Testimony of

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Keeping America Secure:
The Science Supporting the Development of Threat Detection Technologies

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Chairman Hall, Ranking Member Johnson, and Members of the Committee, thank you for the opportunity to appear before you today to discuss the important role that the National Institute of Standards and Technology (NIST) plays in threat detection technologies. Industry, Public Safety, Security, and Defense are all driven to detect and respond to threats in ways that are faster, more definitive, and rely on multiple detection technologies.

Detection technologies are becoming less intrusive, faster, and more sensitive with fewer false signals. As new threats emerge, new detection are often needed to ensure the safety of the American public. Novel detection techniques typically require new measurement standards to validate their operation, to assure that they are reliable and appropriately sensitive.

It is in this mission space that the Department of Commerce's NIST works to support industry and other Federal agencies in meeting these measurement and standards challenges. My testimony today will highlight NIST's role and give examples of NIST's work where the application of our measurement and standards expertise has helped assure the quality and reliability and advanced the state of the art of detection methods used to protect the nation.

NIST's Role in Research and Development in Threat Detection Technology

NIST was established with a specific mission -- to define and advance a uniform, scientific, national system of measurement to support industry and other federal agencies. This system of measurement is underpinned by NIST's measurement science research.

In that role, NIST is responsible for developing and validating measurement methods and standards that will allow industry to accurately and reproducibly assess their processes and products, including the presence of hazardous chemicals in a manufacturing process, monitoring the growth of biopharmaceuticals, and calibration of detectors used to assure that safe doses are delivered in medical treatments like radiation oncology.

The research infrastructure required to enable reliable and reproducible measurements in these important sectors of our economy is frequently well aligned with the research infrastructure which is required to support the accurate and reproducible detection of chemical agents, biological threats, radiological and nuclear threats.

Well defined measurement standards are central when comparing different technologies that are aimed at detecting the same threat in different scenarios, when comparing detection sensitivities of different measurement technologies, and when comparing data obtained by detectors used by Military versus Civilian agencies.

So when the Department of Homeland Security (DHS) Domestic Nuclear Detection Office (DNDO) needed to facilitate manufacturer-independent transfer of information from radiation measurement instruments for use in homeland security applications as well as for detection of illicit trafficking of radioactive materials, they talked to NIST. Working with the American National Standards Institute (ANSI) and the Institute of Electrical and Electronics Engineers (IEEE), a test and evaluation program for detection equipment was established. The data are currently maintained by NIST as part of the program. NIST is also working with DNDO in the

development of Technical Capability Standards to address the mandate in the SAFE Port Act (PL 109-347) to protect our ports from chemical, biological, nuclear and explosive (CBRNE) threats. NIST participates with the DHS Science and Technology Directorate (S&T) in the development of standards for devices which detect chemical and biological agents.

Partnering with Other Government Agencies, Industry, and Academia to Leverage Efforts and Avoid Duplication

NIST works closely with agencies such as the Department of Homeland Security (DHS), the Department of Defense (DOD), the Department of Justice (DOJ), and the National Nuclear Security Administration (NNSA), which are responsible for anticipating emerging threats. Through interactions with their program managers, mission leads, and interagency working groups, NIST is able to remain attuned to threats that are on the horizon, and develop appropriate measurement assurance plans in collaboration with the lead agencies. An example of this kind of interaction can be seen in the recently released National Strategy for Chemical, Biological, Radiological, Nuclear, and Explosive (CBRNE) Standards that was jointly developed by DHS, the Environmental Protection Agency (EPA) and NIST.

NIST helps other federal agencies understand both the scientific basis for potential detection technologies for these emerging threats, and the developments that would be required to achieve a robust and reliable measurement protocol. Given our primary mission to support industry, we are frequently in a position to point to existing detection technology that could be appropriate for detection of an emerging threat. NIST is also in a position to develop measurement standards that meet the need of both industry and the government agencies.

As an example of our support to other government agencies, NIST has been able to apply its experience in the development of calibration standards and measurements used to determine the radiation doses received in various medical procedures in treatments (e.g., mammography, brachytherapy) to help DHS develop methodologies that will measure and characterize the sensitivity of portal monitors that are used to scan shipping containers for radiation and nuclear threats.

NIST is currently working with DHS, and specifically DNDO, S&T, and the Office of Health Affairs, and also with DOD to develop common test methods and testing capabilities for Chemical, Biological, Radiological and Nuclear commercial off the shelf equipment. This effort will avoid duplication in testing efforts across several government agencies. As part of this effort the National Voluntary Laboratory Accreditation Program (NVLAP) is being used for the accreditation of the testing laboratories that are involved in the radiological and nuclear detection tests.

NIST also interacts with academia and industry through standards development organizations, workshops and conferences to ensure transparency of our efforts, and to stay abreast of emerging detector capabilities.

In particular, NIST looks to areas in which the absence of validated data is limiting the utility of a method, where research in measurement methods is required to establish that a method is suited

for reliable use in the field, and where the lack of reference material or calibration is a roadblock to technical progress. Frequently, we get an understanding of new measurement needs through engagement with thought leaders in academia who are delving into the frontiers of science.

Successes and Current Challenges of Improved Detection

Swipe Sampling and Trace Explosives — The best example of this method is deployed in airports where persons or objects are swiped with a cloth that is then quickly analyzed. Working with DHS and the Transportation Security Administration (TSA), NIST has helped develop standard methods for swipe sampling for biologics such as suspicious white powders and for trace explosives. Sampling that preserves the sample, has an understood efficiency for delivering samples to the detector, and meets constraints encountered in the field, has been dramatically improved though developments in measurement science.

In addition to these efforts, NIST has worked to develop a suite of Reference Materials and Protocols that can be used to assess the performance of instruments in the field. These materials and protocols are regularly used by TSA to assess the performance of their instrumentation, and are also being evaluated by the Bureau of Prisons and the State Department for possible use in assessing their instrumentation and training their operators.

NIST continues to make advances in this space and we are currently working to develop the tools that will enable a move to more non-intrusive sampling proceeds. As an example, NIST staff are currently working on solving the measurement challenges that must be overcome to incorporate trace explosive detection methods into credit card readers.

Chemical and Biological Threat Detection - Together with DHS, the Centers for Disease Control and Prevention (CDC), the National Institutes of Health (NIH), and EPA, NIST scientists are working on multiple projects to develop both improved sensor technologies and validated standards and procedures to assist local, state and federal agencies in the detection and response to chemical and biological threats. Examples of NIST work in this space include the following.

- NIST has been working with DOD and others to develop characterization tools to improve the sensitivity and reliability of the detection of numerous bioagents and toxins. Previous collaborations with NIST and the U.S. Army Dugway (Utah) Proving Ground have developed reliable methods based on DNA analysis to assess the concentration and viability of anthrax spores (Bacillus Anthracis). The techniques and data developed through this collaboration are essential steps in developing a reliable reference standard for anthrax detection and decontamination.

- In the wake of the Anthrax attacks, the first responder community needed better guidance and protocols to enable effective detection of biothreat agents during response and decontamination operations. Working with DHS, ASTM International, and the Association of Analytical Communities (AOAC International), NIST led the effort to develop the ASTM E2458 standard for the bulk sample and swab sample collection for suspected biological threat agents and ASTM E2770 for operational guidelines for the

initial response to a suspected biothreat agent. NIST is an active contributor to a DHS-led workgroup comprising also CDC, EPA, and DOE national labs to improve the Federal guidance on validation and use of environmental B. anthracis collection methods.

- Work at NIST in the area of Microelectrical Mechanical Systems (MEMS) and microfluidics is being leveraged by DOD, DHS, and EPA in the development of systems to detect trace amounts of chemicals or toxins in air and water.

Radiological and Nuclear Threats -- With new technologies emerging for detection of radioactive materials, NIST has been active in development of new detection standards. NIST has partnered with both ANSI and the International Electrotechnical Commission (IEC) to facilitate the development of Documentary Standards for portal and handheld detectors for radioactive materials. In addition, NIST has developed calibration capabilities and reference materials, so the performance of the radiation detectors can be reliably ascertained, by DNDO. NIST is working with DNDO and DOD to develop a program for testing commercial off the shelf radiological and nuclear detection instruments in an effort to the implement the 2011 National Strategy for CBRNE Standards, which represents the Federal consensus regarding CBRNE countermeasures standards.

Closing Remarks

Standards play an important role in reliable threat detection, as they establish the reproducibility of the measurement, comparability of measurements made at different locations with different technologies, and the comparability of historical data to the data available today.

Standards are important in quantifying the level of confidence that can be placed in the data.

NIST's focus is on measurement. With deep expertise dealing with measurement repeatability and uncertainty in such wide-ranging areas as Chemical, Nuclear, Biologic, and Explosives, we are well positioned to support the measurement assurance needs of academia, industry and other federal agencies. We do this through the development of standards, guidance and reference materials, and by providing technical advice when and where needed.

In conclusion, NIST expertise in measurement science and standards is playing a recognized role in providing the country with robust threat detection capabilities.

Thank you, again, for the opportunity to testify today. I would be happy to answer any questions you may have.

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Dr. Cavanagh is the Director of the Office of Special Programs at the National Institute of Standards and Technology. He is responsible for measurement science and standards spanning Biology, Chemistry, and Materials Science.

Dr. Cavanagh directly supports the NIST Director and Associate Director for Laboratory Programs by (1) coordinating and providing oversight of high-profile programs that span the mission and expertise of two or more NIST laboratories: (2) helping ensure that research supporting homeland and national security projects/programs is congruent with NIST's research capabilities and overall programmatic priorities, (3) overseeing and enforcing NIST policy on Human and Animal Subjects Research, (4) overseeing the development and implementation of NIST's policies regarding Scientific Integrity and Research Misconduct and (5) directing the day-to-day activities of the Reimbursable Agreements Coordination Office (RACO).

Prior to accepting this position, Dr. Cavanagh served as the Acting Director and Deputy Director of the NIST Material Measurement Laboratory.

Dr. Cavanagh joined NIST in 1979 after obtaining his Ph.D. in Physical Chemistry from Harvard University. He pursued an active research career in Surface Science, using state-selected and time-resolved laser diagnostics to examine the surface dynamics of small molecules.

Dr. Cavanagh is a Fellow of American Physical Society and the American Vacuum Society. Dr. Cavanagh has received the Department of Commerce's Silver and Gold medals, and currently chairs the Versailles Project on Advanced Materials and Standards.

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