Streamlining the Validation of New Forensic DNA Technologies

Dennis Reeder*, Jacquelyn Benfield#, Mark Miller# and Jonathan Tabak#

*Reeder Analytical Consulting, 11973 Westlawn Lane, Frisco, TX; #Applied Biosystems, 850 Lincoln Centre Dr., Foster City, CA

ABSTRACT

As the demand for processing DNA evidence has continued to grow, so has the development of new technologies for DNA analysis. These factors can make it difficult for a crime laboratory to strike a balance between successful case workload management and the evaluation and implementation of new technologies. Laboratory Accreditation and Forensic DNA Analyst education require careful assessment and thorough validation studies to provide confidence in the DNA results, ensuring the generation of robust, reliable and reproducible data.

There are a variety of challenges the Forensic DNA laboratory faces when implementing a new methodology. A common challenge identified by laboratories is a lack of resources available for validation. Laboratories also point to the existence of diverse opinions with respect to validation protocols, sample numbers and definition of appropriate and effective experiments as notable challenges. These variables have been shown to contribute to extensive validation studies that include unnecessary or excessive tests without the benefit of additional confidence. In addition, data management and analysis are cumbersome processes that are often manual operations or utilize a series of tools which analysts have developed on their own.

This presentation introduces time-saving tools and services being developed by Applied Biosystems to significantly streamline the validation of new forensic DNA technologies. First, the AB Validation Software is designed to help support, simplify and standardize validation studies while meeting SWGDAM/DAB recommendations. Second, Applied Biosystems has created a Validation Support Service program, designed to provide the resources, manpower and deliverables to complete validation efficiently and effectively.

VALIDATION SOLUTIONS

1 AB Validation Software: VALID™

VALID™ software is being designed to address the challenges of implementing new forensic DNA technologies by including the following features:

- A simple, user-friendly graphical interface that streamlines data input, analysis and requires minimal training.
- Experimental plan recommendations and design tools to assist laboratories in establishing Forensic DNA-specific validation protocols.
- Integration of all validation workflow processes, including the initial experimental design, PCR set-up, amplification, post-PCR set-up, data analysis of validation experiments, statistical analysis and final reporting capabilities; Automated worksheet and importable set-up file generation for quantification, normalization, dilution/mixture preparation, amplification, capillary electrophoresis and genotyping.
- Validation-specific data analysis and graphing tools that help identify optimal operating parameters and performance characteristics required to establish standard operating procedures and interpretation guidelines.
- Project and documentation management enabling laboratories to track validation progress and maintain validation-associated information for accreditation, training and/or auditing purposes.

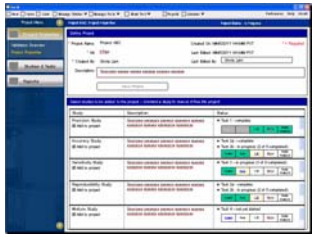


Figure 1. Validation-specific experimental plans are provided that include objectives, sample type and sample size recommendations. Validation project management tools track project status.

Figure 2. Minimal data-entry required. Importable Real-time PCR and CE plate records generated automatically once samples are selected.

Figure 3. Evaluation flags for imported ABI Prism® 7000 and 7500 Real-Time PCR systems for quantification data highlights samples that may need additional processing.

Figure 4. Automatically generated validation study worksheets provide calculated volumes for samples and reagents based on imported quantification data and experimental parameters such as mixture ratios for mixture studies or serial dilutions for sensitivity validation studies.

Figure 5. Validation-specific data analysis tools. GeneMapper® *ID* or Genotyper® software tables are imported to VALID™ software where the data are graphed and summarized to aid in establishing standard operating procedures and interpretation guidelines.

Figure 6. Data analysis concordance tool. Genotyped data imported into VALID™ software can be automatically checked for genotype concordance, eliminating manual comparison.

Report. Applicable validation information and data are incorporated into a formatted easy to follow validation report.

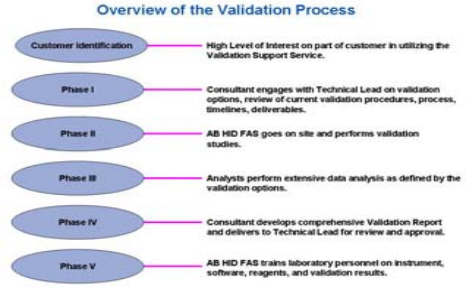
2 Validation Support Service

Goals:

- Create partnership with the client laboratory, under the direction of the laboratory director, technical leader and quality assurance manager.
- Provide the resources, manpower and deliverables to complete validations efficiently and effectively.
- Perform thorough and complete validation experiments, data analysis and reporting to get instruments and chemistries on-line as efficiently as possible: goal of 8 - 12 weeks.
- Meet all SWGDAM/DAB auditing and accreditation standards.

Development Team:

- Program Manager – Mark Miller, Applied Biosystems
- Project Managers (Lead Consultants) – Lucy Davis Houck, Charlotte Word
- Validation Consultant – Dennis Reeder
- Analyst Consultants – Karen Howard, Margaret Terrill – Forensic Analysts
- Industry/Government Leaders identified for review/feedback of program; including NIST and NFSTC
- Applied Biosystems HID FAS – Cortney Boccardi, Catherine Caballero
- Applied Biosystems Validation Software – Jacki Benfield
- Applied Biosystems Marketing – Jonathan Tabak



Validation Options:

Applied Biosystems 31XX Genetic Analyzers:

- AmpFℓSTR® Identifiler® PCR Amplification Kit
- AmpFℓSTR® Yfiler® PCR Amplification Kit
- AmpFℓSTR® MiniFiler™ PCR Amplification Kit
- AmpFℓSTR® COfiler® PCR Amplification Kit
- AmpFℓSTR® Profiler Plus® PCR Amplification Kit

ABI PRISM® 7000 Sequence Detection System or Applied Biosystems 7500 Real-Time PCR System:

- Quantifiler® Human DNA Quantification Kit
- Quantifiler® Y Human Male DNA Quantification Kit.

Validation Studies:

- Reproducibility and Precision/Accuracy
- Concordance
- Sensitivity and Stochastic Studies
- Minimum Threshold Calculations
- Mixture Studies
- Contamination
- NIST Traceability

Grant Funding Update:

- 2006 National Institute of Justice Capacity Enhancement Grant = $27.6M
  "E. Permissible Uses of Funds
  6. Consultant and Contractor Services. Funds may be used to hire consultants and/or temporary contract staff to handle, screen, and (for accredited laboratories only) analyze forensic evidence that may contain DNA, or to validate new DNA analysis technologies."

SUMMARY AND CONCLUSIONS

1. Applied Biosystems is developing multiple solutions to enable crime laboratories to more effectively and efficiently validate new forensic DNA technologies:
   - A unique software package specifically designed to guide, organize and manage the internal validation process.
   - A consultative partnership utilizing qualified external resources to rapidly perform the steps necessary to complete validation.
2. The use of one or both of these options will dramatically reduce the time and internal resources required to complete validation of new forensic DNA technologies.
3. Both options are designed to enable thorough, comprehensive internal validations, meeting all SWGDAM/DAB auditing and accreditation standards, and leading to the development of appropriate standard operating procedures and interpretation guidelines.

LEGAL STATEMENT