



BIOMETRICS
DEPARTMENT OF DEFENSE

**DEPARTMENT OF DEFENSE
BIOMETRICS MANAGEMENT OFFICE
SUMMARY REPORT
Biometric Identification Seminar
Forensic DNA Typing and Prospects for Biometrics**

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**Robert C. Yen
Staff
Department of Defense
Biometrics Management Office**

**Department of Defense
Biometrics Management Office
Biometrics Fusion Center
www.biometrics.dod.mil
☎ (703) 602-5427**

Biometric Identification Seminar Summary Report

Speaker: **John M. Butler, Ph.D.**

Leader, Human Identity Project Team

National Institute of Standards and Technology (NIST), Biotechnology Division

Title: **Forensic DNA Typing and Prospects for Biometrics**

Place: Mitretek Systems, Inc.

Date: 12 May 2004

Time: 2:00-3:00 pm

Number of Attendees: Less than 30 attendees primarily comprised of Mitretek personnel

Overview

During the seminar, Dr. Butler discussed the history of forensic Deoxyribonucleic Acid (DNA) analysis, noting that DNA laboratories around the world primarily use Short Tandem Repeat (STR) markers and fluorescent detection methods to perform DNA testing. He also noted that NIST will review technology developments in the field of forensic DNA typing along with reviewing the role of NIST in these developments. Additionally, Dr. Butler discussed practical applications of DNA typing, including its high accuracy rate in person identification and the implications and expectations for the use of DNA in biometric applications. Dr. Butler also discussed the Federal Bureau of Investigation (FBI)'s Combined DNA Index System (CODIS) database.

History of Forensic DNA Analysis

DNA typing/profiling/fingerprinting methods have revolutionized the law enforcement community with the ability to solve crimes involving biological evidence. Dr. Alec Jeffreys, an English geneticist, first described DNA typing in 1985. He discovered that the number of repeated DNA sequence sections—variable number of tandem repeats (VNTR)—present in a sample could differ from individual to individual. The technique used by Dr. Jeffreys to examine the VNTRs was called restriction fragment length polymorphism (RFLP). The technique used more recently is polymerase chain reaction (PCR)-based.

In the late 1980s, the FBI laboratory began using single-locus RFLP probes in DNA casework. In 1991, the FBI laboratory began using fluorescent STR markers and Chelex extraction. In 1992, FBI started casework with PCR technique. In 1997, the FBI defined 13 core STR loci and described Y-chromosome STRs. In 2000, the FBI laboratory and other labs discontinued running RFLP cases and converted to multiplex STRs.

Practical Applications of DNA Typing

DNA, through its VNTR patterns, can be used to resolve paternity/maternity cases because a person inherits his or her VNTRs from his or her parents. These patterns are so specific that a parental VNTR pattern can be reconstructed even if only the child's VNTR patterns are known.

The U.S. legal system often relies on forensic DNA testing to convict the guilty or exonerate the innocent, particularly in cases of murder and rape. DNA isolated from blood, hair, skin cells, or other genetic evidence left at crime scenes can be compared, through its VNTR patterns, with the DNA of a

criminal suspect. VNTR patterns are also useful in establishing the identity of a homicide victim, either from DNA found as evidence or from the body itself.

Other uses of DNA include identifying an individual's legal nationality.

Examples of DNA Evidence Highlighted in the Media

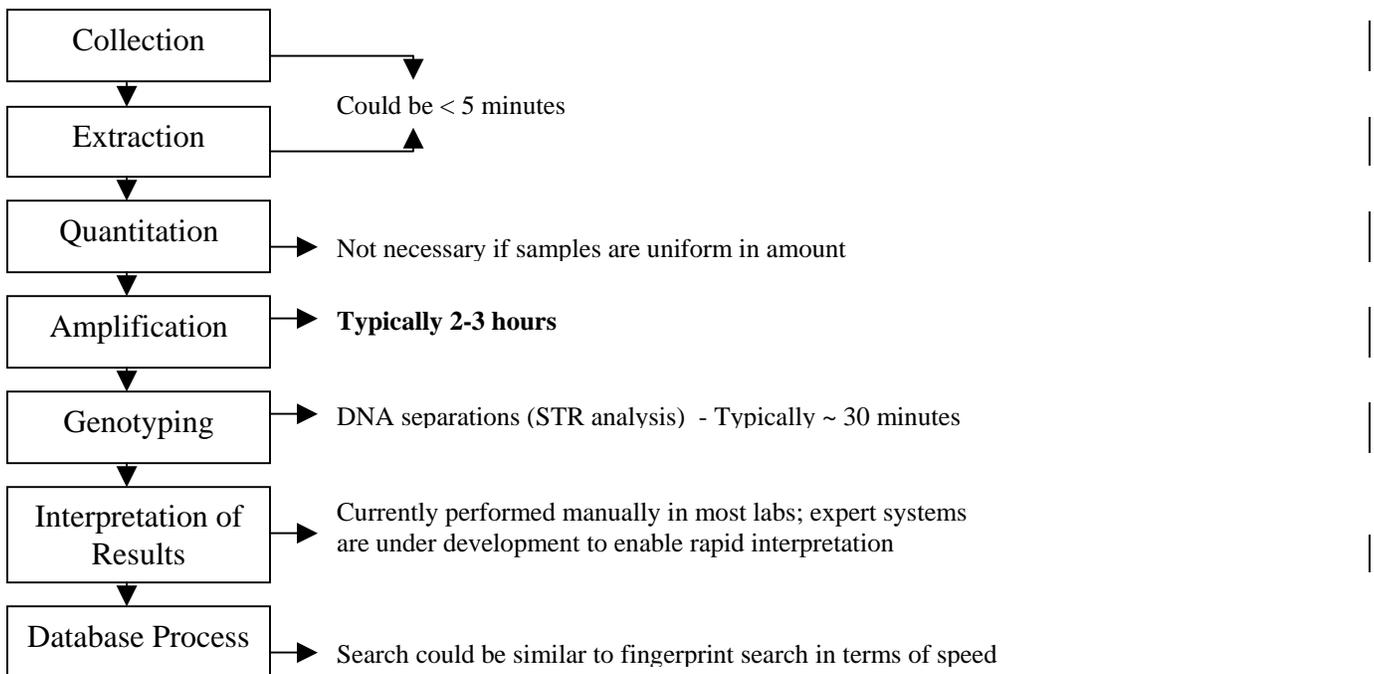
In the last decade, the general public has become more familiar with the power of DNA evidence as it has become more prevalent in media reports. For example, the media reported on the DNA evidence used during the O.J. Simpson murder trial, the on-going efforts to identify victims of the terrorist attacks of September 11, 2001, and the verification of Saddam Hussein upon his capture in December 2003.

The FBI Laboratory's CODIS Database

In October 1998, the FBI launched its CODIS database, which stores DNA samples collected in all 50 states to link serial crimes and unsolved cases with report offenders. The CODIS database allows law enforcement to cross-reference their DNA samples with that of other agencies across the country. Within the database, each record requires 13 core STR markers. Currently, the CODIS database has a backlog of more than 750,000 samples.

Time Required for Testing: Typically a Minimum of 4-5 Hours

The time required for a single DNA testing—from the collection of the sample through the matching result—is typically 4 to 5 hours. As depicted in the illustration below, the portion of the DNA testing that takes the longest time is the PCR with multiplex amplification period which takes 2 to 3 hours.



Conclusion

As a result of this seminar and additional research, the participating team member's conclusion is that the time, technology, and funding required to isolate, store, maintain, and then analyze DNA evidence presents tremendous challenges in the administration of justice. These challenges contribute to the CODIS database backlog of more than 750,000 samples, which represents DNA evidence collected from across the country. For example, the time required for a single DNA testing is typically 4 to 5 hours. Additionally, the technology needed to efficiently maintain and analyze DNA samples is not widely available to law enforcement throughout the country. To resolve this lack of technology, the field of forensic DNA typing should develop a widely available device that allows the proper authorities to accurately process DNA samples and produce matching results quickly. It should be noted that without such a device, fingerprint and/or palmprint matching methods are more likely to remain the prevalent ways in the near term to identify an individual because such matching can be done through the human eye in the absence of an electronic system. Funding, which Dr. Butler did not address in this seminar, is also a significant factor in the processing of DNA evidence. The costs of processing DNA evidence varies by lab and the size and condition of the DNA sample. For example, some reports have stated that a test for a well-sized and well-preserved sample will cost at least \$1,500.

The President's DNA initiative entitled, *Advancing Justice Through DNA Technology*, is an opportunity to resolve the time, technology, and funding issues associated with law enforcement's processing of DNA evidence.¹ The initiative calls for \$232.6 million in federal funding for FY 2004—a \$100.7 million increase—to aid local, state, and federal in improving their DNA collection systems with added funding for staff and technology, training, and assistance.

¹ The National Institute of Justice (Department of Justice), *Advancing Justice Through DNA Technology*, March 2003, http://www.usdoj.gov/ag/dnapolicybook_cov.htm