

NIJ Forensic Science Technology Working Group Operation Requirements, 2015

Updated based on discussion at the Forensic Science TWG meeting held September 15-16, 2015

Technology Working Group Operational Requirements <i>Updated Fall 2015</i>	Scientific Research	Technology Development	Policy or Protocol Development	Assessment & Evaluation	Dissemination &/or Training	Other	Forensic Discipline
Software tools for mixture interpretation of casework samples.				X	X		Forensic Biology/ DNA
Increased IT knowledge and/or software tools for improving DNA data flow and management, enhancing analyst productivity, quality control, and increasing laboratory information security.		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					Forensic Biology/ DNA
Physical separation of cells.				X			Forensic Biology/ DNA
Physical separation of sperm/ epithelial cells, typical of sexual assault case evidence, with minimal or no sample loss.	X	X					Forensic Biology/ DNA
The ability to quickly detect biological materials/fluid at a crime scene or on evidence taken from a crime scene, and simultaneously determine what type of biological fluid/cell type with minimal or no destruction of evidence sample(s).	X	X		X			Forensic Biology/ DNA
Optimization of DNA evidence collection techniques and/or devices.	X	X		X			Forensic Biology/ DNA
Increased DNA recovery of elution and/or extraction methods.	X	X					Forensic Biology/ DNA
Alternate instrumental platform that can perform genetic typing.	X	X		X			Forensic Biology/ DNA

Technology Working Group Operational Requirements

Updated Fall 2015

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Successful analysis of forensic evidentiary samples in a fully automated sample in answer out system where the “answer” would provide CODIS STR profile at a minimum. Other information might include biological fluid type, amount of DNA present, mixture interpretation, and/or mtDNA sequence analysis, YSTR profile, SNP information, etc.)	X	X		X			Forensic Biology/ DNA
The ability to detect/identify biological material that is invisible to the eye or alternate light sources (i.e. material left on touched objects), having sufficient quantity for downstream DNA analysis.	X	X					Forensic Biology/ DNA
Improved methods for examining touch DNA	X	X					Forensic Biology/ DNA
Expert System for Forensic Evidence Analysis (including mixtures)	X	X					Forensic Biology/ DNA
Minimally-/Non-Destructive rapid screening to characterize and determine most probative sample/stain for DNA analysis (in field and/or in lab).	X	X					Forensic Biology/ DNA
A better sexual assault evidence collection kit (to improve rapid rape kit screening and processing).	X	X		X			Forensic Biology/ DNA
Rapid Sexual Assault Kit screening method	X	X					Forensic Biology/ DNA
Better information and understanding of what processes are being used in the field, specifics of workflow and processes throughout the US, and potential/observed effects that upstream treatments have on downstream DNA analyses.				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
Rapid, affordable and minimally-/non-destructive automated test to detect, locate, and/or confirm the presence of semen/sperm in a dried stain and/or swab.	X	X		X			Forensic Biology/ DNA
Age determination of stains (time since deposition)	X						Forensic Biology/ DNA

Technology Working Group Operational Requirements

Updated Fall 2015

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Ability to differentiate and “tag” a cell, identify and associate the biological source and other information, and follow the “tag” through to profile generation.	X						Forensic Biology/ DNA
Software tool designed to estimate the number of contributors, based solely on the data with no hypothesis input requirement from the user.		X	X	X			Forensic Biology/ DNA
A dynamic PCR system that performs quantitation, normalization, and amplification in one instrument phase.	X	X					Forensic Biology/ DNA
Reduce or eliminate laboratory contamination. Method or devices to remove contaminants from commercial products (e.g., pipette tips, tubes, reagents, etc.), for nontraditional methods to monitor the presence of contamination (e.g., changes in instrument sensitivity), and for decontaminating laboratories.	X	X				X	Forensic Biology/ DNA
Studies of the mechanisms involved in DNA damage (including elements/metals that interfere with DNA analysis), and the development of new approaches and novel methods for overcoming damage and/or DNA repair (Identification of damaged DNA and repair mechanisms)	X	X		X			Forensic Biology/ DNA
Novel methods for DNA profiling (including non-PCR based methods for performing forensic DNA analysis).	X						Forensic Biology/ DNA
Non- or minimally-destructive method for DNA isolation	X	X		X			Forensic Biology/ DNA
Better methods for quantitation that provide more information to make decisions regarding downstream analysis methods.	X	X					Forensic Biology/ DNA
Knowledge and understanding about mathematical/statistical methods to assess the significance of finding a DNA profile at the activity level.	X						Forensic Biology/ DNA
More advanced computational methods for forensic laboratory use (e.g., application of machine learning, big data analysis, etc.)	X	X					Forensic Biology/ DNA
Statistical methods to interpret DNA sequences that are generated from mixtures and mosaicisms.	X	X		X			Forensic Biology/ DNA

Technology Working Group Operational Requirements

Updated Fall 2015

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Y-STR database coordination and management.			X				Forensic Biology/ DNA
Development of a Y-STR computer program for mixture interpretation and statistical analysis	X	X					Forensic Biology/ DNA
Increase in the success rate of obtaining DNA profiles from compromised (damaged) DNA evidence	X	X		X			Forensic Biology/ DNA
Evaluation of Next Generation Sequencing systems (instruments, kits and software) for forensic applications			X	X			Forensic Biology/ DNA
Ethical and policy determination for Next Generation Sequencing data.			X				Forensic Biology/ DNA
Develop tools for mixture interpretation for non-standard DNA (e.g., mtDNA, Y chromosome markers, X chromosome markers, SNP markers, and other non-CODIS markers) using new technologies	X	X					Forensic Biology/ DNA
Improve sample processing time for questioned samples	X	X					Forensic Biology/ DNA
Further development of alternative marker population databases (e.g. whole genome mtDNA, Y chromosome markers, X chromosome markers, SNP markers, copy number variants, etc.).			X				Forensic Biology/ DNA
Perform studies required to discover the presence of linkage issues in combining alternative markers and traditional autosomal markers	X						Forensic Biology/ DNA
Further increase the discrimination power using genomic tools other than human DNA	X	X					Forensic Biology/ DNA
Resolution of cases containing complex kinships	X	X					Forensic Biology/ DNA
Body fluid/ cell type identification at the time of genetic analysis	X	X					Forensic Biology/ DNA
Physical characteristics testing	X	X					Forensic Biology/ DNA

Technology Working Group Operational Requirements

Updated Fall 2015

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Kinship Software	X	X					Forensic Biology/ DNA
Better understanding of which tissue types collected from cadavers are best for DNA analysis	X						Forensic Biology/ DNA
Increased accessibility of mtDNA testing to forensic laboratories.	X	X					Forensic Biology/ DNA
Identical twin differentiation	X	X					Forensic Biology/ DNA
Species determination.				X			Forensic Biology/ DNA
Additional polymerases for use in Polymerase Chain Reaction (PCR) amplification	X	X		X			Forensic Biology/ DNA
Long term storage of DNA extracts.	X	X		X			Forensic Biology/ DNA
Access to methods/SOPs/spectra for use in identifying compounds of forensic interest.					X		Controlled Substances, Toxicology
Sufficient quantity of reference materials (to include quantitative samples) for use in forensic labs (to include parent drugs and metabolites).			X			X	Controlled Substances, Toxicology
Faster/easier ways to effectively and accurately separate/identify isomers or metabolites of forensically relevant compounds to the appropriate degree.	X						Controlled Substances, Toxicology
Faster, more efficient, streamlined processes for effective sample detection, collection, handling, and analysis/interpretation, including research to determine source of bottlenecks, as well as to address policy matters pertaining to case processing (e.g. scientific basis for two orthogonal tests).	X	X	X	X			Controlled Substances, Toxicology

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Development and application of emerging or current instrumentation being applied to method development (e.g., microspectrophotometer, using the second derivative, thermal analysis coupled with FTIR or GC-MS, Fast-GC and 2D-GC).	X	X		X			Controlled Substances, Toxicology
Better Laboratory Information Management Systems (LIMS), particularly with respect to systems appropriate for use by medical examiner offices with internal toxicology laboratories.		X	X				Controlled Substances, Toxicology
Standardized minimum acceptance criteria for analytical data generated for case samples.	X		X				Controlled Substances, Toxicology
Research and organization of existing data on isomers of commonly encountered controlled substances, including synthetic substituted cathinones and synthetic cannabinoids.	X		X		X		Controlled Substances
Available published validated methods for extraction and quantitation of THC from various substrates (plant materials, edible material, etc.)	X				X		Controlled Substances
Research to establish most effective, efficient schemes for processing controlled substance evidence.	X						Controlled Substances
Landscape survey of case/sample acceptance policies across the nation.				X	X		Controlled Substances
Better scheduling/legislation regarding emerging drugs, including differentiation of legal versus scientific conclusions.			X				Controlled Substances
Forensically-relevant approaches for statistical interpretation of evidence (e.g. postmortem toxicology levels).	X						Toxicology
Research on correlation of blood and oral fluid values, especially in regards to DUID interpretation, including differences between point of contact devices and lab confirmation.	X			X			Toxicology
Research to examine drug (esp. prescription drugs) levels pre- and post-embalming.	X						Toxicology
Research to identify propensity of particular drugs for postmortem redistribution, to determine value of clinical data for interpretation of postmortem results.	X						Toxicology
Evaluation of BrAC instrument platforms to be disseminated on a national scale.				X			Toxicology

Technology Working Group Operational Requirements

Updated Fall 2015

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Scientific foundations for the evaluation of evidence in support of qualified and definitive conclusions.	X	X					Impression & Pattern/ Trace Evidence
Forensically relevant approaches to the statistical interpretation of evidence.	X	X		X	X	X	Impression & Pattern/ Trace Evidence
Determination of accuracy for forensic conclusions, including potential sources of error.	X	X				X	Impression & Pattern/ Trace Evidence
Support for standards development and validation of forensic methods.	X		X			X	Impression & Pattern/ Trace Evidence
Evaluation of varied types of technical review and verification of casework.	X		X	X		X	Impression & Pattern/ Trace Evidence
Novel and/or improved evidence recognition, collection, and visualization tools and analytical instrumentation.	X	X		X	X		Impression & Pattern/ Trace Evidence
Evaluation of sequential evidence processing methods.	X	X		X			Impression & Pattern/ Trace Evidence
Fundamental understanding of how environmental factors can affect evidence.	X						Impression & Pattern/ Trace Evidence
Evaluation of the effects of training, accreditation and certification on the accuracy of conclusions.			X	X			Impression & Pattern/ Trace Evidence
Understanding of the cognitive processes involved in pattern recognition as applied to forensic identification.	X						Impression & Pattern/ Trace Evidence
Quantitative methods of analysis to augment visual trace evidence examinations.	X	X		X		X	Trace Evidence
Determination of the discrimination power of microscopical hair examinations combined with mtDNA analysis.	X						Trace Evidence
Identification and characterization of nanomaterials in evidentiary materials.	X	X		X		X	Trace Evidence
Development of automated microscopical comparison of human hair.	X	X		X		X	Trace Evidence

Technology Working Group Operational Requirements

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Construction of new and updating of existing databases with properties of new materials.					X	X	Trace Evidence
Optimal methods and materials for the preservation, visualization, recovery and comparison of toolmarks in cartilage and bone.	X	X		X			Tool Marks
Source attribution of drug tablets by examination of manufacturing toolmarks.	X					X	Tool Marks
Fundamental understanding of blood properties, droplet formation, droplet flight 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
Understanding of the effects of ventilation on fire damage and patterns.	X						Fire & Arson Investigation
Characterization of electrical system response as a means to study fire progression.	X	X					Fire & Arson Investigation
Repeatability and reproducibility of test measurements of large-scale structure fires.	X			X			Fire & Arson Investigation
Adequate materials property data inputs for accurate computer fire models.	X			X		X	Fire & Arson Investigation
Evaluation of incident heat flux profiles to walls and neighboring items in support of fire model validation.	X			X			Fire & Arson Investigation
National footwear reference collection database of known and crime scene impressions.						X	Footwear
Understanding of the morphological variability on the shape of the foot and the resulting shoeless impression [barefoot and socked].	X						Footwear
Quantitative assessment of intra- and inter-person handwriting and handprinting variation.	X	X		X			Forensic Document Examination
Understanding of the kinematics of handwriting.	X					X	Forensic Document Examination
Comparative evaluation of automated handwriting identification systems.				X		X	Forensic Document Examination
Methods or techniques for linking printed documents to printers.	X	X					Forensic Document Examination

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Development of improved procedures and technologies for evidence detection and recovery.			X	X	X		Crime Scene Examination
Difficulty in determining the cause and manner of death of infants and children, distinguishing between natural, undetermined, accidental and non-accidental, in some cases, in sudden fatal events and chronic pathology.	X			X	X		Forensic Pathology
Development or 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.	X	X		X	X		Forensic Anthropology, Medicolegal Death Investigations
Potential loss of forensic evidence due to decedent recovery, transport and handling from scene to morgue or what evidence is being obscured by performing evidence recovery prior to removal from the scene.	X		X	X			Medicolegal Death Investigations
Further development of effective biometric (e.g. fingerprints and facial recognition) capture techniques or devices for decedents, including decedents exhibiting various postmortem artifacts, both at the scene and in the morgue.	X	X		X	X		Medicolegal Death Investigations
Further studies to update anthropological morphometric, and growth and development datasets, and expanding underrepresented populations, applicable to assessment of biological profile.	X					X	Forensic Anthropology
Further research studies on force measurement, fracture mechanics and modeling of injuries (to include bone tissue and soft tissue) to improve accuracy of trauma analysis and quantify error rates associated with trauma interpretation.	X						Forensic Pathology

Technology Working Group Operational Requirements

Updated Fall 2015

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Further studies of innovative methods or technologies to determine precise time since death.	X	X		X			Medicolegal Death Investigations
Development or improvement of imaging technologies for injury detection.	X	X		X			Forensic Pathology
Development or improvement of imaging technologies for evidence detection.	X	X		X			Crime Scene Examination
Development of rapid and accessible (affordable) imaging technologies (CT, MRI, other whole-body imaging instruments) for use in postmortem examination.		X	X	X	X		Forensic Pathology
Improved methods or devices that are economical, field portable, and user-friendly to easily locate clandestine graves.	X	X		X			Forensic Anthropology, Medicolegal Death Investigations
There is a potential for bias in forensic analyses, and the forensic community is largely unaware of its impact and desires understanding and quantification when possible.	X		X				Multidisciplinary Forensic Disciplines
Development of a multidisciplinary likelihood ratio model 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						Forensic Anthropology
Development of methods for identifying geographic region or country of origin of unidentified remains.	X	X	X	X	X		Forensic Anthropology, Forensic Pathology, Medicolegal Death Investigations
Development or enhancement of rapid, accurate and nondestructive preliminary tests at the crime scene to gain immediate investigative probative value. These technological developments would provide investigative leads while confirmatory results are pending.	X	X	X	X			Crime Scene Examination

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Development or improvement of technologies or methods to capture 3-dimensional information at the scene and in the lab. Many rapidly developing 3-D imaging technologies could enhance forensic science purposes (investigations, analyses and reconstruction).		X		X			Crime Scene Examination
Further research on bone healing rates and the quantification of healing rate differences by age and by bone element.	X						Forensic Anthropology, Forensic Pathology
Increased knowledge and understanding of bone tissue at the micro- and molecular levels for forensic science applications. Furthermore, additional education and training in bone histological methods and interpretation for forensic applications is needed.	X	X		X	X		Forensic Anthropology, Forensic Pathology
Further research into the effects of not always completing a full 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), etc.	X		X	X	X		Forensic Pathology
Development of a web-based dental radiograph repository to compare postmortem radiographs for identification.		X	X				Forensic Anthropology, Forensic Pathology
Development of secure system for data exchange from scene to lab.		X		X			Crime Scene Examination, Forensic Pathology
Improved analysis and interpretation of sharp force trauma injuries.	X						Forensic Anthropology, Forensic Pathology
Improved analysis and interpretation of blast/explosive trauma injuries.	X						Forensic Anthropology, Forensic Pathology

Technology Working Group Operational Requirements

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Development or improvement of a case management system for easy implementation into the medical examiner/coroner office, without requiring modification.		X		X			Forensic Pathology, Medicolegal Death Investigations