


# Research and Evaluation in Publicly Funded Forensic Laboratories


Tracey L. Johnson, MSFS  
*she / her / hers*  
 Supervisory Physical Scientist  
 Office of Investigative and Forensic Sciences  
 National Institute of Justice  
 tracey.l.johnson@usdoj.gov



1

## DOJ Disclaimer

- Any opinions or points of view expressed are those of the author(s) and do not necessarily reflect the official position or policies of the U.S. Department of Justice.
- Names of commercial manufacturers or products are incidental only, and inclusion does not imply endorsement by the author(s) or the U.S. Department of Justice.
- Unless otherwise noted, all figures, diagrams, media and other materials used in this presentation are created by the respective author(s) and contributor(s) of the presentation and research.



2

## R&E in Publicly Funded Forensic Laboratories



**Purpose:** Identification of the most *efficient, accurate, reliable, and cost-effective* methods to examine and interpret physical evidence for criminal justice purposes.

**Assessing Existing Laboratory Protocols**  
 Improve the understanding of scientific rationale underpinning existing laboratory processes.

**Evaluating Emerging Methods** Assess the value of emerging laboratory processes.

**MUST** be or partner with a publicly funded, accredited forensic lab



3

## Program Goals

- Best Practices
- Reliability
- Cost-effective
- Accuracy
- Efficiency





4

## Assessing Existing Laboratory Protocols - Improve the understanding of scientific rationale underpinning existing laboratory processes.

To achieve this goal, applicants should perform research and evaluation of existing laboratory schemes and methods to determine possible improvements. Examples of such projects include:

- Evaluation of minimum acceptance criteria of analytical data, such as mass spectra, generated in case samples.
- Evaluation of accuracy gained from additional orthogonal testing of controlled substance samples.
- Evaluation of the effectiveness of a blind verification program for technical reviews.
- Evaluation of implementation of software and statistical methods used for the interpretation of DNA mixtures.



5

## Study of Factors Influencing Mass Spectral Data Comparison

**Awardee: Kentucky State Police**  
**PI: Jeremy Triplett**


Seized drug identification by forensic laboratories is considered a mature discipline, yet standardization of data interpretation across laboratories remains an ongoing effort. Gas chromatography-mass spectrometry (GC-MS) is a frequently used analytical technique in seized-drugs analysis, but subjective interpretation of mass spectra (MS) data can introduce variability. This study aims to understand the decision-making process of trained analysts when comparing electron impact (EI) MS data and to inform criteria and standardization for spectral data comparison.

**Aims of the study:**

- Assess analysts' approaches to decision making for electron impact (EI) MS data comparison.
- Collect measurable characteristics of the consensus threshold.
- Determine which factors should be considered for MS quality.
- Capture preliminary eye-tracking data and correlate to measurable characteristics.

**Impact to the Forensic Community:**

- Improve the understanding of (1) the decision-making process of mass spectral (MS) pattern comparison and (2) the priority factors for making positive, negative, or insufficient MS match conclusions.
- Improve best practices, lead to additional guidance documents, or provide a resource for recommendations from the Organization of Scientific Area Committees for Forensic Science for MS interpretation standards.



6

## Assessment of Sexual Assault Kit (SAK) Evidence Selection Leading to Development of SAK Evidence Machine-Learning Model (SAK-ML Model)

**Awardee: Utah Department of Public Safety**  
**PI: Julie Valentine & Chad Grundy**


Across the United States, publicly funded forensic laboratories have different protocols in place on selecting evidence from sexual assault kits (SAKs), primarily swabs collected from victims' bodies, to move forward through DNA analysis. Rather than analyzing all of the swabs contained in SAKs, many publicly funded crime laboratories select a limited number of swabs to analyze. Research has not been conducted on forensic laboratories' decision-making protocols on which swabs and how many swabs should be analyzed in SAKs. Currently, forensic laboratories have varying protocols without substantive research.

**Aims of the study:**

- Evaluate crime laboratories decision-making protocols on the selection of sexual assault kit DNA evidence to develop research-based guidelines on how many and which swabs should have completed DNA analysis
- Create and implement a software program, Sexual Assault Kit Evidence Machine Learning Model (SAK-ML Model), to generate probabilities of developing CODIS-eligible DNA profiles from sexual assault kit swabs

**Impact to the Forensic Community:**

- Inform forensic science by evaluating current laboratory protocols on SAK evidence selection in relationship to the development of CODIS eligible DNA profiles.
- Provide data on SAK predictors for developing CODIS eligible DNA profiles.
- Establish best practices for selection of SAK evidence to analyze; thereby, increasing the number of CODIS-eligible profiles.
- Creation and implementation of the SAK-ML Model will improve crime lab efficiency and outcomes.



7

## Evaluation of Peer Review and Verification Processes

**Awardee: Georgia Bureau of Investigation**  
**PI: George Herrin, Jr**


This project examined drug chemistry, toxicology, firearms and/or latent prints cases completed at the GBI-DFS in 2015 and 2016 in which the technical or administrative review process determined that some level of correction was required prior to release of the report to criminal justice agencies. Technical and administrative review can consume up to 15% of a forensic scientist's work schedule. This study will test the hypothesis that conducting 100% technical and administrative review is the most effective approach to minimizing Type 1 and Type 2 errors.

**Aims of the study:**

- Tabulate reasons for correction or disagreement between verifier/peer reviewer and primary analyst for case reports and/or case.
- Analyze data to determine if correlations exist between the reason for correction and factors involved in the cases such as type or volume of evidence being analyzed or experience of the analyst.
- Incorporate the findings of the data analysis into laboratory requirements for technical review and verification to improve the effectiveness of peer review and/or verification processes.

**Impact to the Forensic Community:**

- Review of the statistics demonstrated a statistically significant decrease in errors in reports with less than 25 pages of data following the operational change as compared to the percentage of reports with errors when 100% were being reviewed.
- The benefits of a decrease in errors on cases released without a review and the time saved by reducing or eliminating peer review, combined with the absence of data indicating that the process is detrimental to the quality of the work product, may prompt other laboratories to conduct their own evaluations.




8

## Evaluating Emerging Methods

To achieve this goal, applicants should conduct research to compare emerging methods to those currently used to accomplish the same purpose in publicly funded forensic laboratories. These evaluations should consider factors such as accuracy, reliability, cost, and analysis time. Examples of such projects include:

- Comparison of a newly developed comprehensive method to existing multi-step method(s).
- Comparison of methodology or instrumentation new to the laboratory or field to instrumentation that is currently used in the laboratory in order to investigate relative form factors such as accuracy, reliability, cost, analysis time, etc.



9

## Validation of a Confirmatory Proteomic Mass Spectrometry Body Fluid Assay for Use in Publicly Funded Forensic Laboratories

**Awardee:** City of New York  
**PI:** Donald Siegel



The inability to make conclusive statements regarding the type of bloody fluid that yielded a DNA profile due to the lack of confirmatory body fluid identification techniques have resulted in challenges when presenting DNA evidence in court. Knowing that a profile came from a particular body fluid gives context to a case that goes beyond DNA STR identification.

**Aims of the study:**

- Validate a confirmatory body fluid assay using proteomic mass spectrometry
- Determine assay performance
- Perform an informatic analysis of peptide marker strength
- Improve specificity by evaluating additional collected MS data
- Establish a data quality management system

**Impact to the Forensic Community:**

- Questions related to the source of DNA profiles at crime scenes are becoming more important to address given the sensitivity of DNA - STR testing.
- A proteomic MS assay for body fluid identification gives forensic laboratories a new tool, comparable in accuracy, precision and statistical underpinnings to the gold standard of forensic science - DNA STR testing.
- Consequently, a confirmatory body fluid assay able to identify the source of DNA will have a significant impact not only for the defense and prosecution, but for improving public confidence in outcomes in criminal justice system.

10

## Advancing the Understanding of 3D Imaging for Firearms Identification

**Awardee:** Houston Forensic Science Center  
**PI:** Preshious Rearden & Peter Stout



The use of 3D microscopes promises to strengthen the field of Firearms Identification. The topographical profiles of fired bullets and cartridges can be compared and evaluated with the use of algorithms. These comparisons will allow numerical values to be assigned to the similarity of these items for the first time in history. This study will look closer at whether using a 3D microscope can allow for enhanced visualization of poor-quality markings and allow for more conclusive determinations of same source vs. different source.

**Aims of the study:**

- Systematically explore the feasibility of sharing images across 3D imaging systems.
- Investigate the usefulness of 3D technology to reduce the probability of inconclusive determinations.

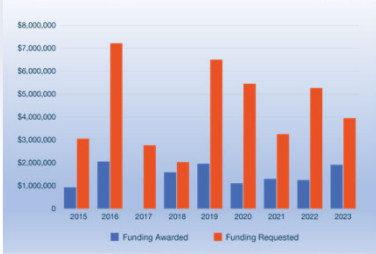
**Impact to the Forensic Community:**

- Identify factors that can be used to improve the shareability of 3D images produced by different vendors and stored in the standard X3P format.
- Address the role of 3D microscopy in reducing the occurrence of inconclusive conclusions.


11

## Funding Levels for R&E in Forensic Laboratories

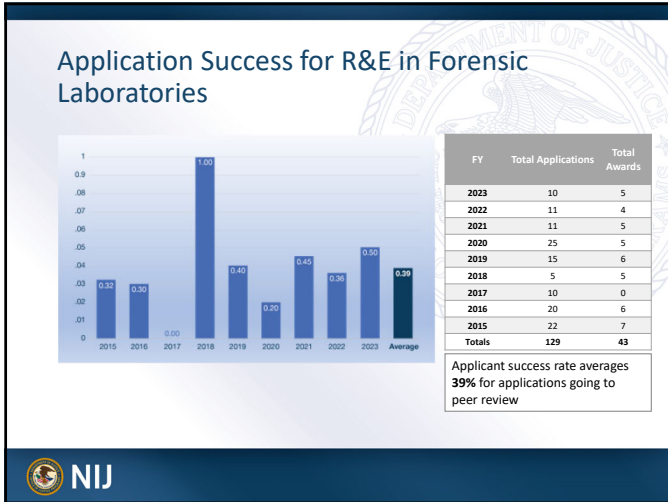


FY	Funding Requested	Funding Awarded
2023	\$3,915,839	\$1,928,846
2022	\$5,290,531	\$1,326,990
2021	\$3,195,652	\$1,334,736
2020	\$5,488,607	\$1,188,390
2019	\$6,560,951	\$1,983,864
2018	\$2,057,944	\$1,597,136
2017	\$2,706,902	\$0
2016	\$7,297,131	\$2,075,248
2015	\$3,010,807	\$928,900

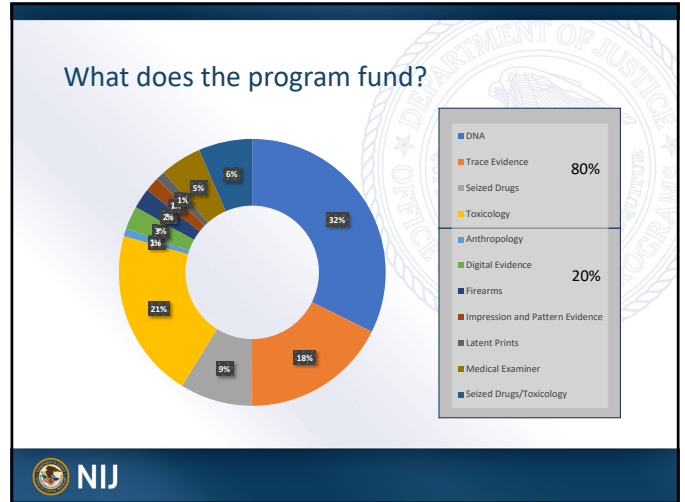
- 43 total awards and \$12M+ since inception in 2015
- Average total available funding per year under this solicitation is **\$1.3 million dollars**
- Average funding awarded per successful application is **\$280K**



12



13



14

### Research Forensic Library @ FIU

THE FIU FORENSIC SCIENCE RESEARCH LIBRARY IS FUNDED THROUGH A COOPERATIVE AGREEMENT FROM THE NATIONAL INSTITUTE OF JUSTICE, OFFICE OF JUSTICE PROGRAMS, U.S. DEPARTMENT OF JUSTICE.

Browse Categories: [Icons for various forensic fields]

Browse Collections: [Logos for various organizations like NIJ, NIST, OSAC, etc.]

Journals & newsletters: [Book covers for various forensic journals]

FIND MORE HERE  
<https://forensiclibrary.org> ← Path

15

### Thank you!

Tracey L. Johnson, MSFS  
*she / her / hers*  
 Supervisory Physical Scientist  
 Office of Investigative and Forensic Sciences  
 National Institute of Justice  
 tracey.l.johnson@usdoj.gov

16