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Validation: What Is It, Why Does It Matter, and How Should It Be Done?

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Validation involves performing laboratory tests to verify that a particular instrument, software program, or measurement technique is working properly. These validation experiments typically examine precision, accuracy, and sensitivity, which all play a factor on the 3 R's of measurements: reliability, reproducibility, and robustness.[1]

Without validation studies, laboratories cannot be confident in results produced by a new genetic test, instrument or software program. These studies help define range and relevance of measurements made with a method. For example, are reproducible results expected when one or only a few cells are used to amplify degraded DNA templates that may be found in casework samples? A dilution series of a well characterized DNA sample to measure sensitivity can help answer the question of what level of input DNA with a new test is expected to produce a full DNA profile. Validation studies will also verify if a new instrument performs as well or better than a previous one in terms of sensitivity or precision of results. Since reliable analytical data are highly desirable in courts of law debating the innocence or guilt of a defendant, validation information underpinning DNA typing measurements is often scrutinized by the court in order to assess admissibility of evidence submitted by forensic laboratories. Thus, validation builds confidence for the court as well as aiding quality assurance in the lab.

Although there is not yet a standardized validation strategy that is generally accepted or utilized across forensic DNA laboratories,[2] bringing a procedure (assay, instrument, or software) "on-line" in a forensic lab typically includes the following steps: (a) installation of the instrumentation or software and purchase of assay reagents, (b) learning about the technique and how to perform it properly, (c) validation of the analytical procedure to define its range and reliability, (d) creation of the standard operating procedures with interpretation guidelines based on the validation studies, (e) training of other personnel on the technique, and (f) each trained analyst passing a qualification test for initial use in forensic casework. After a procedure has been successfully implemented into use with forensic casework, proficiency tests are performed on a regular basis to demonstrate successful application of the technique over time by qualified analysts.

Over the years the forensic DNA community has perpetuated a number of misconceptions regarding validation—many of which are addressed in a recent article.[3] A common perception is that validation can (or should) take many months to perform. Unfortunately, forensic labs often embark on their validation voyage without a map or a clear idea of their intended destination. Without a validation plan, these labs become weary and woeful wanderers that lose valuable time and expend unnecessary labor and reagent costs when driven off course by the winds of worry. Fear of auditors rather than scientific reasoning governs the collection of large numbers of data points in some cases. Thus, the application of a new technology for solving cases more quickly can be delayed because an overzealous number of validation experiments are performed.

Resources available to aid in formulating an effective validation plan include Section 8 of the FBI's DNA Advisory Board Quality Assurance Standards,[4] which describes the primary aspects of forensic DNA validation studies. The SWGDAM Revised Validation Guidelines[5] provide further detail and recommend that a total of at least 50 samples be examined as part of a careful validation study. In addition, the NIST STRBase website contains a validation section with helpful information and links to workshop materials on validation: http://www.cstl.nist.gov/biotech/strbase/validation.htm

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