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Validation Considerations Under the New FBI Quality Assurance Standards

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ABSTRACT

As the implementation of the new 2020 FBI Quality Assurance Standards (QAS) draws near the July 1, 2020 effective date, laboratories are preparing for how the new standards will change current day-to-day laboratory operations, including how they will perform validations and implement new technology. A validation can already pose challenges to laboratories due to the time needed to plan and execute the lab work, develop procedures and train scientists, but new changes to Standard 8 add additional layers of complexity which a lab must consider for a successful validation from planning to audit.

Here we present the considerations of the 2020 QAS changes on validations from the perspective of the Thermo Fisher Scientific HID Professional Services team. With our depth of experience in designing and executing validation services, we will be considering these changes for validation planning moving forward.

INTRODUCTION

The new FBI Quality Assurance Standards (QAS) document goes into effect on July 1, 2020. As with each update since the original release in 1999, the document has revised standards and language to keep up with continued progress in the field. A great deal of advancements have been made since the last time the QAS was issued in 2011. Updated Detection methods and new PCR chemistry are more sensitive, leading to more complex and challenging sample results for interpretation, and software has become a more integral part of the workflow with the use of probabilistic genotyping software. Rapid DNA analysis is poised to become more commonplace, either in the laboratory itself or as a part of the criminal investigation workflow, so laboratories are faced with how to properly integrate that technology into their operations as well.

Validation is central to the successful adoption of these advancements in forensic DNA testing. Standard 8 of the FBI QAS details the requirements for both developmental and internal validations. Laboratories are required to design, execute, and document validations of any new methods in accordance with these standards. This ensures that prior to use of a new method in their laboratory, laboratories have compiled a comprehensive data set that can be used to develop standard operating procedures, including interpretation guidelines, and develop training for scientists so that the limitations of the method are well-understood and variability between scientists is limited.

The Human Identification Professional Services (HPS) team has been performing validations in laboratories since 2007. As standards and guidance documents in the field of forensic DNA have evolved, HPS has worked diligently to develop validation services that not only meet the requirements of the standards, but that thoughtfully generate data that will set our customers up for a successful implementation of a new workflow.

VALIDATION – Design, Execution and Implementation

A notable trend in the new QAS document is the addition of language to emphasize the importance of ensuring that validations are designed with a range of samples that represent those routinely encountered in individual laboratories. Standards 8.3 and 8.3.2.1 added new language to clarify expectations for the number and types of samples expected (**Figure 1**).

This language is complimentary to the language in the recently released OSAC standard: *ANSI/ASB Standard 020 Standard for Validation Studies of DNA Mixtures, and Development and Verification of a Laboratory Mixture Interpretation Protocol*. The goal of both documents is to ensure laboratories conduct validations that are both representative of routine casework samples in their laboratory and comprehensive enough to understand the quality and limitations of the new method so the laboratory can write detailed standard operating procedures to conduct this new method and train analysts to perform the method with limited variability.

Figure 1. Additional language added to Standard 8.3 and 8.3.2.1

8.3

- Except as provided in Standard 8.3.1.1, internal validation of all manual and robotic methods shall be conducted by each laboratory ***with the appropriate sample number and type to demonstrate the reliability and potential limitations of the method***

8.3.2.1

- 8.3.2.1 Mixture interpretation validation studies shall include samples with a range of the ***number of contributors, template amounts, and mixture ratios expected to be interpreted in casework.***

In the pre-validation phase of an HPS validation service, we work with each individual laboratory to ensure that data generated in both the non-probative and complex mixture studies will be sufficient to meet these standards.

SOFTWARE

Software has evolved to be a pivotal part of the DNA expert's day-to-day operations. Depending on a laboratory's workflow, software is probable at each step in the process. A significant amount of language regarding software validations was added as Standard 8.8 to the 2020 QAS. The document categorizes these new requirements for software validation in a couple ways. Standards are categorized based on whether the lab is implementing new software or new modules of existing software, or if the laboratory is implementing a modification to existing software. Software validation requirements are then also categorized based on how software is used in the workflow. Software is categorized as one of the following:

1. A component of an instrument, like HID Real Time PCR Analysis software as a component of a QS5 instrument
2. Software used for analysis and or interpretation of DNA data, like GeneMapper *ID-X* Software v1.6
3. Software used for statistical analysis, like probabilistic genotyping software

Based on how software is categorized, the QAS details specific validation study requirements, including new testing not previously required for software validations in the forensic laboratory setting, like functional, reliability and regression testing (**Table 1**).

Table 1. New software testing

Software Testing Type	Software Testing Goal	Validation Considerations
Functional Testing	Confirm that a software performs the tasks as expected	If the software is expected to perform the assignment of a genotype to DNA typing results, the software should be tested with known samples to ensure the correct genotypes are obtained
Reliability Testing	Confirm the software works appropriately in the laboratory environment.	Each lab must consider the operational environment the new software will be used in and design reliability testing studies to demonstrate how the software is impacted. This may be testing to ensure each site with access to the software has the same functionality, or testing how co-installed software on a computer or network impacts the functionality of the software
Regression Testing	Confirm that modifications or new functionality do not unacceptably alter or terminate a desired functionality that behaved correctly before the change was implemented.	With an understanding of the modifications to the software, a set of data run before the update to the software should be compared to the data run after. This can be used to determine if the update had any impact on the functionality of the software.

The flow charts in **Figure 2** and **Figure 3** illustrate how the QAS categorizes software and required validation studies. There are slight differences between new software or new modules to existing software and modifications (major or minor) to software. HPS has used this flowchart to develop software validation services that will support customers in meeting these new requirements.

Figure 2. Software validation requirements for new software or new modules of existing software

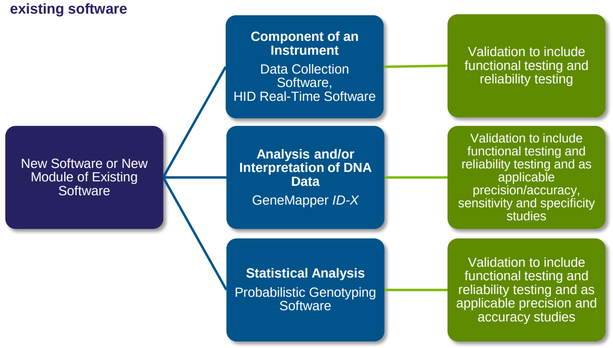
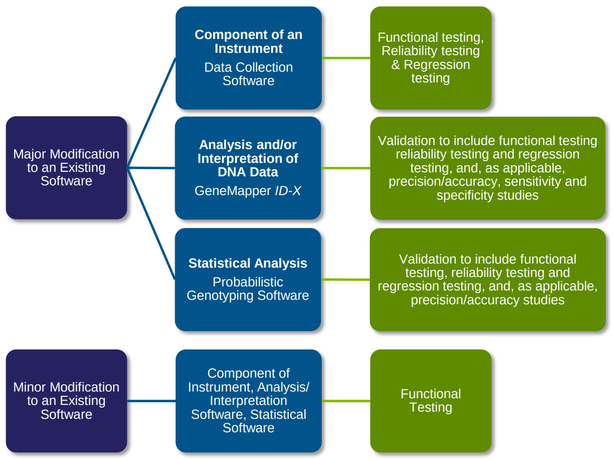


Figure 3. Software validation requirements for modification to existing software



Documentation, as with all validations, will be a crucial part of the validation process for software. Clear documentation of the intended use of the software, the impact of any modifications or new features (if applicable), and the purpose of each study performed will be essential. A laboratory may also consider documenting any features of the software not validated.

RAPID

The 2020 QAS incorporates new standards for Rapid DNA Instrument validations and performance checks. Requirements are designated based on whether the instrument is NDIS approved or used for modified Rapid DNA analysis. (**Figure 4**).

Figure 4. Rapid DNA workflow comparison

According to standard 8.7, an NDIS-approved Rapid DNA system does not require a validation but does require a performance check. The QAS guidance document states the minimum requirements for a performance check of a NDIS approved Rapid DNA system is a positive control in each sample position. A performance check could include a set of samples reflective of those intended to be used by the laboratory (i.e. buccal swabs, saliva or blood samples). These samples would provide an appropriate data set to demonstrate that the NDIS-approved Rapid DNA system is functioning as expected upon installation, and a benchmark data set to compare performance in subsequent performance checks to meet QAS requirements for maintenance of critical equipment under Standard 10 (10.3.2, 10.3.3. and 10.3.5).

A modified rapid DNA system includes rapid systems that are used outside of the scope of an NDIS approval (e.g. crime scene samples, DNA expert interpretation) and would require a validation in accordance with Standard 8. A laboratory should evaluate how they intend to incorporate the Rapid DNA system into their workflow and design a validation that covers the intended sample types and collection methods used to ensure they generate data to support the development of interpretation guidelines for use of the Rapid DNA system in their laboratory.

CONCLUSIONS

The new FBI Quality Assurance Standards for Forensic DNA Testing Laboratories take effect July 1, 2020. With the additional layers of complexity for software validations, additional emphasis on validation design, and new Rapid DNA validation and performance check requirements, laboratories have an increased responsibility for planning, executing and implementing new technology. It is important to begin this process as early as possible so that careful planning and validation design can be completed.

The HID Professional services team has worked with customers to navigate changes in validation standards for 13 years. Our experience working with labs all over the world has given us perspective on the challenges individual laboratories face with validation. Several factors like staffing resources, case workload, and even inexperience with new technology can make validations seem daunting and burdensome. HPS has services to support customers at each phase of the validation process to ease this burden so that laboratories can focus on making an impact.

REFERENCES

1. Federal Bureau of Investigation, "Quality Assurance Standards or Forensic DNA Testing Laboratories" Effective July 1, 2020
2. The Guidance Document for The FBI Quality Assurance Standards for Forensic DNA Testing and Databasing laboratories, Effective 07/01/2020
3. American National Standard ANSI/ASB (2020). Standard for Validation Studies of DNA Mixtures, and Development and Verification of a Laboratory Mixture Interpretation Protocols (Standard 020).

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