THE DEVELOPMENT OF QUALITY ASSURANCE MEASURES IN FORENSIC DNA TYPING

LAWRENCE A. PRESLEY and JAMES L. MUDD, QUALITY ASSURANCE UNIT, FORENSIC SCIENCE RESEARCH AND TRAINING CENTER, FBI LABORATORY, FBI ACADEMY, QUANTICO, VIRGINIA 22135, USA

Introduction

The use of DNA analysis to assist in solving violent crimes has significantly impacted the criminal justice system. Because of the significant discriminating power of forensic Restriction Fragment Length Polymorphism (RFLP) and Polymerase Chain Reaction (PCR) DNA analyses, substantial attention has been directed to the proper use of these DNA technologies by the forensic community. In 1992, the National Academy of Sciences National Research Council stated (NRC,1992):

> "Laboratories involved in forensic DNA typing should move quickly to establish quality assurance programs. After a sufficient time for implementation of quality assurance programs has passed, courts should view quality control as necessary for general acceptance."

Quality control (QC) and quality assurance (QA) have been defined as two different and specific functions (ANSI 1978 and Kilshaw, 1986, 1987a, 1987b). The QC measures are designed to insure that the quality of the product, that is the DNA typing result, meets and satisfies specific criteria. The QA program should provide all concerned, primarily the courts in the forensic application, the criteria that can be used to establish with confidence that the QC functions are being performed acceptably.

The Technical Working Group on DNA Analysis Methods and the International Society of Forensic Haemogenetics

In November, 1988, the first meeting of the Technical Working Group on DNA Analysis Methods (TWGDAM) took place at the FBI Academy in Quantico, Virginia. TWGDAM has since produced guidelines for quality assurance in 1989, 1990, 1991 and 1995 (TWGDAM, 1989,1990,1991,1995), guidelines for quality audits in 1993 (TWGDAM, 1993) and guidelines for proficiency manufacturing and testing in 1994 (TWGDAM, 1994). The DNA Identification Act of 1994 has established the TWGDAM guidelines as interim standards for forensic DNA testing laboratories. United States crime laboratories using DNA analysis generated QA/QC guidelines which incorporated and paralleled the TWGDAM guidelines. The DNA Analysis Unit of the FBI Laboratory suggested an outline of quality control measures for casework in 1989 (Adams et al, 1989). State forensic laboratory directors were becoming increasingly aware of the requirements for detailed, specific and documented QA/QC guidelines (Ferrara, 1990). The DNA Commission of the International Society for Forensic Haemogenetics has also generated recommendations regarding QA/QC protocols for DNA typing of RFLP and PCR-based polymorphisms (ISFH Recommendations, 1989, 1992, 1992, 1995)

Published Validation Studies on Forensic DNA Applications

Since 1985, validation studies have repeatedly addressed specific issues related to forensic evidence samples, and these studies have provided valuable data in helping to establish meaningful quality assurance and quality control measures.

Quality Control Measures in Forensic DNA Analysis

For RFLP analysis, several control measures have been established and include: the K 562 control sample, restriction enzyme monitoring, use of appropriate size markers, DNA quantity estimates and the National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) 2390.

For PCR analysis, control measures have included: positive and negative amplification controls, DNA quantity estimates, reagent blanks and appropriate size markers. Mitochondrial (mt)DNA analysis may require capillary electrophoresis controls as well as automated sequencer instrumental procedures which appropriately document the procedure.

Routine Forensic Casework Quality Assurance Measures

Routine casework will require appropriate written and photographic records, technical reviews and interpretational guidelines. Forensic DNA laboratories will also be required to participate in established proficiency testing programs which may include external and/or internal proficiency testing.

External Quality Assurance Measures for Forensic DNA Laboratories

Several external quality assurance measures may directly affect forensic DNA laboratories. Accreditation for forensic laboratories has been available from the American Society of Crime Laboratory Directors-Laboratory Accreditation Board(ASCLD-LAB) and the National Measurement Accreditation Scheme(NAMAS) in Great Britain. Professional certification in forensic biology is available from the American Board of Criminalistics (ABC). Both ASCLD-LAB and ABC require the court testimony and proficiency test monitoring of forensic DNA examiner/analysts.

Internal and external audits of forensic DNA laboratories are becoming an established measure for monitoring performance.

Conclusion

The forensic DNA community has voluntarily incorporated the concepts and practices of quality assurance and quality control measures and is continually striving to attain the highest quality forensic DNA analyses.

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