Testimony of

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Forensic Science and Standards: NIST's Role

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Introduction
Chairwoman Johnson, Ranking Member Lucas, and Members of the Committee, I am Susan Ballou, the Program Manager of the Forensic Science Research Program within the Special Programs Office at the Department of Commerce's National Institute of Standards and Technology, or NIST. Thank you for the opportunity to appear before you today to discuss NIST's role in forensic science. I will address three different ways that NIST contributes to forensic science: research; development of reference materials, standards, and guidelines; and convening the forensic science community.

Research
Since 1929, NIST has been involved in forensic science, tackling issues that require years of dedicated research and high-tech instrumentation. With extensive expertise in many areas, NIST addresses national forensic science concerns such as DNA analysis, digital evidence, measurement science, and the opioid crisis. A few years ago, NIST established six focus areas of research: Firearms and Associated Tool Marks, Digital and Identification Forensics, Forensic Genetics, Statistics, Toxins, and Trace Detection. NIST frequently collaborates with other federal agencies as well as state and local crime laboratories.

The release of the 2009 National Research Council report, *Strengthening Forensic Science in the United States: A Path Forward*, highlighted areas where forensic science research was needed, and made recommendations for improvements. When the report was issued, NIST already had active projects addressing several of the recommendations. In response to the report's other recommendations, NIST worked to further ongoing efforts related to strengthening the scientific foundation of forensic science examinations in disciplines where NIST had existing expertise. In particular, NIST focused on improving Automated Fingerprint Identification System (AFIS) interoperability and application of statistics to firearm examinations. In the past few years, NIST has conducted research efforts in the current six focus areas.

NIST has worked with many partner federal agencies including the Federal Bureau of Investigation (FBI), the Department of Defense (DOD), the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF), and the Department of Homeland Security (DHS), among others. For example, in 2012, NIST published a document entitled "*Latent Print Examination and Human Factors: Improving the Practice through a Systems Approach*" following a two-and-a-half-year collaboration between NIST and the Department of Justice's National Institute of Justice. This document provides a process map of the steps involved in latent print examination as a means to view key decision points. Important improvements have come because of this work and process maps are being created for other forensic disciplines including handwriting, DNA, and firearms analysis.

Digital evidence is a growing area in forensic science. Ensuring the reliability of software tools used to extract data from computers and mobile devices is a critical need within the law enforcement community. NIST is actively assisting in testing computer forensic software tools. With support from numerous federal, state, and local law enforcement agencies, NIST also maintains the National Software Reference Library, which is used to improve efficiency in criminal investigation digital searches by eliminating the need to look at files from known software applications.

Development of Standards

NIST's research over the last 30 years has resulted in many improvements in DNA measurement. For example, NIST developed Standard Reference Materials (SRMs) such as the Human DNA Standard which is used by DNA labs to make sure their instruments and methods are working properly enabling accurate measurements of DNA markers commonly used in forensic laboratories worldwide for human identification.

NIST continues to lay the statistical foundation for calculating match statistics when using Next Generation Sequencing, or NGS, which produces DNA profiles that can be of greater utility in solving crimes. This research was jointly funded by NIST and the FBI. In cases where only a partial DNA profile is available, the extra data in an NGS-based profile might help solve the case. In addition, evidence that contains a mixture of DNA from several people can be difficult to interpret. The extra data in NGS-based profiles can help in those cases as well.

To assist in firearms analysis, NIST has created a standard bullet and cartridge case to provide a calibrated measuring surface for firearms examiners to test and determine whether their 3D surface scanning microscope is properly calibrated. The SRM also improves interoperability between law enforcement agencies which increased 'hits' across State borders." Previously, not using the same calibrations between agencies was a problem because a crime committed in one jurisdiction could not be linked to another crime in another jurisdiction. Using the NIST SRM, law enforcement labs can digitally compare bullets and get confirmation that same weapon was used in multiple crimes across multiple jurisdictions. NIST also continues to maintain the NIST Ballistics Toolmark Research Database, which is an open-access research database of bullet and cartridge case toolmark data.

NIST's research into in the forensic science field of trace work on paint, glass, hair, fibers and tape is breaking new ground. NIST is conducting work on improving the identification of paint chips, establishing requirements for a glass material standard, and a new way to examine hair. NIST, in collaboration with the FBI, is looking at the use of hair in human identification. Hair offers two significant advantages in linking a person with a location or a piece of clothing: it is easily transferred from the suspect, and is a resilient, non-perishable, artifact. Hair forensics currently uses physical examination such as pigmentation, diameter, scales etc. as a means of association. Using scientific methods, hair can be profiled using protein in the hair shaft. In this way two specific hairs, one from a suspect and one from a crime scene, could be compared and given a stronger probabilistic measure of having come from the same person. To identify anonymous hair found at a crime scene, a library of catalogued hair could be created in analogy to a DNA database.

NIST has conducted research into trace detection of opioids and other illegal drugs. NIST scientists developed SRMs that forensic science laboratories use to validate the accuracy of their identification and quantification of controlled substances. NIST researchers are also developing methods to help investigators detect drugs at crime scenes, in cargo, and at transit hubs, and they are developing tools to identify emerging synthetic and designer drugs. Detecting trace amounts can prevent exposure of first responders to these harmful drugs and identify the types of illicit

fentanyl that drug dealers may lace their supply with. This research can also help first responders in determining the source of an overdose and how to treat the overdose victim.

Convening the Forensic Science Community

Five years ago, NIST established the Organization of Scientific Area Committees for Forensic Science (OSAC) to facilitate the development and promulgation of consensus-based documentary standards and guidelines. This effort assesses whether these standards and guidelines are fit-for-purpose. OSAC has a broad representation of stakeholders from the forensic science, legal, law enforcement, and research communities with more than 550 participants.

NIST also conducts "scientific foundation reviews." The purpose of these reviews is to understand what is known and what data supports methods and practices used in the field. These scientific foundation reviews seek to develop a bibliography of foundational literature, to characterize capabilities and limitations, to identify knowledge gaps, and to share what is learned. The first scientific foundation review involves examining DNA mixture interpretation, and future reviews are planned with bitemark analysis, firearms examinations, and digital evidence. A challenge in conducting these reviews is that there are no standard universal methods in each forensic discipline; words like "validate" and "reliability" often have different meanings to different people. NIST has learned a lot during its initial review and will apply this knowledge during future reviews.

NIST stands ready to assist the forensic science community. Thank you for the opportunity to testify on NIST's work regarding forensic science. I will be pleased to answer any questions you may have.

Susan Ballou

Susan Ballou is the Program Manager for the Forensic Sciences Research Program within the Special Programs Office at the National Institute of Standards and Technology (NIST), Gaithersburg, Maryland. She is also the Federal Program Officer for the NIST Forensic Science Center of Excellence based at Iowa State University and appropriately titled: The Center for Statistics and Applications in Forensic Evidence (CSAFE). Prior to NIST, she served as the lead serologist for the Montgomery County Police Department (MCPD) Crime Laboratory in Rockville, Maryland. Several of her cases have been on the highly acclaimed TV series, Forensic Files. She has worked for the Commonwealth of Virginia Division of Consolidated Laboratory Services at their Merrifield location where she conducted analysis on evidence suspected of containing illicit drugs, body fluids and hairs and fibers. She also held a position as chemist in the Connecticut Office of the Chief Medical Examiner under the supervision of Chief Toxicologist, Dr. Randall Baselt. She holds a Master of Science degree in Biotechnology from The Johns Hopkins University and a Criminal Justice Undergraduate degree from the University of New Haven, West Haven, Connecticut. She has obtained expert status in Federal, State and County Circuit and District courts.

Ms. Ballou is past president of the American Academy of Forensic Sciences (AAFS), of the Mid-Atlantic Association of Forensic Scientists (MAAFS) and recipient of numerous awards to include; the ASTM Award of Merit – Honorary title of Fellow; Outstanding Contributions to the work of ASTM E30 on Forensic Sciences (2015), the AAFS, Criminalistics Section Mary E. Cowan Outstanding Service Award (2012), The ASTM Award of Appreciation – In Recognition of Outstanding Service as an ASTM Committee Chairman (2006-2007), the Department of Commerce Equal Employment Opportunity/Diversity Award (2005), the Department of Commerce Silver Medal (2003), the Outstanding Service Award Rendered for Justice and For the People of Montgomery County, The Assistant States Attorney's Office Montgomery County, MD, (1987-2000) and the Commendation Award, Partners for a Healthier Maryland, Montgomery County Department of Health and Human Services and Shady Grove Hospital, (1997).