

NIJ Forensic Science Technology Working Group Operation Requirements, 2014

Updated based on discussion at the Forensic Science TWG meeting held December 9-10, 2014

Technology Working Group Operational Requirements <i>Updated Fall 2014</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
Software tools for improving DNA data quality & enhancing analyst productivity (e.g. software to 'connect' & automate existing systems).						x	Forensic Biology/ DNA
Ability to differentiate, physically separate, and selectively analyze DNA and/or cells from multiple donors or multiple tissue/cell types contributing to mixtures.	x	x					Forensic Biology/ DNA
Physical separation of cells: a device or procedure to physically separate both cell type and DNA profile.				x			Forensic Biology/ DNA
Better methods to physically separate sperm from epithelial cells.	x	x					Forensic Biology/ DNA
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
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
Better materials to reduce DNA loss during transfer/storage. Better understanding of stability during storage and compatibility of current/new consumables/reagents with downstream processing methods.	x	x		x			Forensic Biology/ DNA

Technology Working Group Operational Requirements

Updated Fall 2014

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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
Alternate instrumental platform(s) to perform genetic typing.	x	x		x			Forensic Biology/ DNA
Better methods for quantitation of both single source and mixed samples.	x	x					Forensic Biology/ DNA
Preliminary differentiation to determine most probative sample(s) for DNA analysis.	x	x		x			Forensic Biology/ DNA
Ability to determine the age of a biological stain.	x						Forensic Biology/ DNA
Ability to successfully generate DNA profiles from forensic type samples in a fully automated sample-in-answer-out system.	x	x		x			Forensic Biology/ DNA
Automated test for definitive confirmation of presence of sperm/semen in stains.	x	x		x			Forensic Biology/ DNA
Ability to identify biological material that is invisible to the eye (with or without aid of alternate light sources), having sufficient quantity for downstream DNA analysis.	x	x					Forensic Biology/ DNA
Novel methods for DNA profiling (including non-PCR based methods for performing forensic DNA analysis).	x	x					Forensic Biology/ DNA
Reduce or eliminate laboratory contamination. Includes method(s) or device(s) to remove contaminants from commercial products (consumables/reagents).	x	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 methods for overcoming damage and/or DNA repair (Identification of damaged DNA and repair mechanisms).	x	x		x			Forensic Biology/ DNA

Technology Working Group Operational Requirements

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Ability to isolate DNA with no or minimal destruction to the physical evidence item.	x	x		x			Forensic Biology/ DNA
Software tool designed to estimate the number of contributors.		x	x				Forensic Biology/ DNA
A dynamic PCR system that performs quantitation, normalization, and amplification in one instrument phase.	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
A better sexual assault evidence collection kit (to improve rapid rape kit screening and processing).	x	x					Forensic Biology/ DNA
Ability to identify the original body fluid/cell type at the time of genetic analysis.	x	x					Forensic Biology/ DNA
Y-STR database coordination and management.			x				Forensic Biology/ DNA
Y-STR mixture interpretation and statistical analysis.	x						Forensic Biology/ DNA
The ability to determine physical characteristics from DNA evidence.	x	x					Forensic Biology/ DNA
Increase in success rate for generating DNA profiles from compromised (i.e. damaged) DNA evidence.	x	x		x			Forensic Biology/ DNA
Evaluation of Next Generation Sequencing technologies for forensic applications.			x	x			Forensic Biology/ DNA
Ethical and policy determination for Next Generation Sequencer data.			x				Forensic Biology/ DNA
Tools for mixture interpretation of data produced on non-standard genetic markers (e.g., mtDNA, Y chromosome markers, X chromosome markers, SNP markers, and other non-CODIS markers).	x	x					Forensic Biology/ DNA

Technology Working Group Operational Requirements

Updated Fall 2014

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Improved sample processing time for DNA analysis of questioned samples.	x	x					Forensic Biology/ DNA
Increased discriminatory power using genomic information other than human DNA (e.g., microbiomes).	x	x					Forensic Biology/ DNA
Improved ability to resolve cases containing complex kinships.	x	x					Forensic Biology/ DNA
Increased accessibility of mtDNA testing to forensic laboratories.	x	x					Forensic Biology/ DNA
Further development of alternative marker population databases (e.g. mtDNA, Y chromosome markers, X chromosome markers, SNP markers).			x				Forensic Biology/ DNA
Ability to differentiate identical twins.	x	x					Forensic Biology/ DNA
Automated sperm searching and identification.				x			Forensic Biology/ DNA
Species determination.				x			Forensic Biology/ DNA
Additional polymerases for improved PCR amplification.	x	x		x			Forensic Biology/ DNA
Long term storage of DNA extracts.	x	x		x			Forensic Biology/ DNA
Improved methods for examining minute amounts of biological evidence: processing evidence down to the single cell.	x	x					Forensic Biology/ DNA
Reduce or eliminate PCR artifacts specifically with low copy number and complex samples.	x	x					Forensic Biology/ DNA

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To develop improved procedures and technologies for the recovery and selection of evidence. Nationally, there should be standards for scene processing. All investigators should follow the same processes/procedures to process scenes nationally.			x	x	x		Crime Scene Examination
Further research studies to determine cause and manner of death in infants and children; distinguishing between natural, undetermined, accidental and non-accidental; in sudden fatal events and chronic pathology.	x			x	x		Forensic Pathology
Development of a system (or expansion of current data systems) with weighting capability for antemortem and postmortem comparisons with the goal of providing a ranked list of “best matches” in forensic anthropology casework.		x		x	x		Forensic Anthropology, Medicolegal Death Investigations
Research studies to determine (1) if evidence is or is not lost during transport of the body from the scene to the morgue, and (2) if evidence is altered during transport of the body from the scene to the morgue.	x		x	x			Medicolegal Death Investigations
Further development of effective biometric (e.g. fingerprints and facial recognition) capture techniques or devices for decedents, both at the scene and in the morgue.	x	x		x	x		Medicolegal Death Investigations
Further studies to update outdated anthropological morphometric and growth and development datasets, specifically applicable to assessment of biological profile.	x					x	Forensic Anthropology
Further research studies on force measurement and modeling of injuries (to include bone tissue and soft tissue) applicable to infants, children and adults to improve accuracy of trauma analysis and quantify error rates associated with trauma interpretation.	x						Forensic Pathology

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Further studies of innovative, useful and practical approaches for precise time since death. The outcome is the development of a procedure to precisely determine time since death.	x	x		x			Medicolegal Death Investigations
Enhancement and improvement of imaging technologies to document potential evidence at the scene and injury (e.g. deep tissue bruising) on bodies, living and deceased.		x		x			Crime Scene Examination, Medicolegal Death Investigations, Forensic Pathology
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. Standardized protocols for advanced imaging process and interpretation then need to be developed.			x	x	x		Forensic Pathology
Further studies to assess the reliability of bitemark analysis and interpretation so that the forensic community understands the reliability or limitation(s) of bite mark analysis.	x			x			Forensic Odontology
Improved methods in locating clandestine graves; economical, field portable, and user-friendly devices 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 likelihood ratio model in personal identification, to include fingerprint, dental and anthropological data to reduce subjectivity in identifications.	x						Forensic Anthropology

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Development of methods to determine country of origin of unidentified remains.	x	x	x	x	x		Forensic Anthropology, Forensic Pathology, Medicolegal Death Investigations
Technological developments that allow for rapid, accurate and nondestructive preliminary testing at a crime scene. Results of this testing have the capability to guide the direction of the investigation prior to traditional confirmatory laboratory testing. These technological developments would provide investigative leads while confirmatory results are pending. These developments would provide immediate lead value to point directly to a suspect or to eliminate potential suspects permitting a more focused investigation.	x	x	x	x			Crime Scene Examination
Improvement of 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 (infants, subadults, adults, and elderly adults) and by location of the fracture(s).	x						Forensic Anthropology, Forensic Pathology
Standardized methodologies for bone histological techniques to improve assessment of: trauma, age, pathology, species of origin (human/nonhuman). Furthermore, additional education and training in bone histological methods and interpretation for forensic applications is needed.	x	x		x	x		Forensic Anthropology, Forensic Pathology

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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
Technological methods of analysis for quantitative evaluation of trace evidence.	x	x		x	x		Trace Evidence
Scientific foundations for the evaluation of evidence in support of qualified and definitive conclusions.	x						Impression & Pattern/ Trace Evidence
Evaluation of varied forms of technical review and verification of casework.			x	x	x		Impression & Pattern/ Trace Evidence
Forensically relevant approaches to the statistical interpretation of evidence.	x				x		Impression & Pattern/ Trace Evidence
Characterization of electrical system response to fire.	x	x					Fire & Arson Investigation
Identification and characterization of nanomaterials in evidentiary materials.	x	x			x		Trace Evidence
Determination of accuracy for addressing error rate issues in Daubert.	x			x	x		Impression & Pattern/ Trace Evidence
Evaluation and validation of the effects of training, accreditation and certification on conclusions.			x	x			Impression & Pattern/ Trace Evidence
Repeatability and reproducibility of fire test measurement.	x			x			Fire & Arson Investigation
Study of the effects of ventilation on fire damage.	x						Fire & Arson Investigation
Adequate materials property data inputs for accurate computer fire models.	x			x			Fire & Arson Investigation
Statistical analysis of intra- and inter-person handwriting variation.	x						Questioned Documents
Comparison and validation of emerging microscopical 3D imaging techniques.		x		x			Impression & Pattern/ Trace Evidence

Technology Working Group Operational Requirements

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Study of the discrimination power of microscopical hair examination combined with mtDNA analysis.	x						Trace Evidence
Novel and/or improved evidence recognition, collection, development tools and instrumentation.	x	x		x			Impression & Pattern/ Trace Evidence
Comparative evaluation of the effectiveness of sequential processing methods.			x	x	x		Impression & Pattern/ Trace Evidence
Fundamental understanding of how environmental factors can affect evidence.	x						Impression & Pattern/ Trace Evidence
Research on how blood interacts with fabrics.	x						Blood Pattern Analysis
Research on the kinematics of handwriting.	x						Questioned Documents
National footwear reference collection database of known and crime scene impressions.						x	Footwear
Toolmarks research on the attribution of illicitly manufactured pharmaceutical tablets.	x						Toolmarks
Evaluation of incident heat flux profiles to walls or neighboring items in support of fire model validation.	x						Fire & Arson Investigation
Construction of new and updating of existing databases with properties of new materials.					x	x	Trace Evidence
Comparative evaluation of automated handwriting identification systems.				x			Questioned Documents
Studies on the morphological variability on the shape of the foot and the resulting shoeless impression [barefoot and socked].	x						Footwear
Research on the cognitive and physiological processes involved in pattern recognition as applied to forensic identification.	x						Impression & Pattern/ Trace Evidence
Methods or techniques for linking printed documents to printers.	x	x					Questioned Documents
Improved discrimination of polymers and polymer products.	x						Trace Evidence
Better dissemination strategies for and/or improved access to current research and technology, especially SOPs, to avoid duplication of effort in method development/problem solving and in house validation/verification.		x			x		Controlled Substances, Toxicology

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Standards/new reference materials for use in forensic labs, especially standards for comparison (to include parent drugs and metabolites).			x		x		Controlled Substances, Toxicology
Research into trends in structure that will lead to stability issues (i.e shelf life); including controlled substances and/or non-controlled substances unintentionally becoming controlled substances.	x						Controlled Substances, Toxicology
Guidelines for a communal determination of "structural similarity". Compilation of existing pharmacological activity data, as well as research to determine the pharmacological activity where it is not known.			x		x		Controlled Substances, Toxicology
More effective , faster, more efficient streamlined processes in 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			Controlled Substances, Toxicology
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	x		Controlled Substances, Toxicology
Research into efficiency of case management policies/casework (e.g. what are the judicial consequences).			x	x			Controlled Substances, Toxicology
Development of best practices for chemical identification among emerging technologies. (e.g. evaluation of different instrument platforms), including analysis of cost effectiveness or other benefit of emerging technology.	x	x		x	x		Controlled Substances
Evaluation of techniques for resolution/identification of forensically relevant isomers, including standardization of criteria to conclude spectra match and use of non-MS techniques (Raman, IR).			x	x	x		Controlled Substances
Standardized/available published methods for extraction and quantitation of THC from various substrates or materials.	x				x		Controlled Substances
Guidelines for: validation of methods, performance of SOPs, verification/validation of instruments.			x		x	x	Controlled Substances

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Uniform understanding in the community of the terms validation, performance verification, and method.			x		x	x	Controlled Substances
Better scheduling/legislation regarding emerging drugs.			x				Controlled Substances
Forensically-relevant approaches for statistical interpretation of evidence (e.g. postmortem toxicology levels). Data mining of existing data sets.	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 correlating DRE findings and toxicology results.	x						Toxicology
Training of sufficient quantity of personnel on difficult/non-robust instrumentation. Guidelines for call for bids to include specifics of training.						x	Toxicology
More robust 'expert' interpretation system that can automatically review raw data from GC/MS and/or LC/MS/MS analysis of toxicology samples to rapidly screen and flag those samples that require more intensive review by analysts and that ideally would be able to automatically calculate quantitative values based upon standards included in the same data batch.	x	x					Toxicology