

# NIJ Forensic Science Technology Working Group Operation Requirements, 2016

Updated based on discussion at the Forensic Science TWG meeting held December 13 and 14, 2016

<b>Technology Working Group Operational Requirements</b> <i>Updated December 2016</i>	Scientific Research	Technology Development	Policy or Protocol Development	Assessment & Evaluation	Dissemination &/or Training	Other	Forensic Discipline
Innovations, validations, and evaluations of software tools for mixture interpretation of casework samples.		X		X	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
Machine Learning based software tools that will fully inform the user on best next steps for DNA data flow and management, enhancing analyst productivity, and increasing quality outcomes, while maintaining laboratory information security.	X	X					Forensic Biology / DNA
Expert System for Forensic Evidence Analysis (including mixtures)	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					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/aged or degraded stain and swab, and a method to efficiently physically isolate sperm cells/sperm-specific-DNA from non-sperm cells.	X	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

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Methods and/or knowledge to inform users about which processes maximize lysis and recovery of DNA at the elution and/or extraction steps, and/or direct amplification, for best downstream DNA analysis results.	X	X		X			Forensic Biology / DNA
Alternate approaches and/or instrumental platforms that can perform genetic typing	X	X		X			Forensic Biology / DNA
Age determination of stains (time since deposition)	X						Forensic Biology / DNA
Better solutions to deal with contamination, such as (1) Methods or devices to remove contaminants from commercial products (e.g., pipette tips, tubes, reagents, etc.), (2) nontraditional methods to monitor the presence of contamination (e.g., changes in instrument sensitivity) with minimal disruption to laboratory workflow, and (3) for decontaminating laboratories.	X	X				X	Forensic Biology / DNA
Ethical and policy determination for Next Generation Sequencing data.			X				Forensic Biology / DNA
Evaluation of Next Generation Sequencing systems (instruments, kits and software) for forensic applications			X	X			Forensic Biology / DNA
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
Develop mixture interpretation software for non-standard DNA testing 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			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

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Software for the resolution of complex kinships	<b>X</b>	<b>X</b>					Forensic Biology / DNA
Rapid Sexual Assault Kit screening method	<b>X</b>	<b>X</b>					Forensic Biology / DNA
A better sexual assault evidence collection kit (to improve rapid rape kit screening and processing).			<b>X</b>				Forensic Biology / DNA
Successful analysis of forensic evidentiary samples (or DNA extracted from them) 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.)	<b>X</b>	<b>X</b>		<b>X</b>			Forensic Biology / DNA
The ability to detect/identify biological material (e.g., cell free DNA) that is invisible to the eye or alternate light sources (i.e. material left on touched objects), having sufficient quantity for downstream DNA analysis.	<b>X</b>	<b>X</b>					Forensic Biology / DNA
Better methods for collection and DNA analysis of evidence processed for latent fingerprints. This includes (1) a comprehensive study on latent print processes and their effect on common DNA chemistries (extraction, amplification, and/or both), (2) improved/new methods to recover DNA from difficult substrates (e.g., tapelifts), (3) better understanding of possible routes of contamination related to latent print processing.	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>			Forensic Biology / DNA
Improved methods for examining and interpreting touch DNA samples (to include cell free DNA)	<b>X</b>	<b>X</b>					Forensic Biology / DNA
Studies to determine if/when front end steps (e.g., serology, sampling, extraction, purification, and/or quantification) should/could be removed from the DNA analysis workflow for the direct amplification of questioned samples.	<b>X</b>			<b>X</b>			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.	<b>X</b>	<b>X</b>					Forensic Biology / DNA

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A secure means for information sharing across accredited NDIS participating forensic science laboratories to increase the understanding about laboratory workflows and processes that are models for best practices to be replicated, and potentially problematic areas to be avoided.				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
The ability to differentiate and “tag” a cell, identify and associate the biological source and other information (such as quality control to detect sample switches), and follow the “tag” through to profile generation	X						Forensic Biology / DNA
A dynamic PCR system that performs quantitation, normalization, and amplification in one instrument phase.	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
Body fluid/ cell type identification at the time of genetic analysis	X	X					Forensic Biology / DNA
Phenotypic testing	X	X	X				Forensic Biology / DNA
Macro screening of biological materials found at crime scenes	X	X		X			Forensic Biology / DNA
Affordable IT solutions for managing QC data to include a handsfree LIMS		X					Forensic Biology / DNA
The use of metagenomics to produce investigative leads	X	X					Forensic Biology / DNA
Direct PCR with simultaneous human specific quant	X	X					Forensic Biology / DNA
Practical studies for the utility of Surname inference for the development of investigative leads				X			Forensic Biology / DNA
Comprehensive Studies on DNA transfer and persistence				X			Forensic Biology / DNA
Novel biological methods for human identification	X	X					Forensic Biology / DNA

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Non- or minimally-destructive method for DNA isolation	X	X		X			Forensic Biology / DNA
Better methods for quantitation that provide more information (e.g., number of contributors, contributor proportions, cell/tissue source) to make decisions regarding downstream analysis methods.	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						Forensic Biology / DNA
Statistical methods to interpret DNA sequences that are generated from mixtures and mosaicism.	X	X		X			Forensic Biology / DNA
Identical twin differentiation	X	X					Forensic Biology / DNA
Genetic identification of Species of Forensic Interest				X			Forensic Biology / DNA
Best Practices for Long Term Extract Storage	X	X		X			Forensic Biology / DNA
Preliminary genetic screening differentiation for triaging biological evidentiary samples	X	X	X				Forensic Biology / DNA
Study of interpretation of report language by scientists and non-scientist stakeholders	X			X			Controlled Substances, Toxicology
Error rate studies on qualitative analysis (single tests and schemes)	X			X			Controlled Substances, Toxicology
Workable protocol for introducing proficiency tests into casework flow so as to be blind			X	X			Controlled Substances, Toxicology
Improved, broader, more available, more representative proficiency testing				X	X		Controlled Substances, Toxicology
Configurable, cost-effective laboratory information management systems		X	X			X	Controlled Substances, Toxicology
Research into scientifically-based acceptance criteria of analytical data generated in case samples	X						Controlled Substances, Toxicology

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Access to methods/SOPs/spectra for use in identifying compounds of forensic interest					X		Controlled Substances, Toxicology
Evaluation of validity of deconvolution software for spectra, such as IR, Raman, MS, etc.	X			X			Controlled Substances, Toxicology
Better understanding of the challenges and relevance of isomers and/or metabolites encountered in forensic samples	X						Controlled Substances, Toxicology
Glossary of terms to define, for example, identification uncertainty (distinct from misidentification), and effective ways to communicate it clearly to customers (LE, triers of fact, etc.)			X		X		Controlled Substances, Toxicology
Effective, faster, more efficient processes in sample detection, collection, handling, and analysis, data handling, and reporting	X	X	X	X			Controlled Substances, Toxicology
Continued advancement of practical forensic application/development pertaining to emerging or current instrumentation (e.g. microspectrophotometer, using the second derivative, thermal analysis coupled with FTIR or GC-MS)	X	X		X			Controlled Substances, Toxicology
Publicly-available anonymized proficiency misidentification reports and corrective action plans					X	X	Controlled Substances, Toxicology
Appropriate and reasonable safety protocols for strong opiates/opioids			X				Controlled Substances, Toxicology
Lack of extensive research and data collection of novel psychoactive substances, to include but not limited to synthetic opioids, cannabinoids, benzodiazepines, and substituted cathinones, and related isomers	X						Controlled Substances
Validated methods for THC quantitation in plant materials, edibles, extracts, etc.	X						Controlled Substances
Evaluation of efficient methods of triaging cases and successful case management agreements among labs and customer stakeholders	X			X			Controlled Substances
Research into most effective, efficient scheme/process for processing evidence	X						Controlled Substances

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Correction algorithm to allow comparison of spectra across instruments that could, for example, compare a reference standard to a library standard and determine an algorithm to correlate them	X			X			Controlled Substances
Scheduling/legislation problems			X				Controlled Substances
Discriminating power using only GC/MS	X	X		X			Controlled Substances
Sufficient quantity of reference materials (to include quantitative samples) for use in forensic labs (to include parent drugs and metabolites)						X	Toxicology
Research on correlation of blood and oral fluid values, esp. in regards to DUID interpretation, including differences between POC devices and lab confirmation	X						Toxicology
Research on pre-analytic artifacts such as postmortem redistribution, site dependence, contamination, poor sampling, etc.	X						Toxicology
Forensically-relevant approaches for statistical interpretation of evidence (e.g. postmortem toxicology levels) to give a better understanding of the value of the data	X						Toxicology
Research to examine drug levels pre- and post-embalming to assist in assessing cause of death if toxicology not completed prior to embalming	X						Toxicology
Nationwide evaluation of administrative testing scheme policies			X	X			Toxicology
Scientific foundations for the evaluation of evidence in support of qualified and definitive conclusions.	X	X					Impression & Pattern/ Trace Evidence
Determination of accuracy of forensic conclusions, including potential sources of error.	X	X				X	Impression & Pattern/ Trace Evidence
Novel approaches to the statistical interpretation of forensic evidence.	X	X		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

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Novel and/or improved evidence recognition, collection, and visualization tools and analytical instrumentation.	X	X		X	X		Impression & Pattern/ Trace Evidence
Fundamental understanding of how environmental factors can affect evidence.	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
Evaluation of sequential evidence processing methods.	X	X		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
Quantitative methods of analysis to augment visual trace evidence examinations.	X	X		X		X	Trace Evidence
Development of automated microscopical analysis and comparison of hair and fibers.	X	X		X		X	Trace Evidence
Identification and characterization of nanomaterials in evidentiary materials.	X	X		X		X	Trace Evidence
Construction of new and updating of existing databases with properties of new materials.					X	X	Trace Evidence
Fundamental understanding of blood properties, droplet formation, droplet flight and the resultant formation of bloodstain patterns.	X	X					Bloodstain Pattern Analysis
An 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



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Algorithms for automated searching of make and model of crime scene footwear impressions within a database of known footwear outsole patterns.		<b>X</b>		<b>X</b>		<b>X</b>	Footwear
Understanding of the morphological variability of the shape of the foot and the resulting shoeless impression [barefoot and socked].	<b>X</b>						Footwear
Quantitative assessment of intra- and inter-person handwriting and handprinting variation.	<b>X</b>	<b>X</b>		<b>X</b>			Forensic Document Examination
Understanding of the kinematics of handwriting and digital signatures.	<b>X</b>					<b>X</b>	Forensic Document Examination
Reference collection databases for questioned document examiners.						<b>X</b>	Forensic Document Examination
Comparative evaluation of automated handwriting identification systems.				<b>X</b>		<b>X</b>	Forensic Document Examination
Optimal methods and materials for the preservation, visualization, recovery and comparison of toolmarks in cartilage and bone.	<b>X</b>	<b>X</b>		<b>X</b>			Tool Marks/ Forensic Pathology/ Forensic Anthropology
Source attribution of drug tablets using manufacturing toolmarks.	<b>X</b>					<b>X</b>	Tool Marks/ Controlled Substances
Development of improved procedures and technologies for evidence detection and recovery.	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>		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 sudden fatal events to include traumatic injury versus sudden non-traumatic causes of death, e.g. channelopathies, genetic disease, metabolic disorders, etc.	<b>X</b>			<b>X</b>	<b>X</b>		Forensic Pathology
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.	<b>X</b>	<b>X</b>		<b>X</b>			Forensic Anthropology, Medicolegal Death Investigations

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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
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 of accessible (affordable) imaging technologies (whole-body imaging instruments), or increasing the availability of existing technologies for use in forensic-specific postmortem examination.		X	X	X	X		Forensic Pathology
Understanding Bias in Forensic Analyses	X		X				Multidisciplinary Forensic Disciplines
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						Forensic Anthropology

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Development of methods and/or systems for identifying geographic region or country of origin of unidentified remains.	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, to include lead-free or unique ammunition.	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
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 an antemortem dental radiograph repository to compare postmortem radiographs for identification.		X	X				Forensic Anthropology, Forensic Pathology
Improved analysis and interpretation of sharp force trauma injuries on hard and soft tissue.	X						Tool Marks/Forensic Pathology/Forensic Anthropology
Improved analysis and interpretation of blast/explosive trauma injuries.	X						Forensic Anthropology, Forensic Pathology
Research to understand and identify hypoxic artifacts and traumatic brain injury in pediatric patients who have been on a ventilator.	X						Forensic Pathology

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Development of novel methods to locate clandestine graves.	<b>X</b>	<b>X</b>		<b>X</b>			Forensic Anthropology, Medicolegal Death Investigations
Studies to determine correlation of phenotypic, ancestral, and other genetic markers to the forensic anthropologist's assessment of skeletal remains.	<b>X</b>			<b>X</b>			Forensic Anthropology
Development of on-scene tests and protocols for the safe detection, and processing of hazardous emerging synthetic drugs.	<b>X</b>	<b>X</b>	<b>X</b>				Crime Scene Examination, Controlled Substances