1992

Setting Standards for the Use of DNA-Typing Results in the Courtroom - The State of the Art

George J. Annas
Boston University School of Law

LEGAL ISSUES IN MEDICINE

SETTING STANDARDS FOR THE USE OF DNA-TYPING RESULTS IN THE COURTROOM — THE STATE OF THE ART

GEORGE J. ANNAS, J.D., M.P.H.

DNA typing, sometimes called DNA fingerprinting or profiling, has been the focus of heated exchanges in courtrooms, the popular press, and scientific journals. It is a powerful law-enforcement weapon, especially in cases of rape, because it has the potential to exonerate a suspect or to place him at the scene of a crime. On the other hand, it is of no use in rape cases like those in which William Kennedy Smith and Mike Tyson were accused, in which coitus is conceded to have occurred and the only real issue is consent. When should judges permit evidence from DNA typing to go to the jury, and what part should the medical and scientific literature play in this decision? Two U.S. circuit courts of appeal have now ruled on standards of admissibility for the results of DNA typing. In early 1992, the Second Circuit Court of Appeals set a low threshold for admissibility,[1] refusing to follow the stricter test adopted in 1990 by the Eighth Circuit Court of Appeals, the only other federal appeals court to rule on this subject.[2]

THE CASE OF RANDOLPH JAKOBETZ

Randolph B. Jakobetz was convicted of kidnapping and sentenced to 30 years in prison. His primary argument on appeal was that the trial judge had wrongfully allowed DNA-typing evidence to be admitted.[1] The victim, a young woman who was on vacation, had stopped at a rest area along a Vermont interstate highway. On leaving the restroom, she was grabbed from behind, handcuffed, and gagged, and her head was covered with a pillowcase. She was then forced into the back of a tractor-trailer truck, which left the area immediately. A half-hour later the truck stopped; Jakobetz, it was alleged, entered the back of the trailer and "proceeded to brutally and repeatedly rape and sexually assault his victim." Four hours later he released her in the Bronx (New York).

At the trial, DNA typing performed by the Federal Bureau of Investigation (FBI) in comparing a blood sample taken from the defendant with a semen sample obtained by vaginal swab from the victim was introduced into evidence. The FBI declared the samples a "match" and calculated that there was only 1 chance in 300 million that the semen sample could have come from someone in the white population other than Jakobetz.[1,3]

DNA typing is based on the assumption that polymorphic repetitive DNA sequences ("variable number of tandem repeats," or VNTRs) in one person are extremely unlikely to be identical with those in any other person. In a lengthy evidentiary hearing, four government witnesses testified that the FBI procedure was "both reliable and generally accepted in the scientific community for forensic purposes." DNA typing is no longer referred to metaphorically as "fingerprinting," because a person's VNTRs are not necessarily unique. A defense expert in *Jakobetz* testified that there may be genetic subgroups in the white population, defined by religion, ethnic group, or geographic location, in which the likelihood of a random match is higher than in the general population and that until more is known about such subgroups, "it is entirely inappropriate to use one data base for all Caucasians" to calculate the probability of a match by chance.[3] For example, there may be a much higher probability that two persons of Greek descent will have identical repetitive DNA sequences than that two randomly selected whites will have matching patterns. The trial judge nonetheless accepted the opinion of government experts that the use of conservative rules of probability estimation offsets any such differences among ethnic groups.

THE CASE OF TWO BULLS

The traditional standard for the admission of evidence based on new technology was enunciated in a 1923 case involving evidence from lie-detector tests — the so-called *Frye* rule:

> Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.[4]

In 1990 in *United States* v. *Two Bulls*, the Eighth Circuit was reviewing the conviction of Matthew Sylvester Two Bulls on charges of aggravated sexual abuse, which grew out of the rape of a 14-year-old girl on the Pine Ridge Indian Reservation in South Dakota.[2] The results of DNA testing indicated that the chance of another Native American's having the same DNA pattern as Two Bulls was 1 in 177,000. The trial judge admitted this evidence after hearing only the government's first witness, who testified that DNA testing was "generally accepted by the scientific community." Two Bulls then conditionally pleaded guilty and was sentenced to 108 months in prison. On appeal, he argued that the trial court had used too loose a standard of admissibility for DNA testing. The Eighth Circuit agreed and reversed the conviction, ruling (on the basis of *Frye*[4] and the *Castro* case in New York[5,6]) that the trial judge not only must make a preliminary finding of the acceptability of DNA testing in general by the scientific community, but also must make a

specific finding about acceptable standards for laboratory testing and must determine that the actual testing procedures used in the particular case "were conducted properly"; the court ruled, further, that the judge should hear "testimony from experts on both sides."[2]

Setting the Standards of Admissibility

The appeals court in *Jakobetz* used a less strict standard than that defined by the Eighth Circuit. In its view, scientific evidence should be treated no differently from any other evidence. Its admissibility for use by the jury should be determined by the judge on the basis of whether its "probativeness, materiality, and reliability . . . outweigh . . . its tendency to mislead, prejudice, and confuse the jury."[1] On appeal, Jakobetz's lawyer argued that the judge had erred in admitting the DNA evidence because its "aura of mystic infallibility" caused the jury to "abdicate its independent fact-finding function, thereby prejudicing his defense." This is a central argument, since DNA typing is a dazzling technique that could well lead a jury to rely on it exclusively in making a determination of guilt beyond a reasonable doubt. The appeals court, however, was not persuaded. Instead, it ruled that the trial judge had properly applied Federal Rule of Evidence 702 (also used in most of the 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.

The Second Circuit, noting the tendency to liberalize rules regarding admissibility and to let the jury decide what weight to give the evidence, concluded that it did not think "that a jury will be so dazzled or swayed as to ignore evidence suggesting that an experiment was improperly conducted or that testing procedures have not been established."[1] But the court decided to go much further than simply affirming the decision of the trial judge (whose procedure, it concluded, would also have satisfied the *Frye* rule). Rejecting both the *Frye* rule and the stricter criteria established in *Two Bulls*, the court concluded that for future cases in the Second Circuit,

> a court could properly take judicial notice of the general acceptability of the general theory and the use of these specific techniques [of DNA typing]. . . . The threshold of admissibility should require only a preliminary showing of reliability of the particular data to be offered, i.e., some indication of how the laboratory work was done and what analysis and assumptions underlie the probability calculations.[1]

DNA evidence can, of course, be admitted for consideration by the jury under both rules. The difference is that under the *Two Bulls* rule a full evidentiary hearing is required, at which witnesses for the government must demonstrate that DNA-typing procedures and testing methods are generally acceptable, that such tests were validly and reliably conducted in the particular case, and that the rules of population genetics applied are both generally accepted and valid in the case in question. Expert witnesses for the defense must also be given a chance to refute each of these assertions. According to the *Jakobetz* rule, no testimony is required about the general acceptability of the theory or laboratory practice of DNA testing, and only affidavits are "normally" needed to determine both that the particular test was properly performed and that the proper rules of population genetics were used. The ruling in *Jakobetz* is a strong endorsement of the validity (and thus the admissibility) of evidence from DNA typing and of allowing a jury to evaluate its weight, and the rule is likely to be widely followed by other courts.

The Report of the National Research Council

Continuing disputes in the nation's courtrooms about the validity and reliability of DNA typing, the methodologic standards to be applied, and the interpretation of population statistics led to a study of the issue by the National Research Council of the National Academy of Sciences. The study was initiated in January 1990, and the final, unanimous report of a distinguished and diverse panel was released in April 1992.[7] The report itself was written before the decision of the appeals court in *Jakobetz*, and the analysis in the legal section of the report is current only through January 1991.

Because of the power and persuasiveness of information obtained by DNA typing, the National Research Council panel called for radical changes in the way the quality of laboratory work is ensured. Specifically, the panel called for formal quality-control programs in all laboratories, called on Congress to require external accreditation and proficiency testing of laboratories by a governmental body, and recommended the establishment of a National Committee on Forensic DNA Typing to provide scientific and technical advice on new methods of DNA typing and related issues as they arise.

On the issue of the admissibility of the results of DNA typing in the courtroom, the panel's recommendations were actually stricter than the *Jakobetz* ruling. The panel recommended that courts take judicial notice that, in principle, DNA polymorphisms provide a reliable method of comparing samples, that each person's DNA is unique (except that of identical twins), and that the current laboratory procedures for detecting variations in DNA sequences are fundamentally sound. On the other hand, the report recommended that unless its acceptability is stipulated by the parties concerned, "the adequacy of the method used to acquire and analyze samples in a given case [should] be adjudicated case by case."[7] In this regard, the panel also recommended that funds be made available to

pay for expert witnesses, that DNA samples be preserved, and that free access to "all data and laboratory records generated by analysis of DNA samples" be granted to the defense. In addition, private laboratories should not be permitted to withhold information about test results and methods from defendants on the grounds that trade secrets are involved.[7]

The most contentious technical issue the panel dealt with, however, was the question of the statistical basis for determining the probability of a match between samples. This issue has been the subject of contradictory papers in the scientific literature.[8,9] A defense witness in *Jakobetz* and his colleague published their critique, based on principles of population genetics, in *Science* in late 1991.[8] A rebuttal, coauthored by a government witness in *Jakobetz*, was published in the same issue.[9] The rebuttal seems directed not to the readers of *Science* but rather to the judiciary, since the authors asserted that the purpose of their paper was to demonstrate how "the significance of a DNA match should be evaluated in a legal setting." This seemed reasonable, apparently, because the thesis of the opposing article was that either new techniques or more population data are required before DNA typing can be validly used at all by a jury.[8]

The National Research Council report was designed in large part to put an end to the pointless and paradoxical situation in which the standards of admissibility in the courtroom and the weight of evidence were being debated in the scientific literature, whereas the standards of scientific validity were being debated at the same time in the courtroom. How did we get to this point? The power and promise of DNA typing were so enticing that a number of private companies entered the business early, and the FBI was not far behind. Working with academic scientists who served as consultants and as expert witnesses for both sides, these companies were able to market their technique to prosecutors.[5] National Research Council panel member Eric Lander, for example, has noted that much of the courtroom conflict can be traced to the understandable desire on the part of prosecutors to get the results of the new technique into the courtroom as quickly as possible.[10] Almost all trial courts initially accepted DNA-typing evidence and continue to accept it.[11] As defense lawyers became more sophisticated, however, they contacted other scientists who pointed out potential problems with the techniques being used and in the statistical assumptions on which interpretation of the results was based.

A Pragmatic Approach

The data to prove or disprove the existence of genetic substructures as alleged in *Jakobetz* do not exist. Rather than recommend that evidence from DNA typing not be admitted in the courtroom until data on population subgroups is accumulated and analyzed (a process that could take 5 to 15 years) or that the possible existence of genetic substructures be ignored, the National Research Council panel adopted a reasonable intermediate position. It decided to "assume for the sake of discussion" that population subgroups may exist in which there is a higher than average likelihood of identical results of DNA typing, and it recommended a statistical approach to deal with this possibility until such time as real data prove or disprove the existence of such subgroups. This approach is designed to come up with a conservative estimate of the probability of a false positive match that will permit the current use of DNA typing without unfairly prejudicing the defendant. This is done by using a conservative modification of the "ceiling" principle to establish the upper-bound frequency for each allele at each genetic test locus that is independent of the ethnic or other subgroup to which the suspect belongs and by applying this frequency when the multiplication rule is used to determine the probability of random matches at multiple sites. Because this method yields an upper limit of the frequency of the allele in the subgroup, there is no need to match frequencies with the subgroup to which the suspect belongs. For now, the panel recommended that the jury be told that the reported population frequency, "although it represents a reasonable scientific judgment based on available data, is an estimate derived from assumptions about the U.S. population that are being further investigated."[7] Of course, the probability of a match can still be increased by increasing the number of DNA loci compared (currently at least four sites are generally used).

What Does It All Mean?

Jakobetz and the report of the National Research Council together provide strong support for the admissibility of DNA-typing evidence in criminal trials, and courts are likely to follow the standards recommended because they are well reasoned and substantially consistent with each other. Law and science seem to be on the same path here. To the extent that the panel's ceiling principle is not accepted by defense attorneys, there will continue to be some debate about how to explain the probability of a random match to the jury. This dispute is not about the admissibility of DNA-profiling evidence, however, but about the weight the jury is likely to give it. Even the most conservative courts are likely to permit a range of reasonable calculations to be presented to the jury. Courtroom debate will now shift to the much more concrete issues of the probability of laboratory error and the current lack of uniform standards, external accreditation, and independent performance testing.

Several lessons can be drawn from the hasty attempts to introduce the results of DNA typing into the courtroom. The obvious one is that it is more appropriate, and certainly more reliable, to resolve scientific controversies in scientific journals and by means of multidisciplinary scientific committees before they are

brought to the courtroom. Attempting to resolve such questions as was initially done in the case of DNA typing effectively requires judges and juries to be arbiters of scientific debates, and at the same time it at least partly converts scientific journals into forums for legal debates on evidentiary standards in the courtroom. The danger for science is probably much more real than the danger in the courtroom, where the judge's instructions, cross-examination, testimony by defense experts, and the appeals process usually prevent grave errors, because actions that might seem reasonable in an adversarial legal process could undermine the more objective scientific process.

The parallel lessons for medicine are equally obvious. New forms of medical technology, including genetic-testing techniques that rely on DNA analysis, will be developed rapidly in the coming years. Industry will exert tremendous pressure on physicians to adopt these techniques as "standard practice." The argument for immediate adoption will not always be made on grounds of good medical practice or the welfare of patients; instead, it will often be made on legal grounds: "If you don't adopt this new technology immediately, you will be sued." This rationale must be resisted (unless one believes that lawyers and judges should set standards for medical practice). Rather, appropriate studies of accuracy, efficacy, and safety should be published in peer-reviewed medical journals, and professional societies should take positions on the merits of the new techniques according to their views of sound medical practice, not their views of evidentiary rules or courtroom practices. With such peer review and consensus, the courts can turn to professional literature and professional societies for reliable guidance about the "standard of care." Without such guidance, both courts and physicians will be left to determine standards of practice on the basis of the opinions of competing expert witnesses — a situation the public and the medical profession are likely to agree is unfortunate.

The analogy can be carried further. Deciding when a particular scientific test is valid is a question primarily for scientists, just as deciding when a particular medical test is valid is primarily a question for physicians. Expert panels can be helpful in making this determination. But evidence of validity answers only the question of admissibility, not that of the weight to be given to the evidence in making decisions. Thus, although DNA-typing evidence may be admissible when the scientists conclude it is generally acceptable, the weight to be given to such evidence in determining guilt or innocence in particular cases is a matter for the jury to decide. Similarly, even after genetic tests are determined to be "standard care" to the extent that they should be routinely offered to patients, the decisions of whether to have the test and what use to make of the information should be left up to the patient.

References

1. United States v. Jakobetz, 955 F.2d 786 (2d Cir. 1992).
2. United States v. Two Bulls, 918 F.2d 56 (8th Cir. 1990).
3. United States v. Jakobetz, 747 F. Supp. 250 (D.Vt. 1990).
4. United States v. Frye, 293 F. 1013 (D.C. Cir 1923).
5. Annas GJ. DNA fingerprinting in the twilight zone. Hastings Cent Rep 1990;20(2):35-7.
6. People v. Castro, 545 N.Y.S. 2d 985 (Sup. Ct. 1989).
7. National Research Council. DNA technology in forensic science. Washington, D.C.: National Academy of Sciences, 1992.
8. Lewontin RC, Hartl DL. Population genetics in forensic DNA typing. Science 1991;254:1745-50.
9. Chakraborty R, Kidd KK. The utility of DNA typing in forensic work. Science 1991;254:1735-9.
10. Lander ES. Research on DNA typing catching up with courtroom application. Am J Hum Genet 1991;48:819-23.
11. Office of Technology Assessment. Genetic witness: forensic uses of DNA tests. Washington, D.C.: Government Printing Office, 1990.

BOOK REVIEWS

Legal Issues in Anesthesia Practice

By William H.L. Dornette, with 13 additional contributors. 402 pp. Philadelphia, F.A. Davis, 1991. $85.

This is a reasonably well written summary of the many legal issues that touch on contemporary medical practice, in particular the practice of anesthesiology. As such, we recommend it to practicing physicians and to all others involved in health care delivery. All will find it a useful primer in medical jurisprudence, one that reviews the effect of the law and legal processes on the health sciences.

The book is divided into six sections. The fundamentals of law are covered first, with chapters on the establishment of the provider–patient relationship and consideration of the various ways in which either party may violate that relationship. There is a particularly good discussion of standards of care that reviews current standards and explores the process of how and when new standards are adopted to replace existing ones. Definitions and detailed consideration of negligence, distribution of liability, and intentional torts (such as assault, battery, and abandonment) are included. Much of this material is tedious but essential, and it serves as a good foundation for the rest of the book.

The author then discusses opportunities and techniques for minimizing exposure to liability and ensuring the consistent delivery of high-quality health care. A chapter on risk management and quality assurance provides an excellent review of the prevention and handling of potentially compensable events. Areas of particular relevance to the anesthesiologist — the preoperative visit, record keeping, the positioning and monitoring of the patient, and post-operative care — are covered in detail. Some of this material is a bit pedantic, but there is also information not commonly reviewed elsewhere; the pathophysiologic aspects of nerve injuries, changing standards of care for monitoring, and liability issues related to equipment and its maintenance are examples. The chapter on informed consent contains an especially useful discussion of the extent of disclosure of risks, the manner in which such disclosure is performed, and possible exceptions to the requirement for informed consent.

The third section covers special problems encountered in the practice of anesthesiology. The chapter on anesthetic agents and techniques is passable but not outstanding. Those on ambulatory care and pregnancy are better, with reasonable discussions of the design and operation of the day-surgery unit, criteria for admission and discharge, and the care of the fetus and mother in the operating room and later the delivery suite. The final two chapters cover the use of blood products and infection with the human immunodeficiency virus (HIV). Both are noteworthy. The discussion of blood