OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need: Applications of the microbiome in DNA transfer and human identification

Describe the need:

Subcategory: emerging technologies

There are potential applications for the microbiome in crime scene processing and human identification, particularly in situations such as DNA transfer, body fluid identification, phenotyping, scene details (i.e., presence or former presence of human biological material). Larger studies are needed to assess longevity of microbial profile, best methods for recovery, and statistical analyses. Additional questions must be addressed such as what is the level of specificity necessary for microbiome characterization and how to determine appropriate targets for analysis. Furthermore, as large language models and AI analytical tools are increasingly applied to forensic sciences, validating these technologies is essential. Ensuring accuracy in AI-driven analyses, especially in complex areas like microbiome characterization, will enhance reliability and provide forensic scientists with robust tools for nuanced crime scene investigations.

Keyword(s): Microbiome, human identification

Submitting subcommittee(s): Human 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)

New methods to aid in human identification or corroboration of other information with biological data

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)?

No

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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2. Wilkins, David, et al. "Diurnal variation in the human skin microbiome affects accuracy of forensic microbiome matching." *Microbiome* 9.1 (2021): 1-12.

3. Kaszubinski, Sierra F., et al. "Evaluating bioinformatic pipeline performance for forensic microbiome analysis." *Journal of forensic sciences* 65.2 (2020): 513-525.

4. Ghemrawi, Mirna, et al. "The genital microbiome and its potential for detecting sexual assault." *Forensic science international: genetics* 51 (2021): 102432.

5. López, Celia Díez, et al. "Microbiome-based body site of origin classification of forensically relevant blood traces." *Forensic Science International: Genetics* 47 (2020): 102280.

6. Neckovic, Ana, et al. "Challenges in human skin microbial profiling for forensic science: a review." *Genes* 11.9 (2020): 1015.

7. Phan, Katherine, et al. "Retrieving forensic information about the donor through bacterial profiling." *International journal of legal medicine* 134.1 (2020): 21-29.

8. Schmedes, S.E., Woerner, A.E., Budowle, B. (2017). Forensic human identification using skin microbiomes. *Applied and Environmental Microbiology*, 83. doi: 10.1128/AEM.01672-17

9. He, Q., et al. (2022). Advances in machine learning-based bacteria analysis for forensic identification: Identity, ethnicity, and site of occurrence. Frontiers in Microbiology. doi: 10.3389/fmicb.2022.73247

10. D'Angiolella, G., Brun, P., Castagliuolo, I., et al. (2020). Skin microbiome analysis for forensic human identification: What do we know so far? Microorganisms, 8(6), 873. doi: 10.3390/microorganisms8060873

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?

Yes, Increased information about the discriminatory power and sensitivity of alternate biological analyses (e.g., proteomics, microbiome, plants, animals) to associate individuals with crime scene evidence

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

Provide alternative methods for human ID, phenotyping and body fluid id. Useful in situations where human DNA may not be present or is less probative.

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

Develop and improve statistical tools for microbial forensics

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

Alternate methods for crime scene analysis.

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

	Major gap in current knowledge	Minor gap in current knowledge
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.