OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need: | Alternative Matrices

Keyword(s): | Alternative matrix, oral fluid, hair, neonatal, breath

Submitting subcommittee(s): | Toxicology | **Date Approved:** | 5/22/20

(If SAC review identifies additional subcommittees, add them to the box above.)

Background Information:

1. Description of research need:

Alternative matrices such as oral fluid, hair, neonatal specimens, and breath are increasingly being used for toxicological testing of drugs, and results are receiving scrutiny in court and other arenas. Both the analytical and interpretive aspects of these matrices should be set forth as areas of needed research.

2. Key bibliographic references relating to this research need:

Multiple:
Palmer, K.L. and Krasowski, M.D. (2019) Alternate Matrices: Meconium, Cord Tissue, Hair, and Oral Fluid. *Methods in Molecular Biology (Clifton, N.J.)*, **1872**, 191–197.

Neonatal:
Concheiro, M. and Huestis, M.A. (2018) Drug exposure during pregnancy: analytical methods and toxicological findings. *Bioanalysis*, **10**, 587–606.

Wabuyele, S.L., Colby, J.M. and McMillin, G.A. (2018) Detection of Drug-Exposed Newborns. *Therapeutic Drug Monitoring*, **40**, 166–185.

Di Trana, A., La Maida, N., Tittarelli, R., Huestis, M.A., Pichini, S., Busardò, F.P., et al. (2019) Monitoring Prenatal Exposure to Buprenorphine and Methadone. *Therapeutic Drug Monitoring*, August 14, 2019: 10.1097/FTD.0000000000000693.

Paniagua-González, L., Jiménez-Morigosa, C., Lendoiro, E., Concheiro, M., Cruz, A., López-Rivadulla, M., et al. (2018) Development and validation of a liquid chromatography-tandem mass spectrometry method for the determination of nicotine and its metabolites in placenta and umbilical cord. *Drug Testing and Analysis*, March 10, 2018: 10.1002/dta.2381.

Oral Fluid:
Desrosiers, N.A. and Huestis, M.A. (2019) Oral Fluid Drug Testing: Analytical Approaches, Issues and Interpretation of Results. *Journal of Analytical Toxicology*, **43**, 415–443.

Veitenheimer, A.M. and Wagner, J.R. (2017) Evaluation of Oral Fluid as a Specimen for DUID. *Journal of Analytical Toxicology*, **41**, 517–522.

Busardò, F.P., Pichini, S., Pellegrini, M., Montana, A., Lo Faro, A.F., Zaami, S., et al. (2018) Correlation between Blood and Oral Fluid Psychoactive Drug Concentrations and Cognitive Impairment in Driving under the Influence of Drugs. *Current Neuropharmacology*, **16**, 84–96.

Lee, D. and Huestis, M.A. (2014) Current knowledge on cannabinoids in oral fluid. *Drug Testing and Analysis*, **6**, 88–111.

Breath:
Hubbard, J.A., Smith, B.E., Sobolesky, P.M., Kim, S., Hoffman, M.A., Stone, J., et al. (2019) Validation of a liquid chromatography tandem mass spectrometry (LC-MS/MS) method to detect cannabinoids in whole blood and breath. *Clinical Chemistry and Laboratory Medicine*, September 17, 2019: 10.1515/cclm-2019-0600.

Trefz, P., Kamysek, S., Fuchs, P., Sukul, P., Schubert, J.K. and Miekisch, W. (2017) Drug detection in breath: non-invasive assessment of illicit or pharmaceutical drugs. *Journal of Breath Research*, **11**, 024001.

Beck, O., Ullah, S. and Kronstrand, R. (2019) First evaluation of the possibility of testing for drugged driving using exhaled breath sampling. *Traffic Injury Prevention*, **20**, 238–243.

Beck, O. (2014) Exhaled breath for drugs of abuse testing - evaluation in criminal justice settings. *Science & Justice: Journal of the Forensic Science Society*, **54**, 57–60.

Hair:
Kintz, P. (2017) Hair Analysis in Forensic Toxicology: An Updated Review with a Special Focus on Pitfalls. *Current Pharmaceutical Design*, **23**, 5480–5486.

Mantinieks, D., Wright, P., Di Rago, M. and Gerostamoulos, D. (2019) A systematic investigation of forensic hair decontamination procedures and their limitations. *Drug Testing and Analysis*, **11**, 1542–1555.

Ferreira, C., Paulino, C. and Quintas, A. (2019) Extraction Procedures for Hair Forensic Toxicological Analysis: A Mini-Review. *Chemical Research in Toxicology*, **32**, 2367–2381.

Khajuria, H., Nayak, B.P. and Badiye, A. (2018) Toxicological hair analysis: Pre-analytical, analytical and interpretive aspects. *Medicine, Science, and the Law*, **58**, 137–146.

3a. In what ways would the research results improve current laboratory capabilities?

Research surrounding oral fluid will result in correlations or lack thereof with blood concentrations and/or impairment, streamlined workflows, development of comprehensive mass spectrometry based screening, and investigation of alternative techniques and instrumentation. All aspects of oral fluid for roadside testing of driving under the influence of drugs are needed. For hair testing, research should focus on optimization of decontamination steps, improving ease of sample preparation, and providing more sensitive methodology to identify unique markers of drug metabolism that document drug intake and not

environmental contamination. For neonatal matrices, research will result in optimized sample preparation, identification of alternative matrices to meconium for capturing in utero or peri/postnatal drug exposure (amniotic fluid, placenta, cord blood or tissue, infant hair, breast milk), best practices for specimen collection, and guidance for analytical scope and sensitivity. Research for breath should focus on evaluation of roadside devices, development of additional roadside screening techniques for a wide range of drugs other than alcohol, and ways to identify or eliminate oral fluid contribution. For all alternative matrices, it is imperative to evaluate or develop suitable reference materials and proficiency testing programs.

3b. In what ways would the research results improve understanding of the scientific basis for the subcommittee(s)?

Results of research will help us understand the interpretive value and timeline for exposure (oral fluid, neonatal, and breath), interpret drug incorporation vs environmental contamination (hair), and understand drug pharmacokinetics (breath).

3c. In what ways would the research results improve services to the criminal justice system?

Oral fluid research will provide a non-invasive sample collection for the roadside while eliminating the need for a phlebotomist or delayed collection (DUID, workplace). Hair research will provide more standardized testing and reliable interpretation (child custody cases, workplace, DFC, PM). Neonatal matrix research will provide more standardized testing and reliable interpretation. Breath research will provide an understanding for use of breath as a "for probable cause" matrix as well as evidentiary value in the realm of public safety.

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

Oral fluid: I
Hair: II
Neonatal: II
Breath: 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.

Approvals:

Subcommittee	Approval date:	04/30/2020

(Approval is by majority vote of subcommittee. Once approved, forward to SAC.)

SAC

1. Does the SAC agree with the research need? Yes [X] No [ ]

2. Does the SAC agree with the status assessment? Yes [X] No [ ]

    If no, what is the status assessment of the SAC: [ ]

Approval date: 5/22/20

(Approval is by majority vote of SAC. Once approved, forward to NIST for posting.)