U.S. Senate
Committee on Homeland Security and Governmental Affairs
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Introduction

Good morning Chairman Lieberman, Ranking Member Collins, and distinguished Members of the Committee. It is an honor to appear before you today to discuss the state of U.S biodefense ten years after letters containing *Bacillus anthracis* or "anthrax" killed five people and sickened seventeen others and to report on the biodefense portfolio within the Department of Homeland Security's (DHS) Science and Technology Directorate (S&T). In the decade since the Amerithrax incident there have been significant gains in the country's ability to detect, respond to and recover from a deliberate bioattack or a natural epidemic of infectious disease.

Designing and implementing a viable biodefense is a complex undertaking. U.S. efforts to date have engaged multiple Federal agencies, national laboratories, state and local governments, first responders, the medical and public health communities, the private sector and individual American households. International biodefense collaborations involving U.S. allies are underway. President Obama and Secretary Napolitano regard biosecurity as a top national priority. The President's recent address to the U.N. General Assembly urged all nations "to come together to prevent, detect and fight every kind of biological danger – whether it is a pandemic like H1N1, a terrorist threat, or a treatable disease."[12]

Overview of Biological Defense Programs at the Science and Technology Directorate

Since its creation in 2002, the Department of Homeland Security's Science and Technology Directorate (DHS S&T) has made many contributions to US biodefense in the form of knowledge products (analyses, standards, assays), new technologies and technical tools and through participation in various Interagency processes. S&T's efforts have been especially focused on:

- Biothreat studies - deepening our understanding of the specific biothreat agents of greatest concern to better focus national preparedness and response activities,
- Detection and Identification of bioagents -developing science-based strategies, practices and technologies required for the timely detection of covert biological attacks, including the development and fielding of the original Biowatch technology, and the precise identification of biothreat agents,

[1] Obama, Barack. "Remarks by President Obama in Address to the United Nations General Assembly." United Nations Headquarters. New York, New York. 21 September, 2011.

- Environmental remediation and area recovery - determining feasible and effective means of identifying and remediating the environmental contamination left in the wake of bioattacks,
- Essential Biodefense Laboratory Infrastructure - building and operating national laboratories essential to biodefense, such as the National Biodefense Analysis and Countermeasures Center (NBACC), the Plum Island Animal Disease Center (PIADC), and the National BioAgro Defense Facility (NBAF),
- Biodefense for Agriculture - conducting, in collaboration with the US Department of Agriculture (USDA), front line research in biodefense of US agricultural assets, including the development of diagnostics, medicines and vaccines relevant to foreign animal diseases
- Bioforensics - establishing a sound technical and operational basis for conducting forensic investigations of bioattacks and biocrimes.

DHS S&T staff have been highly active participants and leaders in numerous, ongoing Federal Interagency efforts to advance US biodefense. I co-chair the National Science and Technology Committee on National and Homeland Security, along with Mr. Zack Lemnios of the Department of Defense (DoD) and Phil Coyle, Associate Director of the White House Office of Science and Technology Policy. Our scientists serve on 32 Committees and Working Groups across the interagency. These working groups and committees examine the full range of biodefense issues from dual-use research, bioterrorism threat intelligence, and first responder detection CONOPs, to diagnostics and the development of medical countermeasures (MCM). These efforts involve all of the executive branch partners including Department of Health and Human Services (HHS), USDA, DoD, Department of Justice, and Environmental Protection Agency (EPA).

While there are still important challenges ahead of us, these extensive efforts have resulted in a government and citizenry considerably more prepared to respond to and recover from a biological attack than we were a decade ago. DHS S&T has been an important part of this progress. Building upon the work started in the national labs and other federal agencies, S&T has crafted a portfolio that addresses the full continuum of the threat. My testimony will provide an overview of the bioterror threat and DHS S&T's biodefense work.

The Bioterror Threat is Real and Will Grow as Bioscience Advances

Ten years after anthrax was mailed to members of the U.S. Congress and to media organizations, dozens of policy, intelligence, and technical reports have affirmed the viability of terrorist groups using biological weapons to cause death, suffering, and socio-economic disruption on a calamitous scale. In 2008, the Commission on the Prevention of Weapons of Mass Destruction Proliferation and Terrorism stated that it, "…is more likely than not that a weapon of mass destruction will be used in a terrorist attack somewhere in the world by the end of 2013." S&T has worked diligently to increase understanding of the full spectrum of potential threats and their consequences.

More than a decade ago, the Defense Science Board affirmed that, "there are no technical barriers to a large-scale bioattack."[2] We are living in the midst of a biotechnology revolution where the knowledge and tools needed to acquire and disseminate a biological weapon are increasingly accessible. It is possible today to manipulate pathogens' characteristics (e.g. virulence, antibiotic resistance), and even to synthesize viruses from scratch. These procedures will inexorably become simpler and more available across the globe as technology continues to mature. Thankfully, the combination of technical expertise required and the restrictions limiting the acquisition of the materials necessary for production still make this a challenging task.

Even small-scale attacks could be highly lethal and disruptive, and as has been noted, there is a real possibility of a campaign of bioattacks on multiple targets (the "reload" phenomenon) – because these weapons are self-replicating organisms. Moreover, it is not necessary for a nation-state to maintain a large stockpile of bioweapons to pose a significant asymmetric threat as the development of a significant offensive bioattack capability could occur within weeks or months.

DHS S&T Biothreat Studies

Understanding the biological threat and the relative risk posed by biological agents is a fundamental need for any biodefense capability. Homeland Security Presidential Directive 10: Biodefense for the 21st Century, DHS S&T has the responsibility to conduct the Biological Terrorism Risk Assessment (BTRA) every two years. The BTRA has been developed in partnership with experts in the law enforcement and intelligence communities, along with input from the scientific, medical, and public health communities, and serves as a starting point for biodefense investment priorities.

The BTRA is a comprehensive, strategic-level assessment designed to 1) aid in identifying and prioritizing credible, high impact threats, 2) aid in identifying and prioritizing vulnerabilities and knowledge gaps, and 3) provide a systematic, science-based, common framework for "what if" analyses. At its core, the BTRA is a model. It does not predict the future, but provides a way to think logically, using common assumptions, about more and less likely possible futures. The BTRA approach encompasses a wide variety of possible attack scenarios to ensure that the assessment outcomes are comprehensive. Consider the scope of the 2010 study which examined:

- 4 types of terrorists (international, state-sponsored, domestic, lone wolf) exploiting
- 43 different bioagents (38 human, five livestock pathogens) that may be obtained from
- 2 locations (foreign and domestic) by
- 5 routes of acquisition (among them theft and environmental isolation) with
- 6 methods of production and weaponization to attack
- 20 different targets (including a subway, stadium, transportation or outdoor events) using
- 8 modes of dissemination (e.g. food, aerosol) causing exposure by
- 2 routes (inhalation or ingestion) resulting in
- 3 public health consequences (illnesses, fatalities, and economic consequences).

[2] Defense Science Board, *Biological Defense*, June 2001; p.18.

The end result is millions of enumerated scenarios of what is possible in bioterrorism. To date, S&T has conducted BTRAs in 2006, 2008 and 2010. Additionally, S&T conducts companion analyses such as the Chemical Terrorism Risk Assessments (conducted in 2008 and 2010), the Radiological and Nuclear Terrorism Risk Assessment (conducted in 2010) and the Integrated Terrorism Risk Assessments (conducted in 2008 and 2010). These risk assessments are used by other Federal departments and agencies to guide their CBRN response planning.

The strength of the BTRA is due in large part to the work conducted by the National Biological Threat Characterization Center (NBTCC). This unique, national-level S&T asset was created by DHS in 2004 as part of the NBACC to address gaps in our knowledge related to high priority biological threat agents and to help support decisions regarding biodefense resource prioritization. The NBTCC performs scientific experiments to address the critical knowledge gaps related to acquisition, production, and dissemination in order to ensure an effective knowledge base for critical decision making in biological defense.

The most significant utilization of the BTRA is its role in providing risk input in shaping the multi-million dollar MCM investment decisions of the HHS. The Project BioShield Act of 2004 outlines the multi-step process utilized by DHS and HHS to ensure that the nation's MCM research, development, and acquisition activities are grounded in a risk-based process. In summary, as identified in the BTRA, the bio-agents which present the greatest risk to the U.S. population are further analyzed in a Material Threat Assessment (MTA) process led by DHS's Biodefense Knowledge Center, located at Lawrence Livermore National Laboratory. During the MTA process, DHS evaluates the intelligence and threat information for top priority agents and develops and models a "highly plausible" consequence scenario includes the number of potentially exposed individuals. The MTAs are provided to HHS, which then conducts further analysis to determine public health impacts. DHS and HHS work collaboratively to review all of these data and determine if an agent poses a significant national security threat. Based on these deliberations, the Secretary of Homeland Security issues a Material Threat Determination (MTD).

To date, DHS has issued 11 MTDs for biological agents, two MTDs for classes of chemical agents, one MTD for radiological materials, and one MTD for nuclear detonation effects. The MTD is a statutory requirement for procurements using BioShield funds; however the issuance of an MTD does not guarantee that the government will pursue countermeasures against that agent. If an MCM is sought, DHS has a statutory responsibility alongside HHS in recommending to the Office of Management and Budget to release the BioShield Special Reserve Funds.

Biological Surveillance, Detection, and Diagnostic Capabilities

Early indication of a biological attack is very challenging due to the dual-use nature of the required knowledge and materials and the small size of operational footprint necessary to produce the agents making detection difficult. In the absence of pre-attack interdiction, it is crucial that the U.S. has the means to detect and mitigate an attack either through large-scale technology programs such as BioWatch or through enhancing the capabilities of First Responders and Public Health professionals by, for example, the creation of better methods for

detecting bioagents in the field or conducting reliable lab analyses. Other S&T investments also work to create sensors which could automatically initiate protective actions (e.g. altering a building's airflow patterns) as well as develop rapid diagnostic capabilities as both a means of detection and a critical element to help mitigate an attack by guiding our response.

Standard Field Protocol for Rapid Resolution of Suspicious White Powders: Since 2001, responses to incidents involving suspicious "white powders" have impacted the First Responder community; these events are often costly and disruptive. S&T has invested in tools to both reduce the cost and impacts of these responses and to standardize the responses to ensure that any real events are optimally handled.

S&T has led an interagency effort with the Center for Disease Control and Prevention (CDC), Federal Bureau of Investigation (FBI), EPA and National Institute of Standards and Technology to develop multiple standards on bulk and swab sample collection of suspected biothreat powders and operational guidelines for initial response to a suspected biothreat agent to ensure that the procedures and sampling strategies used are effective and support confirmation and prosecution if a real incident were to occur. These standards were published by the American Society for Testing and Materials, an international standards organization in 2010. These standards are increasingly being adopted by First Responders and are already in use by multiple states and the FBI.

Rapid Portable BioDetector for First Responders: S&T is developing technology intended to evaluate suspicious powders in the field in a matter of minutes. Although laboratory confirmation is the only way to reliably determine the presence of a biological organism, this technology will help emergency responders assess a threat.

Detect to Protect (D2P): Current biodetection systems are designed to "detect to treat". Studies done by S&T of bioattacks and chemical attacks on subways and by DOD at the Pentagon show that bio-aerosols can spread throughout a subway system or building very quickly. These investigations highlight the need for very rapid, tight connections between initial detection of a release and response actions. Such "detect to protect" systems are challenging to build, because they must balance the need for a fast detection against the fact that fast detection sensors are prone to false alarms.

To address these difficulties, S&T is pursuing a multi-tiered bio-aerosol DP2 program for sensing a bioattack within metro systems, airports, buildings, and stadia. Low cost, rapid "trigger" sensors when tripped immediately initiate "behind the scenes" protective actions to slow spread of an agent, such as changing air flows within a space while turning on a confirmation sensor. The confirmation sensors are high confidence detection technologies provide the high confidence analysis necessary to support high-impact actions such as building evacuations or warnings to shelter in place or alerting of public health officials. Such a multi-tiered detection approach not only helps reduce the spread of the agent and the extent of human exposure in near-real time, but could also reduce system costs by decreasing the required number of expensive confirmer sensors. S&T is currently conducting operational tests and evaluations on the D2P system within the Boston Metro (Massachusetts Bay Transportation Authority – MBTA).

Assay development and standards: A key element of any successful detection or diagnostic tool is the assay which provides the ability to discern the unique molecular signatures of an agent. DHS S&T has a highly robust bioassay program that is focused on the development of improved assays as well as standards and test methodologies to foster confidence in deployed detection systems. Some of the aspects of assay development currently ongoing include:

- Efforts that focus on the creation of highly specific assays with the ability to differentiate microbes at the sub species. This is important because different sub species will have very different impacts on human health. This level of resolution is essential information for public health officials.
- The recent development of a rapid Ricin Detection Assay with extremely high specificity and sensitivity. This assay is currently undergoing its final validation study and is anticipated to be deployed through the Center for Disease Control and Prevention's (CDC) Laboratory Response Network (LRN) before the end of the calendar year.

DHS S&T has led the interagency in the development of standards that guide the appropriate levels of sensitivity and specificity needed for assays deployed in various environments. There are generally two levels of standards for assays, one for use by First Responders when making decisions to evacuate buildings or close off streets, and another used by the CDC to declare medical emergencies and issue medications. Working with the Association of Analytical Communities and their Stakeholder Panel on Agent Detection Assays S&T developed the consensus standards for Public Safety Actionable Assays (PSAA) to support the testing and validation of commercial technologies that might be used by the First Responders in the field. A much higher standard of performance is needed for those assays designed to be used by the CDC LRN when making high-impact public health decisions such as the distribution of antibiotics. At the request of the White House in Fiscal Year 2008, S&T has been working with our Interagency partners including the CDC, DoD, State and Local public health authorities to develop the Federal Standards for Assay Performance and Equivalency (FSAPE) which specifically aims to ensure a common standard for sensitivity and specificity for assays that will be used to make public health actionable decisions. This process is nearing completion and has already received the buy-in from multiple stakeholders in the public health community.

Any bio-detection architecture needs to be a coordinated effort leveraging multiple federal laboratories for sample analysis and public health decisions. S&T led in the establishment of the Integrated Consortium of Laboratory Networks (ICLN) to serve this purpose The ICLN coordinates a network of laboratories that, in the case of an act of bioterrorism, will be accountable for provision of timely, credible, and interpretable data in support of surveillance, early detection, and effective consequence management. By coordinating Federal labs, the ICLN can take a risk-based approach to events and minimize capability gaps of individual labs.

Advanced Biodiagnostics: Currently, there are no approved, point-of-care clinical diagnostic tests that physicians could use to determine if an individual is infected with a bioterror threat agent. The traditional diagnostic approach involves blood culture analysis which requires one or more days to deliver results. In situations where outcomes depend on rapid treatment after

exposure, or in mass casualty situations where scarce resources must be deployed intelligently, the ability to rapidly identify infected victims is a strategic necessity. DHS S&T, in partnership with the DoD Defense Threat Reduction Agency, the National Labs, and the CDC, are pursuing an effort to develop a broad-spectrum diagnostic with the potential to identify exposure to biological agents prior to the onset of symptoms.

Rapid Test for Antibiotic Susceptibility: DHS S&T, in collaboration with the CDC, has developed a rapid assay to determine antibiotic susceptibility for *B. anthracis* and *Y. pestis*. These rapid assays reduce the timeline for answers by 50% compared to the gold standard conventional susceptibility assay. Given that some of the biothreat agents possess very short incubation periods for disease onset and are coupled with high mortality rates after symptomology, the need for rapid antimicrobial susceptibility assays is critical.

Response and Recovery from Bioattacks

Much of our national biodefense investment focuses on detection of and medical treatment for a biological attack. However, it is equally essential to develop capabilities, protocols and technologies that support rapid attribution to identify the source of the attack as well as help an impacted area quickly and appropriately respond to and recover from an attack

Bioattack response and recovery operations are complex and much work remains to be done in this arena. The Environmental Protection Agency (EPA) has the lead in the area of environmental restoration but it is widely acknowledged that the EPA budget is too small to support a robust program. DHS S&T, as well as DoD, have made strategic investments in this area and several of the efforts have yielded valuable insights that I would like to bring to your attention.

Responding to an Attack: S&T's biodefense investments include the development of guidance and technologies to diminish uncertainty and enhance data-driven decisions in the hours and days after an epidemic is first detected. Immediately following a bioattack there will be a critical need for "situational awareness" - information leaders will need to guide the response - but reliable data will be hard to obtain quickly with current systems, technologies, biosurveillance capacities and communication flows. During the initial days following a covert attack, there is likely to be significant uncertainty regarding whether the observed epidemic is natural or deliberate, the scale of the attack, where the attack occurred; who was exposed; whether the bioagent is susceptible to specific antibiotics, whether and where the environment is contaminated, whether and where there might be additional attacks, etc.

Viable Particle Capture Device: This program is developing a low-cost deployable device that continuously samples the air and collects and stores any airborne particles or pathogens in a manner that keeps them viable for laboratory analysis. Because of the low-cost nature of the device it can be widely deployed throughout a city as an augmentation of the BioWatch network and after an attack has been detected the additional sample points would greatly increase the knowledge of where an agent had been dispersed. Even more importantly, the device ensures that any agent collected during an attack is viable allowing laboratories to identify it and test it for virulence and anti-biotic resistance.

Multi-Application Multiplex Technology Platform (MAMTP): The testing systems currently in use at the Laboratory Response Network labs that process the BioWatch samples were designed around the public health mission and are not optimized to support a Biodefense surveillance system in terms of the number of agents that can be tested and throughput. The MAMTP is a technology platform that will be able to perform up to 100 tests or detect 100 targets simultaneously within a single sample. The platform will use a standardized cartridge system to reduce costs and aid in surge capacity which will be needed to handle the thousands of samples that will be collected after an attack in an effort to identify where the agent has spread.

Anthrax Re-aerosolization: A significant question with regard to anthrax attacks is whether the anthrax bacteria, which are unusual as they are protected by an extremely hardy spore coat that makes it resistant to environmental degradation, could become "re-aerosolized" and continue to pose a health threat once it is deposited on surfaces following the initial attack. The answer has significant implications for remediation strategies, but existing data is limited and contradictory. DHS S&T, in partnership with DoD, EPA and the national labs, is conducting studies to understand this problem within urban areas. These studies will address gaps in our understanding and will inform key policy decisions for evacuation vs. shelter-in-place, distribution of medical countermeasures, clean-up, and re-occupancy.

Recovery from an Attack: It is essential that the Nation have the capability to rapidly restore buildings, public infrastructure and critical utilities to full-function after an attack. This need is especially pertinent in the context of anthrax, because of the long-lived nature of this microbe, but understanding the extent, duration and consequences of post-attack contamination needs to be further explored.

Interagency Biological Restoration Demonstration (IBRD): This interagency effort included partnerships with state and local governments in the Seattle Urban Area and was co-funded with the DoD's Defense Threat Reduction Agency. The IBRD program developed a Seattle Region Plan for determining approaches for response and restoration activities, which served as the foundation for the development of the "Interim Consequence Management Guidance for a Wide-Area Biological Attack" document that can be used by other cities.

Mass Transit System Biological and Chemical Dispersion Studies: S&T studied releases of simulated biological and chemical agents in the Boston subway and DC metro systems to determine how material would move, disperse, deposit and could be mitigated through fast acting detection systems and changes to the airflow control systems. This effort is being continued through a partnership with the Washington Area Metropolitan Transit Authority to conduct simulated attacks on the Metro system to develop response protocols and above-ground countermeasure requirements.

Bioforensics: In 2001, there existed numerous challenges associated with microbial forensics investigative capabilities. Among them were no biocontainment lab, staff or equipment singly dedicated to microbial forensic analysis and limited evidence handling processes peer-reviewed analytical methodologies, or quality guidelines. Today, S&T owns and operates a national asset for biological forensics and attribution, the National Bioforensics Analysis Center (NBFAC), which is part of NBACC, was established by HSPD10 as "the lead Federal facility to conduct

and facilitate the technical forensic analysis and interpretation of materials recovered following a biological attack in support of the appropriate lead Federal agency." S&T owns and operates this national asset for biological forensics and attribution.

The NBFAC provides 24/7 support for biocrime and bioterror investigations for the Federal Bureau of Investigation (FBI), DHS Customs and Border Protections , the U.S. Secret Service and other government agencies with dedicated staff, equipment and biocontainment laboratories designed specifically for bioforensic analysis. The NBFAC has developed sensitive and specific assay capabilities for more than 60 bacterial, viral and toxin agents and has processed over 8,000 samples and completed 137 cases in support of Federal Law Enforcement agencies. The NBFAC also maintains a Bioforensic Reference Repository collection of geographically and temporally diverse biological agents to support comparative forensic analyses. The NBFAC trains FBI examiners to safely handle biologically contaminated evidence and supports traditional forensic exams. As a result of NBFAC, the U.S. can now do in days to weeks what previously required months.

Construction of the National Bio- and Agro- defense Facility

S&T was charged by Congress to design and build the National Bio- and Agro-defense Facility (NBAF), a laboratory with the capacity to perform research and development work on large animals at the highest (BSL-4) laboratory biosafety containment levels. After an extensive three year competition and evaluation, Manhattan, Kansas was selected as the site for NBAF. Since 2009, Congress has appropriated $154 million for NBAF design, site preparation and construction. The state of Kansas has pledged to contribute $110 million towards construction costs and has donated land for the site. The total remaining cost of NBAF construction was estimated as of 2011 to be $874 million. Construction of this facility, which is an essential part of the US biodefense infrastructure, is dependent upon continued support from Congress.

For more than 50 years, the Plum Island Animal Disease Center (PIADC) has served as the primary US laboratory facility for conducting vital livestock disease research. Despite its many successes, the age of PIADC facilities, its limited capacity restricts research and is impeding the development of needed countermeasures. PIADC has no capacity to do research at the Biosafety Level 4 (BSL-4), the highest bio-safety level, which is essential to combating the most dangerous animal disease threats. Currently, the U.S. must rely on partnerships with large animal BSL-4 labs in Australia and Canada. In the event of a bioattack on agriculture, or an attack employing a zoonotic disease, the U.S. would be unable to do the research needed for response. PIADC has no surge capacity for response to wide-scale events and its island location off the coast of New York limits operations in adverse weather conditions. Failure to build the NBAF will not only place the security of US agriculture in jeopardy, but would seriously impair U.S. scientific eminence in this important field.

S&T's R&D efforts are subject to ongoing review

Biodefense is just one of the many areas addressed by S&T's diverse portfolio. To ensure that individual R&D projects are meeting the goals established by our partners in the operating components and the broader homeland security enterprise (HSE), S&T has committed to an annual review of our portfolio of basic and applied R&D and all proposed "new start" projects. The review process consists of written materials, an oral presentation by the project manager, and careful analysis of the project's likely impact and feasibility (or "riskiness") as judged against specific metrics determined by S&T with input from the operating components. These metrics are designed to address elements essential to programmatic success in the context of the DHS's QHSR missions, namely:

- *Impact:* Is our portfolio making a significant impact on our customer's mission?
- *Transition:* Are we transitioning relevant products to the field?
- *Technical Positioning:* Is our investment positioning the organization for the future?
- *Customer Alignment:* Are our projects aligned with well-understood customer requirements?
- *Customer Involvement:* Do we have the appropriate level of customer interaction?
- *Innovation***:** Are we sufficiently innovative in the way we approach our challenges?

A review panel of S&T leaders, the DHS Component representatives, and outside experts evaluates and rates each project. By measuring all of our projects against this framework, we will provide a transparent and "shareable" view of all R&D within S&T; enable more strategic, longer-term budget decisions; ensure efficient delivery to the component or end user; and nurture effective communication throughout the process. This particular review model has been used by both Federal and private R&D organizations, including the prize-winning Army Engineering, Research and Development Laboratory. Review is key to ensure that S&T remains focused on the highest priority challenges in biodefense and ensuring that our work is complementary, not duplicative, of other agencies.

Challenges Remain for Biodefense

The design and implementation of a robust, cohesive, and cost-effective biodefense system will be the work of a generation. Despite the significant gains made over the past decade, much work remains to be done to deal with today's – and tomorrow's – challenges. As President Obama has noted, true biodefense against both deliberate and natural epidemics of infectious disease must be an international endeavor.

In the coming years, the DHS S&T Directorate intends to focus its resources on developing capacities to detect bioattacks in near-real time in order to enhance protective response actions. There will also likely be calls to improve detection of a wider range of potential threat agents, including genetically altered, synthetic or unanticipated agents, and possibly to enable detection of food and surface contamination. Faster, more detailed and reliable characterization of bioevents to improve situational awareness and inform response will be necessary. We must continue to develop an agile approach that accommodates possible epidemics of emerging disease or attacks using unforeseen bioagents or agents not addressed by stockpiled countermeasures. Inexpensive, real-time, point-of-care diagnostics will be essential to enabling

rapid identification and treatment of those at risk from epidemic disease and to containing the spread of contagious disease. Strategies for coping with and stopping bioterror campaigns must be developed. Mechanisms of international cooperation in dealing with infectious disease outbreaks and collaborative approaches to financing and refining needed biodefense technologies and countermeasures must evolve.

It is critical to understand that bioscience is in a state of revolution. Advances in our understanding of living systems and our technological ability to manipulate these systems are proceeding globally at a breathtaking pace. The biothreat landscape of the next ten years will not resemble today's. The technologies, tools and capabilities being developed need to be viewed not just through the lens of today's threat agent list, but from the perspective of capabilities available to our adversaries in the future.

Thank you for the opportunity to appear before you today. I am happy to answer any questions you might have.