Rapid DNA Testing

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BY ROBERT SANGER

In 2010, the FBI began the process of encouraging the development of Rapid DNA testing. Rapid DNA testing involves a fully automated process of developing a “short tandem repeat” (STR) profile from a reference sample. The process consists of automated extraction, amplification, separation, detection and allele calling without human intervention. In other words, it is a quick, hands-free method of obtaining a DNA profile.

In this month’s Criminal Justice column we will look at this new and expanding area of scientific technology. We will also look at the efforts to regulate it and maintain appropriate scientific standards, as well as the issues regarding its admission into evidence.

DNA Testing – a Quick Review

Deoxyribonucleic Acid (DNA), as we all know by now, is represented by the double helix chain of sugars and amino acids that holds the library of blueprints for living organisms. In humans, the DNA is contained in the nuclei of every one of the trillions of living cells of the body. In addition, there is mitochondrial DNA (mtDNA) which is found in small bubbles outside the nuclei of those same cells. The mtDNA contains only the blueprints passed down from the mother whereas DNA contains the combined genetic material of both mother and father.

Since Watson and Crick first discovered the structure of DNA in the early 1950s, scientists have been attempting to map a genome (Fredrick Sanger being the first to do so) and, eventually, the human genome (through the Human Genome Project). The base pairings of the amino acids (the “rungs” on the familiar double helix “ladder”) are held in place by two sugar phosphate structures (the “sides” of the “ladder”) and are connected to each other by hydrogen bonds. These base pairings represent the “genes” that have something to do with the development of the organism. There are also long strands of DNA that are (or were) thought to be “non-coding.”

Basically, for forensic purposes, the base pairings of the amino acids can be compared from one DNA molecule to another. Over 99% of human DNA is indistinguishable from one person to another. However, there are certain sequences that tend to vary. In fact, the “non-coding” portions have been found to be the most useful portions for doing comparisons. The current forensic standards involve comparing genetic markers at 13 locations on what is referred to as “short tandem repeats” (STRs), which are present in the human genome. These loci are amplified using polymerase chain reaction (PCR) technology. Testing also includes an analysis of Amelogenin which is determinative of the sex of the donor.

The FBI has compiled and coordinated databases of the results of DNA testing. The combined databases are accessed by a software program known as the Combined DNA Index System (CODIS). CODIS contains DNA profiles contributed by local, state and federal forensic laboratories. There are particular requirements that are supposed to be met for an agency to contribute to CODIS. However, other local, state, private or laboratory-specific databases are maintained outside of CODIS.

In summary, a sample of DNA is obtained from a crime scene, a rape kit, or some other evidentiary source. That sample can then be compared to a known sample. The known sample can be obtained by a buccal swab from a suspect. The sample can also be compared by a “matching” algorithm to the profiles contained in CODIS or some other database. Increasingly, law enforcement is taking advantage of the less regulated local databases to do comparisons. Whatever the source of the match, candidate matches are then compared manually by individual analysts.

DNA analysis, far from the popular conception, is not infallible. There are several factors affecting the validity of DNA analysis. For instance, cross-contamination of samples by the police or crime scene investigators can render the whole enterprise unreliable. In addition, there are stains that may be contributed to by multiple subjects. The process, itself, can contribute to false results, including partial digestion, star activity, contamination by biological or non-biological contaminants, or other processing problems. There can also be the phenomenon of allelic dropout through the denigration of the sample, low copy number
or variances in the process. Finally, there is the issue of mismatching by the DNA analyst.

Nevertheless, DNA matches can be persuasive if certain underlying factors are present. The paradigm of a good match or exclusion would be to have a sufficient sample, properly collected and well preserved, from a single source, evaluated by a competent laboratory using proper protocols and acting independently of law enforcement or other persuasive influences. Barring intentional evidence tampering or negligence, a result from such a process, properly evaluated, can have significant evidentiary value.

**Rapid DNA Testing Technology and Standards**

The concept of Rapid DNA Testing was developed to increase the efficiency of the testing process. The use of an automated device could cut down on the time involved in doing the testing of the sample and the comparison to existing databases. In addition, Rapid DNA Testing has the potential benefit of avoiding a significant portion of the handling of a sample by laboratory technicians or analysts. This potentially reduces the risk of contamination or intentional or negligent misprocessing of the samples.

There are currently a number of vendors who are marketing Rapid DNA Testing products. At the American Academy of Forensic Sciences (AAFS) Annual Meeting this year there were several booths with competing technology. Each vendor was asserting its superiority in the field. Integen, for instance, advertises its RapidHIT Human DNA Identification System (which looks like a small ATM). They claim that, with three minutes of a technician’s time processing five buccal swab samples, it can produce standardized DNA profiles in about 90 minutes.

As reported in prior columns of *Criminal Justice*, there is a serious effort on the part of the federal government -- involving the FBI crime lab (notwithstanding, or because of, problems like those they had with hair samples), the National Institute for Standards and Technology (NIST) and the AAFS -- to create, promulgate and enforce standards in all areas of scientific evaluation. This is being done through the Organization of Scientific Area Committees (OSACs) under the direction of NIST. Previously, the FBI’s Scientific Working Groups (SWG) had been organized to do this work.

In the case of DNA, the existing SWG is called SWGDAM (Scientific Working Group DNA Analysis Methods). Although the OSACs were thought to supersede the SWGs, it appears that SWGDAM will co-exist with the OSAC Subcommittee on DNA Analysis and continue to work with the FBI Quality Assurance Standards for Forensic DNA Testing Laboratories. All of this is guided by the Federal DNA Identification Act at 42 U.S.C. § 14132. Specifically, Rapid DNA Testing will have to comply with all of the resulting standards. Lawyers proffering testimony based on Rapid DNA Testing and those opposing such testimony will have to be up to date on the latest standards from each of these sources.

**Conclusion**

Testimony based on DNA testing has the potential to be very persuasive to the trier of fact. It is subject to admissibility under *Daubert v. Merrill Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1998), *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999) and *Sargun v. University of Southern California*, 55 Cal.4th 747 (2012). Under *Daubert* and *Kumho Tire*, “[t]he objective of [Daubert’s gatekeeping] requirement is to ensure the reliability and relevancy of expert testimony. It is to make certain that an expert, whether basing testimony upon professional studies or personal experience, employs in the courtroom the same level of intellectual rigor that characterizes the practice of an expert in the relevant field.” Under *Sargun*, “... the trial court has the duty to act as a gatekeeper to exclude speculative expert testimony.” *People v. Lucas*, 60 Cal.4th 155 (2014) has held that the third prong of *People v. Kelly*, 17 Cal.3d 24 (1976) still applies (as it must under the more progressive articulation in *Daubert*, *Kumho* and *Sargun*) -- namely, that “the person performing the test in the particular case used correct scientific procedures.”

Even with a largely automated testing device, such as the RapidHIT or similar device, the device must qualify under the standards and must be operated properly by a qualified expert. In addition, of course, all the issues with regard to proper collection and preservation of evidence, contamination, mixed samples and other foundational issues must be addressed. Ultimately, the judge is the gatekeeper with regard to Rapid DNA technology evidence as with all other scientific evidence.

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