Scientific & Technical Review Panel Final Report for 2021-S-0004 Standard Practices for Evaluating Measurement Uncertainty of Quantitative Measurements in Forensic Toxicology

Organization of Scientific Area Committees (OSAC) for Forensic Science

STRP Final Report
2021-S-0004
Standard Practices for Evaluating Measurement Uncertainty of Quantitative Measurements in Forensic Toxicology

Organization of Scientific Area Committees (OSAC) for Forensics Science
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Scientific & Technical Review Panel Members

- Brigitte Desharnais, Laboratoire de sciences judiciaires et de médecine légale
- Jeff Kukucka, Towson University
- Dayong Lee, Houston Forensic Science Center
- Barry Logan, NMS Labs
- Paul Neuharth, Paul Neuharth, Jr. APC/Criminal Defense
- Lori Nix, Georgia Bureau of Investigation
- Mike Smith, FBI Laboratory
- Blaza Toman, National Institute of Standards and Technology (NIST)

Report Summary:

The Scientific and Technical Review Panel (STRP) for "Standard Practices for Evaluating Measurement Uncertainty of Quantitative Measurements in Forensic Toxicology" is an independent panel appointed by the National Institute of Standards and Technology (NIST). A STRP is established with a range of experts to consider how well a standard meets the needs of the forensic science, law enforcement, and legal communities, and to recommend improvements to the standards under review. The STRP appreciates the efforts of Tate Yeatman, Forensic Toxicology Subcommittee Vice Chair, while serving as the subcommittee liaison to this STRP during the review process.

The STRP began its review process with a kickoff meeting on February 4, 2021 and concluded with this STRP final report. The panel reviewed the draft standard and prepared comments for the OSAC Forensic Toxicology Subcommittee.

Report Components:

The STRP reviewed this draft standard against OSAC's *STRP Instructions for Review* which include the following content areas: scientific and technical merit, human factors, quality assurance, scope and purpose, terminology, method description and reporting results. The details below contain a brief description of each reviewed content area and the STRP's assessment of how that content was addressed in the Draft OSAC Proposed Standard.

1. **Scientific and Technical Merit:** OSAC-approved standards must have strong scientific foundations so that the methods practitioners employ are scientifically valid, and the resulting claims are trustworthy. In addition, standards for methods or interpretation of results must include the expression and communication of the uncertainties in measurements or other results.

    1.1. Consensus View – The STRP observed that the proposed standard adopts its basic approach to calculating measurement uncertainty from the National Institute of Standards and Technology, SOP 29-Standard Operating Procedure for the Assignment of Uncertainty, Joint Committee for Guides in Metrology (JCGM) Evaluation of Measurement Data-Guide to the Expression of Uncertainty in Measurement (GUM) and similarly authoritative documents. The standard is thorough in its approach and well-written. It contains suitable references and clear guidance on the approach to calculating measurement uncertainty. Clear guidance is supplied on reporting the results. The document contains a number of useful example problems with detailed calculations. These should prove useful to users seeking to implement the approach and reviewers seeking to further evaluate the approach advocated by the document.

    1.2. Minority View – None

2. **Human Factors:** All forensic science methods rely on human performance in acquiring, examining, reporting, and testifying to the results. In the examination phase, some standards rely heavily on human judgment, whereas others rely more on properly maintained and calibrated instruments and statistical analysis of data.

    2.1. Consensus View – The STRP believes that this draft adequately addresses issues related to human factors and performance. Of principal importance, the standard explicitly recognizes the relevance of human factors such as experience, training, and fatigue in the quantification of measurement uncertainty. Moreover, the computation of measurement uncertainty incorporates reproducibility data from multiple analysts performing the same measurement over time so as to account for both inter- and intra-examiner variability, and the standard includes numerous informative annexes that illustrate the application of this practice.

    2.2. Minority View – None

3. **Quality Assurance:** Quality assurance covers a broad range of topics. For example, a method must include quality assurance procedures to ensure that sufficiently similar results will be obtained when the methodology is properly followed by different users in different facilities.

    3.1. Consensus View – The STRP believes that quality assurance topics are properly covered in this draft standard. Measurement uncertainty, the topic of this standard, is an inherent part of quality assurance. Furthermore, other related items, such as metrological traceability, quality control, and method validation are properly included and referenced throughout the draft standard.

    3.2. Minority View – None

4. **Scope and Purpose:** Standards should have a short statement of their scope and purpose. They should list the topics that they address and the related topics that they do not address. Requirements, recommendations, or statements of what is permitted or prohibited do not belong in this section.

    4.1. Consensus View – Upon review, the STRP sees no reason to modify the proposed language defining "Scope and Purpose" as currently set forth in the document. The document also complies with the proposed language in that the terminology is appropriate and the draft standard's scope and purpose are appropriate.

    4.2. Minority View – None

5. **Terminology:** Standards should define terms that have specialized meanings. Only rarely should they give a highly restricted or specialized meaning to a term in common use among the general public.

    5.1. Consensus View – The STRP finds that the draft standard defines appropriate terms with specialized meaning within the metrology application of uncertainty of measurement, specifically to toxicology. The document balances the need for definitions while avoiding defining commonly used terminology. The STRP recommends using OSAC preferred terms, when available.

    5.2. Minority View – None

6. **Method Description:** There is no rule as to the necessary level of detail in the description of the method. Some parts of the method may be performed in alternative ways without affecting the quality and consistency of the results. Standards should focus on standardizing steps that must be performed consistently across organizations to ensure equivalent results. Alternatively, standards can define specific performance criteria that are required to be demonstrated and met rather than specifying the exact way a task must be done. For example, it may be enough to specify the lower limit for detecting a substance without specifying the equipment or method for achieving this limit of detection.

    6.1. Consensus View – The STRP considers that the proposed standard meets the Method Description requirement. This opinion is based on the fact that the standard provides standardizing steps (i.e., eight steps on how to evaluate and report measurement uncertainty) with specific criteria when applicable (e.g., 4.2.4.3 – minimum requirements for Type B evaluations) and describes alternative ways to evaluate uncertainty depending on the conditions of difference methods (e.g., 4.2.4.2.1.2 – whether a method shows constant or different variance across the calibration range). The STRP verified that the standard minimizes ambiguity by presenting the eight steps in detail and providing examples (e.g., 4.2.2) throughout the main text as well as via four annexes; lists specific factors to include for accurate calculation of uncertainty (i.e., 4.2.3); and specifies when and how to adjust a method's procedure if a limitation is found during the uncertainty evaluation process (e.g., 4.2.6.1 – evaluation of bias).

    6.2. Minority View – None

7. **Reporting Results:** Methods must not only be well described, scientifically sound, and comprehensive but also lead to reported results that are within the scope of the standard, appropriately caveated, and not overreaching.

    7.1. Consensus View – The STRP believes that the standard adequately describes how the results should be presented considering what is known of their reliability and accuracy. It provides clear instruction on how estimates of uncertainties are to be calculated and reported. The worked examples in the standard are helpful in this regard.

    7.2. Minority View – None