# OSAC RESEARCH NEEDS ASSESSMENT FORM

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| **Title of research need:** | Identification of body fluid source (cell type) and association with a DNA profile |

**Describe the need:**

Traditional serology testing is no longer performed in a historically "routine" fashion for all cases, as many laboratories are now moving to direct to DNA (DtD) approaches. DtD approaches are often implemented because of the decreased cost, time to process, and increased success rates, compared to serology testing that commonly yields mixed or ambiguous results (e.g. negative AP testing, positive p30 testing, negative microscopic search for spermatozoa). The differential extraction permits the identification of sperm/male DNA therefore largely removing the need for serology testing on sexual assault items, whereas other labs have moved to a Y-screen approach. Currently, there are many commercial DNA differential extraction chemistries available. However, there is little information as to the nature of the biological source of male DNA in the absence of serology testing or when such testing gives mixed results. Some laboratories consider a level of enrichment of male DNA in the second fraction of a differential extraction as suitable to say spermatozoa are present rather than performing screening tests. Current serology approaches are interpreted in a binary fashion, with a yes/no outcome, although at best, the "yes" result from testing is generally considered "presumptive" (barring viewing sperm on a microscope). There is a need for tests that will allow for a more robust characterization, and ideally, the outright identification of body fluid source/cell type.

Researchers are encouraged to develop protein analysis methods, RNA-based methods, or other novel options that can be considered alongside more traditional serology tests. The development of a robust Bayes' net (BN) approach allowing for a probabilistic assessment of test results may be of value. This would replace the use of wording such as confirmatory or presumptive with a posterior probabilistic assessment. The ideal BN would be designed for individual laboratories to populate the needed probability variables by following a uniform protocol (numbers of samples, types of tests), allowing for a standardized approach across laboratories. It is strongly encouraged that as these tools are developed, they be included in a holistic, validated, and probability based approach, allowing for a balanced, logical, robust, reliable, and transparent presentation of laboratory based findings at court regarding the nature of the biological source that may be associated with the DNA recovered.

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| **Keyword(s):** | Probabilistic assessment of serological results, Bayesian Networks, nature of the biological material, cell type |

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| **Submitting subcommittee(s):** | Human Forensic Biology | **Date Approved:** | 05/16/2025 |

## Background Information:

1. Does this research need address a gap(s) in a current or planned standard? (ex.: Field identification system for on scene opioid detection and confirmation)

This can fill in gaps for serological training and testing standards as well as best practices for DNA testimony.

2. Are you aware of any ongoing research that may address this research need that has not yet been published (e.g., research presented in conference proceedings, studies that you or a colleague have participated in but have yet to be published)?

NA

3. Key bibliographic references relating to this research need: (ex.: Toll, L., Standifer, K. M., Massotte, D., eds. (2019). Current Topics in Opioid Research. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88963-180-3)


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7. Matthew C. Goldstein, Jordan O. Cox, Lori B. Seman & Tracey Dawson Cruz (2020) Improved resolution of mixed STR profiles using a fully automated differential cell lysis/DNA extraction method, Forensic Sciences Research, 5:2, 106-112, DOI: 10.1080/20961790.2019.1646479.
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9. Paris Volk, Allison Holt, Angela Chen, Erin Hanson, Jack Ballantyne. Enhancing the sexual assault workflow: Development of a rapid male screening assay incorporating molecular non-microscopic sperm identification. Forensic Science International: Genetics Supplement Series. 7 (1) (2019) 21-22.
10. Lydie Samie, Christophe Champod, Séverine Delémont, Patrick Basset, Tacha Hicks, Vincent Castella, Use of Bayesian Networks for the investigation of the nature of biological material in casework, Forensic Science International, Volume 331, 2022, https://doi.org/10.1016/j.forsciint.2022.111174

4. Review the annual operational/research needs published by the National Institute of Justice (NIJ) at https://nij.ojp.gov/topics/articles/forensic-science-research-and-development-technology-working-group-operational#latest? Is your research need identified by NIJ?

Related areas include "The ability to associate cell type and/or fluid with DNA profile, primarily for mixture DNA profiles"; "The ability to differentiate, physically separate, and selectively analyze DNA and/or cells from multiple donors or multiple tissue/cell types contributing to mixtures, with minimal or no sample loss"

5. In what ways would the research results improve current laboratory capabilities?

This would allow for the recovery of some information that is not obtained in DtD workflows and for a probabilistic evaluation of the evidence given propositions of sperm cells vs. other cell types as the source of the male DNA.

6. In what ways would the research results improve understanding of the scientific basis for the subcommittee(s)?

This would give a better understanding of the efficacy of differential extraction procedures, collection procedures and cell separation technologies

7. In what ways would the research results improve services to the criminal justice system?

This research would assist the jury when the question at trial involves activity level propositions and improve the detectable quantity of male DNA in sexual assault cases.

8. Status assessment (I, II, III, or IV): III

| | **Major** gap in current knowledge | Minor gap in current knowledge |
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| **No or limited** current research is being conducted | I | III |
| **Existing** current research is being conducted | II | IV |

*This research need has been identified by one or more subcommittees of OSAC and is being provided as an informational resource to the community.*