OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need:	Development, validation, and interlaboratory performance testing of analytical and interpretation frameworks for using organic gunshot residue in firearm-related investigations
Keywords:	Gunshot Residue, GSR, Organic Gunshot Residue, OGSR, Analytical Methods

R&D Need Rank: Low, Medium, High	Medium	**SAC Approved Date:**	July 8, 2026

Submitting subcommittee(s): Ignitable Liquids, Explosives, and Gunshot Residue

Research Need Summary:

The purpose of these research needs is to build a stronger scientific foundation for forensic science standards. The information provided herein will help to evaluate and strengthen existing standards, and/or fill any standards related gaps. In the space below, please provide a brief narrative of the need to be addressed. This should include:

- The identity of any specific standards that would be affected/improved/evaluated
- A discussion on gaps that exist within the standards or standards related gaps that need to be filled
- How this work would fill those gaps
- An overview of any current or past research efforts that may be relevant to this effort
- A discussion regarding how this research might improve current laboratory capabilities and/or forensic services within the criminal justice system
- Any relevant references

When a firearm is discharged, two types of gunshot residues (GSR) are generated: inorganic (IGSR) and organic (OGSR). Current approaches to determine if GSR is present on an individual or surface focus on the inorganic residues arising from the primer (pGSR). Factors such as the availability of lead-free primer mixtures, the need to differentiate GSR particles from other environmental sources, and the need to increase the overall efficiency and accuracy of GSR analysis have contributed to the increasing interest in OGSR analysis.

Several research studies have laid the scientific foundations for OGSR and have demonstrated its value in complementing pGSR analysis. More studies that build the knowledge base on the practical aspects of OGSR analysis are needed.

The following research areas have been identified as crucial to transitioning OGSR from research to implementation in laboratories:

- Stability of OGSR on collection media
- Collection and detection of OGSR from substrates other than hands/skin. For example: hair, clothing, wet surfaces, and others.
- Persistence and secondary transfer characteristics of OGSR related compounds
- Population studies and secondary transfer characteristics of OGSR related compounds
- Additional OGSR targets (example: nitroglycerin and nitrocellulose degradation products and others)

- Alternative techniques that provide similar or improved sensitivity compared to GC-MS and LC-MS techniques
- Compatibility of collection media and sample preparation with existing forensic laboratory instrumentation
- Novel approaches for screening for GSR and improving efficiency of laboratory analysis
- Evaluation of workflow performance rates for pGSR and OGSR via interlaboratory studies
- Evaluation of interpretation frameworks for combined pGSR and OGSR analysis

Selected bibliographic references relating to this research need:

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2) R.V. Taudte, C. Roux, L. Blanes, M. Horder, K.P. Kirkbride, A. Beavis, The development and comparison of collection techniques for inorganic and organic gunshot residues, Anal Bioanal Chem 408 (2016) 2567–2576. https://doi.org/10.1007/s00216-016-9357-7.
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9) C.E. Ott, K.A. Dalzell, P.J. Calderón-Arce, A.L. Alvarado-Gámez, T. Trejos, L.E. Arroyo, Evaluation of the Simultaneous Analysis of Organic and Inorganic Gunshot Residues Within a Large Population Data Set Using Electrochemical Sensors, Journal of Forensic Sciences 65 (2020) 1935–1944. https://doi.org/10.1111/1556-4029.14548.
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11) V.R. Minzière, C. Weyermann, Organic and inorganic gunshot residues on the hands, forearms, face, and nostrils of shooters 30 min after a discharge, Science and Justice 64 (2024) 557–571. https://doi.org/10.1016/j.scijus.2024.08.002.
12) T.D. Ledergerber, L. Barbosa, K. Dalzell, L. Arroyo, T. Trejos, Characterization and classification of organic gunshot residue from neat smokeless powder, cartridge cases, and the hands of known shooters, Forensic Chemistry 45 (2025) 100683. https://doi.org/10.1016/j.forc.2025.100683

13) C. Vander Pyl, W. Feeney, L. Arroyo, T. Trejos, Capabilities and limitations of GC–MS and LC-MS/MS for trace detection of organic gunshot residues from skin specimens, Forensic Chemistry 33 (2023). https://doi.org/10.1016/j.forc.2023.100471.
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This research need has been identified by one or more subcommittees of OSAC and is being provided as an informational resource to the community.