Building the Biodefense Policy Workforce

Workshop Report

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Executive Summary

Following 9/11 and the anthrax letters in 2001, the field of biodefense[1] significantly expanded to address global health, public health preparedness and response, medical countermeasure development, and civilian biological research, some of which includes select agents. The increasing investment in biodefense and concern about a bioterrorism attack within the United States and abroad suggests that the landscape for biodefense policy issues and workforce needs continue to evolve. During the past year alone, concerns about oversight of high-containment laboratories; vetting of personnel (personnel reliability); the efficacy of security measures in place for the select agent program; medical countermeasure research, development and distribution; bioterrorism and pandemic influenza preparedness; misuse of beneficial biological research and technologies; and microbial forensics have generated several policy evaluations and prompted the development of policy recommendations and legislation. Both governmental and non-governmental experts were, and continue to be, influential during this policy process. Although there exist several biodefense education and training programs as well as fellowships, there is still a critical need to educate the next generation of policy experts and scientists about these issues and encourage their involvement in the development of biodefense policies.

Two units of AAAS—the Center for Science, Technology and Security Policy and the Program on Scientific Freedom, Responsibility and Law – have conducted a study on educational initiatives to build a knowledgeable workforce in biodefense policy development and program management. The **goals** of this study were:

- to document and describe existing educational programs and materials on biodefense policy education initiatives;
- to highlight major challenges and knowledge gaps associated with existing educational initiatives on biodefense policy; and
- to provide recommendations for improving the overall system of workforce development for individuals working on biodefense policy development and program management.

We convened a group of experts in biodefense and biosecurity on August 11, 2009 at AAAS to review existing educational initiatives on biodefense policy, and to inform recommendations for improving workforce development activities in this area.

Workshop Summary

At the AAAS workshop, participants discussed the needs of the current federal workforce for biodefense and science and technology (S&T) policy as well as currently available education and training programs to address those needs. There was confusion about what constitutes the biodefense policy workforce; many participants wanted to include education programs on building a public health workforce capable of responding to a bioterrorism incident as well as the life science community about the potential biosecurity risks of their research. There was some disagreement among participants

[1] Biodefense is defined as defensive measures against a biological weapons attack while biosecurity has been more broadly defined as measures to protect against harm from a biological agent and includes traditional biodefense and public health activities. Since 2001, activities associated with biodefense and biosecurity seemed to have conflated so that both terms describe the full range of activities to mitigate or prevent an attack using biological weapons.

about whether biodefense should be a distinct discipline or an area of interest. However, there was clear consensus about the need to recruit and educate the next generation of biodefense policy experts using an interdisciplinary curriculum; to train mid-career biodefense policy makers to enhance their knowledge of the subject and become aware of current policy issues; to provide funding mechanisms to sustain these programs and support students in the programs; to encourage and reward professional scientists to become aware of and involved in the policy process; and to support multi-disciplinary research on biodefense policy issues within the academic community.

Workshop participants highlighted several major gaps and challenges:

- There is currently a very poor system in place to make young scientists (undergraduate and graduate students, and post-doctoral fellows) aware of "alternative" careers in science. Specifically, they are trained for a career in laboratory research but lack the skills to enter into a career in science policy or participate in policy-oriented activities.
- The tenure systems at research institutions do not support academics dividing their time between the research and other activities, such as involvement in the policy process or technically-trained principal investigators focusing solely on policy-relevant research in biosecurity.
- There is little incentive and institutional support for scientists and other academics to engage in multi-disciplinary collaborations (i.e., between technical and non-technical experts) to conduct policy-relevant research activities on biodefense issues.
- There is insufficient funding for short-term projects and for sustaining long-term collaborations and projects on biodefense issues.
- The level of interest, need and funding to sustain biodefense education programs is currently dependent on U.S. government priorities.
- Prospective students may not be able to afford the tuition costs for biodefense education programs and may need financial support to take these courses.
- The current balkanized structures in the federal government as well as some non-governmental settings limit the ability to work in the multi-disciplinary teams that are required to create and implement biodefense policy.
- Currently, there is no ideal metric for determining the efficacy of existing and future biodefense policy education programs.

These challenges should be considered when building and maintaining a knowledgeable workforce and involving professional scientists in the policy process.

Recommendations

The programs presented at the workshop and follow-up discussions identified the breadth of existing programs, as well as gaps and challenges in program development. It is our hope that the findings and recommendations in this report will improve education efforts in support of workforce development for individuals involved in biodefense policy development and/or program management.

Workshop participants identified several challenges in recruiting and promoting the involvement of scientists in the policymaking process. These challenges are common to any science policy subject-matter. The following recommendations focus on encouraging and rewarding scientists for their extracurricular involvement in the policy process.

1. **Universities and professional societies should expose undergraduate, graduate, post-doctoral scientists, and faculty to all possible career options and funding opportunities to pursue careers outside academia. Undergraduate and graduate students should be educated about public policy and how policy affects their research, and how scientific knowledge could impact the policy process.**

2. **Research institutions should encourage the involvement of students, post-doctoral fellows, and principal investigators in the policy process by consulting (e.g., federal government, National Research Council committee members, or professional society public policy boards), participating in policy meetings, or conducting policy-oriented research in addition to their discipline-specific research activities.**

3. **Research institutions should create a reward system for senior scientists that promotes involvement in public policy and encourages mentorship of younger scientists in policy-related issues.**

4. **Principal investigators should seek funding, where available, for policy-oriented research from a wide variety of federal or intergovernmental agencies and private foundations** – e.g., for biodefense policy research, funding could be sought from the National Science Foundation, Department of Energy, the National Institutes of Health, Department of Homeland Security, or the European Commission, to list a few, as well as private foundations. Biodefense activities are undergoing diversification to include international development, ethics, and safety, for which funding sources exist.

5. **Research institution recruitment, retention, and professional recognition policies should reward multidisciplinary research activities (i.e., experts with relevant technical and non-technical backgrounds) on a variety of policy topics.** These research activities could be short-term or long-term to address current and future policy issues. Such research is valuable on its own merit; however collaborative research can enhance the quality and message of the research activity.

Specifically focusing on the biodefense policy workforce, workshop participants discussed several methods for enhancing current education programs as well as developing new programs. While participants stressed the importance of a broad, interdisciplinary education, they noted the importance of developing education programs that recognizes workforce challenges of specific biodefense agencies.

6. **Program designers should ensure that programs stress an interdisciplinary curriculum and provide a broad education that encompasses the basic needs of the biodefense policy workforce.**

7. **Education programs should be designed to provide students with a broad understanding about biodefense issues, and the critical skills and ability to problem-solve that will enable them to address effectively the challenges of the federal policymaking community and specific biodefense agencies.**

8. **Mentorship and community building activities should be incorporated into continuing education for biodefense policy experts.** These activities help build professional networks, foster innovative thinking, and promote awareness of timely policy issues.

9. **For full educational value, table top exercises and simulations should be developed to include realistic scenarios and a variety of stakeholders, with multiple disciplines and perspectives. Facilitators and students should be prepared with all relevant information needed to participate fully.**

10. **Biodefense education programs must have sustainable funding mechanisms in order to develop and maintain programs that encourage active participation by students in the policy process as they gain their certificate or degree. Fellowships, scholarships, or other forms of financial compensation could support students in academic programs.** These mechanisms could be provided by the federal government, private foundations, or professional societies.

11. **Biodefense policy programs should recruit younger students from all educational levels – bachelors, masters, or doctoral – and incorporate field experience into their education. Mid-career professionals should continue to be trained by these programs to enhance their knowledge and marketability.**

Report

Background

Prior to 2001, U.S. biodefense initiatives were largely concentrated within the Departments of Defense (DoD) and State (DoS). Both the DoD and DoS had programs redirecting the research efforts of former weapons scientists and facilities to beneficial research activities, termed cooperative threat reduction.[2] In addition, the DoS was involved in treaty compliance and verification discussions of the Biological Weapons Convention (BWC), and DoD scientists were developing vaccines against diseases thought to be likely biological warfare agents.[3] Prior to 1999, the vast majority of biodefense countermeasures research was managed and executed through the DoD. A few select biosecurity programs, like the select agent program[4], bioterrorism preparedness education programs,[5] and export control programs, were overseen by other U.S. agencies. Much of the biodefense workforce prior to 2001 came from a military, public policy, or nuclear/chemical arms control background. Civilian life scientists in the U.S. were generally not aware of these activities, nor were they formally trained in biological arms control and nonproliferation. Although a few academic scientists were working with select biological agents, their goal was not biodefense, but rather to understand pathogenesis and host immune response for improved public health.

Following 9/11 and the anthrax letters in 2001, the field of biodefense significantly expanded from its origins in battlefield biodefense and international arms control to address global health, public health preparedness and response, medical countermeasure development, and civilian biological research, some of which includes select agents, and dual use research.[6] According to the GAO, by 2001, more than 20 federal departments and agencies had a role in preparing for or responding to a bioterrorist attack. Total annual funding of civilian biodefense activities rose from $576 million in 2001 to over $5

[2] See http://www.dtra.mil/oe/ctr/programs/index.cfm and http://www.bepstate.net/ for more information. However, prior to 2001, the U.S. Department of Energy had funded a small number of redirection programs for former Soviet weapons scientists through its Initiatives for Proliferation Prevention Program.

[3] The Biological Weapons Convention (BWC) is a multi-lateral treaty prohibiting the development, production, acquisition, transfer, retention, stockpiling and use of biological and toxin weapons. Over 160 nations are signatories. Following the failure of the verification protocol in 2001, an intersessional process was established under which parties to the treaty meet with non-governmental experts to address issues related to the BWC. See http://www.unog.ch/80256EE600585943/(httpPages)/04FBBDD6315AC720C1257180004B1B2F?OpenDocument for more information.

[4] Select agents are pathogens and toxins itemized by the U.S. Departments of Health and Human Services (HHS) and Agriculture (USDA) that pose significant risks to human, animal, and/or plant health (42 CFR 73). See http://www.selectagents.gov/ for more information.

[5] See Pinard WJ, Lee E, Frankel MS, Berger KM, Workforce Development: Preparing the Next Generation for Infectious Disease Threats (AAAS, 2009). See http://cstsp.aaas.org/content.html?contentid=2215.

[6] The term 'dual use' has several definitions. The most common definition is technologies that are used for civilian and military (i.e., military weapons) applications. 'Dual use research'' in biosecurity policy discussions refers to beneficial biological research that could be misused by malicious individuals for nefarious purposes. The NSABB and National Research Council recognized that an element of immediacy needed to be added to research activities of greatest concern to national security, otherwise all biological experiments could be considered dual use. Thus, the NSABB coined the phrase 'dual use research of concern' to describe biological research activities that could be directly misapplied for harmful purposes.

billion in 2008.[7] Thus, the academic and private biological sciences community became more firmly integrated into the post-2001 biodefense infrastructure. During the past eight years, several initiatives have emerged to educate health professionals to prepare for and respond to a bioterrorism incident.[8] Similarly, biosafety professionals have been introduced to biosecurity concepts, primarily from the select agent program and engagement with the National Institutes of Health Office of Biotechnology Activities.[9] While many life scientists are still fairly unaware of biosecurity issues, several academic, governmental, and international activities have been initiated to raise the level of awareness of issues like dual use research and legal obligations with regard to national and international security.[10] Biosecurity outreach activities have begun to address guidance as well as awareness. In the same vein, a few education and training programs have been developed to educate current and future biodefense policy professionals. However, much of the training still remains on-the-job, with much of the existing workforce not formally educated in a biological science and related policy areas, although this trend is changing.

The increasing investment in biodefense and concern about a bioterrorism attack within the United States and abroad suggests that the landscape for biodefense policy issues and workforce needs has changed dramatically and will continue to evolve. During the past year alone, concerns about oversight of high-containment laboratories; vetting of personnel (personnel reliability); the efficacy of security measures in place for the select agent program; medical countermeasure research, development and distribution; bioterrorism and pandemic influenza preparedness; and biological/microbial forensics have generated several policy evaluations and development of policy recommendations and draft legislation.[11] Both governmental and non-governmental experts were, and continue to be, influential during this policy process. The governmental experts at this AAAS workshop represented several different sectors – research, international programs, transportation, public health, and law enforcement.

In addition, many non-governmental experts are involved in biodefense and biosecurity policy. The congressionally mandated Commission on the Prevention of Weapons of Mass Destruction

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[7] Franco C. Billions for biodefense: federal agency biodefense funding, FY2008-FY2009. *Biosecur Bioterror*. 2008 Jun;6(2):131-46. The Center for Arms Control and Non-Proliferation's analysis of the biodefense budget, which includes the Department of Defense, lists ~ $9 billion were spent on biodefense in FY2009 (totaling ~$57 billion from FY2001 – FY2009) in the United States. See Center for Arms Control and Non-Proliferation, Federal Funding for Biological Weapons Prevention and Defense, Fiscal Years 2001 to 2009 (2008). http://www.armscontrolcenter.org/media/fy2009_bw_budgetv2.pdf.

[8] Pinard WJ, Lee E, Frankel MS, Berger KM, Workforce Development: Preparing the Next Generation for Infectious Disease Threats (AAAS, 2009). See http://cstsp.aaas.org/content.html?contentid=2215.

[9] See http://oba.od.nih.gov/rdna/rdna_symposia.html#CONF_005d for more information.

[10] United Nations. Biological and Toxins Weapons Convention (Geneva, Switzerland, 2008). See http://www.unog.ch/80256EE600585943/(httpPages)/008056527905C32EC125755A004B2B1B?OpenDocument; National Science Advisory Board for Biosecurity. Strategic Plan for Outreach and Education On Dual Use Research Issues (2008). See http://oba.od.nih.gov/biosecurity/PDF/FinalNSABBReportonOutreachandEducationDec102008.pdf; Commission on the Prevention of Weapons of Mass Destruction Proliferation and Prevention. *World at Risk* (2008). See http://www.preventwmd.gov/report/; Meeting Report, Sustaining Progress in the Life Sciences: Strategies for Managing Dual Use Research of Concern--Progress at the National Level, *Biosecur Bioterror* **7**, 93 (2009).

[11] For example: Executive Order 13486: Strenghthening Laboratory Biosecurity in the U.S. (2008); Select Agent Program and Biosafety Improvement Act of 2009 (H.R. 1225 and S. 485); WMD Prevention and Preparedness Act of 2009; and NIH. Synthetic Nucleic Acids and the NIH Guidelines for Research Involving Recombinant DNA Molecules (2009); see http://oba.od.nih.gov/rdna_rac/rac_pub_con.html.

Proliferation and Terrorism (WMD Commission)[12] consisted of former politicians, policy makers, and its staff was comprised of primarily non-governmental experts.[13] Other advisory groups – most notably, the National Science Advisory Board for Biosecurity,[14] National Biodefense Science Board,[15] the Biological Sciences Experts Group,[16] JASONS,[17] BioChem 20/20, and several National Academy of Sciences committees – all consist of non-governmental experts from academia, non-academic research institutions, private industry, professional trade associations, or think tanks. In addition to these formal mechanisms for input by outside experts, experts also contribute to the policy process through other informal mechanisms.

Science and Security Workforce

The workforce that is needed to address domestic and international biodefense initiatives from arms control treaties to disease surveillance to biological research infrastructure has changed since the mid-1990's, even more drastically since 2001. In 2003, a report by the Partnership for Public Service suggested that agency-specific needs assessments, federal hiring strategies, and funding for training and salaries are critical to improving the government's biodefense workforce.[18] At a recent hearing on the WMD Prevention and Preparedness Act of 2009, former Senators Bob Graham and Jim Talent discussed the need to enhance the biodefense intelligence workforce because of the expected retirement by 2014.[19] A few programs exist that provide education for mid-career policy experts and new, younger scientists in biodefense policy. These programs include the Pandemics and Bioterrorism: From Realistic Threats to Effective Policies from Massachusetts Institute of Technology,[20] and the Public Policy and Biological Threats Program from the University of California, San Diego's Institute on Global Conflict and Cooperation.[21] Some education programs have expanded to include younger generations and to provide academic degrees (both masters- and doctoral-level). George Mason University[22] and Georgetown University[23] have established biodefense policy programs for scientists and non-scientists to receive certificates or degrees in biodefense policy. The University of Maryland University College has a specialization in Biosecurity and Biodefense within

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[12] The WMD Commission published the report, *World at Risk*, which generated concern about the threat of bioterrorism and the possibility that beneficial civilian research could inadvertently contribute to it. This concern prompted the Senate Homeland Security and Governmental Affairs committee to write legislation to improve security of biological threat agents and mitigation activities following a biological incident. This legislation is still in draft form and is expected to be introduced in fall 2009.

[13] See http://www.preventwmd.gov/home/ for more information.

[14] See http://oba.od.nih.gov/biosecurity/biosecurity.html for more information.

[15] See http://www.hhs.gov/aspr/omsph/nbsb/ for more information.

[16] Bhattacharjee, Y. Panel Provides Peer Review of Intelligence Research. *Science* 7 December 2007 318: 1538.

[17] See http://fas.org/irp/agency/dod/jason/.

[18] Homeland Insecurity: Building the Expertise to Defend America from Bioterrorism: Partnership for Public Service (2003); Partnership for Public Service. Homeland Insecurity: Building the Expertise to Defend America from Bioterrorism. *Biosecur Bioterror* 2003;1(3):223-4.

[19] Senate Homeland Security and Governmental Affairs Committee Hearing, Preparation For Attacks Using Weapons of Mass Destruction. (September 22, 2009). See http://hsgac.senate.gov/public/index.cfm?FuseAction=Hearings.Hearing&Hearing_ID=6da43cb1-c958-4e67-8d2b-d85a3f407377 for more information.

[20] See http://web.mit.edu/professional/short-programs/courses/combating_bioterrorism.html for more information.

[21] See http://igcc.ucsd.edu/cprograms/PPBT/PPBT2009.php for more information.

[22] See http://pia.gmu.edu/grad/biod/ for more information.

[23] See http://grad.georgetown.edu/pages/certif_biodefense_ppol.cfm, http://grad.georgetown.edu/pages/certif_biohazard.cfm, and http://microbiology.georgetown.edu/masters/biohaz/ for more information.

its Biotechnology Studies Program.[24] Texas Tech University has offered a Certificate in Biodefense Law for law students since 2004.[25] Texas Tech University School of Law also has a proposed LLM in Biosecurity Law, for which they are currently seeking funding. DePaul University offers courses for educating lawyers about biodefense issues.[26] The University of Medicine and Dentistry of New Jersey has a biodefense certificate program for scientists.[27] Georgia Institute of Technology, through a MacArthur-funded program at the Sam Nunn School of International Affairs, offers the opportunity for graduate students in the life sciences and bioengineering to spend a year exploring science and security policy issues.[28] The University of Maryland (Advanced Methods of Cooperative Security Program[29]) and Princeton University (Program on Science and Global Security[30]) both offer general science and security education programs that include biodefense topics. The recently revised AAAS Guide to Graduate Education in Science, Engineering and Public Policy is a useful resource for educational programs in science policy.[31]

In addition, several other mechanisms exist to encourage more broad interactions among the science and technology, and policy communities. For many years, the Union of Concerned Scientists has organized a series of annual science and security seminars. Although the series has not typically focused on biodefense and biosecurity, it has been a valuable part of engaging the scientific community on other science and security topics. Several Foundations, including the John D. and Catherine T. MacArthur Foundation, the Carnegie Corporation of New York, the Ploughshares Fund, U.S. Institute of Peace, Lounsbery Foundation, and Sloan Foundation, have funded efforts to build expertise within the academic and non-governmental communities on a variety of science and security issues. Finally, several fellowships exist to educate scientists about the policy process via apprenticeship. Many of the fellowship recipients remain connected to or are part of the policy community. The programs include the AAAS Science & Technology Policy Fellowships,[32] the National Academy of Sciences Christine Mirzayan Science & Technology Policy Graduate Fellowship Program,[33] the Institute of Medicine's Robert Wood Johnson Health Policy Fellowship,[34] the Jefferson Science Fellowship at the U.S. Department of State,[35] the Foster Fellows Visiting Scholars Program at the U.S. Department of State,[36] and the Fulbright Scholars Program,[37] among others. Many of these fellowships are geared toward mid-career scientists interested in becoming involved in the policy process and/or pursuing a career in science policy.

Despite these initiatives, there remains a need to educate the next generation of policy experts and scientists about policy issues, regardless of area. Many areas of science and technology have been scrutinized by the public and policy makers. These include stem cell research, climate change,

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[24] See http://www.umuc.edu/departments/biot/biosecurityMS.shtml for more information.
[25] See http://www.ttu.edu/biodefense/certificate.php for more information.
[26] See http://www.law.depaul.edu/centers_institutes/iwcc/bio_vio.asp for more information.
[27] See http://www.umdnj.edu/gsbsnweb/academic_programs/certificate_programs4.htm for more information.
[28] See http://www.cistp.gatech.edu/ for more information.
[29] See http://cissm.umd.edu/projects/amcs.php for more information.
[30] See http://www.princeton.edu/sgs/ and http://www.princeton.edu/sgs/seminars/biosecurity/ for more information.
[31] See http://www.aaas.org/spp/sepp/sepabt.shtml for more information.
[32] See http://fellowships.aaas.org/ for more information.
[33] See http://sites.nationalacademies.org/PGA/policyfellows/index.htm for more information.
[34] See http://www.iom.edu/?id=5084&redirect=0 for more information.
[35] See http://sites.nationalacademies.org/pga/jefferson/ for more information.
[36] See http://www.state.gov/t/vci/c6275.htm for more information.
[37] See http://www.cies.org/about_fulb.htm for more information.

evolution, space exploration, nuclear weapons and power, cyber security, and biodefense and select agent research, to list just a few. In some cases (e.g., stem cells), policy makers are engaged in debates on how to manage the ethical and scientific issues. In other cases (e.g., nuclear power), scientific information is provided to policy makers to inform their debates. Both situations require experts who understand both the policy process and possess the appropriate technical expertise.

As described earlier, the policy process involves input from many different sources and stakeholders. The products - whether released publicly as statements, guidelines, laws, regulations, or actions – inform the myriad of programs implemented and managed by government, non-government, and contractor staff. Throughout the policy development and implementation process, external experts from non-governmental organizations, academia, private industry, research institutions, and/or the public can provide their opinions informally or formally, for example, via Federal Advisory Committee Act (FACA)[38] process. Some of this input can be advocacy pieces in favor or in opposition to a given issue, as in the case of lobbying organizations, or it can strike a more neutral perspective. Other input is gleaned from the experiences of existing programs, both privately and publicly administered. While some policy makers have sufficient knowledge to carry out their duties, others may need additional subject-matter expertise. However, in all cases, it is critical to understand how policy is created and implemented, whether in the United States or internationally. As this cursory description indicates, the processes of developing policies and implementing programs are very complex and require a workforce that includes a wide range of policy, legal, and subject matter expertise.

Focusing again on the biodefense policy workforce, the vast array of issues that must be addressed requires that individuals working on these issues are knowledgeable about their area as well as the overall strategic biodefense mission of their country. The programs to educate this workforce must be sustainable in order to withstand shifting priorities and/or limited funds. The current fiscal constraints on research funding combined with a dearth in tenure-track faculty positions have forced many life scientists to contemplate "alternative" careers in science. This appears to be a ready pool of technical experts who could be taught about science policy, biodefense, and current policy debates in this area. The bigger question is how to recruit and educate those individuals in science policy generally, and biodefense policy specifically, to contribute to the overall policy process.

The AAAS Project

Two units of AAAS—the Center for Science, Technology and Security Policy and the Program on Scientific Freedom, Responsibility and Law – have conducted a study on educational initiatives to build a knowledgeable workforce in biodefense policy development and/or program management. The **goals** of this study were:

- to document and describe existing educational programs and materials on biodefense policy education initiatives;

[38] The Federal Advisory Committee Act (FACA) was passed to ensure that advice provided by government advisory committees is objective and publicly accessible. See http://www.gsa.gov/Portal/gsa/ep/contentView.do?contentType=GSA_OVERVIEW&contentId=9673 for more information.

- to highlight major challenges and knowledge gaps associated with existing educational initiatives on biodefense policy; and
- to provide recommendations for improving the overall system of workforce development for individuals working on biodefense policy development and/or program management.

We held a workshop on August 11, 2009 at AAAS headquarters in Washington, DC, with a group of biodefense and biosecurity experts to review current education programs on biodefense policy, as well as to discuss how well these programs address the information needs of the relevant audiences. The agenda, questions asked, and lists of speakers and participants are included in the Appendix. Workshop reading material was provided in advance to each attendee.[39] Government representatives from the White House National Security Council, White House Office of Science and Technology Policy, Office of the Director of National Intelligence, Federal Bureau of Investigation, and Department of Defense attended the workshop.

We invited instructors to discuss their educational programs with the group, and workshop participants raised questions about the content of the programs, the level of understanding of the students, the audience, and the challenges in designing and implementing the programs. Along with these discussions, workshop attendees were asked to consider other educational offerings before proposing possible recommendations for developing the workforce involved in biodefense policy development and program management.

Workshop Summary

At the AAAS workshop, participants discussed the needs of the current federal workforce for biodefense and S&T policy as well as existing education and training programs to address those needs. Although participants discussed the education needs of scientists conducting potentially contentious research and the public health workforce for responding to a bioterrorism incident, the focus of this workshop was on building a cadre of policy makers knowledgeable about biodefense. There was some disagreement among participants whether biodefense should be a distinct discipline or an area of interest. There was clear consensus, however, about the need to recruit and educate the next generation of biodefense policy experts with an interdisciplinary curriculum; to train mid-career biodefense policy makers to enhance their knowledge of the subject and become aware of current policy issues; to provide funding mechanisms to sustain these programs and support students in the programs; to encourage and reward professional scientists to become aware of and involved in the policy process; and to support multi-disciplinary research on biodefense policy issues within the academic community.

The workshop began with a general discussion about the current status of the federal science and technology workforce and its needs in general. This was followed by a discussion of the biodefense workforce within the intelligence community and the initial panel discussion ended with a focus on biodefense policy workforce regardless of employment sector – government, academia, think tank, etc.

The federal government is currently facing an impending shortage of knowledgeable science and technology policy experts, who not only have expertise in S&T issues but also understand how policies are made and implemented. While in the private sector 41% of employees are over 45 years old, approximately 58% of federal government employees are over 45 years old, with an average age of 46

[39] AAAS set up a workshop website with reading material (see http://cstsp.aaas.org/Biodefense_Policy/index.html).

years. This suggests that within the next 20 years, a large percentage of the federal workforce will be approaching retirement or will have already retired from the government. This creates a "brain drain" within the federal government, where employees with institutional memory and knowledge about various policy issues will be leaving government service. Thus, there is a need to educate and train the next generation of S&T policy experts who are not only proficient in their subject area but also understand the federal budgetary process, the Congressional process, the roles and responsibilities of government agencies, and the process by which interagency coordination occurs. In addition, the workforce must also be able to communicate issues and potential solutions to a wide range of individuals within or outside the federal government who have varying levels of technical understanding.

The biodefense workforce in the intelligence community is involved in various aspects of intelligence collection, analysis and science and technology assessment. Approximately 9% of the intelligence workforce concentrating on weapons of mass destruction (WMD) threats is devoted to biodefense. Unlike the rest of the government, the bio-workforce in the intelligence community is predominantly young – 35 years old, or under with 47% in the first five years of hire. Approximately 75% have advanced degrees and are encouraged to maintain continuing education within their discipline. The workforce would highly benefit from formal education in biodefense-related issues or the life sciences. A few programs exist to provide this continuing education, including fellowships to pursue research sabbaticals. In addition, several programs exist to recruit young scientists into the intelligence community, including temporary employment opportunities, the Pat Roberts Intelligence Scholars Program,[40] the Stokes Educational Scholarship Program,[41] and the SMART Scholarship Program,[42] to name a few. Like other federal agencies, the intelligence community struggles with recruitment and retention of its biodefense workforce. This is in part due to the salary structure within the government and the numerous employment opportunities (with higher salaries) in the private sector or contracting firms that employ individuals with only a few years of field experience.

Regardless of sector, biodefense policy experts are of great value if they have subject matter expertise and knowledge of the policy process. Workshop participants highlighted the importance of a broad, multi-disciplinary education that included relevant scientific principles, public policy, and cultural and linguistic training. There was some discussion about whether to make biodefense its own discipline or whether to keep it as a multi-disciplinary field. Most participants supported biodefense as a multi-disciplinary field. This was mainly due to the tremendous assets gained from diverse disciplines and expertise. Two examples that demonstrate the benefits of a multi-disciplinary approach are the Southeastern Regional Center of Excellence for Biodefense and Emerging Infectious Diseases (SERCEB)[43] and Western Regional Center of Excellence for Biodefense and Emerging Infectious Diseases (WRCE).[44] SERCEB has a Policy, Ethics and Law Core that convenes a multi-disciplinary committee to review and address any social, ethical or legal issues related to the biodefense research being conducted within the affiliated university laboratories. These have included information regarding dual use research and related biosecurity issues (including the BWC) as well as human

[40] See http://www.dia.mil/employment/student/2008_PatRoberts_Intelligence_Scholar_Program_FINAL.pdf for more information.
[41] See http://www.nsa.gov/careers/opportunities_4_u/students/stokes.shtml for more information.
[42] See http://www.nsa.gov/careers/opportunities_4_u/students/undergraduate/smart.shtml for more information.
[43] See http://www.serceb.org/ for more information.
[44] See http://www.rcebiodefense.org/rce6/rce6pub.htm for more information.

subjects oversight and biosafety.[45] The WRCE Law Policy Ethics Core (LPECore) conducts research relevant to relevant policy, laws, and regulations in six areas of interest: laboratory biosecurity law, right to publish, vaccine approval regulations, animal research regulations, international human subject testing guidelines and international intellectual property for biodefense researchers. The WRCE LPECore holds intellectual property law clinics for advising researchers on product development, and has established a Hotline for Biosecurity Law that fields questions from biodefense researchers regarding policy, law and ethics.[46] These programs are part of the eleven National Institute of Allergy and Infectious Diseases Regional Centers of Excellence (RCE). Workshop participants noted that the RCE contracts do not include requirements or funding mechanism for establishing a policy and law core. Thus, the two examples described above are the only RCEs with policy and law cores of the eleven total RCEs.[47] These core programs not only educate and enhance ongoing scientific research in biodefense, but they also contribute their academic expertise in the policy process. The gaps and challenges section will highlight the challenges for involving scientists in the policy process.

Educational Programs

As described in the introduction, several academic programs exist to educate young or mid-career professionals in biodefense policy. These programs help provide the knowledge base for younger students and augment the field experience of mid-career professionals. The students go on to work in the federal government (including the intelligence community), contracting firms, academia, or think tanks. These individuals may play a role during policy development or program implementation, or they may contribute as independent policy researchers or analysts.

A combination of didactic lectures and exercises are used among all the programs discussed at the workshop. The instructors for the lectures are either from the institution or guest lecturers from the field. The guest lecturers can provide a real-world perspective on the development and implementation of policy. In addition to their educational value, guest lecturers also help students learn more about careers in biodefense and their professional development. Once students are in the field, some of these lecturers have served as their mentors.

Exercises consist of active role playing simulations with students, followed by a discussion about the choices made during the exercise. Most participants agreed that with advanced planning, instruction, and researching of the roles, exercises are very useful tools to teach students about policy development and application as they relate to specific incidents. One example of this is a Texas Tech University simulation in which immediate legal advice had to be given without time for detailed research on the topic, a situation that could happen in a terrorist incident and/or public health emergency.

Below is a selection of existing programs for educating the biodefense policy workforce:

> *George Mason University Biodefense Graduate Program*[48]
> George Mason University's Biodefense Graduate Program offers masters and doctoral degrees in biodefense. The programs takes a multi-disciplinary approach to learning about biodefense policy issues by requiring students to learn about microbiology, biotechnology, security,

[45] See http://www.serceb.org/cores_policy.htm for more information.
[46] See http://www.rcebiodefense.org/rce6/core_law.htm and www.ttu.edu/biodefense for more information.
[47] See http://www3.niaid.nih.gov/LabsAndResources/resources/rce/sites.htm for more information.
[48] See http://pia.gmu.edu/grad/biod/ for more information.

intelligence analysis, and policy. A selection of the courses offered include: Approaches to Biowarfare Medical Treatment and Response; Development of Vaccines and Therapeutics; Ethics and International Security; and Terrorism and Weapons of Mass Destruction. In addition, students are required to take courses on international relations and all-hazard emergency preparedness. For mid-career students, this program serves to augment their current field experience and improve their job performance. For younger students, the program seeks to provide the necessary knowledge base to enter into the job market.

Texas Tech University School of Law Certificate in Biodefense[49]
Texas Tech University School of Law offers its law students a certificate program in biodefense from its Center for Biodefense Law and Public Policy. Students of this program have a biodefense concentration with the law degree. The certificate program requires students to take 14 of 90 course hours of biodefense-specific electives. Courses include Law and Bioterrorism; National Security Law; Law and Psychiatry; and Law, Science Policy and Scientific Evidence. In addition to coursework, the certificate program has a written component that enables students to present their research in a yearly student symposium. Examples of these written assignments include pamphlets on the Department of Health and Human Services (HHS)-Centers for Disease Control and Prevention (CDC) Select Agents, the Select Agent selection process, and avoiding loss of patentability caused by oral and poster presentations. When relevant, these pamphlets are distributed to the WRCE[50] investigators to help them navigate the legal and regulatory environment pertaining to their research. Texas Tech University School of Law has also created a Biosecurity Law LLM degree program and joint JD/MS Environmental Toxicology degree program.[51]

University of Medicine and Dentistry of New Jersey Certificate Program in BioDefense[52]
The University of Medicine and Dentistry of New Jersey (UMDNJ) offers a Certificate Program in BioDefense in the Graduate School of Biomedical Sciences. The students are mostly biologists contemplating medical school or a non-laboratory career track. However, the program does educate first responders and federal employees. The BioDefense certificate offers courses on biochemistry, molecular biology, cell biology, select agents, bioterrorism and homeland security. Examples of courses include: Introduction to Select Agent Biology, Biological Terrorism and Weapons of Mass Destruction, a Seminar in Homeland Security, Biochemistry and Molecular Biology, Cell Biology, and a seminar series on biodefense legislation, legal reports and history.

Public Policy and Biological Threats Summer Training Workshop[53]
The University of California, San Diego's Institute on Global Conflict and Cooperation (IGCC) runs the Public Policy and Biological Threats Summer Training Workshop. The IGCC program immerses the students in a 9-day long program that includes guest lectures from experts in various biodefense communities and table top exercises. The students come from a variety of disciplines, including the biological sciences, from the U.S. and abroad. To enhance the

[49] See http://www.ttu.edu/biodefense/certificate.php for more information.
[50] This is the Western Regional Center of Excellence for Biodefense and Emerging Infectious Diseases.
[51] See http://www.ttu.edu/biodefense/courses.php for more information.
[52] See http://www.umdnj.edu/gsbsnweb/academic_programs/certificate_programs4.htm for more information.
[53] See http://igcc.ucsd.edu/cprograms/PPBT/PPBT2009.php for more information.

interaction, lecturers stay on site with the students and time is built into the program for networking and professional development. This program covers a wide range of topics including Bacterial and Viral Pathogenesis, Bioweapons, and Disease Intelligence and Surveillance. In addition, the program capitalizes on current events (e.g., H1N1 2009) to address relevant biodefense activities during the course.

Pandemics and Bioterrorism: From Realistic Threats to Effective Policies[54]
The Massachusetts Institute of Technology (MIT) Security Studies Program offers a short course on Pandemics and Bioterrorism: From Realistic Threats to Effective Policies. This course has existed for several years and serves to augment the mid-career professional's field experience. It focuses on the latest developments in the field of biodefense and the application of organizational theory to practice. The 2009 course covered the H1N1 2009 pandemic, the 1976 swine flu mass immunization, SARS & H5N1 avian influenza, biological weapons and national security, and case studies on the anthrax letters and smallpox immunization program.

Gaps and Challenges[55]

Workshop participants identified several gaps and challenges in educating a biodefense policy workforce and involving scientists in the policy process. Many of the challenges differ between programs concentrating on building an educated policy workforce and those seeking to better involve scientists in the process. A few challenges, like general lack of funding and support for multi-disciplinary activities, are shared by both groups.

Because federal funding for basic and applied biological research has leveled off, more young biological scientists are considering non-laboratory career options, specifically science policy. There is currently a very poor system in place to make young scientists (undergraduate and graduate students, and post-doctoral fellows) aware of "alternative" careers in science. Specifically, they are trained for a career in laboratory science but lack the skills to enter into a career in science policy or participate in policy-oriented activities. Though prominent, this challenge is not universal since many scientists do enter and have successful careers in science policy as well as contribute to the policy process as an auxiliary activity.

Workshop participants discussed how the tenure system at research institutions does not support academics dividing their time between research and other activities, such as involvement in the policy process or technically-trained principal investigators focusing solely on policy-relevant research in biosecurity. The tenure system rewards investigators for scholarship, education and national (e.g., public) service. Scholarship includes funding and publications, education includes formal teaching and informal laboratory training or mentorship, service includes serving on institutional or external committees such as Institutional Review Bodies or NIH study sections. Involvement in ancillary activities, such as becoming involved in the policy process, detracts from securing federal funding and publishing in high-impact journals.

[54] http://web.mit.edu/professional/short-programs/courses/combating_bioterrorism.html for more information.
[55] Some of the biodefense-specific challenges were identified in a 2007 University of Pennsylvania ISTAR workshop on biosecurity and federal training. Dr. Harvey Rubin was the organizer. See http://www.istar.upenn.edu/index.html for more information.

While discussing whether biodefense should be its own academic discipline or remain as a multi-disciplinary field, workshop participants tended to support the multi-disciplinary structure. While there is increased emphasis on multi-disciplinary collaborations in which external social scientists are incorporated into technical research projects, many participants noted, however, that there is little incentive and institutional support for scientists and other academics to engage in multi-disciplinary collaborations (i.e., between technical and non-technical experts) to conduct policy-relevant research activities on biodefense issues. This is reinforced by the lack of available funds for funding short-term projects and sustaining long-term collaborations and projects on biodefense issues. This problem is shared by academia, professional societies, think tanks, and some governmental offices. In 2009, the only private foundation funding biodefense policy research or biodefense activities was the Alfred P. Sloan Foundation.

Following the 2001 anthrax attacks and the significant increase in biodefense activities, several academic programs were created in order to formally educate the next generation of biodefense policy workforce or augment and enhance the performance of the existing workforce. Many of these programs rely on public or private funding or student tuition as their principal funding source, although mid- to late-career professionals taking these courses may have their tuition covered by their employer. The level of interest, need and funding to sustain biodefense education programs currently is dependent on U.S. government priorities and the availability of funding from public or private sources. In addition, prospective students may not be able to afford the tuition costs for biodefense education programs and may need financial support to take these courses.

Workshop participants discussed how current balkanized structures in the federal government as well as some non-governmental settings limit the ability to work in the multi-disciplinary teams that are required to develop and implement biodefense policy. As is true with most S&T policy issues, biodefense requires a broad understanding of the technical and related non-technical issues. This multi-disciplinary knowledge base is necessary to comprehend fully the issue at hand and to create or affect policy that considers all relevant aspects of a given issue.

Although not a prominent part of the overall workshop discussion, some participants alluded to evaluating the success of their education or training programs. There is currently no good metric for determining the efficacy of education programs on biodefense policy.

Recommendations

At the workshop, participants discussed existing education programs for biodefense and science policy, more generally, as well as gaps and challenges in developing and sustaining those programs. It is our hope that the findings and recommendations of this report will improve education efforts in support of workforce development for individuals involved in biodefense policy development and/or program management.

Workshop participants identified several challenges in recruiting and promoting involvement of scientists in the policy process. These challenges are common to any science policy subject-matter. The following recommendations focus on encouraging and rewarding scientists for their extracurricular involvement in the policy process.

1. **Universities and professional societies should expose undergraduate, graduate, post-doctoral scientists, and faculty to all possible career options and funding opportunities to pursue careers outside academia. Undergraduate and graduate students should be educated about public policy and how policy affects their research, and how scientific knowledge could impact the policy process.**

2. **Research institutions should encourage involvement of students, post-doctoral fellows, and principal investigators in the policy process by consulting (e.g., federal government, National Research Council committee members, or professional society public policy boards), participating in policy meetings, or conducting policy-oriented research in addition to their discipline-specific research activities.**

3. **Research institutions should create a reward system for senior scientists that promotes involvement in public policy and mentorship of younger scientists in policy-related issues.**

4. **Principal investigators should seek funding, where available, for policy-oriented research from a variety of federal or intergovernmental agencies and private foundations** – e.g., for biodefense policy research, funding could be sought from the National Science Foundation, Department of Energy, the National Institutes of Health, Department of Homeland Security, or the European Commission, to list a few, as well as private foundations. Biodefense activities are currently being diversified to include international development, ethics, and safety, for which there are funding sources.

5. **Research institution recruitment, retention, and professional recognition policies should reward multidisciplinary research activities (i.e., experts with relevant technical and non-technical backgrounds) on a wide variety of policy topics.** These research activities could be short-term or long-term to address current and future policy issues. Such research is valuable on its own merit; however collaborative research can enhance the quality and message of the research activity.

Specifically focusing on the biodefense policy workforce, workshop participants discussed several methods for enhancing current education programs as well as developing new programs. While participants stressed the importance of a broad, interdisciplinary education, they noted the importance of developing education programs that recognizes workforce challenges of specific biodefense agencies.

6. **Program designers should ensure that their programs stress an interdisciplinary curriculum and provide a broad education that encompasses the basic needs of the biodefense policy workforce.**

7. **Education programs should be designed to provide students with a broad understanding about biodefense issues, and the critical skills and the ability to problem-solve that will enable them to address effectively the challenges of the federal policymaking community and specific biodefense agencies.**

8. **Mentorship and community building activities should be incorporated into continuing education for biodefense policy experts.** These aid in building networks, innovative thinking, and learning more about timely policy issues.

9. **For full educational value, table top exercises and simulations should be developed to include realistic scenarios and a variety of stakeholders, with multiple disciplines and perspectives. Facilitators and students should be prepared with all relevant information needed to participate fully.**

10. **Biodefense education programs need to have a range of sustained mechanisms for funding to develop and maintain the programs and encourage active participation by the students in the policy process as they gain their certificate or degree. Fellowships, scholarships, or other forms of financial compensation could support students in the academic programs.** These mechanisms could be provided by the federal government, private foundations, or professional societies.

11. **Biodefense policy programs should recruit younger students from all educational levels – bachelors, masters, or doctoral – and incorporate field experience into their education. Mid-career professionals should continue to be trained by these programs to enhance their knowledge and marketability.**

Conclusion

Since 2001, biodefense has become a major concern in the U.S. and in many other countries. Within the U.S., biodefense activities have significantly expanded to address civilian biological research and development activities as well as the public health sector. Biodefense policy makers are no longer simply addressing the traditional arms control and nonproliferation aspects of state-sponsored programs, redirection of former weapons scientists and facilities, and treaty negotiation and compliance. Today, policy makers must understand a variety of biological agents and experimental activities (e.g., synthetic biology and potentially contentious microbiological techniques), biosafety and high-containment laboratories, vaccine and drug development, public health preparedness, disease surveillance, and other scientific and health related topics. In addition, the concern over non-state actors and lone terrorists requires the policy maker to consider the cultural, societal, economic, and other related non-technical aspects of an issue. Developing and implementing policy in these diverse fields requires not only subject matter expertise, but also an understanding how the policy process works and the skills to navigate new policies/programs through that process. Thus broad, interdisciplinary education or training to build and maintain a knowledgeable workforce for biodefense policy development and program implementation is required, and involvement of scientists is critical to the policy process. We hope the challenges highlighted in this report and the recommendations provided to address those challenges will increase the quality and quantity of S&T policy experts, particularly in the biodefense policy workforce.

Table 1. Biodefense Policy Education Programs

Academic Institution	Department	Program	Extent of Biosecurity Content
Cornell University	Science and Technology Studies	Course - The Dark Side of Biology: Biological Weapons, Bioterrorism, and Biocriminality	Explores scientific, political, legal, and ethical dimensions related to biological weapons and dual-use technology.
DePaul University	College of Law	Course - International Security and Bioviolence/International Security Law	Touches upon dual-use, but not a major focus of course.
George Mason University	Department of Public and International Affairs	Biodefense degree program	Courses on microbiology, biotechnology, security, intelligence analysis, biodefense and public policy, medical countermeasure development, ethics, international security, terrorism, and all-hazards preparedness.
George Washington University	Department of Health Policy	Biodefense and Biosecurity; Disease, Security and Public Policy - These are electives	Overview of the terms, technologies and fields of biodefense and biosecurity. Government initiatives are discussed to combat threat of biological weapons, including securing former offensive research sites around the world and ensuring pathogen security.
Georgetown University	Graduate School of Arts and Sciences, Department of Microbiology and Immunology	Biohazardous Threat Agents and Emerging Infectious Diseases	Addresses the knowledge gap in the science of biohazardous agents and emerging infectious diseases facing the world community - whether such threats occur naturally or are purposefully distributed.
Georgetown University	Graduate School of Arts and Sciences	Biodefense and Public Policy	Courses in microbiology, bioterrorism, disease surveillance, medical countermeasures, public policy, risk assessment, and federalism.
Georgia Institute of Technology	Sam Nunn School of International Affairs	Courses: Science, Technology, and International Affairs; Emerging Technologies & Security	biodefense

Massachusetts Institute of Technology	Security Studies Program	Pandemics and Bioterrorism: From Realistic Threats to Effective Policies	Covers a range of biosecurity concerns
Princeton University	Woodrow Wilson School of Public and International Affairs	Program on Science and Global Security	Includes biosecurity seminar series
Texas Tech University	School of Law, Center for Biodefense, Law, and Public Policy	Certificate in Biodefense; Joint JD/MS Environmental Toxicology Program	Courses: Law and Bioterrorism; National Security Law; Law and Psychiatry; and Law, Science Policy and Scientific Evidence. A written component that enables students to present their research in a yearly student symposium
University of California, San Diego	Institute on Global Conflict and Cooperation	Public Policy and Biological Threats Summer Training Program	Bacterial and Viral Pathogenesis, Bioweapons, Disease Intelligence and Surveillance, and other timely and relevant topics
University of Maryland	Center for International and Security Studies at Maryland	Advanced Methods for Cooperative Security Program	Controlling Pathogens Project
University of Maryland University College	Graduate School of Management & Technology	Biotechnology Studies Program; Specialization: Biosecurity and Biodefense	bioterrorism, threat analysis and response and biodefense and information technology
University of Medicine and Dentistry of New Jersey	Graduate School of Biomedical Sciences	Certificate Program in BioDefense	Courses in biochemistry, molecular biology, cell biology, select agents, bioterrorism and homeland security

Appendix

Workforce Development: Biodefense Policy

August 11, 2009
AAAS, Abelson/Haskins Room
9:00 am – 5:00 pm

Agenda

9:00	**Welcome**: Opening Remarks by AAAS
9:15	**Biodefense Workforce Needs** *Lawrence Kerr, Ph.D.*, Office of the Director of National Intelligence *James B. Petro, Ph.D.*, National Security Council *Peter Emanuel, Ph.D.*, Office of Science and Technology Policy
10:15-10:30	Break
10:30-12:15	**Panel: Educational Programs** Biodefense Graduate Program *Greg Koblentz, Ph.D., M.P.P.*, George Mason University Law and Biodefense Certificate *Victoria Sutton, Ph.D., M.P.A, J.D.*, Texas Tech University Certificate Program in BioDefense *Nancy Connell, Ph.D.*, University of Medicine and Dentistry of New Jersey
12:15	Lunch
12:45-2:15	**Panel: Educational Programs** (continued) Public Policy and Biological Threats *Samuel Bozzette, M.D.*, RAND Pandemics and Bioterrorism: From Realistic Threats to Effective Policies; MIT *Greg Koblentz, Ph.D., M.P.P.*, George Mason University
2:15-2:45	**Unaddressed Gaps and Challenges** *Kathleen Vogel, Ph.D.*, Cornell University
2:45-3:00	Break
3:00-5:00	**Discussion on Findings and Recommendations**
5:00	**Adjourn**

Workforce Development: Biodefense Policy

August 11, 2009
AAAS, Abelson/Haskins Room
9:00 am – 5:00 pm

Discussion Questions

- What is the best program design?
  - What is the best educational context these programs?
  - What content/topics should be included in the program?
  - What resources are already available and what additional resources are needed?

- How can we effectively implement these programs?
  - What are the challenges for implementing these programs?
  - What audience (i.e. disciplines) is appropriate for these programs?

- How can these programs be made sustainable?

Workforce Development: Biodefense Policy

August 11, 2009

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Workforce Development: Biodefense Policy

August 11, 2009

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