 Id. at 1091.
222 Id. The court cites to high rates of recidivism among certain types of felons to support the government interest. Id. at 1091 n.10. Later in the opinion, however, the court puzzlingly states that its opinion does not rely on recidivism issues. See id. at 1092.
223 Landry, 709 N.E.2d at 1091.
224 Id.
225 Id. at 1094. The state constitutional analysis was essentially the same as the federal analysis. See id.
226 Roe v. Marcotte, 193 F. 3d 72 (2d Cir. 1999).
227 CONN. GEN. STAT. § 54–102g (1994).
equal protection.\textsuperscript{228} The court in \textit{Roe} stated that the blood test is a Fourth Amendment search.\textsuperscript{229} Furthermore, the court indicated that:

except in well-defined circumstances, a search is not reasonable unless it is carried out pursuant to a judicial warrant issued on probable cause. In general, searches performed in the absence of a warrant and pursuant to an exception must nevertheless be predicated upon "probable cause to believe that the person to be searched has violated the law," or, at the very least, "some quantum of individualized suspicion."\textsuperscript{230}

The court, however, did not end its inquiry there.\textsuperscript{231} Instead, the court referred to the "special need" exception as articulated by the Supreme Court in \textit{Skinner v. Railway Labor Execs. Ass'n}, 489 U.S. 602 (1989).\textsuperscript{232} In \textit{Skinner}, the Supreme Court stated that in some circumstances a showing of individualized suspicion or probable cause would not be a constitutional floor.\textsuperscript{233} The Supreme Court indicated that a search may be reasonable despite the absence of individual suspicion in situations where the privacy interests are minimal and an important governmental interest would be placed in jeopardy by a requirement of such suspicion.\textsuperscript{234} Most of the cases since \textit{Skinner}, however, have considered non-law enforcement situations ensuring institutional security or public safety.\textsuperscript{235} DNA database testing, therefore, does not fall into one of these traditional "special need" contexts.\textsuperscript{236}

The Second Circuit nonetheless found that an application of the special need exception to DNA sampling would not be an unreasonable extension.\textsuperscript{237} Instead, they analogized to the "special needs" recognized in \textit{Griffen v. Wisconsin}, 483 U.S. 868 (1987).\textsuperscript{238} In that case, the

\begin{thebibliography}{99}
\bibitem{228} \textit{Roe}, 193 F.3d at 75–76.
\bibitem{229} \textit{Id.} at 77.
\bibitem{230} \textit{Id.}
\bibitem{231} \textit{See id.}
\bibitem{232} \textit{Id.} at 77–78.
\bibitem{233} \textit{Skinner}, 489 U.S. at 624.
\bibitem{234} \textit{Id.}
\bibitem{236} \textit{Roe}, 193 F.3d at 78–79.
\bibitem{237} \textit{Id.} at 79.
\bibitem{238} \textit{Id.}
\end{thebibliography}
Supreme Court held that a warrantless search of a probationer's home was reasonable under the "special needs" exception.\textsuperscript{239} The court relied on research that showed that intensive supervision of probationers reduced recidivism.\textsuperscript{240} Thus, the Supreme Court held that the search was a type of regulatory function that was reasonable as applied to probationers but not the public at large.\textsuperscript{241}

Applying this reasoning to DNA sampling, the Second Circuit likewise relied on statistics showing that certain classes of offenders have higher recidivism rates.\textsuperscript{242} Therefore, the court concluded that there was a strong state interest in solving both past and future crimes.\textsuperscript{243} The court then balanced this interest against the minimal intrusion of a blood test\textsuperscript{244} and the "lack of discretionary decisions" involved in choosing whom to sample,\textsuperscript{245} and found the sampling constitutional.\textsuperscript{246} Unlike the Massachusetts court in \textit{Landry}, however, the Second Circuit stressed that it was not basing its holding on the diminished expectation of privacy reasoning.\textsuperscript{247}

Regardless of whether courts rely on the "diminished expectation of privacy" reasoning or the "special need" exception, all courts that have considered DNA database statutes have relied to some degree on recidivism rates.\textsuperscript{248} Thus, as DNA databases become more expansive, i.e. including all convicted offenders,\textsuperscript{249} non-convicted arrestees,\textsuperscript{250} or everyone at birth,\textsuperscript{251} critics have and will become more dubious of the

\textsuperscript{239} \textit{Griessen}, 483 U.S. at 870–74.
\textsuperscript{240} \textit{Id.} at 875.
\textsuperscript{241} \textit{Id.}
\textsuperscript{242} \textit{Roe}, 193 F.3d at 79.
\textsuperscript{243} \textit{Id.}
\textsuperscript{244} \textit{See Skinner}, 489 U.S. at 625 (confirming that blood tests do not constitute an unduly extensive imposition on an individual's privacy).
\textsuperscript{245} \textit{See National Treasury Employees Union v. Von Raab}, 489 U.S. 656, 667 (1989) (testing of all employees who applied for certain positions was reasonable because no official discretion was involved).
\textsuperscript{246} \textit{Roe}, 193 F.3d at 80. Applying the "rational basis" test, the court held that the statute did not violate the Equal Protection Clause of the Fourteenth Amendment. \textit{See id.} at 82. The court held that the even if the statute was under-inclusive, it could not be invalidated on that basis alone. \textit{See id.}
\textsuperscript{247} \textit{Id.} at 81–82.
\textsuperscript{248} \textit{See}, e.g., \textit{Roe}, 193 F.3d at 79; \textit{Jones v. Murray}, 962 F.2d 302, 307 (4th Cir. 1992); \textit{Landry}, 709 N.E.2d at 1091 n.10.
recidivism argument. Opponents argue that the government interest will decrease and, therefore, the potential for a Fourth Amendment violation will increase.

2. Potential for Abuse

In addition to Fourth and Fourteenth Amendment constitutional challenges, DNA databanks create another cause for concern. As mentioned before, each state’s DNA legislation differs in many respects. One inconsistency among the states is the existence and type of abuse protections. People fear that without proper safeguards in place, unauthorized people will be able to access the data stored in the databases. Critics say that this could have far more dangerous effects than a corruption of a fingerprint database because of the type of information stored. Beyond its identification uses, DNA also can provide volumes of information about a person and his family, including the ability to predict susceptibility to diseases. Without proper protections, the data potentially could be used as another type of genetic discrimination. Critics foresee that insurance companies could use the data to raise premiums or reject extending coverage. Others fear that some could be declined job offers or experience employment discrimination based on the data.

Unfortunately, many states do not have adequate protections in place against such abuse. Among the states that do explicitly prohibit such uses, some lack specifically defined punishments. Other states simply provide for the authorized uses of the data but even those are not specifically defined. Vague phrases such as “law enforcement purposes” conceivably can be interpreted very broadly or

253 See id. at 66–67.
254 See Bowser, supra note 110.
255 See Hibbert, supra note 49, at 779.
256 See id.
257 Bowser, supra note 110.
259 Id.
260 Bowser, supra note 110.
261 Id.
262 Id.
263 See Hibbert, supra note 49, at 821.
264 See id.
265 See id. at 779–81.
very narrowly. For instance, the phrase could be interpreted to mean that the data can only be used for identification purposes. Some, however, could interpret the same phrase to allow for looking for specific genetic traits such as diabetes to help provide non-identification clues in a criminal investigation. Some opponents even fear that the phrase could be interpreted extremely broadly to allow for a type of eugenics. They suggest that eventually scientists may find a “violence gene” that could be used by law enforcement to weed out people prone to criminal activity. Therefore, legislatures and organizations, such as the National Commission on the Future Use of DNA Evidence, are constantly working to reword legislation in order to prevent any possible misuse.

3. Backlog and Laboratory Concerns

One of the biggest concerns facing state and federal law enforcement agencies with the expansion of DNA databanks is the issue of backlog. Currently there are approximately 1.5 million convicted felons who qualify to be included in the databanks but have not been sampled. Furthermore, not every state that has a database statute is collecting samples from all eligible classes of people. Some states have backlogs of samples that have not been appropriately analyzed yet. Federal and state agencies are blaming this backlog on a lack of funds and support. Thus, in the face of DNA database expansion, lawmakers must be conscious of the financial practicality of actually implementing the changes.

Another related implementation problem concerns the type of testing used on the samples. Many states are realizing that their databases are both internally and externally incompatible and therefore

266 See id. at 781–82.
267 See id.
268 Hibbert, supra note 49, at 782.
269 Bowser, supra note 110; Schumacher, supra note 46, at 1654–55.
270 Bowser, supra note 110.
271 See Reilly, supra note 206.
272 See Tuchman, supra note 42; Asplen, supra note 206.
273 Asplen, supra note 206.
274 Niezgoda, supra note 200.
275 Id.
276 Id.
277 See id.
278 See id.
ineffectual.\textsuperscript{279} Samples from crime scenes may be too small to undergo RFLP testing and therefore must be subjected to PCR testing.\textsuperscript{280} The offender samples may be larger and therefore need to be tested using the RFLP technique.\textsuperscript{281} Thus, the crime scene samples will not be compatible with offender samples for purposes of looking for a match.\textsuperscript{282} The same problem occurs on a national level when one state uses PCR while another state uses RFLP testing.\textsuperscript{283} In response to this problem, the FBI is trying to expand the use of a standardized technology that would eliminate incompatibility issues.\textsuperscript{284} 

In addition to the testing procedures used by laboratories, others are concerned with the presence or lack of standardized laboratory requirements.\textsuperscript{285} Under the DNA Identification Act, laboratories must meet certain specified standards to satisfy federal requirements for inclusion in CODIS.\textsuperscript{286} Some state statutes, however, lack similar requirements and essentially leave it up to the laboratory personnel to ensure testing quality.\textsuperscript{287} Thus, on the state level, many critics worry that without such standards in place the potential for mistakes and ultimately false matches could rise to dangerous levels.\textsuperscript{288}

B. The Britain Experience: A One in Thirty-Seven Million Chance of Mistake?

In 1993, a royal commission on the criminal justice system in the United Kingdom set up a rudimentary DNA database using RFLP analyzed samples.\textsuperscript{289} The database included approximately three to four thousand samples and only tested the samples at a single locus on the DNA strand.\textsuperscript{290} Under the legislation at the time, however, the samples allowed for inclusion were severely limited.\textsuperscript{291} Only samples from convicts who had been convicted due to DNA could be included in the

\begin{itemize}
\item \textsuperscript{279} Niezgoda, \textit{supra} note 200.
\item \textsuperscript{280} See \textit{id.}
\item \textsuperscript{281} See id.
\item \textsuperscript{282} See id.
\item \textsuperscript{283} See id.
\item \textsuperscript{284} Niezgoda, \textit{supra} note 200.
\item \textsuperscript{285} See Lander, \textit{supra} note 54.
\item \textsuperscript{286} Niezgoda, \textit{supra} note 200.
\item \textsuperscript{287} See Hibbert, \textit{supra} note 49, at 797.
\item \textsuperscript{288} See \textit{id.}
\item \textsuperscript{289} Lynn Fereday, Comments at the Meeting of the National Commission on the Future of DNA Evidence (July 26, 1999), in \textit{Proceedings, at} http://www.ojp.usdoj.gov/nij/dnamtgrans6/trans-i.htm (last visited Feb. 22, 2000).
\item \textsuperscript{290} Id.
\item \textsuperscript{291} See \textit{id}. 
\end{itemize}
database. Even with these limitations, however, law enforcement officials were able to achieve a number of successful hits from the database.

After considerable lobbying the legislature passed the Criminal Justice and Public Order Act in 1994, which allowed for the sampling and storing of DNA from any individual who had been convicted, cautioned, or suspected of committing a recordable offense. Then in 1995, Britain officially opened the first true criminal DNA database. As the world’s largest database of its kind, the English database has experienced exponential growth. Over the past year the amount of included samples increased from 470,000 to 660,000.

Like its United States counterpart, the database includes samples from crime scenes and convicts. It also contains, in contrast, samples from suspects in unsolved crimes. In addition, the English database differs from most American databases in that it includes far more classes of offenders. Instead of simply including samples from sex offenders and other felonies, it also includes samples from offenders of “petty” crimes such as burglaries and car thefts.

Moreover, unlike most database statutes in the United States, the British system authorizes law enforcement to take samples from people arrested of crimes before conviction. Under this system, while a person is awaiting conviction or acquittal, his sample is stored and searched in the database just like any other sample from a convicted felon. If the person is acquitted, however, the sample is expunged. If a match is found in the interim, it can be used by law enforcement even if the person is later acquitted of the crime for which he was originally arrested.

\footnotesize{\bibliography{nature}}
In addition, British law enforcement agencies utilize a technique popularly known as DNA "dragnetting." During a particular investigation, police round up a group of people, usually by geographic region, and ask for voluntary samples. Although the samples are supposed to be voluntary, many have suggested that the police use highly persuasive techniques to coerce people into giving samples. The police then put the samples into a separate database to compare to samples from a specific crime scene. Once the crime is solved the voluntary samples are destroyed, and they are always kept separate from the main database.

Overall, British officials estimate that the main DNA database eventually will include one third of all English men between the ages of sixteen and thirty. Furthermore, some law enforcement personnel have expressed the desire to have the entire citizenship tested and recorded. With so many samples included, the database averages between four hundred and seven hundred matches a week, as opposed to the approximate six hundred total matches attributable to the United States databases. In addition, the United Kingdom has registered the database to be shared with other countries throughout Europe and beyond.

Unfortunately, the overwhelming size of the British database has its drawbacks. In late January 2000, British database officials faced a major setback. During a meeting with the United States National Commission of the Future of DNA Evidence, British authorities announced that Great Britain's national DNA database had resulted in a mistaken identification. In 1999, Manchester police lifted the DNA from evidence left at the scene of a burglary. The sample was analyzed at six loci, or points of identification, and entered into the DNA database.

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306 Id.
307 See Fereday, supra note 289.
308 See id.
309 Id.
310 Id.
311 FBI National DNA Database, supra note 298.
312 Blair, supra note 118.
314 Fereday, supra note 289.
315 See Willing, supra note 120.
316 See id.
317 Id.
318 Id.
The computer then matched it to one of the 660,000 samples on file. British authorities estimated that the likelihood of the match occurring at random was one in thirty-seven million. The matched suspect, however, provided an alibi and the police decided to conduct another DNA test. The second time, a new technique was used that could compare the samples at ten loci rather than six. The suspect's DNA did not match at all of the additional loci and he was released.

Although the recent mismatch is officially considered the first mistake produced by a national database, law enforcement communities all over the world have reason to be concerned. An investigator from the British government appeals board is concerned that everyone in the United Kingdom who was previously convicted with six loci testing will demand review for possible similar mistakes. British authorities claim that the mismatch was probably caused by the rapidly increasing size of the database. One database spokesman was even reported to have said that such a mistake was "to be expected." The reasoning is that as more samples are added, the higher the chance that the samples will be similar along more loci. Thus, other countries, such as the United States, who test more loci or have smaller databases, claim not to be immediately concerned. When looking to the future, however, some FBI officials are worried that similar mismatches could occur as the databases become more expansive.

519 Id.
520 Willing, supra note 120.
521 Id.
522 Id.
523 Id. A technique that examines ten loci has a one in one billion likelihood of a mismatch.
524 Id.
525 See Willing, supra note 120.
526 Id.
527 Id.
528 Id.
529 Id.
531 See Willing, supra note 120.
C. Birth of DNA Databanks in the Far East

Within the past decade, many other countries, especially those in the Far East, also are experiencing the DNA Revolution.332 Like officials in the United Kingdom and the United States, legislatures in Australia, China, and New Zealand have realized the immense law enforcement potential of DNA and have begun to examine the possibility of investigative DNA databanks.333 Likewise, they also have experienced similar resistance from civil libertarian groups and the public at large.334 Because these databanks are only in their infancy or developing stages, the most pressing question facing legislatures is deciding whose samples to include in the databanks.335 In addition, opponents are also raising the familiar privacy and access concerns.336

1. Australia

In late 1999, Australia's federal government decided to fund a national forensic DNA database as part of a fifty million dollar national criminal investigation system.337 Currently, only a few of the territories have legislation that allows for the police to build up a DNA databank.338 The push for the national database, however, has caused the other territories to begin to review and model similar legislation.339

The Model Criminal Code Officers Committee of the Standing Committee of Attorneys-General published the Model Forensic Procedures Bill in May 1999 to act as a guide for the territories to develop or enhance their DNA legislation.340 The territory of Victoria closely follows the model by authorizing police to seek court orders to secure DNA samples from convicted murderers and rapists.341 The legislation

333 See Smith, supra note 313; Parwani, supra note 332, McBride, supra note 332.
334 See Smith, supra note 313; Parwani, supra note 332, McBride, supra note 332.
336 See id.
337 Smith, supra note 313.
338 See id.
339 See id.
341 Smith, supra note 313.
in the Northern Territory, however, is more closely modeled after the British legislation. Because the police do not classify the sample as intimate, they are able to secure samples without obtaining consent or a court order. In addition, the Northern Territory legislation is more like the British model in that it allows for sampling from a broader class of convicts, including those guilty of some driving offenses.

Other states in Australia, however, are having more difficulty developing DNA databank legislation. In New South Wales (NSW), police and privacy officials are locked in a heated debate over proposed databank legislation. In mid-April 2000, the police in the small town of Wee Waa conducted one of Australia’s first mass DNA screens. After the brutal rape and beating of a ninety-three year old woman, police requested all of the six hundred adult males of the town to submit voluntary DNA samples for identification. Despite the voluntary nature of the procedure, many opponents suggested that declining to provide a sample would be seen as highly suspect. Furthermore, critics believed that police did not really expect to find the rapist through the DNA sampling. Instead, they opined that the mass screen was actually a political tactic to get support for the highly controversial NSW DNA databank legislation.

Under the proposed legislation that is before the State Cabinet, police would be authorized to begin to build a DNA databank in 2001. The databank would consist of saliva samples taken from...
NSW prisoners convicted of crimes that carry a minimum sentence of five years imprisonment. \(^{353}\) Moreover, some proponents of the database, such as the National Party MP for Barwon, have urged that the legislation be further expanded to include people convicted of petty offenses. \(^{354}\) On the other side of the controversy, civil liberties groups, such as Justice Action, fear that mass DNA screenings and databanks not only violate the public’s rights but also serve as "a movement of the onus of proof onto the public itself. People are to feel guilty until proved innocent." \(^{355}\) In addition, the NSW Privacy Commissioner worries that the proposed legislation does not have enough safeguards in place to prevent misuse and control access. \(^{356}\) The Privacy Commissioner finds it alarming that the NSW Government did not consult Privacy NSW during the debate over the databank legislation. \(^{357}\) Further, he suggests that the Government is being pressured by the Police Commissioner to pass the legislation despite the fact that it lacks many of the privacy safeguards present in the Model Forensic Procedures Bill. \(^{358}\) Thus, the Privacy Commissioner has urged the government to consider a number of issues before passing any legislation, including deciding who will be sampled, who will have access, what kind of auditing will be done, and the procedures for expansion. \(^{359}\)

2. New Zealand

New Zealand first raised the issue of DNA testing in 1978 when the New Zealand Criminal Law Reform Committee published a Report on Bodily Examination and Samples as a Means of Identification. \(^{360}\) At that time, the recommendation of testing criminal suspects was met with heavy resistance. \(^{361}\) During the next several years, the controversial report all but disappeared from the public’s conscience. \(^{362}\) In the late 1980s, however, a private bill was introduced

\(^{353}\) Id.
\(^{354}\) Id.
\(^{356}\) Puplick, supra note 340.
\(^{357}\) Id.
\(^{358}\) Id.
\(^{359}\) See id.
\(^{360}\) McBride, supra note 332.
\(^{361}\) See id.
\(^{362}\) See id.
that proposed many of the same recommendations.\textsuperscript{363} After remaining dormant for a few years, New Zealand’s Minister of Justice announced government support for DNA testing and a national DNA databank.\textsuperscript{364}

The Criminal Investigations (Blood Samples) Act was passed in 1995 and went into affect in 1996.\textsuperscript{365} Under the Act, DNA samples from persons convicted of certain offenses, volunteers, and suspects are included in a national databank.\textsuperscript{366} Over 11,000 samples have been entered in the databank since its inception, and officials estimate that approximately three hundred samples are added each month.\textsuperscript{367} Starting in 1998 the databank began to search for comparisons between the individual samples and unsolved crime scene samples.\textsuperscript{368} Currently, approximately thirty percent of the crime scene samples match an individual sample present on the database.\textsuperscript{369} In addition, about twenty percent of the unsolved crimes match samples from other crimes on the database.\textsuperscript{370}

Despite the obvious success of the New Zealand databank, some groups still are concerned about the privacy issues implicated.\textsuperscript{371} While the Act was still under consideration, New Zealand’s Privacy Commissioner expressed concern over some of the legislation’s provisions.\textsuperscript{372} While noting the presence of certain safeguards, the Commissioner objected to the inclusion of voluntary samples of innocent people.\textsuperscript{373} He stated in a report regarding the proposed legislation that only samples from those convicted of serious offenses should be entered into the databank.\textsuperscript{374} He supported his contention by arguing that certain convicted felons pose a greater risk to society as potential recidivists, while no similar justification exists for the inclusion of vol-

\textsuperscript{363} See id.
\textsuperscript{364} Id.
\textsuperscript{366} Id.
\textsuperscript{367} Id.
\textsuperscript{368} Id.
\textsuperscript{369} Id.
\textsuperscript{370} ESR, supra note 365.
\textsuperscript{371} See McBride, supra note 332.
\textsuperscript{373} Id.
\textsuperscript{374} Id.
untary samples of innocent people. Likewise, the Auckland Council for Civil Liberties worries that DNA databanking creates a slippery slope of state surveillance that infringes the public’s privacy rights. The general concern is that as society becomes more accepting of DNA sampling, police will continue to expand the DNA databank until it includes a large, if not complete, portion of society.

3. China

Ever since the 1997 rape and murder of Democratic Progressive Party official Peng Wan-ju, sex crimes have become a central issue for the public in China. According to an analysis conducted by sociologists, approximately 10,000 sexual assaults are reported each year in Taiwan. In 1995, 624 people were prosecuted for sex crimes but only 216 were convicted. Sociologists claim that the low conviction rate is due to the difficulty of gathering appropriate evidence in such cases. Given these troubling statistics, China was ripe to pass a law in early 1999 that allows the Ministry of Justice and the Ministry of the Interior to establish a DNA databank. Under the law, convicted and suspected sex offenders would be asked to provide voluntary blood samples. If they refuse, a prosecutor may force them to provide samples via a subpoena. The legislation allows the DNA samples to be kept for at least ten years. In addition, written and photographic documentation of the DNA records may be retained until ten years after the death of the person who provided the sample.

A similar proposal in southern China that would allow the formation of a DNA database, however, has encountered more resistance. Under the proposal, people suspected of committing crimes with a jail term of five or more years would be required to submit a non-

375 Id.
376 McBride, supra note 332.
377 See id.
379 Id.
380 Id.
381 Id.
382 See id.
383 DNA Tests Now Mandatory for Sex Offenders, supra note 378.
384 Id.
385 Id.
386 Id.
387 See Parwani, supra note 332.
intimate sample.\textsuperscript{388} The database also would include samples from criminals convicted of serious offenses.\textsuperscript{389} In addition, the draft law allows people to volunteer to submit a DNA sample to eliminate themselves from suspicion for specific crimes.\textsuperscript{390}

Proponents of the law argue that the draft law is too restrictive because it would require judicial authorization or consent in order to force a sample from a suspect.\textsuperscript{391} They claim that this will cause a tremendous backlog in the courts.\textsuperscript{392} On the other side of the debate, some argue that inclusion of convicts’ samples is unfair to ex-convicts who are supposed to have paid their debt to society.\textsuperscript{393} In addition, others argue that the law should not allow for the inclusion of voluntary samples.\textsuperscript{394} They claim that this is a tactic to collect samples from society as a whole.\textsuperscript{395} Although the samples would be voluntary, many maintain that this would shift the burden of proof onto the public to prove their own innocence.\textsuperscript{396} In addition, the Privacy Commissioner for Personal Data is closely reviewing the proposed legislation to ensure that it does not conflict with the Personal Data (Privacy) Ordinance.\textsuperscript{397}

III. Analysis

In 1998, the Honorable Laurie Robinson addressed the issue of international crime at The Twelfth International Congress on Criminology.\textsuperscript{398} During the speech, the Department of Justice announced the establishment of an International Center within the National Institute of Justice.\textsuperscript{399} The Center is responsible for stimulating comparative research and information sharing among criminal justice research institutes around the world.\textsuperscript{400} The call for such a division was based on the realization that crime no longer can be confronted in

\textsuperscript{388} Kang-Chung, supra note 120.
\textsuperscript{390} Parwani, supra note 332.
\textsuperscript{391} See Kang-Chung, supra note 120.
\textsuperscript{392} See id.
\textsuperscript{393} See id.
\textsuperscript{394} See Parwani, supra note 332.
\textsuperscript{395} See id.
\textsuperscript{396} See id.
\textsuperscript{397} Privacy Chief to Check DNA Sample Bill, supra note 389.
\textsuperscript{398} Honorable Laurie Robinson, Address at The 12th International Congress on Criminology (Aug. 28, 1998).
\textsuperscript{399} Id.
\textsuperscript{400} Id.
isolation. During the address, the assistant attorney general indicated that criminals now have the ability to cross international borders within a few hours. Therefore, crime has become a global issue and "what happens in one part of the world impacts all the rest. And crime problems and trends are no different."

Thus, the development and potential of an international DNA database is not hard to imagine. The United Kingdom already shares its DNA database information with other participating countries. Countries that still are developing and modifying database laws, such as the United States and Australia, have seen tremendous expansion of acceptable legislation. These countries are quickly responding to the demand for justice and lower crime rates by allowing for the inclusion of samples from more and more classes of people. Some believe that a mandatory general public database is not far off.

An International DNA database certainly could provide potential benefits. In early 2000, a twenty-six year old navy crewman, John Eric Armstrong, was implicated in at least sixteen slayings of prostitutes all over the world, including Japan, Korea, and Israel. It is suspected that Armstrong spent his eight years aboard the USS Nimitz going from port to port strangling women. Armstrong claims that he killed or attempted to kill every prostitute with whom he had sex. An international DNA database definitely could aid law enforcement in the investigation of these and other similar sexually related crimes. Other international crimes, however, tend to be white-

401 Id.
402 Id.
403 Robinson, supra note 398.
404 See Fereday, supra note 289; Sievers, supra note 37.
405 Fereday, supra note 289.
406 See, e.g., Tuchman, supra note 42; Hibbert, supra note 49, at 769; Smith, supra note 313.
407 See, e.g., Tuchman, supra note 42; Hibbert, supra note 49, at 769; Smith, supra note 313.
408 See, e.g., Smith, supra note 313; Parwani, supra note 332; Smith, supra note 251.
409 See, e.g., Hull, supra note 335; Smith, supra note 313; Robinson, supra note 398.
411 Id.
412 Id.
413 See Lander, supra note 54.
collar crimes and Internet abuse. An international DNA database would be far less useful to the investigations of these crimes.

Thus, before implementing an international database, government officials should carefully review the true benefits of such a system. Because many international criminal investigations would not be aided by such a system, it is not clear that a balancing test between the database pros and cons would favor an international system. One of the biggest concerns that would need to be addressed is the potential for tremendous backlog and an unwieldy amount of data. Not only would a large international database cause traditional backlog problems, but it would also raise new concerns.

The United Kingdom already has encountered problems with its large databank. The more samples included on the system, the more likely it will produce false matches. Therefore, as countries combine their data, the statistical significance of a match will be watered down. Laboratories would have to begin to test more loci to improve the statistical significance. In addition, an international database will make it more difficult for statisticians to derive the necessary population comparison statistic. Therefore, such a database eventually could become a hindrance to prosecutors. Furthermore, the potential for juror mystification will increase and judges likely will become less willing to admit evidence of database produced matches.

Moreover, the development of an international database would demand extreme harmonization efforts. Currently, local and national DNA database legislation differs on many points. Some laws

414 See Robinson, supra note 398.
415 See Lander, supra note 54.
416 See, e.g., Lander, supra note 54; Robinson, supra note 398; Higgins, supra note 42, at 64–64.
417 See Tuchman, supra note 42; Willing, supra note 120.
418 See Tuchman, supra note 42; Willing, supra note 120.
419 See Willing, supra note 120.
420 See id.
421 See id.; Lander, supra note 54.
422 See Zeigler, supra note 330; Willing, supra note 120.
423 See Lander, supra note 54.
425 See Daubert, 509 U.S. at 595.
426 See, e.g., Hibbert, supra note 49, at 776–81; Smith, supra note 313; Parwani, supra note 332.
427 See, e.g., Hibbert, supra note 49, at 776–81; Smith, supra note 313; Parwani, supra note 332.
allow for testing of suspects and arrestees, while others only allow for testing of certain convicts.\textsuperscript{428} In addition, each law has different access, use, and privacy provisions.\textsuperscript{429} Participating countries would have to come together to develop a standard for each of these issues.\textsuperscript{430} Given the recent trend towards databank expansion, it is probable that many civil libertarian groups would worry that states and countries with stricter standards would be forced to relax their restrictions on an international level.\textsuperscript{431} In addition, an international database would be more difficult to monitor for access abuse.\textsuperscript{432} Thus, without specific auditing procedures in place, concerns over samples being used for insurance and job discrimination also would arise.\textsuperscript{433}

Moreover, local and national database legislation differs in the way DNA samples are collected and tested.\textsuperscript{434} Some samples are collected from saliva while others are collected from blood.\textsuperscript{435} In addition, some are tested using the RLPF process, while other samples are tested with PCR procedures.\textsuperscript{436} Moreover, each country tests a different number of loci.\textsuperscript{437} In order for an international databank to be effective, samples need to be uniform for both scientific and legal reasons.\textsuperscript{438} The United States already has had to confront the scientific problem caused when samples are inconsistent because they are analyzed using both RLPF and PCR testing.\textsuperscript{439} Moreover, officials in China and Australia are focusing on the legal issue of how the sample is taken.\textsuperscript{440} A mouth swab sample is considered non-intimate while a blood sample is intimate.\textsuperscript{441} Under certain legislation, intimate samples require consent or a court order while other samples do not.\textsuperscript{442}

\textsuperscript{428} See, e.g., Hibbert, \textit{supra} note 49, at 776–81; Smith, \textit{supra} note 313; Parwani, \textit{supra} note 332.

\textsuperscript{429} See, e.g., Hibbert, \textit{supra} note 49, at 776–81; Smith, \textit{supra} note 313; Parwani, \textit{supra} note 332.

\textsuperscript{430} See, e.g., Hibbert, \textit{supra} note 49, at 776–81; Smith, \textit{supra} note 313; Parwani, \textit{supra} note 332.

\textsuperscript{431} See Smith, \textit{supra} note 313.

\textsuperscript{432} See Puplick, \textit{supra} note 340.

\textsuperscript{433} See Bowser, \textit{supra} note 110.

\textsuperscript{434} See Fereday, \textit{supra} note 289; Smith, \textit{supra} note 313.

\textsuperscript{435} See Smith, \textit{supra} note 313; Hamblett, \textit{supra} note 199.

\textsuperscript{436} See Fereday, \textit{supra} note 289.

\textsuperscript{437} See Zeigler, \textit{supra} note 330.

\textsuperscript{438} See Fereday, \textit{supra} note 289; Smith, \textit{supra} note 313.

\textsuperscript{439} See Fereday, \textit{supra} note 289.

\textsuperscript{440} See Smith, \textit{supra} note 313; \textit{Privacy Chief to Check DNA Sample Bill}, \textit{supra} note 389.

\textsuperscript{441} See Smith, \textit{supra} note 313.

\textsuperscript{442} See id.
Given these serious potential problems, an international DNA database may not be the answer that governments and victims’ families are looking for. Instead, countries should continue to develop their own national DNA databank laws to answer these concerns individually. After carefully reviewing privacy and abuse concerns locally, legislatures can provide for international sample sharing on a case-by-case basis. DNA database laws can be drafted to allow law enforcement officials to share samples with other countries in specific instances. Because individual governments would draft the laws, it would be less likely that some countries would feel pressured to expand their legislation to match the provisions of other countries. The laws could explicitly set out what data will be entered and shared and how data from other countries would be used.

In addition, such a system also would prevent the watering down of DNA statistical, and therefore legal, significance. While a large, centralized international databank would cause a backlog and a reduction in statistical significance, a system of individual DNA databanks sharing data on a case-by-case basis would not have the same effect. Prosecutors and law enforcement could maintain the statistical strength of the samples by comparing crime scene data to countries individually, therefore reducing the sample pool. With smaller databanks there would also be a lower chance of incorrect matches. In addition, individual databanks would make it much easier for scientists to determine population comparison statistics. Moreover, a system of individual national databanks would be easier to audit for potential access abuse. It would be much easier for officials to monitor smaller databanks rather than trying to oversee a massive system. In addition, legislatures have to provide for some type of criminal sanction for abuse. If there is a centralized international database, a criminal sanction could create jurisdictional problems. With individual databanks, however, each country can de-
velop its own criminal sanctions without regard to jurisdictional issues.

CONCLUSION

In the wake of the horrific stories of young Hope Denise Hall and the ninety-three year old Australian rape victim, it is easy and understandable for the public at large to demand justice at all costs. Just as many of the male citizens of Wee Waa, Australia were willing to submit DNA samples to help solve a terrible crime, many people across the world cannot understand why anyone would want to get in the way of improved crime fighting.

Society must be cautioned, however, in the era of the DNA Revolution. The potential for error, privacy violations, and jury mystification become greater each day, and yet, many are quick to assume that the only people who have reason for concern are the guilty. Thus, in developing an international crime-fighting tool, legislatures need to be aware of the potential negative ramifications of a centralized system. With such awareness, legislatures could provide the benefits of an international database while eliminating some of the costs by focusing on individual national databank legislation and data sharing. Otherwise, the potential for abuse arising out of unwarranted expansion could infringe upon the rights of society as a whole. If that happens, not only criminals would have a reason for concern.