Operating and Managing a Statewide DNA Program

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The success of the Virginia Division of Forensic Science's DNA program is based upon managing the DNA program from a central location, consistency in the methods and procedures used, cooperation and continual dedication of the laboratory staff, as well as overseeing of all technical issues by a single technical leader. To streamline the analysis of the evidence samples, the most probative items of evidence are examined first for biological materials. Once biological materials are identified, DNA analysis is performed and the resulting foreign short tandem repeat profile is entered into the Combined DNA Index Systems for routine searching of the profile against Virginia's and the nation's convicted offender DNA Data Banks. In addition, the foreign profile is also searched against other foreign profiles obtained from previously analyzed evidence samples, thereby helping the law enforcement agencies in Virginia solve crimes that would otherwise go unsolved.

Key words: databases, factual; DNA; DNA fingerprinting; forensic medicine; laboratories; short tandem repeats; United States

The Virginia Division of Forensic Science is comprised of a system of four laboratories: a headquarters laboratory located in Richmond, Virginia, and three regional laboratories located in Fairfax, Norfolk, and Roanoke, Virginia. Each of the laboratories has a Forensic Biology Section that serves the law enforcement agencies in the surrounding communities. In total, the Division services more than 300 law enforcement agencies across the state of Virginia. The Headquarters Laboratory, or the Central Laboratory Forensic Biology Section, employs two casework supervisors and twelve casework examiners who examine evidence for the presence of biological material and then conduct a DNA short tandem repeat (STR) analysis on the appropriate biological stains that are identified. Each of the three regional laboratories has one casework supervisor and five to six casework examiners.

Each of the regional laboratory Forensic Biology Sections employs two support staff and the Central Laboratory Forensic Biology Section employs five support staff, whose duties include aiding in the handling, opening, and air drying of the evidence to preserve the biological material deposited on the evidence before analysis, staining microscope slides to help locate and identify spermatozoa, preparing reagents, pouring electrophoresis gels, and conducting other support duties. The Central Laboratory also houses the Virginia Convicted Offender DNA Data Bank in accordance with the state laws of Virginia (1,2). One Data Bank supervisor and two qualified Data Bank examiners conduct STR analysis on the blood samples that are submitted to the Virginia Division of Forensic Science from all convicted offenders in the State of Virginia. Due to the approximately 25,000 new offender blood samples that are submitted to the Division each year from the Department of Corrections, local and regional jails, and local health departments, the Division also employs seven part-time staff to assist with the drying down of the blood samples onto stain cards, storing of the samples after they are dried, entering the inmate information (i.e., name, social security number, Department of Corrections inmate number, date of birth, race, and sex) into a computer for tracking purposes, and entering the convicted offender STR profiles in the Virginia DNA Data Bank referred to as the Combined DNA Index System (CODIS) (3,4). In addition, the Central Laboratory Forensic Biology Section also has one part-time research and development person who validates the new procedures and helps to troubleshoot problems when they occur with the procedures that are currently on-line.

Management Structure

The entire forensic DNA program for the Virginia Division of Forensic Science is overseen by a Program Manager, who is responsible for handling administrative matters associated with the section, and a Section Chief, who serves as the technical leader for the Division's DNA program. The supervisor(s) in each of the laboratories is responsible for overseeing the day-to-day operations of his/her DNA program with the guidance from the Section Chief on technical matters and the Laboratory Director and/or Forensic
Biology Program Manager on administrative issues. The Division of Forensic Science Forensic Biology Section organizational structure is illustrated in Figure 1.

To ensure all DNA STR analyses, policies, and procedures are handled consistently statewide throughout the Division’s Forensic Biology Section, a standard set of procedures and policies have been established in accordance with the Federal Bureau of Investigation’s (FBI) quality assurance standards, which all Forensic Biology staff are required to follow (5,6). If modification of a procedure is necessary, the Section Chief is responsible for issuing an addendum to the procedure before the new procedure can be implemented.

**Casework Management**

The Forensic Biology Section receives between 2,000 and 2,500 cases on a statewide basis each year. Approximately 75% of these cases contain biological material on which a DNA analysis can be conducted. Although many items of evidence may be submitted to the Division, not all items of evidence will necessarily be examined. The casework examiner will first examine the evidence believed to be the most probative to the case for the presence of possible biological material (i.e., seminal fluid or blood) based upon the information provided by the investigating officer through a telephone conversation or the information listed on the Request For Laboratory Examination form that is submitted with the evidence. If the most probative items of evidence do not contain biological material, the casework examiner will examine additional items of evidence for the presence of biological material. Generally, one to two items of evidence, plus the known standards from the victim, suspect, and/or elimination person (i.e., husband or boyfriend) are analyzed per case. When the controls (i.e., reagent blanks, positive and negative amplification controls, and extraction blank) are added, a case examiner routinely loads 10 to 12 samples per typing gel.

Each year, 20% to 25% of the 2,000 to 2,500 cases that are submitted to the Virginia Division of Forensic Science’s Forensic Biology Section involve a perpetrator who is unknown. In order to assist the law enforcement community in the identification of these individuals, the foreign DNA profile that is obtained from the evidence sample(s) is entered and searched against the Virginia DNA Data Bank at the state level of CODIS referred to as the State DNA Index System (SDIS), and subsequently searched at the national level of CODIS referred to as the National DNA Index System (NDIS).

For each case (regardless of whether a suspect has been identified or not), the DNA profile that is foreign to the victim and believed to have come from the perpetrator is entered into CODIS and searched against either the offender index comprised of the DNA profiles from convicted offenders in Virginia, searched against the casework/forensic index comprised of the foreign DNA profiles identified on the evidence in all cases analyzed in Virginia requiring a DNA analysis, or searched against both indices. If a suspect has been identified in a case and his/her DNA profile matches the foreign DNA profile found on the evidence, the examiner will search the foreign DNA profile.

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**Figure 1.** Forensic Biology Section organizational chart. The Virginia Division of Forensic Science Forensic Biology Section is overseen by the section program manager who handles the administrative issues for the section and the section chief who is responsible for handling all technical issues. Each of the Division’s four laboratories has one or two supervisors who are responsible for overseeing the day-to-day operation of his/her section.
profile against the casework index to determine if the suspect case can be linked to any cases where a perpetrator has not been identified. If no suspect has been identified in a case, the examiner will search the foreign DNA profile obtained from the evidence against both the casework and offender indices to determine the identity of the perpetrator, as well as to determine if he/she may be connected to another unsolved crime.

Convicted Offender Sample Analysis

A foreign DNA profile obtained from an evidence sample analyzed by the Division is more likely to match an individual convicted of a felony in Virginia than in another state. Thus, to increase the size of the convicted offender database in Virginia as quickly as possible to help identify perpetrators in non-suspect cases, it was decided that the blood samples obtained from convicted offenders would be first analyzed using Promega’s GenePrint® PowerPlex™ 1.1 System loci (CSF1PO, TPOX, TH01, vWA, D16S539, D7S820, D13S137, and D5S818) on the Hitachi FMBIO II Fluorescent Image Analysis System (Hitachi Software Engineering Company, Ltd., San Francisco, CA, USA) and associated StaRcall analysis software to assign allele designations (7,8). These samples would subsequently be analyzed using the GenePrint® PowerPlex™ 2.1 System loci (FGA, TPOX, D8S1179, vWA, Penta E, D18S51, D21S11, TH01, and D3S1358) (9). Ultimately, this decision proved to be a wise decision resulting in the Division’s ability to make approximately three Data Bank hits per week. However, due to the large number of convicted offender samples that were backlogged and the Division’s inability to analyze this high volume of samples with its current staff, in 1998 the Virginia General Assembly provided funding and language in its 1998-2000 biennial budget. It allowed the Division of Forensic Science to outsource 50,000 to 70,000 samples per year over three fiscal years (1999-2001) in order to eliminate the existing backlog of 150,000 samples.

In July 1998, the Virginia Division of Forensic Science began to outsource these samples to The Bode Technology Group, Inc., located in Springfield, Virginia, at a rate of approximately 70,000 samples per year for analysis at the PowerPlex™ 1.1 System loci. The Virginia Division of Forensic Science also continued to analyze some of these samples in-house on a lower level and review the data returned from The Bode Technology Group, Inc. In January 2000, the Division began to analyze the convicted offender samples at the PowerPlex™ 2.1 System loci and enter the DNA profiles into CODIS. Subsequently, in May 2000, the Division began to analyze cases involving a mixture of body fluids from more than one individual at the PowerPlex™ 2.1 System loci to help resolve complex mixtures using the additional loci. The PowerPlex™ 2.1 System has successfully aided the casework examiner to reduce the number of adventitious hits that occur when a mixture of profiles is searched in CODIS at solely the PowerPlex™ 1.1 System loci.

Conclusion

Much of the success of the Virginia Division of Forensic Science’s DNA program is attributable to following a standard set of procedures and policies throughout the Forensic Biology Section, analyzing the blood samples submitted from the convicted offenders, analyzing evidence from non-suspect cases, the staff’s continual dedication and willingness to un-
dergo training and conduct validation studies to implement new DNA technologies, as well as having a single technical leader who oversees the entire technical DNA program.

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References


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