Forensic Science Technology Working Group Operational Requirements, November 2018

Updated based on discussion at the Forensic Science TWG meeting held November 14 and 15, 2018.

Technology Working Group Operational Requirements Updated November 2018	Scientific Research	Technology Development	Policy or Protocol Development	Assessment & Evaluation	Dissemination &/or Training	Other	Forensic Discipline
A portable minimally-/non-destructive method to quickly detect and locate biological materials for DNA testing.	X	X		X			Forensic Biology / DNA
The ability to detect and locate sufficient biological material (e.g., epithelial cells, extracellular DNA, etc.) associated with touched or worn objects, that is not visible to the eye or with alternate light sources, for downstream DNA analysis.	X	X		X			Forensic Biology / DNA
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.	X	X		X			Forensic Biology / DNA
Optimization of DNA evidence collection techniques and/or devices that also maximizes recovery of DNA from the collection substrate.	X	X		X			Forensic Biology / DNA
A more efficient and better workflow for collection and processing of rape kits.	X	X	X	X		X	Forensic Biology / DNA
Best extraction methods for optimal recovery of DNA from different sample types amendable to downstream analysis. (e.g. what methods work best with what sample types).	X	X		X			Forensic Biology / DNA
Minimally-/Non-Destructive rapid screening, to characterize sample/stain, based on factors about the contributors such as gender, number, and proportion of contribution, for DNA analysis.	X	X		X			Forensic Biology / DNA

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Forensic application of genetic testing approaches that are not currently/typically used in forensic laboratories.	X	X	X	X			Forensic Biology / DNA
The ability to link a DNA profile to a particular biological fluid or cell type or other information such as age of stain, phenotype, gender, etc.	X	X		X			Forensic Biology / DNA
Better understanding of advanced approaches to removing steps from typical DNA processing workflow (i.e., assessment of DNA typing results following direct amplification of biological evidence and/or DNA samples extracted from evidence).	X	X	X	X			Forensic Biology / DNA
Increase knowledge in how to estimate the number of contributors, based solely on the data with no hypothesis input requirement from the user.	X	X	X	X			Forensic Biology / DNA
Expert System for Forensic Evidence Analysis (including mixtures).	X	X					Forensic Biology / DNA
Innovation, new development, validation and/or evaluation of free and open software tools for mixture interpretation of casework samples for autosomal STRs typed by capillary electrophoresis methods.		X		X		X	Forensic Biology / DNA
Develop mixture interpretation software for DNA sequence based testing	X	X					Forensic Biology / DNA
Knowledge, statistical algorithms, and ultimately a probabilistic haplotyping tool for mixture interpretation of lineage markers (e.g., Y-STR, mtDNA).	X	X					Forensic Biology / DNA

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Better characterization of existing databases and further development of population data of forensically relevant genetic markers (e.g., SNPs, Y-STRs, whole genome mtDNA, X-STRs, autosomal STR sequence data), to include populations that are currently underrepresented in existing databases.	X	X				X	Forensic Biology / DNA
Better understanding and characterization of linkage issues in combining alternative markers and traditional autosomal markers for forensic applications including identification and/or kinship determination.	X						Forensic Biology / DNA
Software that performs comparisons between unknown samples and reference database in an effort to identify potential family relationships using multiple marker systems. (e.g., Y-STRs, SNPs, X-STRs, auSTRs, mtDNA, etc.)	X	X					Forensic Biology / DNA
Objectively generated knowledge and understanding to assist the assessment of the significance of finding a DNA profile that might inform mathematical/statistical methods to address activity level.	X			X			Forensic Biology / DNA
Studies to determine best practices for distinguishing and/or interpreting related individuals in DNA mixtures when using probabilistic genotyping software programs.				X			Forensic Biology / DNA
Better understanding of the impact of single vs replicate amplifications of low level DNA samples on data interpretation using probalistic genotyping approaches.	X		X	X			Forensic Biology / DNA
Age determination of stains (time since deposition).	X						Forensic Biology / DNA

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Increase in the success rate of obtaining forensic quality data from compromised (damaged) DNA evidence.	X	X		X			Forensic Biology / DNA
Increased information about the discriminatory power and alternate applications of genomic analysis (e.g., metagenomics) of biological materials other than human sources (e.g. microbiome, plants, animals) for forensic science.	X	X					Forensic Biology / DNA
Better foundational knowledge and understanding of practical utility for methods/tools for the determination of phenotypic information (e.g., hair color, pigmentation, eye color, cranial/face structure, height, age, etc.)	X	X	X	X			Forensic Biology / DNA
Identical twin differentiation.	X	X		X			Forensic Biology / DNA
Determination of the practicality and potential implementation impacts for computational models linking CODIS to current genealogical databases.	X	X	X	X			Forensic Biology / DNA
Development of forensic genealogy testing procedures for use by crime laboratories.	X	X	X	X		X	Forensic Biology / DNA
Increased knowledge, best practices, and solutions to detect, reduce, and eliminate laboratory contamination.	X	X	X	X		X	Forensic Biology / DNA
IT solutions (e.g., machine learning based), systems, and/or tools to improve laboratory efficiency (e.g., managing QC data, automated data flow, and management, etc.)	X	X		X			Forensic Biology / DNA

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Comprehensive, Systematic, Well Controlled Studies that provide both foundational knowledge and practical data about "touch evidence", DNA transfer and persistence in the real world, and best practices for interpretation.	X	X		X			Forensic Biology / DNA
Better and more affordable materials to reduce DNA loss/damage during transfer/storage. Increased knowledge & understanding of stability of DNA or other biological materials during storage	X	X		X			Forensic Biology / DNA
Ethical and policy considerations for the investigative use of personal information determined by high resolution DNA analysis.	X		X	X			Forensic Biology / DNA
Error rate studies on qualitative analysis (single tests and schemes). The conclusion of such a study will also explain its limitations.	X			X			Controlled Substances and Forensic Toxicology
Research into scientifically-based acceptance criteria of analytical data generated in case samples. The effectiveness of this study could be improved if performed in conjunction with the study for error rate on qualitative analysis (single tests and schemes).	X			X			Controlled Substances and Forensic Toxicology
Process optimization regarding scene evaluation, evidence collection and handling, submission acceptance criteria, analysis, data management, and reporting.	X		X	X			Controlled Substances and Forensic Toxicology
Research and data collection to gain a better understanding of the relevance of isomers of novel psychoactive substances, such as (but not limited to) synthetic opioids, cannabinoids, benzodiazepines, and substituted cathinones.	X						Controlled Substances and Forensic Toxicology

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Evaluation of occupational stress and detrimental effect on forensic labs staff and on work quality.	X			X			Controlled Substances and Forensic Toxicology
Improved, broader, more representative proficiency testing to include some blind testing.			X	X	X		Controlled Substances and Forensic Toxicology
Limber, configurable, cost-effective laboratory information (data) management systems and/or add-on components/modules.		X				X	Controlled Substances and Forensic Toxicology
Access to methods/SOPs/validation plans/peer-reviewed literature for use in identifying compounds of forensic interest.					X		Controlled Substances and Forensic Toxicology
Continued advancement of practical forensic application/development of emerging or current instrumentation (e.g., microspectrophotometer, using the second derivative, thermal analysis coupled with FTIR or GC-MS, TOF/QTOF). A clear case should be made for how new technology either does something that current technology cannot, or is an improvement over current technology (more sensitive, faster, more cost effective, etc.).	X	X		X			Controlled Substances and Forensic Toxicology
Retrospective evaluation of corrective actions in routine casework to include proficiency testing.				X	X		Controlled Substances and Forensic Toxicology

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Research to establish validated methods for THC quantity in plant materials, edibles, extracts, etc. that accounts for the moisture content of the plant.	X						Controlled Substances
Research to establish consensus basis for reporting scheduling status of drugs in legally complex scenarios (novel psychoactive substances, "class" laws, controlled substance analogs) and improved collaboration and dissemination of scheduling actions on local, state, and federal levels.			X		X		Controlled Substances
Research on interpretation of scientific report language by non-scientists stakeholders. A glossary of terms to clarify commonly misunderstood words and phrases, e.g. identification uncertainty versus misidentification, to improve written communication with stakeholders.	X			X	X		Controlled Substances
Research into most efficient scheme/process for processing evidence.	X			X			Controlled Substances
Discriminating power between closely related analytes using only GC/MS, for at least Schedule 1 and 2 drugs.	X	X		X			Controlled Substances
Evaluation of efficient methods of triaging cases and successful case management agreements among labs and customer stakeholders.	X			X			Controlled Substances
A correction algorithm to allow comparison of spectra across instruments. Such an algorithm would correlate a reference standard to a library standard.	X	X		X			Controlled Substances
Research on the correlation of blood and oral fluid values, particularly in regards to DUID interpretation and postmortem, with an emphasis on studies pertaining to pharmacokinetics and pharmacodynamics of drug partitioning into oral fluid.	X						Forensic Toxicology

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Research on pre-analytic artifacts such as postmortem redistribution, site dependence, contamination, poor sampling, etc.	X			X			Forensic Toxicology
Improved collaboration and dissemination between pathologists and toxicologists, including training on sample taking and recording.			X		X		Forensic Toxicology
A sufficient quantity of new pharmaceutical and emerging illicit substance reference materials (to include quantitative samples) for use in forensic labs (to include parent drugs and metabolites).						X	Forensic Toxicology
Forensically-relevant approaches for statistical interpretation of evidence (e.g. postmortem toxicology levels) to provide a better understanding of the value of the data.	X						Forensic Toxicology
Nationwide evaluation of administrative testing scheme policies for medical examiner/coroner offices.			X	X			Forensic Toxicology
Research to examine drug levels pre- and post-embalming to improve assessment of cause of death if toxicology is not completed prior to embalming.	X						Forensic Toxicology
Research to determine the prevalence of DFC drugs in actual casework from adjudicated cases.	X						Forensic Toxicology
Scientific foundations for the evaluation of forensic evidence in support of expert conclusions	X	X		X		X	Impression & Pattern/ Trace Evidence
Development and validation of standardized forensic methods and conclusions	X	X	X				Impression & Pattern/ Trace Evidence

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Determination of accuracy and reliability of forensic analyses and conclusions, including potential sources of error	X	X					Impression & Pattern/ Trace Evidence
Practical statistical approaches for the interpretation of forensic evidence	X	X		X		X	Impression & Pattern/ Trace Evidence
Evaluation of the effectiveness of varied types of review and/or verification of casework	X		X	X			Impression & Pattern/ Trace Evidence
Evaluation of qualified language of association, along the continuum from investigative leads to definitive conclusions	X		X				Impression & Pattern/ Trace Evidence
Novel and/or improved evidence recognition, collection, and visualization tools and analytical instrumentation for field and lab use	X	X		X	X		Impression & Pattern/ Trace Evidence
Evaluation of the effects of inter- and intra-disciplinary sequential evidence processing and analytical methods	X	X	X	X			Impression & Pattern/ Trace Evidence
Determination of the optimal content and frequency of proficiency tests to evaluate performance and mitigate risk	X		X				Impression & Pattern/ Trace Evidence
Understanding of the cognitive processes involved in pattern recognition as applied to forensic comparative analysis	X						Impression & Pattern/ Trace Evidence

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Quantitative methods of analysis to augment visual trace evidence examinations	X	X		X			Trace Evidence
Comprehensive evaluation of the detection and utility of organic gunshot primer residue	X	X		X		X	Trace Evidence
Fundamental understanding of how environmental factors can affect trace evidence	X						Trace Evidence
Construction of new and updating of existing databases with properties of manufactured materials						X	Trace Evidence
Identification and characterization of nanomaterials in evidentiary materials	X					X	Trace Evidence
Reliable methods to classify spatter stains	X	X		X			Bloodstain Pattern Analysis
Fundamental understanding of droplet formation, droplet trajectory and the resultant formation of bloodstain patterns	X	X					Bloodstain Pattern Analysis
Understanding of the interaction of blood with fabrics and textiles	X						Bloodstain Pattern Analysis
Standardized procedures for collecting, preserving and analyzing building system electronic data		X		X			Fire & Arson Investigation
Understanding of the effect of materials properties on the development and interpretation of fire patterns	X						Fire & Arson Investigation
Understanding of the creation and obscuration of fire patterns due to ventilation effects	X						Fire & Arson Investigation
Evaluation of methods for origin and cause determination				X			Fire & Arson Investigation
Field and laboratory techniques for the quantitative measurement of fire patterns	X	X		X			Fire & Arson Investigation
Tools for fire investigators to evaluate the effects of fuel characteristics on the growth and spread of fires		X				X	Fire & Arson Investigation

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Characterization of electrical system response as a means to study fire progression	X						Fire & Arson Investigation
Adequate materials property data inputs for accurate computer fire models	X					X	Fire & Arson Investigation
Evaluation of incident heat flux profiles to walls and neighboring items in support of fire model validation	X						Fire & Arson Investigation
Repeatability and reproducibility of test measurements of large-scale structure fires	X						Fire & Arson Investigation
Evaluation of the probative value of general wear on outsoles during footwear examinations	X						Footwear
Determination of relevant populations for the interpretation of class associations in footwear/tire impression evidence	X					X	Footwear/Tire Tread
Evaluation of Schallamach features in footwear outsoles and their utility for source determination	X						Footwear
Algorithms for automated searching of make and model of crime scene footwear or tire impressions within a database of known footwear outsole or tire tread patterns		X		X		X	Footwear/Tire Tread
Understanding of the relationship between manufacturing techniques and the resultant features used for outsole comparisons	X			X			Footwear
Understanding of the morphological variability of the shape of the foot and the resulting shoeless impression [barefoot and socked]	X						Footwear
Understanding of the variability of dimensional characteristics that occur during the replication of impressions	X	X					Footwear/Tire Tread
Reference collection databases of handwriting samples, copybook curricula, and typewriter and computer font styles						X	Forensic Document Examination
Quantitative assessment of intra- and inter-person handwriting and handprinting variation	X	X		X		X	Forensic Document Examination

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Assessment of the comparability of different forms of writing from individuals (e.g., initials, signatures, handwriting, hand printing, foreign writing)	X						Forensic Document Examination
Understanding of the kinematics of handwriting and digitally captured signatures	X						Forensic Document Examination
Comparative evaluation of automated handwriting identification systems.				X			Forensic Document Examination
Evaluation of the effects of training and certification on the accuracy of conclusions			X	X			Forensic Document Examination
Optimal methods and materials for the preservation, visualization, recovery and comparison of tool marks in cartilage and bone	X	X		X			Tool Marks/ Forensic Pathology/ Forensic Anthropology
Source attribution of drug tablets using manufacturing tool marks	X	X		X		X	Tool Marks/ Controlled Substances
Enhanced, and cost-effective, development/improvement of technologies and capabilities for visualizing and imaging evidence at the scene.	X	X		X			Crime Scene Examination
Difficulty in determining the cause and manner of death of infants and children, distingushing between natural, undetermined, accidental and non-accidental - in sudden fatal events to include traumatic injury versus sudden non-traumatic causes of death, e.g. channelopathies, genetic disease, metabolic disorders, etc.	X						Forensic Pathology

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Enhancement of unidentified decedent system(s) with weighting capability for antemortem and postmortem comparisons with the goal of providing a ranked list of "best matches" to effectively and efficiently identify potential candidates or hits. Current human identification systems could be improved to more efficiently and effectively identify potential candidates or hits.		X		X			Forensic Anthropology, Forensic Pathology, Medicolegal Death Investigations
Potential loss of forensic evidence due to decedent recovery, transport and handling from scene to morgue. What evidence is being lost by performing evidence recovery prior to removal from the scene?	X		X	X			Medicolegal Death Investigations
The lack of effective biometric capture techniques and devices for the digital acquisition of decedent data. Effective technologies do exist for biometric capture for living persons, but not decedents, including decedents exhibiting various postmortem artifacts.	X	X		X	X		Forensic Pathology, Medicolegal Death Investigations
Unknown how well estimation of biological profile correlates with genetic markers. There is a need for studies to determine correlation of phenotypic, ancestral, and other genetic markers, to the forensic biological profile assessment of human remains.	X						Forensic Anthropology
Further research studies on force measurement, fracture mechanics and modeling of injuries (to include hard tissue and soft tissue) to improve accuracy of trauma analysis and quantify error rates associated with trauma interpretation.	X						Forensic Pathology, Forensic Anthropology
Difficulty in determining precise time since death. Further studies of innovative methods or technologies to determine precise time since death.	X	X		X			Forensic Anthropology, Forensic Pathology, Medicolegal Death Investigations

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Difficulty in detecting subtle injuries (e.g. deep tissue bruising) on bodies, both living and deceased.	X	X		X			Forensic Pathology
Advanced imaging technologies in postmortem examination are expensive, inaccessible for most agencies, and difficult to interpret and require specialized expertise. Further research into the utility of advanced imaging technologies in postmortem examination, assessing the cost-benefit of the imaging results with the financial burden of purchasing such technologies and hiring expertise required, and development of standardized protocols.		X	X	X	X		Forensic Pathology
Development of a multidisciplinary statistical model, for example, likelihood ratio, for use in personal identification, based on population frequencies of traits (anthropological, friction ridge, radiological, odontological, pathological, biological, etc) to reduce subjectivity in decedent identifications.	X			X			Forensic Anthropology, Forensic Pathology, Medicolegal Death Investigations
Development of novel, improved or enhanced presumptive tests (rapid, accurate and nondestructive) for evidence analysis and interpretation at the scene. Although, presumptive tests exist, there is always an opportunity for improved, enhanced or novel tests.	X	X		X			Crime Scene Examination
Further research on bone healing rates, at the macro- and micro-levels, and the quantification of healing rate differences by age and by bone element.	X						Forensic Anthropology, Forensic Pathology
What are the consequences of differing levels of postmortem investigation? Is there an unknown error rate in diagnosis of cause and manner of death due to the necessity to decide field investigation vs. no-field investigation, autopsy vs. not-autopsy, external exam vs. autopsy, and the roles of ancillary tests (toxicology, histology, microbiology).	X		X	X	X		Forensic Pathology

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Obtaining records for human identification through dental comparison. MDI's cannot find a dentist to compare postmortem radiographs for identification purposes; nor find the dentist to locate antemortem records.		X	X				Forensic Anthropology, Forensic Pathology
Inability to read through hypoxic artifacts and identify traumatic brain injury in pediatric patients who have been hypoxic for any period of time.	X						Forensic Pathology
Difficulty in locating clandestine graves; inability to use current technology effectively.	X	X		X			Forensic Anthropology, Medicolegal Death Investigations
There is a lack of training opportunities for practitioners, lack of resources, and difficult to retain employees to meet caseload demand within the MDI community.					X		Forensic Anthropology, Forensic Pathology, Medicolegal Death Investigations
There is a lack of innovation, and collaboration with other science disciplines (particularly outside of the forensic science arena), specifically within forensic anthropology and forensic pathology.	X	X		X	X	X	Forensic Anthropology, Forensic Pathology
There is a lack of information regarding the impact of quality assurance processes in forensic pathology. It is unclear if quality assurance processes are doing what they are intended to do.	X		X				Forensic Pathology