

Switching to 20 Core CODIS Loci and the Impact on SAKI Testing

On January 1, 2017, laboratories participating in the National DNA Index System (NDIS) switched to a DNA amplification kit that types a minimum of 20 core loci from the Combined DNA Index System (CODIS) to align with the FBI requirement that was enacted that same day. This date was based on a 2014 survey that indicated forensic laboratories, on average, would require approximately 18 months to make this change in kit chemistry.

Warranted Change

Prior to the cut-off date, the FBI CODIS core loci working group had been evaluating the CODIS core loci and possible expansions since 2011. Expanding the CODIS core loci became imperative as CODIS continued to grow in size in order to reduce the possibility of fictitious matches. Following are other benefits of expanding the core loci:

- ◆ Increasing the discrimination value and inclusion
- ◆ Aiding in complex kinship cases
- ◆ Having increased compatibility with international databases

Seven additional loci were chosen based on the previously mentioned benefits, their compatibility with existing loci, vendor ability to incorporate loci, and the understanding that these loci contain no predictive value for medical or disease information.

| Original 13 Core Loci | | | |
|-----------------------|---------|---------|--------|
| CSF1PO | D3S1358 | D5S818 | D7S820 |
| D8S1179 | D13S317 | D16S539 | D18S51 |
| D21S11 | FGA | TH01 | TPOX |
| vWA | | | |

| Additional Loci to Create 20 Core Loci | | | |
|--|---------|----------|----------|
| D1S1656 | D2S441 | D2S1338 | D10S1248 |
| D12S391 | D19S433 | D22S1045 | |

Vendor Response

Three main vendors dominate the U.S. market for amplification kit chemistry; they each designed kits to test, at minimum, the 20 core loci; improve discrimination power; increase recovery of degraded and inhibited samples; and

heighten sensitivity. In addition to the 20 required loci, vendors chose to include additional markers compatible with earlier versions of kits and/or adding in Y-STR markers, creating a total of 24- to 27-locus kits.

Locus Kit Examples

- ◆ PowerPlex® Fusion (24-locus kit)
- ◆ PowerPlex Fusion 6C (27-locus kit)
- ◆ Applied Biosystems™ GlobalFiler™ (24-locus kit)
- ◆ Investigator 24 Plex (24-locus kit)

Complete Implementation Delays

Changes in amplification kit chemistry can affect all procedures before and after amplification; the process of amplification can be very time-consuming for forensic databasing and casework processing laboratories. In addition, several unforeseen matters—such as the following—can cause timeline delays:

- ◆ Kit influence on coinciding industry changes in STR mixture interpretation
- ◆ Supply procurement policies requiring evaluation of all vendors before selecting one
- ◆ Updated kits were new to the market; in some instances, the chemistry needed modifications (requiring revalidation)
- ◆ Impact on contracts and pricing established with private DNA testing vendors, some of which required contract modifications or new request for proposals

The FBI approved extensions to this time frame, as appropriate, if a laboratory could not meet the original cut-off deadline for implementation of a 20-plus loci kit. If an extension has ended and there are still profiles that need to be uploaded to CODIS that were tested with a minimum of 13 core CODIS loci, a laboratory should contact their NDIS custodian for permission to upload. A transition of this magnitude will take time and laboratories should acquire proper authorization in order to meet auditing requirements.

Hits with 13 and 20 Loci

Most profiles stored in CODIS were processed with the 13 core CODIS loci; searching requirements continue to be performed with these loci and will for the foreseeable future. Thus, laboratories have and will obtain hits in which one sample was processed with the 13 core loci and the other was processed with the 20 core loci. When possible, the additional 7 loci offer further filtering of matches.

Example: Sexual assault evidence sample originally processed with AmpFLSTR® Identifiler® (16-locus kit) hits a newly uploaded offender profile processed with PowerPlex Fusion (24-locus kit).

However, this is not much different than a partial evidence sample with data at 8 loci hitting an offender sample with data at more than 13 loci. In reality, laboratories have always had to deal with differences in loci tested between kit manufacturers and incomplete profiles hitting against complete profiles.

If a laboratory makes an inclusion, any statistical calculations will be performed on the evidence sample and the loci it has in common with the included reference sample.

Reprocessing samples with the same kit or with more loci may be valuable when the review of the hit data is complex or inconclusive. Such examples could include a single difference between an evidence sample and a reference sample or mixture data in which drop out or degradation is apparent.

Conclusions

Collaboration with laboratory personnel is critical during this transition period. The laboratory can help determine if samples involved in CODIS hits that were processed with different kits would benefit from additional testing or explain when further testing is unwarranted or unnecessary. The laboratory can also reach out to their NDIS custodian if samples processed with only the 13 core CODIS loci still have not been uploaded. Profiles developed with the 13 core CODIS loci are extremely valuable and effort should be made to obtain the proper documentation for upload authorization.

For the Glossary of Forensic DNA Terms provided by the National Institute of Standards and Technology, visit www.bit.ly/forensic_DNA_terms.

References:

1. Hares, D. R. (2015). Selection and implementation of expanded CODIS core loci in the United States. *Forensic Science International: Genetics*, 17, 33–34. doi:10.1016/j.fsigen.2015.03.006
2. National DNA Index System (NDIS) Operating Procedures Manual. FBI Laboratory. Version 6, effective July 17, 2017.

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For more SAKI briefs by Amy Jeanguenat, read *DNA Testing 101: Sexual Assault Kits* (www.bit.ly/DNA_testing_101) and *Sexual Assault Kit Testing Process* (www.bit.ly/SAK_testing_process).