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Essay: The Future of DNA Testing and Law Enforcement

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ESSAYS

THE FUTURE OF DNA TESTING AND LAW ENFORCEMENT*

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I have been asked to give my perspective on the future of scientific technology and law enforcement. When I started putting down some ideas for this presentation, I quickly realized that the two areas have become so intertwined that I could not separate them. So my comments will address the two areas together.

There have been incredible changes in the field of forensic DNA technology in the past fifteen or sixteen years since Sir Alec Jeffries helped solve two rape/murder cases in England using DNA to identify Colin Pitchfork as the true perpetrator and to exonerate an individual who had been falsely accused. I think that in the future we are going to see still more changes, although we have reached a steady-state in some regards. For example, I believe that testing at the thirteen core STR (short tandem repeat) loci is here to stay Information from these thirteen regions of human DNA is being collected from convicted offenders and perpetrators in all fifty states in the United States and then stored in the FBI Combined DNA Index System ("CODIS") DNA database. Because of this effort, federal, state, local, and private DNA

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testing laboratories are committed to making this the test of choice. Using this test, criminal cases with no leads are being solved daily throughout the United States and internationally. The costs to put this test online and maintain the test in the laboratory are huge; thus, although additional tests may be added on in the future, this test will remain the main focus for crime laboratories for a long time.

There has clearly been a rapid decrease in the amount of RFLP[1] testing done, which I think will continue to decrease. Although RFLP testing has a lot of power, it does have significant limitations for the types of samples that can be tested, especially compared to the much more sensitive PCR[2]-based tests. I think in the not too distant future, there will be few to no labs doing RFLP testing. Similarly, the use of the *DQα / DQA1* and PM[3] (Polymarker) PCR-based tests, that have been around for a number of years, is rapidly declining; they may stay as a screening mechanism in some laboratories prior to moving on to STR testing, but having those tests be the main focus in any crime lab will certainly not be the case. I am not sure that the single-locus D1S80[4] PCR-based test, which only saw moderate use in forensic laboratories, is even being used any more. I predict that, in very short order, it will be an obsolete test.

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[1] RFLP (restriction fragment length polymorphism) is a process used in DNA identification testing to detect differences in the size (or length) of a DNA fragment in an individual compared to other individuals. This technique requires a fairly large biological sample containing DNA that has not been degraded, or broken down, by environmental insults (for example, by exposure to sunlight, growth of microorganisms, etc.).

[2] PCR (polymerase chain reaction) is a process used in DNA identification testing in which one or more specific small regions of the DNA is copied using a DNA polymerase enzyme so that a sufficient amount of DNA is generated for analysis. A very small biological sample may be tested using PCR.

[3] The *DQα / DQA1* and PM test is a PCR-based test that was widely used in DNA identification testing in the United States in the 1990s. This test detects differences at six regions in human DNA.

[4] D1S80 is a region of the DNA on chromosome 1 that contains a 16-base pair DNA sequence that is repeated in tandem from fourteen to approximately forty times; this region has been commonly tested using PCR with the AmpFLP D1S80 PCR Amplification Kit for human identification testing.

I foresee an increase in Y chromosome[5] testing. There are a number of cases where this test will be very, very important. For example, in cases where there are multiple male perpetrators, the mixtures obtained with STR testing would be uninterpretable. Y chromosome testing can be used to help sort out the number and identity of the male donors. Another example of where Y chromosome testing will be helpful is in sexual assault cases where saliva is deposited as opposed to semen. The results obtained from these samples are often difficult to interpret when tested with the standard STR test because we are unable to separate out the DNA from the saliva donor and test that separately. However, by doing Y chromosome testing, we can now separate out the male DNA. Similarly, there has been an increase in mitochondrial DNA[6] testing for those samples that cannot be tested by STRs, such as hair shafts and dried bones. Currently, mitochondrial DNA testing is playing an important role in post-conviction testing, in identification of bodies or body parts, and in cases where biological samples are very limited or very old. Mitochondrial DNA testing will continue to grow and be an important test.

Contrary to what many people have been saying for years, I think the cost of doing DNA identification testing will increase. The cost of purchasing commercially-available test kits and actually doing a test will probably go down. However, the associated costs of doing that test and the cost per case will increase significantly. Let me elaborate on some of the things that will affect cost.

The cost of personnel will increase. With the increase in DNA testing, the number of scientists that are doing DNA testing is increasing rapidly. During the earlier stages of science in the courtroom (for example, fingerprinting) and for other areas of scientific testimony, there has not been much scrutiny of the scientist. However, experts doing DNA testing are undergoing rigorous scrutiny in the courtroom. On several occasions, I have spent forty-five minutes on voir dire. Experts

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[5] The Y chromosome is the DNA in the nucleus of a cell that is present only in males. Testing of DNA from the Y chromosome can be used to link males descended from a common male ancestor.

[6] Mitochondrial DNA are the DNA located in the many mitochondria present in each cell of the body. The sequencing of mitochondrial DNA can link individuals descended from a common female ancestor.

in DNA identification testing must have the background and the training to testify to the DNA results. Every time one of us does a DNA test or testifies, our reputation and the reputation of the laboratory is on the line. The scientists that are doing the testing are professionals and they must be appropriately compensated.

Additional costs to individual laboratories will go way up. The standards for forensic testing laboratories are increasing, including a requirement to be accredited if they want to get any federal funding. Laboratories must meet those standards to stay accredited and to take their work into court. Maintaining accreditation is not a cheap process. The paper trail that is required for accreditation is costly. There are many documents that have to be maintained and retained indefinitely. There are increased quality control checks needed every year. There are more tests that need to be done, more documents that need to be maintained, and more instruments that need to be checked and validated.

Part of the recommendations and requirements are that the individual scientists be highly trained. DNA analysts now have to take a required list of courses to meet the standards. If a laboratory hires someone who has not taken the courses, that individual must complete those classes before he or she can be a qualified DNA expert. In addition, there are guidelines suggesting what training a DNA analyst should have. Some of these are extensive and may not consider previous training of the analyst, which may require redundant training. Each scientist is required to complete an external proficiency test twice a year. These tests must be purchased from a proficiency test provider approved by the American Society of Crime Laboratory Directors Laboratory Accreditation Board ("ASCLD-LAB"). Continuing education of a DNA analyst is now a mandate. Each scientist must attend annual external meetings. This is a huge expense for the laboratory in two ways. First, while attending the meeting, scientists are out of the laboratory and not doing the case work that needs to be done. Second, there are substantial costs associated with traveling to and attending meetings.

Additionally, with the increase in DNA testing and its standards, there will be a need for a corresponding increase in managers to supervise the analysts, Quality Control ("QC")

managers to oversee the quality of the laboratory, as well as individuals to perform routine QC, maintain documentation, and provide discovery, etc. As a result of these various requirements, the costs to train individuals and monitor the laboratories is increasing, and will likely continue to increase.

The number of audits for a laboratory is increasing. To maintain the required accreditation, laboratories must undergo periodic audits to demonstrate the compliance of the laboratory. In addition, laboratories must meet the DNA Advisory Board/FBI Standards which require an annual audit. They may also have to undergo certain state audits. For example, New York has created a forensic DNA auditing/accreditation group to assess DNA testing for the state of New York. Any laboratory doing DNA forensic testing in or for New York must meet state requirements. Private laboratories will likely be affected more than public laboratories since an additional audit may be required for each contract the private laboratory has to do DNA testing. Personnel lose time from casework to not only participate in the audits, but also to train and do audits at other laboratories.

The requirements and the standards for individual crime laboratories will continue to increase. Forensic DNA testing laboratories may see some continued increase in standards, however there will likely be a more substantial increase in standards for other forensic disciplines as well as an increased requirement to meet those standards. For example, for a forensic DNA laboratory to be ASCLD-LAB accredited, every laboratory in that location, including firearms, fingerprinting, and toxicology laboratories, as well as every other laboratory associated with the laboratory (for example, state laboratories in different locations) must meet accreditation standards in their respective disciplines.

Many laboratories are moving towards newer types of equipment that increase efficiency, such as automation robotics. These will ultimately reduce the per test cost. However, the cost of getting the equipment into the laboratory and validating that equipment is huge. Each piece of equipment that comes into a laboratory has to be put through extensive validation studies to demonstrate that it performs correctly in the laboratory. There are maintenance contracts and repair fees to keep the equipment maintained. RFLP

testing in retrospect is incredibly cheap. If an RFLP gel box does not work, one simply buys a new box for $100-$200, runs a quick check, and puts it into use. This is not the case for the new testing equipment. In addition, the laboratory must maintain documentation of the training for each scientist on the use of that particular instrument. Again, this requires a huge volume of time and paperwork, and all of the paperwork must be available and provided for discovery if ordered by the courts. Thus the cost of going to automation is high in order to ultimately end up with a cheaper test.

The cost of doing one particular case is likely to increase. Prosecutors or law enforcement may require that more samples per case be tested and that more types of tests are performed on each sample. This may include Y chromosome and mitochondrial testing. Also, the human genome project is bound to have an impact on forensic testing. We are likely to identify other regions of DNA that are even more valuable than the ones we are currently using. The addition of more loci to our battery of tests will put us to the point of individualization. We will no longer need to go into court with statistical data and say, "In my opinion, within a reasonable degree of scientific certainty, the defendant is the source of this sample." We will be able to say, "We have tested so many regions of the DNA that it is not possible the DNA can be from anybody else. The DNA is from this person." There is the potential of testing samples we have not even thought about now that could be tested in the future. Testing fingerprints is not very far away. We are now routinely testing stamps, cigarette butts, and chewing gum, which years ago many people thought could not be done. There are going to be more samples that can and will be tested in the future.

There will be an increase in caseload. There is a large number of state, city, and local jurisdictions that are starting to test or contract out backlogged no-suspect cases. For political reasons and with the size of the CODIS convicted offender database growing daily, most jurisdictions will no longer be able to hold those cases in their forensic lockers. In addition, to receive certain types of funding, laboratories will be required to test their no-suspect cases. Testing of post-conviction cases may also be on the rise for the next several years. Testing for samples from different types of crimes, such as burglaries, that

may not have routinely been tested in that jurisdiction in the past, will now be increased as data accumulate demonstrating the link of perpetrators in less serious crimes to major crimes. DNA collected from a dried bloodstain on a window from a burglary, for example, provides fabulous data—no mixtures and we know when the blood was deposited. There are cases for which prosecutors may not have traditionally done DNA testing in the past, but now may not have an option due to post-conviction testing issues and increased jury expectations. Prosecutors may now need to test the biological samples relevant to a case regardless of the other evidence available for a conviction.

I have already mentioned that discovery is a big issue for many laboratories. For the next few years, the amount of discovery for STR testing and the use of the new types of equipment is going to increase. This will affect costs and can be burdensome to some laboratory staff. In the long run, the amount of material requested will decrease once the tests have been established in the laboratory and accepted in the courts, but increased documentation for discovery will continue to be needed for each new test or equipment added in the laboratory.

I would like to predict, and I hope this will happen, that there will be an increase in independent case review. I think that defense attorneys in this country are not getting enough help with looking at casework that has been done by the state. I strongly encourage the defense community to, at a minimum, get a copy of the case folder, have someone look at the data to be sure that the work was done correctly, and that it is being appropriately interpreted. Humans make mistakes and the data should be reviewed.

On the technology front, there is a push to go to miniaturization. The idea is that a crime scene technician will take a small black box to a crime scene, collect a sample, and place it in this box. The DNA will be extracted, tested, and the results will be beamed back to a laboratory for an interpretation. Investigators would know in very short order that they are looking for a male and may be able to match the DNA profile to one in a database or match it to a suspect that has been identified.

There are predictions that we will be able to test DNA for physical markers and thereby identify the physical characteristics of a perpetrator. In the future, it may be possible to identify the age of the person who deposited the DNA or determine when the DNA sample was deposited. Plant, cat, and dog DNA testing have played key roles in several cases already; the use of nonhuman DNA testing in criminal cases is likely to increase.

Scientific advances in human DNA identification testing have had a major impact on law enforcement agencies and on their ability to solve crimes. We should expect that continued advances in this area will provide increased assistance to law enforcement in their vital role to society.