Scientific Engagement in the Broader Middle East and North Africa

Lessons in Promoting a Safe and Secure Research Environment

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“International Engagement: Bioscience for a Safe and Secure Society”
Scientific Engagement in the Broader Middle East and North Africa:
Lessons in Promoting a Safe and Secure Research Environment


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About the Report
This report describes the challenges faced and suggestions made for promoting safe, ethical, and secure life sciences research in the broader Middle East and North African regions. The information relayed in this report comes from four workshops and a collaborative sub-grant program that the American Association for the Advancement of Science Center for Science, Technology and Security Policy (CSTSP) conducted in the region between 2010 and 2012. CSTSP held the meetings in collaboration with the Jordan University of Science and Technology, Kuwait Institute for Scientific Research, Institute Pasteur of Tunis, University of Tunis Faculty of Science, and Dubai Healthcare City. The project was conducted with the generous support of the U.S. Department of State Biosecurity Engagement Program.

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Disclaimer
The statements, challenges, and suggestions included in this report reflect the discussions at the workshop and do not necessarily represent the views of JUST, KISR, IPT, FST, DHCC, and the AAAS Board of Directors, Council, or membership.

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We would like to include a special thank-you to our host collaborators - Dr. Hayfaa Almudhaf from the Kuwait Institute for Scientific Research (KISR), Dr. Hechmi Louzir and Hichem Ben Hassine from the Institute Pasteur of Tunisia, Dr. Amel Bennamer-Elgaaied from the Faculty of Science of the University of Tunis, and Dr. Ayesha Abdullah from the Dubai Health Care City. Their efforts were critical to the success of the meetings in Kuwait, Tunisia, and United Arab Emirates. CSTSP wants to thank KISR, the Kuwait Foundation for the Advancement of Science and Dubai Health Care City for generously supporting meeting-related expenses for the Kuwait and UAE meetings, respectively.
CSTSP would like thank the scientists who attended our regional meetings, voiced their opinions, applied for the collaborative grants, shared their experiences with their students and peers, and assumed leadership roles in the meetings and collaborative subgrant projects. Without the involvement, trust, and honesty from all scientists involved, AAAS would not have learned so much about the needs and interests of scientists from the BMENA region and could not have developed programs to meet the needs of regional scientists.

We would like to extend a special thanks to all those scientists who have invested significant time in continuing the efforts that were initiated during the project. The list of scientists who have played a stronger role in facilitating follow-on activities is available at http://www.aaas.org/cstsp/files/BMENABioscienceForum-Final.pdf.

Finally, we would like to thank AAAS leadership and CSTSP staff members who contributed to the project, including a number of former CSTSP staff— including Thomas Hennig, Meghan Seltzer, Kayleen Gloor, Diya Timothy and Laura Boselovic, and Dr. Gerald Epstein.

When AAAS and the BEP program began developing the meetings and collaborative subgrant program, only two other organizations were carrying out bioengagement activities in the region. Around the same time that AAAS began planning its first meeting, the Biosafety and Biocontainment International Conference (BBIC) began to hold conferences in the region on biosafety and biosecurity issues, which led to the development of national biosafety associations across the region. Prior to the AAAS program and BBIC, the Nuclear Threat Initiative was supporting a regional effort on water-borne disease surveillance (Middle East Consortium for Infectious Disease Surveillance). All three efforts addressed biological risks in different, but complementary, ways - scientific responsibility and international cooperation, biosafety and biosecurity, and infectious disease surveillance.

CSTSP is confident that our efforts have promoted trust-building between scientists from the United States and BMENA countries; linked responsible scientific stewardship (which includes safety, security, ethics, and environmental consciousness) with scientific progress and international collaboration; and built a network of scientists with different levels of seniority, types of scientific disciplines, and research focus.

We hope that this compendium report provides important information, suggestions from BMENA and U.S. scientists, and lessons learned to those individuals and organizations that fund and/or implement bioengagement programs in the BMENA region.

Sincerely,

Norman P. Neuretier, Director
Kavita M. Berger, Associate Director
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AAAS Center for Science, Technology and Security Policy
Executive Summary

Biological science and biotechnology are advancing at an unprecedented rate and being applied to such diverse sectors as energy, agriculture, health, the environment, and national security. The life sciences have become such an important part of today's global economy and vitality that many countries have invested in research and workforce development in the biological sciences. Many countries and regions face problems in health, agriculture, energy, and available resources; possible solutions to many of these problems come from life science research and international cooperation in the biological sciences. International research partnerships not only produce knowledge and products to address problems, they also play an essential role in transferring skills, applying research results to societal needs, and promoting shared standards of practice to minimize research-related risks. In addition, scientific partnerships can improve relations between countries—creating lines of communication where none previously existed—and enhance safety and security worldwide. Successful and sustainable partnerships that build on mutual interests, complementary capacity, supportive infrastructure, and available funding are often most effective for identifying possible approaches for addressing complex global challenges.

Scientists with the interest and resources to initiate and maintain partnerships with colleagues in other countries and overcome existing barriers to collaboration serve as the foundation for successful international cooperation. The scientific environment in which research is conducted varies between countries and contributes to the realization of long-term partnerships. Factors that contribute to building and maintaining long-term partnerships are research capacity and supportive infrastructure, which includes political, societal, and institutional structures. According to scientists working in the broader Middle East and North Africa region (BMENA), some of their greatest challenges relate to training and retaining a robust life science workforce,

1 BMENA refers to states countries are defined as the states within North Africa, the Middle East, including Afghanistan, and Pakistan.
and developing institutional administrative support systems and political initiatives. Recognizing and addressing these challenges is critical to continuing and expanding international cooperation with scientists from BMENA countries, and supporting national research priorities in critical areas such as health, agriculture, energy, and the environment.

Scientific cooperation is widely viewed as beneficial by scientists, institutions, and countries involved. However, the manner in which some past cooperative activities were initiated and progressed has raised concerns about the motivations of researchers and funders, the purpose and benefits of research, and the ethical and risk-based dilemmas associated with research. As public concern about ethical and risk-associated aspects of research grows, current and future generations of scientists face the enormous challenge of conducting socially acceptable and publically accountable research.

The Center for Science, Technology, and Security Policy (CSTSP) of the American Association for the Advancement of Science (AAAS) initiated a series of interactive dialogues and a collaborative grant program between scientists in the United States (U.S.) and BMENA countries to promote safe, secure, ethical research and cooperation in the biological sciences.

The Meetings and Key Themes

Under the theme of “International Engagement: Responsible Bioscience for a Safe and Secure Society,” CSTSP convened four meetings across the BMENA region with officials and scientists from research institutions and leading scientists in fourteen BMENA countries (Afghanistan, Algeria, Egypt, Iraq, Jordan, Kingdom of Saudi Arabia, Kuwait, Lebanon, Morocco, Pakistan, Qatar, Tunisia, the United Arab Emirates (UAE), and Yemen), the U.S., the United Kingdom, France, Italy, and Brazil. The main goals of the meetings were to link scientific collaboration with responsible science (focusing on key safety, security, and ethical issues) and to enhance cooperation between scientists in BMENA countries and the U.S. Each meeting built on the previous meetings and resulted in strong regional interest in developing a network of scientists to promote safe, secure, and ethical biological research and international collaboration in the region.

Meeting participants described lessons learned from past collaborative research activities and provided suggestions for improving their ability to cooperate with international scientists. The major themes that emerged from the four meetings were:

1. Collaboration is integral to the conduct of science and can be used to promote science that addresses pressing societal problems. Research activities that focus on local and

national needs, build local capacity to support research, and compliant with the national regulatory environment contribute to long-term collaborative efforts.

2. Successful collaborations involving multiple scientists, institutions, and countries should address the needs of and benefit all collaborating partners and their respective countries. The basis of successful collaboration is mutual understanding of benefits, roles, and responsibilities; transparency and open communication; similar laboratory practices for safety, security, and ethics; and an understanding of legal and operational issues.

3. Strong institutional and governmental support (e.g., funding, legal resources, regulatory guidance, best practices) facilitates the initiation and maintenance of international scientific collaborations.

4. A robust and educated scientific workforce is critically important to initiating and maintaining short- and long-term scientific collaborations. Including early-career scientists in research collaborations is important for building and sustaining a ready scientific workforce to address local, national, or global challenges.

5. Biosafety, biosecurity, and bioethics are a set of overlapping and complimentary concepts that are integral to a flourishing and sustainable scientific enterprise. Laboratory practices to identify and mitigate research-related risks should be compatible with the local infrastructure and culture. However, collaborating partners should ensure that their institutional and laboratory policies and practices to educate scientists about and address research risks are complementary, if not equivalent.

6. Governments, research institutions, professional societies, and individual scientists all have a “collective responsibility” to minimize ethical, safety, and security risks associated with biological research.

7. Partnerships that build on existing but complementary expertise and capacity can provide new and unique opportunities for scientists to address regional or international challenges in a resource-limited environment.

8. Scientific networks can provide funding opportunities, training opportunities, and a forum to discuss scientific issues, research activities, responsible science, and new technologies.

**Cooperative Grants**

CSTSP launched a cooperative grant program following the first regional meeting to encourage the development of new research collaborations between BMENA and U.S. scientists. The goal was to provide seed funding for projects that could result in longer-term cooperative research partnerships.

CSTSP awarded five sub-awards under this program. The project titles were:
• Ensuring Safe, Secure and Ethical Conduct of Biomedical and Behavioral Research in Tunisia;
• Infectious Disease Collaborative Research Initiative;
• Middle East Genomics Training and Science Center;
• Training in Nanobiotechnology for Detection of Environmental Viruses; and
• Transboundary Ecosystem Health in the Pamirs.

The projects on Ensuring Safe, Secure and Ethical Conduct of Biomedical and Behavioral Research in Tunisia and Middle East Genomics Training and Science Center have resulted in longer-term partnerships and follow-on activities. The project on Transboundary Ecosystem Health in the Pamirs expanded on an existing partnership to include scientists from Pakistan and Afghanistan. One investigator from the project on Infectious Disease Collaborative Research Initiative has become interested in developing biosecurity and biorisk management resources and institutional training programs in his country.

Conclusion

The 21st century has been called the age of biotechnology with its rapid advances benefiting health, agriculture, the environment, and energy. Many countries have invested heavily in biological research, and education and training of young scientists to address local and national challenges. At the same time, concerns have been raised about the safety and security of the conduct and communication of biological research, and use of biology to deliberately cause harm. During the past decade, several countries and intergovernmental organizations have initiated activities to reduce the safety and security risks associated with biological research and harmful infectious diseases.

The outstanding challenge of promoting research and scientific collaboration to address national needs, while minimizing the potential risks of theft and misuse of research and results, must be addressed if the benefits of biology are to be realized. The AAAS project in the BMENA sought to address this challenge by linking scientific collaboration and research conduct with responsible science (ethical, safe, and secure research).

As a result of AAAS's project, several scientists have established institutional review bodies to review human and animal subjects research, initiated long term international partnerships, proposed initiatives to address biosafety and biosecurity, and joined together to create a regional network focused on promoting biological research and responsible science. In addition to these successes, the project encountered several difficulties. Specific lessons learned from the meetings and collaborative grant program are described in detail in the report. Heeding these

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lessons will provide future opportunities for productively and positively engaging with BMENA scientists on highly sensitive issues such as biosecurity and biosafety.
Chapter 1

Cooperative Bioengagement

Science contributes to many aspects of society and dissemination of scientific knowledge and technical capabilities has allowed many countries to benefit from advances in biological science and biotechnology. Scientific advances have improved medications and medical procedures, increased agricultural productivity, diversified energy sources, and spawned new industrial processes. However, some of the same research has led to concerns about the use of research materials or results to cause harm. Specifically focusing on infectious disease research, governmental, intergovernmental, and nongovernmental organizations have raised concerns about the potential for accidental or intentional release of laboratory-developed strains of pathogens to harm human, animal, or plant populations. In the U.S., this concern has driven significant investments in scientific research to identify and mitigate outbreaks of harmful infectious diseases. Many other countries also invest in research and health care activities to identify and control outbreaks caused by natural exposure to these same infectious diseases. Addressing concerns about the safe, secure, and ethical conduct of biological research is central to enabling science and technology to make advances that benefit humanity.

Potential Safety and Security Risks Associated with Biological Research

To ensure that research activities can benefit society, scientists should minimize any research-related risks, including possible misuse of knowledge and expertise for personal gain or to cause harm to people, animals, and/or the environment. The U.S. has made concerted efforts during the past twenty-five years to enact extensive federal legislation to regulate the possession, use, and transfer of pathogens and toxins that could cause significant harm to public health and national security. These policies were developed to prevent development and use of biological weapons by countries, individuals, and groups. Several countries, including Germany, the United Kingdom, and Canada have similarly strict regulations and laws governing the possession of
select harmful pathogens. Other countries, such as Egypt, ban university researchers from working on infectious diseases altogether.

One confounding problem is that many of the restricted pathogens occur naturally in the environment, causing significant public health and agricultural damage. Restricting laboratory-based research on these pathogens does limit biological risks, but also counters the ability of researchers to study and develop viable solutions to prevent or severely limit infection and the spread of the pathogens. Through this lens, the absence of targeted and appropriate pathogen research can itself become a national, regional, and international security problem.⁴

![Figure 1: Spectrum of Biological Risks from Natural to Unintended to Intentional](image)

**Biological Weapons**

During the Cold War, the Soviet Union and the U.S., along with several other countries, developed large biological warfare programs and weapons stockpiles. The U.S. and their allies halted their efforts in 1969, after President Nixon declared that the U.S. biological weapons program be abolished.

Two months prior to Nixon’s issuance of the Executive Order to eliminate biological weapons in the U.S., the World Health Organization (WHO) issued a report highlighting the potential mass

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⁴ To provide an example not discussed in the meeting, in 2011 Egypt had an outbreak of H5N1 that infected almost 150 people and killed 51 in the Fayoum Governorate. As the government bans research on infectious diseases, the absence of experienced pathogen researchers inhibits early disease detection and pathogen characterization. Statistics from GN Radwan et al., “Knowledge, attitudes, and practices of avian influenza among backyard poultry breeders in Fayoum Governorate, Egypt,” *Journal of the Egyptian Public Health Association* (2011).

casualties that could result from biological warfare. The results were staggering and set the stage for the 1972 Convention on the Prohibition, Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and their Destruction. The treaty prohibits the development, possession, and stockpiling of pathogens or toxins in “types and quantities that have no justification for prophylactic, protective or other peaceful purposes.” After the treaty was signed in 1972, a few countries pursued biological weapons for different social and political purposes. The Soviet Union - one of the three depository countries - expanded their biological weapons program after 1972; the program persisted and grew until shortly after the fall of Soviet Union in 1991.

Though an overwhelming majority of countries, if not all, do not have biological weapons programs, terrorist organizations have indicated their interests in using biology to cause harm. Within this historical context and present reality, governmental, nongovernmental, and intergovernmental efforts have been undertaken to prevent inappropriate use of biology.

**Concerns about Intentional Misuse of Biological Research**

Scientific information about infectious diseases is shared with other scientists and health officials through publication, conference abstracts, and scientific symposia. Withholding information generated from basic research studies runs counter to the positive traditions of scientific freedom and openness. However, during the past decade, and particularly the last year, global discussion about communicating methods and knowledge from research involving certain types of pathogens has become a primary topic of discussion. These concerns are not limited to communicating research findings. Since the early 2000s, members of the security and scientific communities have raised concerns about use of beneficial, peaceful biological research to cause harm (the so-called dual use dilemma).

Minimizing the risk of malevolent use of biological information and technology requires buy-in from the scientific community about the risks and mitigation strategies and a sustained focus on prevention rather than protection. Simply building large walls and posting armed guards around life science research laboratories does not prevent individuals with malicious intent from acquiring the knowledge and skills to illicitly use biology to cause harm. Instead, acknowledgement that not all individuals have positive intent and implementation of long-term efforts to promote trust, transparency, and positive research behavior creates an environment wherein scientists look out for each other and pursue only peaceful and beneficial research.

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Laboratory Biosafety and Biosecurity

Scientists, security experts, health officials (particularly human and animal health officials), agriculture experts, some environmental experts, and members of the public are concerned about the release of pathogens from the laboratory, whether by accident or deliberately. Although many health and research laboratories house and/or support active research on harmful pathogens, a very small number of accidents have occurred that have resulted in widespread infection in humans or animal and plant populations. The measures taken to prevent such accidents are referred to as biosafety. Preventing purposeful release or theft of laboratory pathogens requires additional measures, primarily security measures (e.g., personnel security) to prevent individuals who intend to steal laboratory pathogens from gaining access to those facilities. During the past decade, this has come to be referred to as biosecurity. However, biosecurity is used in the agricultural context as preventing crops from natural infections. With greater focus on preventing accidental and intentional release of laboratory pathogens, a few trade associations, governmental agencies, and intergovernmental organizations have explicitly defined the terms, biosafety and biosecurity, and created a new term (biorisk management) that encompasses both concepts.

The WHO defines laboratory biosafety as “the containment principles, technologies and practices that are implemented to prevent unintentional exposure to pathogens and toxins, or their accidental release.” Biosafety measures use physical barriers, negative pressure airflow, special equipment, and competency training of personnel to minimize the risk of accidental exposure of laboratory workers to pathogens or accidental release of pathogens into the environment. The WHO defines laboratory biosecurity as “institutional and personal security measures designed to prevent the loss, theft, misuse, diversion, or intentional release of pathogens and toxins.”

Of the two concepts, biosafety is implemented to a far greater extent than biosecurity, possibly because laboratory biosecurity is a relatively new concept, even within the U.S. As of 2012, over twenty-five biosafety trade associations exist globally and many of them, often through support from cooperative bioengagement programs, address biosafety and biosecurity together. In many countries, laboratory biosafety and biosecurity are not distinguishable conceptually or linguistically. As a result, laboratory biosafety and biosecurity measures (namely physical barriers and personnel evaluation) have been combined to form a new field, “biorisk management.” Efforts to develop a global standard for biorisk management have occurred though the global adoption and implementation of these standards is unknown. Nevertheless,

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many organizations, including those primarily focused on biosafety, have begun to incorporate biorisk management in their cooperative activities with research and diagnostic laboratories.

**Three-Pronged Approach to Minimizing Biological Risks**

Biosafety, biosecurity, and bioethics are a set of overlapping and complimentary concepts that are integral to a robust and sustainable scientific enterprise. Artificially distinguishing these concepts from one another in training and oversight of research might not accurately reflect their complimentary nature possibly resulting in compliance and resource challenges for research institutions.

Best practices to prevent accidental release of a pathogen from a laboratory might also prevent theft of a pathogen. However, unlike biosafety the concept of biosecurity includes the notion of intent to deliberately use biology to cause harm. Bioethics complements laboratory biosafety and biosecurity by addressing behavioral challenges and the problem of intent. For example, the ethical principle of beneficence is an affirmation of only doing research for beneficial purposes and the principle of non-maleficence is a commitment of not doing any harm. Because of their long-standing importance in science and medicine, these principles resonate with many researchers and health officials, perhaps more so than absolute awareness of U.S. or WHO guidance on biorisk management. Implementing practices on and educating scientists about laboratory biosafety, biosecurity, and bioethics increases the likelihood of preventing accidental or deliberate biological hazards.

Though various national and intergovernmental groups have defined the terms, “biosafety,” “biosecurity,” and “bioethics,” their meanings and practices vary throughout the world and are influenced by local cultures, governing structures, and social values and preferences. In addition, the meaning of “safe and secure research conduct,” to which all three concepts contribute might also be subject to culturally-based definitions. Consequently, knowledge of the local culture, society, values, political pressures, commercial influences, and governing structures is necessary to implementing biosafety, biosecurity, and bioethical practices that effectively mitigate biological risks throughout the world.

The objective is not to pursue biosafety, biosecurity, or bioethics as ends in themselves, but to integrate these principles during the course of robust, internationally recognized research activities.

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10 Tim Trevan states that a lack of global awareness of biosecurity and biosafety exist despite the critical importance of these concepts to minimizing biological risks. Tim Trevan, “Building National Biosafety and Biosecurity Strategies in the Middle East and North Africa,” *The International Council for the Life Sciences* (2009).

Infectious Disease Surveillance

During the past fifteen years, the threat of avian H5N1 influenza virus spreading to humans, emergence of West Nile virus in North America, emergence of SARS and MERS coronavirus, intentional use of anthrax, and the emergence and rapid spread of H1N1 influenza virus have contributed to the development of policies, international agreements, and programs to rapidly identify infectious disease outbreaks. In 2005, the World Health Assembly passed the revised International Health Regulations that enhanced WHO’s abilities to respond to public health emergencies of international concern, required countries to meet core competencies to enable rapid detection and reporting of potential public health emergencies, and expanded the list of reportable public health emergencies from three infectious diseases to outbreaks caused by natural, accidental, or deliberate introduction of biological, chemical, nuclear, or radiological agents. The U.S. has issued its National Strategy for Biosurveillance elevating the federal government's priority to rapidly detect infectious disease outbreaks of national and international urgency. In addition, the U.S. launched the Global Health Initiative in 2009 to improve global health by integrating and coordinating global health activities among relevant government agencies.

The recognition that infectious diseases, regardless of origin, can spread globally through transportation and trade routes or natural migratory pathways increased concern about the need for partnerships with the animal, plant, and environmental health communities (i.e., “One Health/One Medicine”). The veterinary community is an important part of infectious disease surveillance efforts because over 80% of pathogens infect both animals and humans, and animals display illness before humans. The recognition that animals serve both as a potential source of infection and as sentinels for identifying unusual or potentially catastrophic infectious disease outbreaks has driven investment in expanding disease surveillance to wildlife and domesticated animal populations.

International networks of institutions, biological scientists, and health experts facilitate efforts focused on early warning and rapid characterization of natural or man-made infectious disease outbreaks. Both SARS and the 2011 E. coli 0104: H4 are examples of successful ad hoc, international cooperation to rapidly identify outbreaks of international significance. Examples of sustained international cooperation to monitor infectious diseases across national borders include the Nuclear Threat Initiative’s Middle East Consortium for Infectious Disease

12 http://www.who.int/ihr/about/en/
15 For more information of the GHI, see: www.ghi.gov
Surveillance (MECIDS)\textsuperscript{17} and Mekong Basin Disease Surveillance (MBDS) systems.\textsuperscript{18} MECIDS, which began in 2001, is a network of university-based scientists in Jordan, Palestine, and Israel that shares information about water-borne diseases in the region. MBDS, also created in 2001, is a network of public health experts in Cambodia, the Yunnan province of the China, Laos, Myanmar, Vietnam, and Thailand with a mission to detect and control infectious disease outbreaks. The U.S. government has cooperated with other countries in conducting exercises to assess current capacities for detecting and responding to infectious disease outbreaks of concern,\textsuperscript{19} and to strengthen preparedness and response capabilities to public health threats of international concern.\textsuperscript{20}

**Past and Current Bioengagement Approaches**

**The Former Soviet Union**

In 1992, U.S. Senators Sam Nunn and Richard Lugar co-authored legislation to establish the Cooperative Threat Reduction (CTR) program within the U.S. Department of Defense (DoD) in the Defense Threat Reduction Agency (DTRA).\textsuperscript{21} The DoD’s CTR program primarily focused on reducing the risks of existing nuclear weapons facilities and expertise before 1997 and subsequently expanded the program to include risks posed by the former Soviet Union’s (FSU) biological and chemical weapons program. The program sought to accomplish four key objectives:

1. “Dismantle Soviet weapons of mass destruction and associated weapons infrastructure;
2. Consolidate and secure Soviet weapons of mass destruction and related technology and materials;
3. Increase transparency and encourage higher standards of research conduct; and
4. Support defense and military cooperation, with the objective of preventing proliferation.”\textsuperscript{22}

Concerns about biological weapons quickly arose when Russian President Boris Yeltsin admitted in 1992 that the Soviet Union had a large, secret biological weapons program. Teams of U.S. and British scientists and government officials visited a few of the research and production facilities that were part of the former Soviet Union’s biological weapons program. As economic conditions deteriorated, most facilities were willing to accept financial assistance from the U.S. to refurbish their laboratories and help former biological weapons scientists pursue peaceful research activities, such as the development of vaccines, drugs, and diagnostics.\textsuperscript{23}

\textsuperscript{17} For more information on MECIDS please see: \url{http://www.mecidsnetwork.org/}
\textsuperscript{18} For more information on MBDS, please see: \url{http://www.mbdsoffice.com/}
\textsuperscript{19} http://www.nti.org/gsn/article/south-korea-announces-biodefense-exercise-us/
\textsuperscript{20} See Global Health and Security Initiative. \url{http://www.ghsi.ca/english/index.asp}
\textsuperscript{21} The U.S. Department of State through programs like the Biosecurity Engagement Program (BEP) has worked closely with DoD CTR programs as the DoD has expanded the scope of its programs beyond the former Soviet Union.
\textsuperscript{22} See Defense Threats Reduction Agency (DTRA) at \url{http://www.dtra.mil/oe/ctr/index.cfm}
Today, the global situation has changed. Cooperative programs in the biological sciences, based on the CTR foreign assistance model, have largely ended in Russia. Russia is now investing in life science research and development at universities, industrial, and government laboratories. Partnership with the U.S. has taken on a new form – that of scientific cooperation rather than threat reduction. For example, President Obama and President Medvedev established a Bilateral U.S.-Russia Presidential Commission, the U.S. Massachusetts Institute of Technology and Russian Skolkovo Foundation has created a twinned research university (the MIT Skoltech Initiative), and the U.S. National Institutes of Health and Russian Academy of Medical Sciences launched the U.S.-Russia Scientific Forum.

Bioengagement in the 21st Century

The changing political and economic landscape of the 21st century has led to new concerns about the risks involved with biological research. These concerns are less focused on countries developing biological weapons as they are on the misuse of legitimate research originally conducted for beneficial purposes, accidental release of biological materials from research and health laboratories, and lack of rapid detection and early warning of public health emergencies affecting several countries of the world. In addition, terrorists co-opting research knowledge and tools for malicious purposes are also a significant concern. Realization of the societal benefits of biological research requires that bioengagement approaches recognize the importance of institutional, regional, and international scientific partnerships and link risk mitigation with scientific progress.

Within this context, the U.S. and several of its allies have initiated cooperative bioengagement programs throughout the world – including in the Middle East, North Africa, Asia, and Africa – to build local capacity for minimizing laboratory biosafety and biosecurity risks and identifying and reporting infectious disease outbreaks of potential international concern. Several simultaneous and overlapping activities are supported that promote infectious disease surveillance and advanced warning through health systems strengthening and stakeholder engagement; educate life scientists about dual use research; and implement biorisk management and biosafety training programs at research and diagnostic laboratories. As organizations with non-security missions contribute as funders and implementers to these engagement efforts, the face of cooperation is changing from a focus on threats to a focus on partnerships and mutual benefit.

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24 http://www.state.gov/p/eur/ci/rs/usrussiabilat/index.htm
25 http://web.mit.edu/sktech/
26 http://www.fnih.org/press/releases/foundation.nih-launches-first-us%E2%80%93russia-scientific-forum-planning-meeting-advance
U.S.-BMENA Bioengagement

In 2006, the U.S. Department of State (DoS) began engaging scientists in Libya and Iraq, and shortly thereafter, they supported efforts to promote safe and secure scientific and public health activities in many other countries across the BMENA region.\(^\text{29}\) The DoS has since funded biorisk management training, dual use education, health system strengthening efforts, and the development of national biosafety associations in many BMENA countries. In addition to the DoS, the DoD has begun promoting biological safety, security and improvement of public health systems in the BMENA region.\(^\text{30}\) In Pakistan, DoD supports collaborative research projects to facilitate U.S.-Pakistan scientific cooperation.

A number of other U.S. government agencies are involved in scientific cooperation with BMENA countries. The U.S. Centers for Disease Control and Prevention (CDC), through their Global Disease Detection (GDD) program, established initiatives to develop and strengthen regional capacity to detect, identify, and contain emerging infectious diseases and bioterrorist threats.\(^\text{31}\) The U.S. National Institutes of Health (NIH) has supported health related research ranging from studies on infectious diseases to genetic diseases, such as cancer, in the BMENA region. Some of the NIH investments are collaborative research projects involving scientists from the U.S. and BMENA countries. The U.S. Department of Energy (DOE) has initiated efforts to support the Middle East WMD Free zone.

In addition to government agencies, nongovernmental organizations have also supported regional and international cooperation in the MENA region. The Nuclear Threat Initiative was among the first nongovernmental organizations to support regional scientific cooperation in the form of the Middle East Consortium for Infectious Diseases network.\(^\text{32}\) Today, many nongovernmental organizations, such as the National Academy of Sciences and International Council for the Life Sciences, work with BMENA scientists to promote safe and security research and diagnostic activities and to build capacity to identify infectious diseases.\(^\text{33}\)

The AAAS Program

In 2009, the AAAS Center for Science, Technology, and Security Policy (CSTSP) received a grant from DoS to host a series of dialogues in the BMENA region and develop a small collaborative grant program. The goals of the overall project were to: build a regional and global network of scientists, health experts, and biosecurity experts; foster relationships among

\(^{29}\) For more information on BEP, see: [www.bepstate.net](http://www.bepstate.net)


\(^{31}\) For more information see, The Centers for Disease Control and Prevention, *Where We Work* at: http://www.cdc.gov/globalhealth/gdder/wherewework.htm

\(^{32}\) For more information see: http://www.nti.org/

\(^{33}\) MECIDS available at: [http://www.mecidsnetwork.org/](http://www.mecidsnetwork.org/)
disparate communities; enhance scientific collaboration; and enhance cultural understanding and respect between the scientific and security communities.

From 2010 to 2012, CSTSP collaborated with local organizations to hold dialogues in Jordan, Kuwait, Tunisia, and United Arab Emirates and supported five collaborative grants. The meetings and collaborative grant program are briefly described below:

- **Jordan, 2010**: The first meeting was held in collaboration with the H.R.H. Princess Haya Biotechnology Center of the Jordan University of Science and Technology (JUST). This meeting focused on identifying successes and barriers towards international scientific collaboration in biotechnology and biological research, including infectious disease research; determining the available pool of biological scientists at education and research institutions in the BMENA region available for collaboration; and facilitating a dialogue on shared principles and standards of practice for ethics, safety, and security to promote collaboration.

- **Kuwait, 2011**: The second meeting was held in collaboration with the Kuwait Institute for Scientific Research (KISR) and partial support from the Kuwait Foundation for the Advancement of Science and KISR. This meeting focused on examining national priorities to which existing biological research and biotechnology can contribute, the scientific capacity needed to address national priorities, and the mechanisms (through development or collaboration) by which countries can gain needed capacities.

- **Tunisia, 2011**: The third meeting was held in collaboration with the Institut Pasteur de Tunis and the Faculty of Science Tunis, University of Tunis El Manar. This meeting included early-career scientists working with infectious diseases. It focused on building and expanding the network of early career and well-established scientists from the BMENA countries, Europe, Brazil, and the U.S. to address important scientific and public health issues; linking responsible science with research on infectious diseases; and providing opportunities for career development and peer mentorship.

- **United Arab Emirates, 2012**: The fourth meeting was held in collaboration with the Dubai Healthcare City (DHHC); the DHHC provided partial support for this meeting. This meeting included early career scientists working in genomics, which is fundamental to nearly all life science research activities. The goals of this meeting were similar to those of the meeting in Tunisia but the focus was on linking safe, secure, and ethical concepts with research and collaboration on genomics research.

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34 The Jordan University of Science and Technology provided in-kind support for the meeting and hosted a reception for all participants.
35 The Institut Pasteur de Tunis and Faculty of Science Tunis provided in-kind support for the meeting.
Building on the first meeting in Jordan, CSTSP released a cooperative grant competition to provide scientists who attended that meeting or whose institutions were represented at the meeting with an opportunity to initiate research collaborations. The goal was to provide seed funding for projects that could result in long-lasting cooperative research partnerships.

Proceedings from each meeting and a description about the collaborative grant competition are presented in subsequent chapters. CSTSP believes the lessons learned from these activities provide useful insight for developing long-lasting, positive scientific cooperative partnerships between biological scientists from the U.S. and BMENA countries.
The AAAS Center for Science, Technology, and Security Policy in collaboration with the H.R.H. Princess Haya Biotechnology Center of the Jordan University of Science and Technology hosted a workshop on “International Engagement: Responsible Bioscience for a Safe and Secure Society” in Amman, Jordan in October 2010. Meeting participants came from thirteen BMENA countries, the United States, and the United Kingdom. The goal of the workshop was to encourage international cooperation between biological scientists from the U.S. and the BMENA region.\textsuperscript{37}

The following chapter describes the major themes from the workshop and presents suggestions offered by meeting participants to address current challenges.

Scientific Capacity and Collaboration

A vibrant scientific infrastructure is dependent on many factors, including science, math, and engineering education; sustainable funding; human capacity; independent but cooperating academic and industrial research institutions; an enabling legal framework; and public and political support. According to meeting participants, all countries in the BMENA region face challenges in encouraging and maintaining a robust scientific infrastructure, applying science to national needs, and fostering collaboration at the regional and international levels.\textsuperscript{38}

\textsuperscript{36} Preparred by: Gwenaëlle Coat (AAAS Center for Science, Technology and Security Policy), Thomas A. Hennig (AAAS Center for Science, Technology and Security Policy), Saied Jaradat (JUST H.R.H. Princess Haya Biotechnology Center), Gerald L. Epstein (AAAS Center for Science, Technology and Security Policy), and Kavita M. Berger (AAAS Center for Science, Technology and Security Policy).


\textsuperscript{38} Collaboration is defined here as a partnership between two or more scientists (from universities, governmental and non-governmental research institutions, and/or the private sector) working together to study a scientific question.
According to the 2010 UNESCO Science Report, several BMENA countries are increasing their investments in science and technology research and development. Suppmenting these investments, foreign governments are funding scientific activities in BMENA countries. These foreign investments may not be sustainable and run the risk of developing scientific capacity to address donor country priorities rather than recipient country needs.

Scientific collaboration is integral to the pursuit of scientific knowledge and could provide an avenue for building local research capacity, sharing information, learning new skills, and augmenting existing research capacity. However, many countries in the BMENA region have limited national, regional, and/or international collaborations and finding partners for scientific collaboration may be challenging. Some meeting participants indicated that working with scientists from countries outside the region is easier than collaborating with regional scientists. Meeting participants also suggested that successful collaboration among scientists from different institutions, sectors, and countries should address the needs of all collaborating partners and their respective countries. Likewise, desired outcomes and the value to each collaborator should be clearly identified up front. However, misunderstandings may arise if potential partners do not fully disclose their motivations before entering into collaboration. This situation may delay, complicate, or even prevent collaborations.

Further, political requirements from funding agencies may limit the scientific potential of the collaboration by specifying partners whose expertise is not well-suited for the research project or by mandating research areas that may not be relevant to national needs. For example, BMENA countries are encouraged by foreign governments and the WHO to address biosafety and biosecurity issues. However, the relative priority of biosafety and biosecurity in the regional compared with other regional and/or national needs is unclear.

Generally, conflicting legal, operational, and laboratory practices pose real challenges for global scientific collaboration. Meeting participants agreed that good laboratory practices and shared principles of research conduct—including quality of results, ethics, safety, and security—can facilitate collaboration. An example (not discussed at the meeting) is that many research institutions voluntarily adhere to the standards for the care and use of research animals provided by the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC). Implementing these standards at research institutions can facilitate collaboration among scientists in the U.S. and internationally. Legal and operational issues, such as intellectual property or ownership of biological samples, are also critical to the success of collaborations.

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40 Good laboratory practices refers here to research practices that laboratories around the world ought to carry out in order to provide safe, secure and responsible research environments. It does not refer to specific regulated practices (i.e. Good Laboratory Practice (GLP) and Good Manufacturing Practice (GMP), as defined by the U.S. Food and Drug Administration).
Support System for Scientific Research and Collaboration

Institutional and government support (e.g., funding, legal resources, and regulatory guidance) is important for helping scientists to initiate and maintain collaborations. Resources that help researchers address local and national needs, build local capacity to support research, and comply with national regulatory environment are examples of the types of assistance that could be provided.

In the United States, research institutions often have in-house resources to help their scientists comply with relevant institutional policies, and local and national laws and regulations. These services may include personnel to help with funding and grant applications, legal questions, public-private partnerships, technology transfer, and export controls. However, meeting participants suggested that many universities in BMENA countries lack comparable support systems, leaving scientists to seek collaborative research activities and navigate the collaborative process on their own. This kind of institutional support would greatly assist scientists from BMENA countries in identifying and sustaining partnerships and competing for collaborative grants.

Several BMENA countries require extensive government approval of individual and collaborative research activities prior to their initiation. The approval process for research proposals can be extremely time-consuming and difficult in countries where all relevant ministries (e.g., Ministries of Health, Agriculture, Education, Defense, or other agencies as appropriate) must approve projects. This process is particularly challenging if the ministries do not communicate with each other about research priorities. One participant indicated that within their country, six levels of governmental approval might be required to initiate research projects. Another participant noted that the approval process is often not formalized. This situation can be exacerbated by institutional, research-specific, or other relevant approval processes. For example, research collaborations involving human subjects may be delayed, deterred, or otherwise complicated if each of the research institutions involved must obtain its own Institutional Review Board approval. In addition, researchers from some countries might require multiple government approvals to travel to conferences or for other scientific purposes. Opportunities to conduct research, communicate research to global audiences, and build relationships with foreign scientists may be diminished if approval for travel is denied.

Mechanisms to identify, harmonize, and integrate review and approval processes would facilitate research activities and collaborative programs.

Mutually Beneficial Objectives

For any scientific collaboration to be successful and persist, the objectives and goals of the collaborators must be defined from the outset and the collaboration must benefit all parties.

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42 In the United States, Institutional Review Boards (IRB) review research involving human subjects, to protect the rights and welfare of people involved in the research.
involved. A representative from a U.S. research institution described an example where all relevant experts, including the local universities and government and non-governmental organizations involved, formed a ‘project advisory committee’ to help write the project proposal, design the research, and assess the priorities of all the potential partners prior to initiating a project.

Participants suggested that project objectives do not have to be identical for each partner, but they do have to benefit all partners. The partnership may result in different, and not necessarily equivalent, benefits to each partner. One meeting participant described a scenario of inequitable collaboration in which the international partner provides all the resources, planning, and logistics for a project and the local partner serves merely as a point of contact and facilitator for obtaining in-country permission to conduct the research. While this approach may lead to successful collection of research data, it does not build any in-country capacity (structural or intellectual) and consequently, is not mutually beneficial or sustainable.

**Relationships between the Scientific Community and the Public**

Promoting public interest and trust in science is difficult for all scientists. In the U.S., many efforts exist to promote scientists communicating with the public about the benefits of biological research in order to educate the public and gain support for research. Some funding agencies even require that scientists reach out beyond the laboratory to the public. In the BMENA region, building support for science from policymakers and the public is even more difficult. One challenge highlighted by some meeting participants is that few political leaders in the region have formal or informal scientific advisors to inform the development of high-level national policies for science. Further complicating the interactions between science and policy, few policymakers in the region possess significant science literacy and those policymakers who are scientifically literate have little influence over national policymaking and implementation. However, research can provide knowledge and tools needed to address national priorities.

According to meeting participants, national priorities that could be addressed through biological research include agriculture (e.g., increased crop production, food safety, animal and plant disease surveillance and control), energy (e.g., biofuels), health (e.g., disease surveillance and response), the environment (e.g., biodiversity), and water and sanitation (e.g., water-borne disease surveillance and purification). In many BMENA countries, no assessments have been conducted of the relevant scientific expertise already available to address these priorities.

Formal relationships between the scientific community and relevant government offices might result in increased success in applying research to address national priorities. Few formal

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mechanisms exist to solicit input from laboratory scientists or research administrators about scientific contributions that can address national needs, funding needs for research and application of results, and the regulatory environment for biological research. Many workshop participants advocated for scientists becoming involved in policy development and implementation, which is routine in the United States. Participants linked increasing scientific input into the policy process with raising the profile of scientists and science in BMENA countries. One approach suggested by meeting participants to increase policymaker support for scientific input is by improving scientific literacy through elementary and secondary education in science, technology, engineering, and mathematics (STEM). Increasing support for STEM education might result in a tighter link between research capacity, scientific workforce, and national needs in BMENA countries.

**Workforce Development: Training and Education**

For scientific activities (collaborations included) to be successful, research institutions must have a robust and educated scientific workforce. U.S. scientists are educated in a highly interactive system that integrates lecture-based learning with experiential training in the laboratory or other training environments. This system, typically extending beyond graduate education to include one or more postdoctoral fellowships, is designed to provide scientists with opportunities to become independent laboratory researchers. The skills gained through postdoctoral training include: seeking research funding, publishing research in internationally recognized journals, managing research finances, and mentoring laboratory staff (research technicians, students, and post-doctoral fellows). Throughout graduate and postgraduate training, life scientists are made aware of important societal concerns and legal issues, such as human and animal subject protections and intellectual property protections. Postdoctoral fellowships do not exist in many BMENA counties. As a result, many young and promising scientists accept fellowships outside the region and do not come back, contributing to a “brain drain” that affects scientific productivity in BMENA countries. However, well-trained and experienced BMENA scientists and physicians, some of whom trained at U.S. and European universities, form a nucleus of competent biological scientists and researchers in the region.

Some workshop participants reported that scientists from BMENA countries who have received training outside the region are not necessarily offered positions that reflect their additional training. This situation confers the impression to the research community that scientific merit may not necessarily be rewarded or that research need not be conducted at international standards. They also suggested that in some institutions and countries, the reward structure is, in part, based on the number of publications, regardless of whether those articles are in internationally recognized journals. Meeting participants stated that they would like their research to be internationally recognized either through publications or presentations at international conferences. By publishing in or having access to internationally recognized, peer
reviewed journals, scientists have opportunities to discuss their research internationally, learn about and use innovative scientific techniques, demonstrate scientific capability, access scientific knowledge that might help address national priorities, explore a range of potential applications of their research, and identify potential collaborators.

**Responsible Research Stewardship**

Participants discussed the importance of shared principles and practices of biosafety, biosecurity, and bioethics, which researchers can aspire to achieve as a means of furthering scientific collaboration and developing scientific capacity and workforce.

Funding agencies from other countries, such as the U.S. National Institutes of Health, require all grantees to comply with provisions such as human and animal subject protection, biosafety, and pathogen security. However, many BMENA countries do not have formal mechanisms to implement and assess compliance with existing biosafety, biosecurity, and bioethics standards. Several of these countries have not codified these concepts in national guidelines or law and those countries with laws have not necessarily adapted the concepts to account for country-specific scientific, political, or cultural environments. Scientists from BMENA countries that lack sufficient mechanisms to comply with funder requirements on biosafety, biosecurity, and/or bioethics could be ineligible to compete for funds.

Meeting participants raised societal, governance, and cultural issues as important factors that contribute to successful scientific partnerships and the development and implementation of good laboratory practices. Societal differences may not affect the core principles of responsible research but they may influence how policies and procedures based on those principles are developed and implemented. One example cited at the meeting involved obtaining informed consent to participate as a human subject in a research project; in some countries, research participants are willing to give consent but are unwilling to sign a consent form. This example demonstrates the need to develop culturally sensitive approaches for ensuring human subjects protection and by extension, addressing other ethical, safety, and security issues.

**Laboratory Biosafety and Biosecurity**

International engagement focused on laboratory biosafety and biosecurity often involves the training of scientists from recipient countries by U.S. or European entities and implementing physical barriers to limit access to laboratories containing harmful infectious diseases. These efforts are guided by the WHO laboratory biosafety and biosecurity manuals or the U.S. Biosafety in Microbiological and Biomedical Laboratory guidance.44

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Meeting participants cautioned that foreign investments to implement biosafety and biosecurity practices and procedures should be compatible with the recipient country’s supporting infrastructure (e.g., energy availability) and the institution’s financial and human resources. Professional associations could help develop guidance for country-specific procedures and materials for training. In several BMENA countries, biosafety associations have been established to address biosafety and biosecurity concerns. These efforts have been supported and encouraged by countries from outside the region.

In addition, workshop participants suggested that development of sustainable programs may mean continual interaction between local biosafety professionals and future trainees. One approach, “train-the-trainer,” provides the opportunity for biosafety and/or biosecurity training to be brought to the region, adapted, and then adopted by local practitioners for their institutions. Education experts stressed that training materials used for biosafety and biosecurity must be based on the trainees’ level of expertise and job responsibilities.

**Bioethics**

Bioethics includes a wide variety of issues, such as fraud, plagiarism, fabrication of results, mentorship, human and animal subjects protection, and intellectual property rights. Though biosecurity has not been incorporated in most bioethics or responsible conduct of research training programs, meeting participants appreciated bioethics as a complementary set of principles to laboratory biosafety and biosecurity.

Several countries have created national or institutional bioethics committees to develop national procedures to address bioethical concerns. Egypt, Morocco, Tunisia, Jordan, and Saudi Arabia all have multiple active organizations. Some of these committees are part of stand-alone bioethics centers, while others are contained within larger organizations that conduct ethics research in a variety of fields and sectors. The national bioethics committees tend to focus on teaching, raising awareness, and advocacy for bioethics standards. Some of these committees also review research. The bioethics committees interpret international regulations and standards of ethics in ways that are consistent with relevant cultural and regulatory practices. For example, the ethical framework in the region, as described by meeting participants, is focused on collective benefit, whereas the American system focuses on individual benefit.

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47 For example, see the Centre of Biomedical Ethics and Culture, Pakistan website; available at: [http://www.siut.org/bioethics/](http://www.siut.org/bioethics/). Accessed January 20, 2011.
In addition, several international efforts have been initiated to develop common understandings of bioethical concepts. Meeting participants suggested that any international standard, guidance, or legal instrument created to facilitate scientific collaborations should respect cultural and societal differences.

**Suggestions**

Participants suggested approaches to help address some of the challenges facing regional researchers on scientific capacity, public interest in and awareness of science, and scientific collaboration. These suggestions may provide opportunities to improve the perceived or actual importance of science in BMENA countries and address issues of international concern, including responsible conduct and security. The suggestions do not necessarily represent consensus views or the views of AAAS or JUST. A subset of the suggestions identified during the meeting are described below.

The suggestions, which were provided by meeting participants, have not been analyzed or evaluated and do not reflect ease of implementation.

1. **Scientists in BMENA countries should develop educational programs to increase scientific understanding and appreciation in the region.**

Implementing educational programs for policymakers, institutional leaders, and the public could be a useful approach to increase the appreciation for science and its various applications within these communities. These programs could improve communication between scientists and the public on critical societal issues and enhance the role of science in addressing national priorities. To complement formal education programs, scientists should reach out to government policymakers to improve their understanding of biological research and its importance to national prosperity.

2. **Governments of BMENA countries and their scientific workforces should work together to develop strategies for building national scientific capacities.**

Governments, along with the scientific community, should create new or strengthen existing committees to develop well-defined strategic plans for building capacity that clearly articulate the short- and long-term objectives. These committees could first identify low-cost opportunities for building their country's scientific capacity, include scientists in the policymaking process, enhance professional development of scientists, and provide mechanisms to integrate responsible stewardship with education and training in the biological sciences. They could identify clearer and less burdensome administrative procedures to facilitate research and collaboration; for example, by designating official points of contact to serve as liaisons to the scientific community.
or by facilitating communication and coordination among ministries that fund, regulate, or approve scientific and/or collaborative activities.

Countries within the BMENA region might consider establishing a regional office for coordinating scientific investments to help with workforce development, capacity building, and regional collaboration. This office could receive support from regional and international organizations and facilitate information-sharing between committee members from different countries.

3. **THE SCIENTIFIC COMMUNITY, IN PARTNERSHIP WITH THEIR GOVERNMENTS, SHOULD DEVELOP RESOURCES TO ENCOURAGE SAFE, SECURE, AND ETHICAL CONDUCT OF RESEARCH.**

Scientists and research institutions would benefit from an online, regional portal that lists all relevant documents, laws and regulations, guidance, educational materials, and best practices that scientists will need to encourage safe, ethical, and secure research practice. This online database could be linked to experts who could provide individual guidance and consultation when needed. Such an effort could be developed by the scientific community or a regional scientific organization, with support from regional governments.

4. **SCIENTISTS AND RESEARCH ADMINISTRATORS SHOULD DEVELOP STANDARDS OF PRACTICE FOR BIOETHICS, BIOSAFETY, AND BIOSECURITY WITH THE HELP OF INSTITUTIONAL, NATIONAL, REGIONAL, AND INTERNATIONAL EXPERTS AND RESOURCES.**

Scientists and institutional administrators should help develop standards for bioethics, biosafety, and biosecurity at the institutional, national, and regional levels. These standards could be based on intergovernmental standards, such as the WHO laboratory guidance documents. Policymakers should support this process. Actively involving scientists in the development of safe and secure laboratory policies and practices could increase acceptance of those requirements and practices within the scientific community and demonstrate to the public that scientists do consider societal concerns. Scientists already engaged in such activities should encourage involvement of their colleagues from different disciplinary sectors in the efforts.

Scientists who are also institutional administrators might contribute to the development of policies and programs for implementing biosafety, biosecurity, and bioethics practices at research institutions in a low-cost, long-term manner. Expanding participatory engagement and self-governance in laboratories could increase awareness of principles and practices at the institutional, national, regional, and international levels.
To facilitate risk identification and mitigation, institutions could also create review committees that assess safety, security, and ethical risks of research and provide suggestions for minimizing those risks. Furthermore, institutions should create mechanisms to monitor safety in laboratories. Developing such a mechanism would help identify institutional needs for training and implementation of safety measures. Train-the-trainer programs have been particularly useful in facilitating wide-spread education on research-related risks. In addition, these programs might provide an avenue for accreditation of scientists who have completed various educational programs.

5. **The U.S. government and governments of BMENA countries should emphasize international scientific collaboration in areas of mutual interest.**

Online networking tools should be developed and expanded to build the number of qualified scientists from BMENA countries who are interested in scientific collaboration. When exploring collaborative activities, scientists should identify research areas of mutual interest to the U.S. and BMENA countries that have potential for sustainable, long-term scientific collaborations. All collaborating partners should ensure that they communicate their objectives clearly and consider mutual benefits from the outset. Collaborations should build on the strengths of all scientists involved, particularly those in the region. Plans for scientific collaboration must comply with international and national laws and regulations, and respect for cultural sensitivities.

**Conclusion**

Scientific cooperation offers significant opportunities to advance biological research to address national priorities, and discuss shared principles and standards of practice. Based on meeting discussions, scientists at research universities in BMENA countries face several institutional, national, and regional challenges, including limited career development and advancement, a lack of communication with and support by policymakers, and a disconnect between research activities and societal needs. Further, the environment in which science is conducted in many of these countries inhibits the quality, relevance, and international stature of the research. Few resources exist specifically to help BMENA scientists with legal and operational research issues and achieve high standards of practice for biosafety, biosecurity, and bioethics. This lack of support, along with limits to current scientific capacity and workforce, currently inhibits many BMENA scientists from competing internationally and fostering scientific collaborations.

Notwithstanding the challenges described at the meeting, the 2010 UNESCO Science Report suggests that several BMENA countries are increasing their investments in science by funding education, research and development, and regional collaboration in an effort to boost
prosperity. Whether these investments will be systematic and sustained enough to build a robust and globally connected life sciences community in the region remains an open question.

The AAAS CSTSP and Kuwait Institute for Scientific Research hosted a workshop on “International Engagement: Responsible Bioscience for a Safe and Secure Society” in Kuwait City, Kuwait in March 2011. Meeting participants came from fourteen BMENA countries, the United Kingdom, and the U.S. The goals of the workshop were to examine national priorities to which existing biological research and biotechnology could contribute, identify scientific capacity needed to address national priorities, and explore mechanisms by which countries could acquire needed scientific capacity. In addition, the meeting explored common principles in bioethics, biosafety, and biosecurity to facilitate international scientific collaboration and address concerns about risks of biological research. A list of organizations that meeting participants identified as important to building regional and international scientific networks are included in Appendix F.

Prior to the meeting, experts from Georgetown University, Purdue University, and AAAS asked participants a series of questions about their individual perceptions of national priorities, existing and needed scientific and human capacity, and principles in bioethics, biosafety, and biosecurity (see Appendix E). These questions were designed to facilitate discussion during the meeting.

The following chapter describes the major themes from the workshop and presents suggestions offered by meeting participants.

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49 Prepared by Gwenaëlle Coat (AAAS Center for Science, Technology and Security Policy), Hayfaa Almuadaf (Kuwait Institute for Scientific Research), Gerald L. Epstein (AAAS Center for Science, Technology and Security Policy), and Kavita M. Berger (AAAS Center for Science, Technology and Security Policy)

Scientific Input to the Policy Process

The range of scientific input throughout the BMENA region varies by country. In some BMENA countries, science and policy have little influence on each other, with participants arguing that science should be completely independent of the policymaking process. For example, countries such as Algeria have established national committees to define and review research investments that address national priorities. In other countries, research institutions are leading efforts to design research capacity to address national priorities. They are developing strategic plans that describe short-, mid-, and long-term research goals that would be flexible and adaptable to changing national priorities.51

In general, meeting participants felt that the scientific community should have greater input in their countries’ policymaking process. The value of science for meeting societal needs depends on setting priorities and goals for research that align with national priorities, and developing metrics by which policymakers and scientists alike can assess the success of the program, priorities, and goals. Meeting participants suggested that involving the scientific community in the policymaking process would help ensure that research activities align with national and local priorities.

Participants acknowledged that educating society about the value of science is critical for effective communication and interaction with policymakers and building of public trust. Indeed, maintaining public trust and support for science were among the key drivers motivating meeting participants to address responsible research conduct, which includes addressing appropriate safety, security, ethical, and legal considerations. Meeting participants stated that increased transparency of research activities and laboratories would result in greater public trust and increased public appreciation of the value of science. The use of microorganisms for bioremediation was provided as one example of a project that demonstrates the importance of open, trustworthy, and objective communication between the scientific community and the public.

National academies of sciences and the Islamic World Academy of Sciences provide a mechanism through which scientists from BMENA countries can interact with policymakers. Equally important, they could provide a platform for scientists to communicate with policymakers and learn about international initiatives for biological research, including programs on biorisk management, responsible research conduct, the International Health Regulations, the Biological and Toxins Weapons Convention, and regional interests. Participants noted that in some BMENA countries, that national academy of sciences does not provide the desired level of

51 Even within countries that do value scientific input within the policy process, turnover of government officials is a major challenge facing the scientific community because it can lead to changing national priorities and the potential relevance of research activities to address societal needs and concerns.
communication and awareness of critical science and society needs. In these countries, an alternate platform for communication between scientists and policymakers must be found.

Participants noted that communication with appropriate government bodies could also help implement uniform policies and recommendations. For example, participants suggested that research strategies and infectious disease surveillance systems developed at the community level should be shared with the applicable government agencies (an example of bottom-up research and policymaking). Participants felt that doing so would promote societally relevant research and encourage the development systematic policies, regulations, and research investments at the community, institutional, and national levels. Participants also suggested that a two-pronged approach of science and policy that interact with and are responsive to the needs of the other sector may be a partial solution to addressing important national priorities and societal concerns.

Many participants noted that there are limitations to government interest within the sciences. These participants indicated that peace and stability are higher national priorities than building research capacity. However, these same participants also stated that “track-two” diplomacy efforts, such as international scientific partnerships and joint research, can themselves be useful tools for building peace.

### Responsible Research Conduct: Shared Principles for Bioethics, Biosafety, and Biosecurity

Scientists from all countries share a basic understanding of bioethical and biosafety principles. However, development, education, oversight, and implementation of practices based on these principles vary among countries. Participants acknowledged current activities to develop shared principles and practices with respect to bioethics, biosafety, and biosecurity.52

Participants described “collective responsibility” as a core concept to addressing risks associated with biological research. Governments, research institutions, professional societies, and individual scientists all contribute to minimizing ethical, safety, and security risks associated with biological research. Community efforts to address the concept of “do no harm” were discussed as critical to achieving responsible conduct of biological science. This concept refers to ethical, safety, and security principles that discourage any actions taken by researchers that would intentionally or unintentionally harm research subjects, neighboring communities, and the larger society.

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Risks of Research

Participants supported the idea that risks are contextual. Risk management practices have to be local, practical, and sustainable to address risks while avoiding collateral damage to research. Pakistan is currently taking an integrated approach to addressing ethics, safety, and security risks for biological research. This approach, while influenced by American definitions of these risks, is being implemented in ways that are complementary to that country’s biological sciences environment. Participants suggested that risk mitigation includes: tools for education and training about the identification and minimization of risk, policies to prevent the accidental release of pathogens and toxins, venues to discuss and share accepted and effective strategies, and national and regional standards for biosafety and biosecurity.

Two of the many factors that contribute to potential risks of research and discussed in depth during the workshop are: 1) a lack of proper laboratory and scientific infrastructure, such as appropriate biological containment, that can lead to a dangerous research environment; and 2) a lack of robust doctoral and post-doctoral education and training programs that counter the problem of “brain drain” and promote more globally-recognized research methodology and activities.

Country reporting of unintended risks or outcomes of research or behavioral misconduct also varies. Some countries have national infrastructure to encourage reporting, others have systems limited to the local level, and still others have both local and national reporting mechanisms. The reporting structures discussed at the meeting involved health organizations or ethical committees, suggesting greater concern with accidental release of biological materials than with intentional biological risks. Regardless of what reporting structure is in place in a given country, scientists have expressed concern about the consequences of reporting negligent or suspicious behavior and the potentially negative effects that reporting could have on one’s career.

Dual Use Life Sciences Research

The dual use dilemma, the concern that legitimate life sciences research could be used to intentionally cause harm, is a concern not widely shared by BMENA scientists. Several participants believed that dual use referred to research with multiple positive outcomes; for example, research that benefits all partners. Concerns about the misuse of beneficial biological research were raised by only BMENA scientists who had previously been exposed to those concerns through interactions with U.S. and European colleagues.

When discussing dual use experiments, American participants distinguished between dual use research and dual use research of concern, in which the latter category implies greater and more immediate risk of misapplication to cause harm. Their precise use of these terms assumed that

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experiments falling in these categories could be distinguished from one another. One BMENA participant expressed concern that the examples typically used to illustrate dual use research of concern do not reflect existing scientific capacity in BMENA countries and asked whether concerns over dual use would prevent transfer of technologies that could be used to address societal needs in BMENA countries. Questions that arose out of the dual use conversation were:

- What constitutes a dual use experiment?
- Who should review experiments to identify those with dual use potential and how should this review be done?
- How should experiments with dual use potential be addressed?
- To whom should dual use experiments be reported?

Focusing on biosecurity alone detracts from the promise of science, the range of risks associated with science, and ethical and behavioral issues that affect intent.

Dual use is currently communicated in a manner that does not fully and sufficiently convey the underlying concept, which is to minimize the risk that beneficial research could be misused to cause harm. The problem is not the translation of the words, but in how the concept is described. Dual use tends to be understood as multiple or mutual benefit and security is associated with personal or individual security. Defining dual use as an ethical dilemma to reinforce the idea that biology should not be used to cause harm is clearer and more acceptable to the scientific community and therefore, the preferable way to describe this issue.

Education
A variety of approaches can be used to educate scientists about biosafety, biosecurity, and bioethics principles and practices. Active learning approaches are most effective and could include short courses, mentorship, case studies of misconduct, awareness campaigns, scientific exchanges and collaborations, and sharing of information about laboratory accidents or lapses and corrective actions.

Formal programs educating scientists about complex ethical, safety, and security issues vary among countries. Most countries have training programs addressing ethical issues, but only a few are developing training programs specifically for biosafety and biorisk management. Pakistan provides education to their scientists about dual use research, Morocco provides training on biorisk management, and the U.S. National Academy of Sciences have developed a faculty training program on dual use research for and with Egyptian scientists. In many countries, scientists are educated about risks before research is initiated, but periodic training during the conduct of research is not necessarily done.

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Communication
Participants continuously stated that communicating the benefits and risks of biological research is extremely important to highlighting the societal value of research and build public trust. Communication between the public and the policymaking community is important to building a scientifically literate society. Although BMENA scientists do not have the same level of access to policymakers that scientists do in the U.S., they acknowledged the need to build and maintain open communication with policymakers and the public.

Participants also supported communication between scientists from countries within and outside the region to discuss risks, examine specific examples, and share corrective actions or good practices to minimize the risks. Scientific networks are among the best ways to share good research practices and scientific expertise, and to develop education programs.

National Priorities in BMENA Countries\textsuperscript{56}

Meeting participants identified energy, food, water, and health as the top national priorities of BMENA countries. They also identified specific priorities - many shared by several BMENA countries - to which science could contribute.

Specific societal priorities cited at the workshop were:

- Agriculture (Pakistan and Morocco)
- Peace and Security (Afghanistan)
- Infectious Diseases (Tunisia, Afghanistan, and Pakistan)
- Drought resistant plant production (Kuwait)
- Efficiency of oil production (Kuwait)

According to meetings participants, translation of basic research to application to address these national priorities requires a robust research infrastructure; multi-sectoral, multi-disciplinary, and multi-national collaboration; enabling government rules, regulations, and policies; funding, sustainability, and economic opportunity; and public awareness.

\textsuperscript{56} The national priorities listed in this chapter may not reflect the priorities of the policy makers of the countries represented at the 2\textsuperscript{nd} workshop in Kuwait.
One meeting participant described the value of involving members of the public and policymaking community in promoting innovation in science. One American participant, however, cautioned that policymaker involvement in science, in the absence of sufficient mutual engagement between scientists and policymakers, can lead to the politicization of science. That participant cited examples of advocacy groups in the U.S. pressing for specific disease cures without understanding the broader base of biological research required to produce them, and politically-motivated restrictions against funding specific research projects.

**Kingdom of Saudi Arabia and the Study of Mass Gathering: Opportunities for Collaboration?**

For more than fourteen centuries, the city of Mecca, in the Kingdom of Saudi Arabia (KSA), has been the spiritual center for Muslims around the world. An estimated 2.5 million pilgrims each year make the Hajj pilgrimage to fulfill their Islamic duty to visit and pray in Mecca at least once in their lifetimes. Because of the 2009 H1N1 pandemic, KSA encouraged collaboration between its health ministry and international public health agencies, which led to the “First Global Forum on Mass Gathering Medicine: Implications and Opportunities for Global Health Security.” The Jeddah Declaration on mass gathering health, which outlines six goals to implement the new medical discipline, was adopted at the end of the meeting.

This example demonstrates the importance of international collaboration to address common problems. In this case, the product was a strategy and plan for detecting, preventing, and responding to infectious disease outbreaks of global concern and scale.

2. For more information, see the Forum web site at: http://conferences.thelancet.com/massgatherings/.
Existing Capacity in the Biological and Biotechnological Sciences

Although much life science research in BMENA countries may not be cutting-edge, an interested and active scientific base does exist in the region. Most countries have ongoing research activities on infectious diseases, food production and safety, genetic diseases, environmental remediation and conservation of natural resources, alternative energy, and water treatment and waste sanitation.\(^5\)

A few meeting participants noted that in some instances, the research conducted does not reflect the societal priorities of the region. This situation may result from lack of communication or differing priorities between the scientific and policymaking communities. Despite these potential differences, the basic tools and technologies used or developed in universities and research centers to address research priorities could also contribute to addressing science-based national priorities. By thinking about how to leverage existing research capacity and capability to address national priorities, the policymaking and scientific communities might find common ground upon which to develop long-term relationships and further benefit society.

Meeting participants stated that a robust scientific workforce is essential for developing national capacities that address national and global problems. Participants suggested that education programs should focus on teaching researchers about multiple scientific disciplines and research areas to equip them with the necessary skills to conduct nationally-relevant research. In addition, sustained funding for research and salaries, and opportunities for career advancement that might include involvement in research collaborations, scientific exchange, or training in countries outside the region are all important to building a knowledgeable scientific workforce. These personnel-focused investments will improve the research capacity to meet organizational and national research goals, and reduce brain drain from the BMENA region.

Current Research Priorities of National Interest\(^6\)

Meeting participants listed several research areas currently under active study that could address pressing national priorities. However, participants stated that many of these research areas are

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5. AAAS can provide enormous opportunity to enhance interactions between the scientific community and the public, promote education on scientific methodology and normative behavior (i.e., ethics, safety, and security) and enhance the scientific infrastructure.

6. Some BMENA countries (e.g., the Gulf countries) are investing in their basic S&T and higher education sectors. Other countries in the region (e.g., Qatar, Egypt, and Tunisia) have gone beyond these basic investments to fund applied R&D activities. AAAS-JUST “International Engagement: Responsible Bioscience for a Safe and Secure Society workshop report available at [http://www.aaas.org/cstsp/files/InternationalEngagement.pdf](http://www.aaas.org/cstsp/files/InternationalEngagement.pdf).
underfunded, lack the needed laboratory infrastructure or personnel, or have limited opportunities for regional or international collaboration. These research areas include:

- Waste management and treatment solutions for biological, chemical, and radiological containments
- Water and sanitation
- Genomics and genetic diseases
- Food production
- Infectious disease research
  - Disease surveillance
  - “Biothreats”
  - Ecology of infectious diseases
  - Epidemiology, transmissibility, and presentation of symptoms of zoonotic diseases in wildlife and human populations.\(^{59}\)

Participants advocated for the development of strategic plans that include short-, mid- and long-term goals for building a multi-disciplinary workforce, promoting scientific collaboration, leveraging existing research capacity, and developing desired scientific capacities to meet national priorities. Scientific leaders could catalyze change in workforce development and research opportunities with greater communication and coordination with their respective government agencies. One key aspect of this change is improving and expediting high-level approvals required for project initiation, a challenge faced by many scientists in countries throughout the world.

Workshop participants agreed that younger scientists are essential to building a strong, innovative, and sustainable research capacity. To encourage greater involvement of early-career scientists and foster “champions” within this age group, workshop participants emphasized the need for enhanced education and training of early-career scientists on scientific methodology and ethical, safe, and secure conduct of research. Many participants felt that universities should go beyond purely didactic instruction to a research-based curriculum (i.e., active learning) to prepare future generations of researchers. Participants also advocated the development of networks of early-career scientists to promote good research conduct. One participant commented that existing organizations or programs (e.g., the Young Academies of Sciences in Egypt and Pakistan) could be leveraged to build the necessary networks.

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\(^{59}\) Zoonotic diseases are infectious diseases that can be transmitted between animals and humans.
Leveraging Scientific Collaboration to Gain Desired Research Capacity

Meeting participants agreed that collaborative research is an effective means of building scientific expertise; managing limited resources and scientific infrastructure; and addressing national research priorities. However, the full benefit of these collaborations might not be realized without aligning national and institutional policies that govern research.\(^6^0\) In addition, similarities and differences in the conduct of science – for both research methodologies and responsible behavior - among collaborating partners may affect the ability of the collaboration to achieve project goals and address relevant priorities of the countries involved. To ensure that collaborations are mutually and maximally beneficial, issues such as roles and responsibilities of partners; scientific and human capacity in the research area in question; and common definitions, standards of conduct, and scientific procedures must be considered.

Participants identified industries or research areas upon which potential regional or international collaborations could be built to increase research capacity. These areas were divided into five categories:

- Petroleum industry
  - Efficacy
  - Bioremediation solutions

- Food production
  - Quality control
  - Disease resistance
  - Water and food contamination
  - Industrialization crop production

- Health
  - Genomics
  - Quality control of new medical products
  - Chronic or hereditary diseases, such as cancer, heart disease, and diabetes
  - Stem cell research
  - Infectious disease surveillance in human populations
  - Surveillance of water-borne infectious diseases

- Energy
  - Biofuels and other bio-energy research
  - Solar energy research

- Environment
  - Waste management
  - Ground water contamination and purification

\(^6^0\) Egypt is an example of a country that leverages collaborations and student exchanges to gain research capacity.
• Security
  o Biotechnology to help in stabilizing conflict-torn countries.\textsuperscript{61}

Participants mentioned that scientists in the BMENA region already engage in some regional and international collaboration to address national priorities. Indeed, some BMENA countries are changing the interpretations of their national constitutions in ways that could facilitate international collaboration.\textsuperscript{62} Other countries require partnerships to include scientists from different sectors, for example, health and agriculture, for all scientific projects. Despite positive changes toward enhanced international collaboration, meeting participants identified six persisting challenges that hamper current efforts to enable collaboration:

1. Research funding
2. Workforce
3. Technology transfer and intellectual property rights and protection
4. Controls over the transfer of laboratory materials such as export controls and measures to prevent use for terrorism
5. Visa policies
6. Legal language in specific contracts that effectively impairs collaboration

Sharing a common history, geographic location, or common language might help build scientific relationships. For example, North African countries are more inclined to collaborate with the European Union over the United States because of shared historical relations and language. Furthermore, participants felt that South-South collaborations could be easier to facilitate because fewer cultural barriers exist. Collaborations between universities and public health ministries and officials, which do exist in some countries, could be a fruitful path to improving identification, characterization, and monitoring of regional disease outbreaks and sharing of epidemiology data.

Despite agreement that international collaboration could build scientific capacity and expertise, some participants believed that countries should develop their own scientific infrastructure rather than leverage capacity from other countries to gain needed or desired expertise and tools. Participants relayed that cost analyses may help BMENA countries determine the comparative effectiveness of in-country research investments, regional or international collaborations, or importing expertise and products. For example, after conducting a cost analysis, one country invested in product development of monoclonal antibodies because of the high costs of importing them. In-country development of these antibodies resulted in lower research costs for

\textsuperscript{61} Biotechnology can enable detection of causative agents (e.g., infectious disease, radiation, and chemicals) for unusual outbreaks, identification of explosives, or development of tools to help countries respond to and recover from nationally significant conflicts.

\textsuperscript{62} In July 2011, Morocco passed a referendum that made international treaties and conventions supersede national laws. To reflect this vote, the Moroccan government initiated the process of changing its national legislation to be more consistent with international treaties and conventions. This change may have a positive effect on facilitating international scientific collaboration.
customers. Another example cited during the meeting was the joint purchasing of equipment for multiple investigators. This method lowers costs for individual researchers and could contribute to the exchange of ideas and new collaborations based on the small network created by acquiring the equipment together. A similar concept would be to develop shared databases and strengthen the use of information technology in research activities.

**Suggestions**

Participants suggested approaches that might provide opportunities to improve regional or national research capacity and enhance links between research efforts and initiatives to address national priorities. Suggestions built on the importance of addressing societal concerns, such as safety, security, and ethical risks of research, while improving research capacity and partnerships. The suggestions do not necessarily represent consensus views or the views of AAAS or KISR. A subset of the suggestions identified during the meeting are described below.

The suggestions, which were provided by meeting participants, have not been analyzed or evaluated and do not reflect ease of implementation.

1. **Governments of BMENA countries should develop a national research strategy that involves near-, mid-, and long-term plans for promoting nationally-relevant research.**

   Strategic planning could involve defining the level of research that should be conducted in a given country, such as the proportion of fundamental and applied research; infrastructure needs to support the research efforts; and the requisite workforce needed to conduct the research.

2. **Governments of BMENA countries, research institutions, and scientists should leverage regional networks and collaborative research efforts to address societal priorities of mutual interest, promote information and sample sharing, and enhance educational efforts to build a workforce that actively minimizes risk while promoting needed research.**

   Sharing research assets and leveraging existing infrastructure provides new opportunities for scientists to work together under conditions of limited resources. Scientists with complementary expertise and tools can address research questions of mutual interest without having to build capacity (particularly in resource poor countries). These new partnerships, particularly if informed by strategic planning for research, can strengthen scientific efforts in the region and promote research on pressing regional and global challenges.

3. **Universities should develop research capacity and skilled scientific workforce to address national priorities.**
Taking into account the expertise and skills gained through scientific partnerships, universities could define the human resources needed to address national and regional priorities and provide more opportunities for research collaboration of early-career and more senior scientists.

In addition, countries could help build a knowledgeable and skilled workforce by developing a system that incentivizes scientists who receive their education and training in other countries to return to their home countries. Incentives could include funding and support for career advancement, such as scholarships, scientific exchanges, and regional and international collaboration opportunities.

4. **Research institutions should develop processes to mitigate accidental or intentional risks associated with biological research and promote information sharing about plausible risks and corrective actions.**

The policies and practices that research institutions implement to identify and manage research-related risks should match country governance structures, needs, and culture.

**Conclusion**

Scientific collaboration offers significant opportunities to advance biological research efforts to address national priorities and share good research practices on biosafety, biosecurity, and bioethics. Many BMENA countries share similar environmental, physiological, and social challenges with each other and with other countries around the world. Building on these common challenges, BMENA countries could leverage regional and international scientific partnerships to gain needed research capacity to address national challenges, promote education and development of shared principles and practices in responsible conduct, and enhance national research and development capacity.

During the time of the meeting, several countries across the Middle East and North Africa were experiencing great social and political change. Participants and organizers wondered whether these changes might offer new opportunities for scientific cooperation and enhanced communication between the scientific and policymaking communities. However, the current socio-political environment within countries experiencing significant change poses challenges to prioritizing scientific research and collaborations to address societal needs, promote globally-recognized science, minimize research-related risks, and improve the scientific workforce.
Chapter 4

Tunisia Meeting
31 October – 1 November 2011

The AAAS CSTSP, the Institut Pasteur de Tunis, and Faculty of Science, University of Tunisia hosted a workshop on “Infectious Diseases and International Engagement: Responsible Bioscience for a Safe and Secure Society” in Tunisia in October 2011. Meeting participants came from fourteen BMENA countries, the U.S., Brazil, and France. The goal of the meeting was to introduce early-career scientists to key legal, methodological, and societal concerns that need to be considered during the design and conduct of joint research projects; ethical, environmental, safety, and security risks associated with infectious disease research; global networks for infectious disease research; and funding considerations and priority-setting for international cooperation on infectious disease research.

The following chapter describes the major themes from the workshop and presents suggestions offered by meeting participants.

Early-Career Scientists in Research

Diverse teams that include both senior and junior scientists from natural and social science disciplines are essential to conducting creative, high-quality research by providing greater diversity of expertise to address particularly complex national and global challenges. Including underrepresented groups, such as women or early-career scientists, in these collaborative teams also provides unique and beneficial perspectives to research efforts of social and/or national

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importance. Including early-career scientists in these collaborative activities is critical for encouraging scientific creativity, openness, and responsibility, which might prevent brain drain.

Early-career scientists benefit from strong mentorship from their senior advisors and supportive environment at their institutions. Senior scientists can encourage early-careers scientists to become active members of global scientific networks in addition to teaching scientists about the subject areas on which they work and laboratory skills. Institutions can provide valuable opportunities to early-career scientists to gain additional knowledge about new techniques, scientific areas, and researcher responsibilities through regional and international visits, exchanges, and study abroad programs. The efforts of senior scientists and institutions must be matched by political will and an enabling political system, which encourage students from all areas and backgrounds to excel in science, technology, engineering, and mathematics (STEM) education, pursue careers in science, and build partnerships with scientists from other countries.

**Important Factors for Collaboration**

Research on problems of mutual concern, particularly challenges that significantly affect local populations, provide a solid basis for collaboration. Examples of these problems include infectious disease surveillance, public health capacity, antimicrobial resistant pathogens, vector-borne diseases, “One Health,” and biorisk management. Further, collaborations that help build local research capacity to address social needs (e.g., development of vaccines and drugs for locally circulating strains of pathogens) provide opportunities to build trust and long-term relationships between project partners, improve local response to national and regional challenges, and develop processes to resolve or minimize barriers to collaboration.

Successful collaborations require mutual understanding, transparency, trust, and responsibility between and among research partners and their sponsor(s). Trust between partners is necessary to ensure that biological materials are being used appropriately - i.e., materials are not used for personal gain or to cause harm - and all ethical, legal, and procedural requirements are addressed adequately. Strong collaborations involve well-trained, skilled scientists that have solid scientific reputations from well-respected research institutions. Partners must have complementary expertise, skills, and capacity. In addition, sensitivity of cultural and linguistic differences between partners is critically important to ensuring effective communication about project expectations; ethical, legal, and social issues and requirements; methodological and operational

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64 “One Health” is the concept that the health of animals, plants, humans, and the environment are interconnected and should be addressed with equal importance.

65 Publication is often used as a metric for assessing the skills and abilities of scientists. Therefore, publication in solid, peer-reviewed journals and the quality and number of publications are important factors in assessing the knowledge, skills, and research interests of potential partners.
issues; and identification and resolution of any problems that might arise before, during, and after the period of cooperation.\textsuperscript{66}

Differences in operational, ethical, safety, security, and environmental standards between collaborating partners should be addressed, one step at a time, until common standards are agreed upon and institutionalized within the research group. Those individuals and institutions with greater international collaboration experience have likely already dealt with related challenges and developed appropriate procedures and policies. For those institutions with less experience, a first step in developing international cooperation is to set up processes and risk management practices that enable cooperation, are sensitive to local norms, and promote best practices in biosecurity and biosafety.

The principal investigators and the research teams should be involved in the initial project development through the final communication of results. Projects that involve all contributing partners and equitably distribute workload, responsibility, and recognition among partners have a higher likelihood of being sustained over longer periods of time. Further, defining the roles and responsibilities of each collaborating partner - including responsible communication of research results, authorship of papers and presentations, ownership of intellectual property, handling of research tools and results, and access to data - before initiating a collaborative project enables the development of productive scientific relationships and research programs.

This meeting specifically identified gaps that often exist in and inhibit the success of cooperative research programs in the BMENA region. These gaps include: different or absent policies for managing risks, sharing of data, research activities, and project budgets; practices to mitigate ethical, environmental, safety, and security risk; and plans for responsible communication of project results. Awareness of key issues and challenges involved in initiating and maintaining collaborative efforts should not deter scientists from collaborating. Instead, scientists should strive to overcome research-associated challenges to enable successful completion of research projects and maintenance of scientific relationships.

Before the start of a collaboration, scientists may not be able to anticipate all of the challenges they could face during the course of the project, but researchers can work together to address challenges and minimize risk as they are encountered. Scientific visits and exchanges can be used as an important mechanism for learning about how potential partners address many of the operational and behavioral issues that might arise during the course and after completion of a project. In addition, exchanges can be used to clarify the roles and responsibilities of potential partners and institutional missions to meet expectations and objectives of the joint project.

\textsuperscript{66} Information technology tools, such as the internet (i.e., online video conferencing and electronic mail), could facilitate communication between partners.
Legal Considerations of International Collaboration

Legal requirements, project objectives, and research expectations must be aligned and clearly articulated at the beginning and throughout the lifetime of cooperative projects. Differences in regulatory and legal infrastructure between countries may vary on ethical, risk-based, methodological, operational, and other relevant issues, which may affect the oversight and conduct of the scientific collaboration. Clear understanding of these requirements by all research partners and their institutional support staff is crucial to agreeing on the project objectives and partner expectations.

The specific legal requirements with which collaborating partners must comply are dictated by the project activities and governing framework of the sponsoring country and the countries in which the research is conducted. Examples of compliance requirements that could apply to infectious disease research are protection of human subjects, animal subjects, and human clinical samples; biosafety and biosecurity; and export controls. Still, other legal issues (e.g., taxation, payment agreements, and other contractual obligations) apply to all collaborative research activities. In addition, transportation of pathogens, storage materials (for example, dry ice) and other biologics - vaccines, drugs, and human samples - are regulated differently among countries, which might delay or halt research activities.

When engaging in cooperative projects, knowing the intent, motivations, regulations, and practices of partners for sharing of materials, knowledge, and pathogens that could be misused - either for personal gain or to cause harm - is extremely important for promoting successful and transparent collaboration. In many cases, permission is needed to share samples, but the pertinent requirements might differ by government office and institution. In general, scientists could reduce any risks involved with material or information sharing by knowing the person requesting the materials, their purpose, and end use of the requested materials, and the nature of the request. Since pathogens are found naturally, individuals with questionable intent may still gain access to harmful pathogens even if legal measures exist to restrict pathogen and information sharing.

Technology transfer and intellectual property are critically important to developing mutually acceptable project expectations. For example, intellectual property rights generated in a joint project tend to be held by entities in high-income countries, even though the burden of infectious disease is often in low-income countries; while common, this intellectual property agreement fails to promote mutual benefit of project outcomes. This and other administrative, procedural, and ownership issues should be addressed prior to the start of a project.
**Ethical, Environmental, Safety, Security Risks**

A critical part of high-quality, socially-relevant, and collaborative science is the delicate balance between the benefits and risks of scientific knowledge to society.

All scientists involved in collaborative research are responsible for minimizing or preventing harmful or negligent use of research tools and knowledge, and for ensuring that facilities and equipment are used properly and institutional guidelines are followed. Laboratory heads play a critical role in imparting the appropriate principles and practices to their laboratory staff and students. Interpretation of ethical, safety, and security concerns affects how scientists understand, prioritize, and implement risk mitigation measures in the laboratory. Differences in individual interpretation of research-related risks might pose challenges to regulatory compliance and research conduct.

**Regulatory and Procedural Differences**

Regulatory and procedural differences in addressing biosafety and biosecurity between countries and institutions might affect collaboration. Increased awareness of risks associated with accidental release or deliberate theft of pathogens might help scientists minimize those risks in practice. Several research institutions in the BMENA region have Institutional Biosafety Committees (IBCs). During the meeting, participants described examples of regulatory, procedural, and facility-specific differences for addressing biosafety and laboratory biosecurity risks:

- Genetic modification of organisms is illegal in at least one of the countries represented at the meeting.
- Several countries have guidelines for genetically modifying organisms.
- Shipping dry ice is not permitted by one country.
- Laboratories in some countries are not allowed to have certain kinds of equipment, such as PCR machines, centrifuges, and various laboratory tools.
- Some countries have strict controls on research with dangerous pathogens.
- One country requires approval to import drugs.
- Transfer of antimicrobial resistance is not allowed in some countries and would require approval in other countries.
- Some countries ban shipping blood out of the country.

**Ethical Considerations and Associated Requirements**

Independent review committees provide scientists with greater opportunity to identify and address ethical challenges. Several countries have dedicated ethics committees at the institutional or national levels.
Ethical considerations and regulation of research involving protection of human and animal subjects differs among countries. Some countries currently have national review boards to review and oversee human subjects research, while others do not have such committees. Further, some of the countries that currently lack human subjects review committees are interested in developing them because these committees provide opportunities to their scientists for international collaboration. When conducting animal subjects’ research, some countries have no laws dictating the appropriate care and use of research animals. Other countries have stringent laws regulating research with animals. Some countries have laws on animal welfare, but often those laws are ignored by researchers and institutions. Some countries have no laws on animal welfare, but research institutions have implemented their own policies with which scientists must comply.

The pressure to deal with urgent social issues - in health, agriculture, environmental fitness, and energy - may impose ethical challenges, including conflict of interest; differences in expectations for research results; and differing evaluations about legal, ethical, safety, security, and environmental risks of research. For example, conflict of interest might arise when research projects are supported for their contributions to building laboratory capacity rather than for scientific merit.

**Scientific Excellence and the Global Scientific Enterprise**

Scientific interaction may be greater and longer-lasting with an institution that strives for scientific excellence rather than one that does not achieve global standards of excellence. Scientific excellence depends on the quality of education and training; quality of scientific environment, including the research and administrative infrastructure, visibility of the institution, and research competitiveness of institution; use of technology; and political will. Two important aspects of high-quality internationally-recognized science are independent evaluation and peer review, and clear scientific communication, both of which benefit from global scientific networks.

Scientific networks can help provide support infrastructure; funding opportunities; a forum to discuss challenging scientific and social issues, raise awareness of new technologies or techniques, and list training opportunities; and provide opportunities to address global challenges, such as infectious diseases. Global networks can:

- Encourage horizontal (peer-to-peer) and vertical (scientists in different stages of their careers) communication and interaction, providing both mentorship and leadership opportunities;
- Provide a better understanding of different career paths – beyond laboratory science - that scientists can take to address global issues;
• Promote communication between scientists and non-scientists to promote science and technology, improve the scientific dialogue with the public and policymakers, and enhance political interest and support for science within a country;
• Contribute to outreach and education of the general public and policymaking communities to get ahead of any problems and provide the public with tools to assess risks and benefits of research activities. Enhancing the public’s understanding of science can result in increased vigilance against potential misuse of science;
• Facilitate the development of public-private partnerships and private-private partnerships to link basic research with operational programs that address national priorities; and/or
• Provide opportunities for research funding. Philanthropic organizations - governmental and non-governmental - often develop their funding priorities based on their leadership, social need, and assessments from experts.67

Suggestions

Participants suggested approaches that might provide opportunities to improve international collaboration among regional infectious researchers. Suggestions focused on improving the educational and professional development path of early-career scientists. The suggestions do not necessarily represent consensus views or the views of AAAS, IPT, or FST. A subset of the suggestions identified during the meeting are described below.

The suggestions, which were provided by meeting participants, have not been analyzed or evaluated and do not reflect ease of implementation.

1. **THE SCIENTIFIC COMMUNITY SHOULD ADDRESS RESEARCH-RELATED RISKS BY ENHANCING INTERNATIONAL SCIENTIFIC COLLABORATION.**

Most, if not all, infectious disease research involves risk, whether ethical, environmental, safety, and/or security risk. Awareness and perception of risk is highly dependent on the socio-cultural, political, and research environment in which the research is conducted. Collaborating partners from the U.S. and BMENA countries might govern research, assess risk, and mitigate risk differently. Although these differences can cause barriers to collaboration, they can provide significant opportunity to learn about the underlying concerns that make something a risk and identify possible mitigation strategies for reducing risks. Ultimately, the process of identifying and addressing barriers to collaboration provides opportunities for all partners involved to transfer good practices, methods of risk assessment, and approaches for risk mitigation in ways that are culturally sensitive, easily understood, and intuitive.

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67 Examples include: the Qatar Foundation, which aligns their research investments with existing scientific capacity and encourages scientific entrepreneurship; and the U.S. National Institute of Allergy and Infectious Diseases (NIAID), which works with G8 countries to develop research objectives for health.
2. **Scientists should develop clear plans for managing different aspects of a collaborative project prior to its initiation.**

Differences in research governance among countries might affect the implementation and successful completion of certain types of research. For example, scientists from countries that do not allow testing of antimicrobial resistance might not be able to participate in research collaboration on antibiotic resistance. Scientists and research institutions should learn about the governing framework of collaborating institutions to resolve potential conflicts and ensure compliance of legal requirements by all collaborating partners.

Before initiating collaborative projects, scientists should write an agreement or contract that includes legal issues, project objectives, roles and responsibilities of the institution and scientists, handling and communication of research results, and management of different expectations and conflicts of interest. This agreement could incorporate clear plans to address common challenges (e.g., management of research activities, data, personnel, and collaborative processes and ethical, legal, and social implications of research activities) as a way of resolving any problems that might arise during the course of a collaborative project.

Scientists should develop a communication strategy at the outset of a collaborative project to ensure that partners have mutually agreed upon authorship, access to research results, access to products, and other issues as relevant. Communication to fellow scientists, collaborating partners, and the broader public audience should be done responsibly account for particular sensitivities from all partner countries involved.

3. **Scientists, research administrators, and relevant government offices should develop standards and policies for minimizing ethical, environmental, safety, and security risks that are adaptive and focused on good practice rather than prescriptive requirements.**

Research risks change over time and with different social and political contexts. At any time or in any social context, the risks of research might reflect society's concern about misuse or inappropriate use, negligence, or intentional use of biology to cause harm to individual research participants, other researchers, or the broader community. However, risks also might include harmful infectious diseases (natural and man-made), which could harm a specific or significant portion of a country's population. Relevant government offices and research institutions should ensure that risk assessment and mitigation policies are able to adapt to any risk a researcher, practitioner, or government entity might encounter. Research institutions and scientists should develop risk assessment and mitigation strategies that could hold up as risks change over time. In both cases, policies and procedures developed to address research risks should promote scientific advancement so that research results could be used to counter infectious disease outbreaks.
4. **Research institutions should create a supportive research environment in which to identify and mitigate research-related risks.**

Research institutions should train scientists to identify and mitigate research-related risks of greatest importance in their countries. Institutional officials and scientists could leverage existing training resources at other institutions if none exist in their own organizations. For example within the region, the Institut Pasteur de Tunis and NAMRU-3 could provide resources for training, laboratory evaluation, and scientific expertise for infectious disease research, detection, and surveillance.

Institutions should provide a supportive research environment to enable scientists to identify and minimize ethical, safety, and security risks. This environment could include, but is not limited to, legal expertise to adequately address national and international laws, career advancement programs, and training opportunities.

**Conclusion**

While this chapter details the preparations scientists should undertake prior to the initiation of collaboration, no preparation perfectly anticipates all the challenges faced during the course of or after project completion. Enhanced awareness of likely challenges, experience gained from prior or ongoing collaboration, and an institutional and national environment that supports and enables research and collaboration can provide the appropriate resources and skills necessary to address risks and challenges as they occur.
The AAAS CSTSP and the Dubai Health Care City hosted a workshop on “International Engagement in Genetics and Epigenetics: Responsible Bioscience for a Safe and Secure Society” in the United Arab Emirates (UAE) in March 2012. Meeting participants came from thirteen BMENA countries and the U.S. The goal of the meeting was to educate early-career scientists from the BMENA region about the legal, methodological, and ethical and risk-based issues associated with the design and conduct of joint research projects; ethical, environmental, safety, and security risks associated with genetic and epigenetic research; global networks for scientists working in genetics and epigenetics; and funding considerations and priority-setting for international scientific collaboration.

The following chapter describes the major themes from the workshop and presents the participants' suggestion to establish a network from the participants of the AAAS meetings.

**Building Regional Research and Human Capacity**

Two related scientific areas of interest in the region are genomics and epigenetics. Advanced understanding of how these sciences contribute to prevention of chronic diseases, determine susceptibility and vulnerability to infectious diseases, and affect agricultural and environmental fitness drives much of the interest in developing these sciences within the BMENA region. Participants highlighted that possible unique elements in the Arab genome might provide

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69 Genomics is the study of genomes of organisms.

70 Epigenetics is the science of understanding how non-genetic molecules affect the function of gene projects or different cells in the organism.
scientific insight about the physiologic determinants of prevention, onset, and progression of infectious and genetic diseases, which could in turn help in the development of better disease surveillance and treatment options in the region. Some meeting participants believed that regional collaborations could help build regional capacity to understand and fight locally-prevalent diseases, such as the hereditary disorder of the blood, thalassemia.

Participants expressed the need for a well-trained, knowledgeable workforce to conduct genetic and epigenetic research, screen for genetic disorders, and assess the results to provide reliable, accurate health information. The skills needed to build such a workforce include scientific writing for publications and research proposals, knowledge of the scientific method, and ethical and other research-related norms (e.g., participant privacy). The availability of funding sources to help develop the necessary scientific and human capacity is critical for the development and long-term success of scientific organizations providing genetic services to their nation. Jordan has recently begun developing a training center to develop the next generation of genomic scientists ready to address common regional genetic disorders.

Participants described the general workforce development needs of early-career scientists to prepare them for successful careers in research and/or successful collaborative partnerships. These needs include:

- Knowledge of the scientific method, including implementing risk mitigation strategies (e.g., biosafety concepts for protecting one's self and colleagues in the laboratory and preventing release of biological materials into the environment);
- Information-sharing about research results and new technologies - activities which could be facilitated through networks and collaborative research activities;
- Experience writing original grant proposals and scientific articles;
- Experience managing grants and research projects;
- Experience identifying research-related risks before, during, and after the completion of a research project. Some meeting participants thought these considerations should extend to broad communication or use of the research results and technologies; and
- Awareness of and willingness to comply with local, national, and international legal requirements.

Imparting these skills on early-career scientists through formal education and experiential learning would help countries develop a knowledgeable and vigilant workforce that conducts research to benefit humankind.

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71 A number of organizations provide such training for publication and grant proposal writing, for example: CRDF Global (http://www.crdfglobal.org/focus-areas/capacity-building/professional-skills-for-scientists-and-engineers) and TWAS (http://twas.ictp.it/)
Nexus between Scientific Progress and Responsibility

Developing the scientific workforce to better address risks or societal concerns, communicate with the public and policymakers, and collaborate internationally is critically important for advancing nationally- and globally-relevant science. Participants described examples of how research institutions and senior scientists could educate early-career scientists about prevalent research norms:

- A discussion-based forum that encourages early-career scientists to become active rather than passive participants in the dialogue.
- A comfortable research environment enabling early-career scientists to develop critical thinking skills by encouraging them to ask questions about research activities, consider social considerations pertaining to their research, and challenge scientific dogma.
- Mentorship in training early-career scientists about the “spirit of science,” including common principles of beneficence (i.e., conduct research for good), non-maleficence (i.e., not harming individuals through research), and respect (i.e., protecting human and animal research subjects). Participants suggested that the most effective mentors stay abreast of social concerns associated with technology and research progress and approaches to address these concerns.

Although international guidance and standards on ethical, safe, and security behavior exist, institutions and scientists are responsible for ensuring that research is conducted in a responsible manner and in full compliance with regulatory requirements. In the U.S., research institutions receiving federal funds are required to have an Institutional Biosafety Committee to review research involving recombinant DNA, Institutional Review Board to review human subjects research, and Institutional Animal Care and Use Committee to review animal subjects research. Many research institutions in the U.S. that are privately funded also have established these review committees to demonstrate their research responsibility. In addition, many countries throughout the world have established similar review bodies to promote responsible research and/or to facilitate international scientific cooperation. These review bodies take into account local context during the review process and comply with the local and national governing structure. In the BMENA region, a few countries have established review committees to address human and animal subjects protection and several scientists have attended training workshops on laboratory biosafety and biosecurity.

However, these review committees, national policies, and training programs cannot keep pace with research advancement and technology development. For example, research and technologies enabling genetic and epigenetic studies existed for over a decade before issues such as gene patenting, data privacy, and sample protection emerged as serious ethical concerns.
Participants highlighted several responsibilities that scientists should consider research activities and technology developments. These responsibilities included:

- Ensuring the general welfare of humans and animals involved in research;
- Recognizing the potential significance of research activities to address community or regional priorities or needs;
- Encouraging self-regulation and accountability of research-related risks and responsible research behavior;
- Staying abreast of new scientific developments and evolving societal concerns, which include new ethical, safety, and security concerns associated with different types of research activities; and
- Becoming proficient in exercising “ethical relativism” to enable ethical decision-making about research related activities.\(^2\)

Some meeting participants were hopeful that the moral foundation that underpins many societies could facilitate a common understanding of ethical, safety, and security concepts. However, other participants stressed the difficulty in standardization of practices because of cultural and societal differences and sensitivities. The example that participants cited was of human and animal subjects protections, where the core principles are shared among scientists but the practices and certification procedures differ between countries.

**Financial and Legal Aspects of Scientific Cooperation**

In today’s scientific environment, where journals and funders require significant amounts of data before articles are published or proposals are funded, collaboration and team research offer benefits to all scientists involved. Diverse expertise and greater human capacity are brought to bear on research activities, enhancing data collection and analysis and improving likelihood of obtaining noteworthy findings.

Even when promising scientific partnerships are identified, funding for the proposed research project or the development of the collaboration might not be readily available. Knowledge of philanthropic organizations and their priority funding interests, and communication with funding agencies are a critical component for identifying support for scientific collaboration. Meeting participants suggested that a regional funding mechanism through which South-South research

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\(^2\) Ethical relativism refers to the idea that conceptions of right and wrong depend on the prevailing views of the individual, culture, and time period. One example provided to explain this concept was the researcher’s responsibility in providing diagnostic results of a retinal blastomy test if they knew that the results would be used to support the filing of a divorce.
collaboration could be supported would significantly aid efforts to promote research partnerships and leverage existing research capacity to address national priorities.\(^7\)

Research collaborations are built on mutual understanding of the objectives and expectations of the partnership, clearly articulated and delineated roles and responsibilities of all partners, trust between partners, and acknowledgement and acceptance of cultural differences and sensitivities. Difficulties affecting the duration and quality of the partnership arise when issues, such as taxation, intellectual property, export control, and payment provisions, are not adequately addressed prior to project initiation. Supportive research environments that are able to address problems as they arise enable the development of nascent partnerships and growth of established partnerships. Successful partnerships take time, patience, and trust. One U.S. meeting participant enumerated the necessary steps to developing a successful collaboration: 1) understand the scientific needs and capabilities of the partner country; 2) formulate a plan for implementing project activities and handling technology transfer; 3) assess the capability of the partner institution, laboratory, and researchers and provide appropriate training as needed; and 4) build in activities to transition the collaboration to a long-term research partnership.

The BMENA BioScience Forum: Building the Network

Meeting participants were enthusiastic about continuing to build trust and momentum around issues of responsible science and international research cooperation, which was an integral part of the AAAS meetings in the BMENA region. Participants suggested that a forum be developed to continue the efforts and unify participants from all meetings.

**Creation of the BMENA BioScience Forum.**

Meeting participants suggested the mission of the network should focus on linking international research collaboration, professional development, and sharing of principles and good practices on responsible science (i.e., bioethics, biosafety, and biosecurity). The suggested vision for the network was either to promote a sustainable research environment for a safer, healthier society or to encourage ethical, safe, and secure research environment in the BMENA region. Participants suggested that the network could promote international collaboration through professional development of network members and facilitate collaborative efforts that promote responsible science.

Meeting participants suggested the following activities could be undertaken by the network:

- Develop shared practices and standards of bioethics, biosafety, and biosecurity;

\(^7\) Participants suggested this mechanism could be provided by the Arab League and resemble the European Union’s Framework program.
• Improve advocacy for patient involvement in research studies and improve human subjects protection for these patients;
• Encourage international collaboration by providing:
  o A list of biological and biotechnological research activities, publically available data sets, and publications;
  o A list of bioethics, biosafety, and biosecurity regulations, guidance, best practices, and education materials;
  o A list of possible philanthropic organizations;
  o A list of approaches for strengthening intellectual property policies and procedures in BMENA countries;
• Mentor early-career scientists on the process of international collaboration, research management, scientific writing, and responsible science;
• Provide site-specific training and technical assistance to improve institutional biosafety, biosecurity, and bioethics processes;
• Provide training to improve scientific writing;
• Establish a science and technology policy fellowship in BMENA countries to improve scientific input in the policy process;
• Encourage dialogue between network members, policymakers, and members of the public; and/or
• Engage in scientific cooperation efforts linking various bioethics, biosafety, and biosecurity efforts in the region (e.g., connecting the UNESCO Bioethics Program, WHO biorisk management programs, and relevant national entities).

Conclusion

Building scientific and human capacity to develop regional expertise in emerging fields, enhance research efforts, and facilitate international collaboration are critical to addressing several national, regional, and global priorities. Early-career scientists trained with the necessary skills to navigate legal and operational issues associated with cooperative research, identify and mitigate research-related risks, and engage in internationally-relevant research will be well-poised to participate successfully in international and regional scientific efforts.

However, the benefits of research (both in capacity building and results) will not be realized if research efforts do not match national needs. Involving the scientific community in the policymaking process would help ensure that scientific research activities align with national and local priorities. The BMENA region has experienced a tremendous amount of turmoil during the past three years and the emerging political architecture of the region remains unclear. Despite the political challenges, regional scientists have worked to better cater their research to meet the needs of their countries in a safe, secure, and ethical manner.
The network that emerged from this meeting (the BMENA BioScience Forum) built on the series of AAAS meetings by tying biosafety, biosecurity, and bioethics concepts as an intrinsic part of research efforts and international scientific collaboration. Going forward, the network will face a number of challenges, including working with other regional networks to complement rather than compete with these networks, providing programs to address member needs, ensuring long-term enthusiasm and interest in the network, and identifying suitable metrics to assess the network’s value. Overcoming these challenges will help the network provide useful opportunities for professional development and collaborative research to future generations of BMENA scientists.
Collaborative Grants

The AAAS CSTSP received funding from the U.S. Department of State to support five small grants to encourage safe and responsible international research collaboration between scientists from the United States and BMENA countries. This grant competition built on the discussions and themes from the meeting in Jordan (see Chapter 2). Eligible applicants were either participants or scientists from research institutions represented at the meeting.

The specific objectives of the grant competition were:

- To facilitate long-term, mutually beneficial international scientific collaboration in the biological sciences;
- To explore a common conceptualization of safe, secure, and ethical conduct of research and approaches for implementing those norms in laboratories and/or research institutions;
- To explore, recommend, and suggest ways of overcoming barriers and challenges towards international scientific collaboration in the areas of biotechnology, infectious disease, and biomedical research to combat disease;
- To promote education, recruitment, and retention of talented scientists; and
- To build a network of scientific and institutional leaders in the region and their U.S. counterparts.

Following a two-step, peer review process, AAAS selected five cooperative projects that demonstrated scientific merit, met at least one of the objectives of the grant competition, and articulated how the project could be sustained over the long-term. The five grants were:

- Faculty of Science of Tunisia and Georgetown University. Ensuring Safe, Secure and Ethical Conduct of Biomedical and Behavioral Research in Tunisia
The following chapter describes the five grants and lessons learned from the cooperative grant competition.

**Collaborative Grants**

*Ensuring Safe, Secure and Ethical Conduct of Biomedical and Behavioral Research in Tunisia*

Project contributors included a multi-disciplinary team of biomedical and behavioral researchers, laboratory and other study managers, ethicists, social scientists, lawyers, and research administrators from Georgetown University in Washington D.C. and the Faculty of Sciences of Tunisia. The project sought to contribute to ensuring safe, secure, and ethical conduct of biomedical and behavioral research in Tunisia.

The initial focus of the project was to prepare a code of conduct or protocol that would outline procedures to ensure safe, secure, and ethical conduct of biomedical and behavioral research, and to provide short-term training opportunities to young Tunisian scientists at Georgetown University. The project focus expanded to include capacity building for those young Tunisia research scientists and also to engage Tunisian biomedical researchers in a process to evaluate and provide recommendations on strengthening bioethics, biosafety, and biosecurity within the current biomedical research environment in Tunisia.

Following the completion of the AAAS-funded project, participants have continued to address bioethics, biosafety, and biosecurity as they engage in joint research. Partners have instituted an Institutional Review Board (IRB) committee at the Faculty of Sciences in Tunisia. According to the project investigators, “Georgetown University and the Faculty of Sciences in Tunisia identified common research experience and interests in bioethics and in non-inflammatory breast cancer, which they chose to conduct collaborative research studies in as a means of building

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74 Information taken from Final Grant Report to AAAS: University of Tunis, Faculty of Sciences and Georgetown University, “Ensuring Safe, Secure and Ethical Conduct of Biomedical and Behavioral Research in Tunisia,” (May 31, 2012).
relationships for sustainable collaboration.” The title of the joint project is *Inflammatory Breast Cancer Pilot Study and the Study of Perceptions Regarding Ethical Issues Related to Medically-Assisted Reproduction.*

**Infectious Disease Collaborative Research Initiative**

Research conducted at the Department of Experimental Pathology, Microbiology and Immunology at the American University of Beirut (AUB) overlaps with the research conducted at the South Texas Center for Emerging Infectious Diseases (STCEID) at the University of Texas San Antonio (UTSA). This grant sought to stimulate collaborative research between AUB and STCEID in the general area of infectious disease, and more specifically in the focused research areas of microbial pathogenesis and immunity to microbial infections, with particular attention to gastrointestinal illness, zoonotic diseases, sexually-transmitted diseases, and mycoses. Through the grant award, two symposia were held - one at AUB and the other at UTSA - that involved scientists from both institutions. The goal of these symposia was to identify areas of mutual interest between scientists from both participating institutions to catalyze future collaborative projects between the institutions.

Detection and characterization of *Vibrio cholerae* strains endemic to Lebanon were identified as an area of mutual interest for AUB and STCEID. Project investigators decided to initiate a small cooperative project to characterize endemic strains of *V. cholerae*, which causes the human disease cholera, and help scientists in Lebanon predict the onset of future cholera epidemics. Funds that were not used during the symposiums were used at AUB to isolate *V. cholerae* from non-sea water sources and characterize these samples using biological and serological techniques. The samples were sent to the University of Texas, San Antonio, where project researchers are conducting molecular characterization of the *V. cholerae* isolates, which includes genetic analysis, virulence factor expression analysis, and biofilm formation characterization.

**Middle East Genomics Training and Educational Science Center**

The Jordan University of Science and Technology and Los Alamos National Laboratory proposed a five-year plan to improve the MENA region’s genomic research infrastructure and build the required workforce to support this scientific capability. The project investigators proposed to begin developing this capability through the establishment of research and human resources capacity-building activities.

The goal of the collaborative project was to transfer genomics technologies and skills to the Middle East to develop the foundation to support the genomic research that could protect citizens from many threatening genetic and infectious diseases, enhance metagenomic translational

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75 University of Tunis, Faculty of Sciences and Georgetown University, “Ensuring Safe, Secure and Ethical Conduct of Biomedical and Behavioral Research in Tunisia,” Final Grant Report to AAAS CSTSP (May 31, 2012).

76 Information taken from final grant to AAAS CSTSP: “Infectious Disease Collaborative Research Initiative” (July 2, 2012).

77 Information taken from final report to AAAS CSTSP: “Middle East Regional Genomics Research and Training Center ‘Realizing the Vision’” (June 15, 2012).
research in the biotechnology sector, improve pharmacovigilance (i.e., drug safety and efficacy) in the Middle East, and build students’ interest in conducting responsible genomic science. The overall objective of the project was to establish a Middle East regional genomics research and training center at the Princess Haya Biotechnology Center, Jordan University of Science and Technology. The Center would provide a regional hub for the development and transition of genomic science to the Middle East. In addition, the Center will communicate and build capacity in codes of professional conduct and biosecurity.

Partners in Jordan and the U.S. were eager to cooperate with each other on this project and began exchanges prior to the awarding of the cooperative grant. Through AAAS support, project investigators developed a strategy and business plan for short- and mid-term activities required to build the necessary research and human capacities in the genomic sciences at the Jordan University of Science and Technology. During the project, participants identified advanced genomic scientific capabilities (e.g., affordable second, third, or future generations of genomic sequencing) as a principal need within the Middle East basic and commercial life science research enterprise and regional economic environment. Project investigators identified five priority research areas of the Center: Industrial Genomics, Molecular Epidemiology, Diagnosis and Characterization of Metabolic Disorders, Infectious Disease Surveillance, and Integrated -OMICS applied to medicine.

**Training in Nanobiotechnology for Detection of Environmental Viruses**

Early detection of infectious diseases provides the best opportunity for intervention and prevention of outbreaks. This project initiated collaboration between investigators from Morocco and the U.S. to develop new methods for identifying and diagnosing pathogenic viruses found in environmental samples. The goal was to provide a system for the development of effective environmental biosensing devices in Morocco.

Project investigators initiated training programs in Morocco and the U.S. to educate scientists about the use of nanobiotechnology and environmental virus detection. These training programs included meetings and laboratory visits at the University of California, Irvine and the University of Hassan II Mohammédia in 2012. The University of California, Irvine initiated a series of internships for Moroccan students and professors to gain experience working in American laboratories. These internships provided opportunities for international cultural, scientific, and technology exchange; experience working in a research laboratory group; and formal training integrating academic knowledge with research experience. Two doctoral students and two professors from University of Hassan II Mohammédia participated in the internship program.

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78 Ibid, 4.
The success of the internship program prompted the University of California, Irvine and University of Hassan II Mohammédia to explore the possibility of establishing a long-term visiting scholars program for Moroccan doctoral students and senior researchers.

Transboundary Ecosystem Health in the Pamirs

The Pamirs, bordered by the Hindu Kush, Himalayan, Karakoram, and Kunlun mountain ranges, have a unique ecosystem because of their relative geographic isolation and low human footprint. The Pamirs are home to endangered species, such as Marco Polo sheep and snow leopards. Within the region, livestock diseases pose the greatest risk to the unique wildlife. The abundance of domestic animals leads to forced cohabitation between livestock and their wild counterparts. Three countries - Afghanistan, Pakistan, and Tajikistan - share the Pamirs, yet no mechanisms are in place for monitoring health issues or sharing information across borders. The goal of the collaborative project was to encourage the acceptance within these three countries of a “One Health” approach to the study of livestock, wildlife, and human diseases and to demonstrate through an example of “coordinated and shared data collection and analysis that a global approach to animal health management is feasible despite physical borders and political sensitivities.”

Project investigators from the Wildlife Conservation Society (WCS) and the University of Veterinary and Animal Sciences, Pakistan (UVAS) organized field missions to the Pamirs in Afghanistan, Pakistan, and Tajikistan to collect and analyze serum samples from animals in 2011. A workshop was held in Dushanbe, Tajikistan in March 2012, to discuss the findings of the project and health effects of transboundary diseases. The workshop also exposed regional participants to international infectious disease experts and technical training opportunities in serodiagnostics. Workshop participants offered a number of recommendations and initiated a partnership between the institutions involved in Pakistan, Afghanistan, Tajikistan, and the WCS.

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82 “One Health” refers to the recognition that animal, plant, environmental, and human health are linked and that efforts to address health problems in one will impact the health of the others.
83 Stephen Ostrowski, Tahir Yacub, and Peter Zahler, “Transboundary Ecosystem Health in the Pamirs.” 2. The funding provided by the AAAS grant to the WCS and the UVAS was a subset of a larger grant which included funding from USAID and partner institutions located in Tajikistan and Afghanistan.
84 Ibid, 1.
Lessons Learned from the Cooperative Grant Program

Throughout the course of the AAAS cooperative grant program, several challenges arose affecting the success and duration of individual projects. The major lessons learned are described in detail below.

*Plan collaborative research partnerships to facilitate follow-on activities that sustain the research effort and partnerships past initial funding.*

The *Researcher Guidebook*, a joint publication by the Defense Threat Reduction Agency and the University-Industry Demonstration Partnership of the National Academies, states that development of “a genuine collaborative relationship requires a strategic, long-term arrangement.”  

With initial seed funding, the AAAS cooperative grant program sought to catalyze long-term scientific partnerships between U.S. and BMENA scientists. In several cases, these short-term grants resulted in longer-term partnerships. However in other cases, project partners struggled to work through communication or workforce problems that arose during the course of the grant. Nevertheless, most of the scientific relationships have continued. The brief duration of the grants posed challenges to some of the research partners and AAAS.

*Suggested Correction: All grant applicants should pay close attention to grant application deadlines and project timelines, particularly if they are extremely short. In addition, applicants should review application materials for information about renewal or extension of projects just in case they encounter delays during project implementation. If possible, the duration of cooperative grant programs should be at least two years to facilitate the development of positive, trusting partnerships and to build in time for unanticipated delays. Applicants should ensure their proposed projects could be completed in the timeline provided. Regular communication with the funder may help identify and characterize difficulties quickly and allow the funder and grantee to find solutions together.*

*Ensure that enough funds are requested to complete the proposed project activities.*

The cost of laboratory research ranges from hundreds of thousands to millions of dollars depending on the costs for materials, travel (if any), facility maintenance, personnel, equipment, and overhead (which includes costs for review and oversight of research, and assuring regulatory compliance). Some research activities require funds for export control licenses, physical security, and visas. Funding agencies might face legal restrictions on what their funds can be used for,

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which might prohibit the grant recipients from requesting (and receiving) funds to cover the full amount of direct and indirect costs.

The AAAS grant competition provided $75,000 in funding to collaborators, which might not be enough to cover the full range of direct and indirect costs involved in the support and conduct of collaborative research. Grant recipients that proposed non-laboratory projects had extra funds available after completing their project activities and requested reprogramming to provide additional cooperative opportunities to project staff. In one case, project investigators supplemented the collaborative grant with funds from an existing and related research project.

**Suggested Correction:** Cooperative grants that allow recipients to cover all major research-related costs (both direct and indirect) would help researchers support nascent partnerships and research activities. In addition, investigators could creatively find complementary funding, understand the limits of their research institutions, and/or change institutional procedures to create a more supportive research environment and provide opportunities for cooperative projects and research partnerships to succeed.

*Develop clear lines of communication and use common language to ensure concepts and agreements are understood by all collaborating partners.*

Clear communication between collaborating partners and their respective administrative support staff is essential for the successful completion of a cooperative project, particularly if partners have not previously worked together. The mode and style of communication, and language used, are critically important to ensuring that all partners and their institutions understand the project goals, legal and contractual requirements, and project timelines.

**Suggested Correction:** Collaborating partners and their research institutions should develop communication plans to ensure open, clear, and understandable communication between all parties. In addition, all partners and their support staff should ensure they fully understand the grant requirements, roles and responsibilities of all individuals involved, and legal requirements associated with successful completion of the project. If partners do not speak the same language, arrangements should be made to ensure accurate translation of all communications.

*Define the project objectives, goals, and requirements prior to project initiation.*
Differences in the expectations of prospective partners and their institutional cultures, missions, and requirements can cause significant difficulties in establishing new scientific partnerships. However, clear and open communication between partners about these differences can assist in resolving conflicts that arise from these differences, which ultimately leads to more effective partnerships between scientists and funders. Clearly articulating the project objectives, partner roles and responsibilities, and research activities and division of labor (based on partner capabilities and access to materials) prior to project initiation often helps resolve conflicts and address difficulties encountered during cooperative research. At least three of the AAAS-sponsored cooperative grants laid out a project plan that clearly described all project objectives and investigator roles and responsibilities prior to initiating their joint project activities.

Suggested Correction: Prior to project initiation, collaborating partners should clearly define their objectives, expectations, roles and responsibilities, and plan of action. Project partners should work with their institutional support staff and administrators to review the project and identify relevant legal requirements; this will minimize the likelihood of occurrence of otherwise avoidable delays and ensure compliance with relevant regulatory and grant requirements. Grant recipients and funders should clearly define and resolve any differences in expectations and deliverables for the cooperative projects prior to project initiation.

In addition to these overarching topics, prospective partners should inquire about institutional policies and practices for management and oversight of sponsored research and sharing of research information, including communication of results, publication rights, and intellectual property. Prospective partners should identify any technology transfer concerns and needs for export control, if any; understand the legal, institutional, and contractual requirements with which both partners should comply; and consider the long-term plan for continuing the partnership. Finally, cooperative partners should consider how their research contributes to building institutional and national capacity and scientific progress.86

Conclusion

International cooperation can contribute to regional stability and security through building local capacity, involving researchers in global scientific networks, addressing research-related risks, and promoting nationally-relevant research activities. Successful scientific collaborations built on mutual interest and concern can improve trust and transparency between partner institutions and countries, which in-turn provides more opportunities for cooperative research engagement. Even narrowly defined projects, such as the development of an international database of scientists and their research activities, might enable researchers to identify new partnerships and engage in new research efforts.87

While AAAS and its grant recipients faced challenges during the cooperative grant program, all five partnerships were successful in different ways. The investigators of the project, Ensuring Safe, Secure and Ethical Conduct of Biomedical and Behavioral Research in Tunisia, are currently developing new project ideas and seeking funding for those proposals; the project, Middle East Genomics Training and Science Center, has entered its second stage and partners are continuing to work together to build the genomics center; the scientists involved in the project, Training in Nanobiotechnology for Detection of Environmental Viruses, are seeking funding for establishing a visiting scientist program; project investigators for the project, Pakistan and Wildlife Conservation Society. Transboundary Ecosystem Health in the Pamirs, have indicated that they initiated a new institutional collaboration; and the Lebanese researchers from the project, Infectious Disease Collaborative Research Initiative, are seeking funding to develop biosafety and biosecurity training programs at Lebanese research institutions.

Chapter 7

Conclusion

The AAAS project, including the four meetings and cooperative subgrant competition, was designed to link the concepts of bioethics, biosafety, and biosecurity to high-quality research and international scientific cooperation. Each of the four meetings built off previous meetings and was informed by AAAS’s BMENA collaborators and colleagues. Throughout its project, AAAS worked with scientists from twelve countries in the Middle East and North Africa, Afghanistan, Pakistan, United States, United Kingdom, Brazil, and France.

Various lessons from both successful and unsuccessful cooperative scientific efforts were discussed and suggestions were proposed for improving the ability of scientists to work in collaborative efforts. During the discussions, major themes emerged:

- Collaboration is integral to the conduct of science and is seen as a mechanism for advancing science and addressing societal problems.
- Successful collaborations from different institutions, sectors and countries must address the needs of all collaborating partners and their respective countries, providing mutual benefit for all parties.
- Successful collaborations are based on mutual understanding, transparency, good laboratory practices, an understanding of legal and operational issues, and scientific responsibility.
- Strong institutional capacity and support, and skilled scientific workforce are critical to enabling international cooperation.
- The inclusion of early-career scientists in research and collaborative activities was highlighted as important for building and sustaining creative thinking and strong international partnerships.
• Research activities that address local and national needs, build local capacity to support research, and comply with national regulatory requirements could serve as opportunities for cooperation.

• Foreign investments to implement biosafety and biosecurity practices and procedures should be compatible with recipient countries’ supporting infrastructure and culture.

• Involving the scientific community in the policymaking process would help ensure that research activities align with national and local priorities.

• Governments, research institutions, professional societies, and individual scientists all have a collective responsibility to minimize ethical, safety and security risks associated with biological research.

• Bioethics, biosafety, and biosecurity measures are most effective when integrated with research progress.

When AAAS and the Jordan University of Science and Technology hosted the first meeting, attendees questioned the intentions of AAAS, a U.S.-based organization, discussing sensitive science and security topics in the region. This skepticism began to change after the first meeting and regional scientists with whom AAAS engages began to increase their trust in the organization and recognize the interconnectedness between responsible science, scientific progress, and international cooperation. By 2012, meeting participants developed strong professional friendships amongst themselves, which led to their support for additional dialogue and interaction.

Although no immediate plans are in place to continue the meeting series in its previous form, the establishment of the BMENA BioScience Forum and promise of the network’s first annual meeting in 2014 provides a useful transition from the AAAS-led meetings to regionally-led activities. The long-term vision is to have regional based dialogue, training, and mentorship to promote safe and secure scientific advancement.
Jordan University of Science and Technology (JUST)
The Jordan University of Science and Technology is a leading institution for higher education in Jordan having been ranked as its top research institution. Established in 1986, it is home to 55 departments and more than 20,000 undergraduate students. The JUST Her Royal Highness Princess Haya Biotechnology Center is a regional leader in molecular biology and biotechnology research, focusing on studying genetic disorders in the Arab world. The Center provides support for collaborative efforts within the university and with the government and private sector.

Kuwait Institute for Scientific Research (KISR)
KISR’s mission is to promote scientific and applied research, particularly in matters related to industry, natural and food resources, and other primary constituents of the national economy in an endeavor to serve the goals of economic, technological, and scientific development, and to advise the government on scientific matters and on scientific policy issues. The main objectives of the institute are to: conduct scientific research and studies concerned with the progress of national industry and which facilitate the preservation of the environment; encourage Kuwait to practice scientific research and nourish the spirit of research in the younger generation; explore and study natural resources and means for exploiting them, energy and water resources, and methods to improve agriculture and develop aquatic resources; render scientific, technological and research consultation services to the government and to national establishments; follow up the development of scientific and technological progress, and adapt it in ways that conform with the local environment; establish and foster relations, and carry out mutual research with higher education institutes and the technological and scientific sectors in Kuwait and various parts of the world; and participate in the study of ways to verify the resources of the national economy by investing the results of scientific and technological research in industry and directing it in the services of the Kuwait’s economic and social development goals.
Institut Pasteur de Tunis (IPT)
Established in 1893, The Institut Pasteur de Tunis is a public health institution under the guardianship of the Ministry of Public Health. It has three missions: Research and training, diagnosis and public health, and production of vaccines and sera. IPT is internationally well established and collaborates with several foreign scientific institutions. The Institute is also member of the Institut Pasteur International Network that includes 32 institutes throughout the world. Institut Pasteur de Tunis is linked to the history of medicine in Tunisia and to the discoveries in the field of infectious diseases, especially, since Charles Nicolle’s Nobel Prize.

Faculty of Science of Tunis, University El Manar
The Faculty of Sciences of Tunis, truly called Faculty of Mathematical, Physical and Natural Sciences, was founded in 1960 in the premises of the Institute for Advanced Studies in Tunis, which depended on the University of Paris, since its inception in 1945. From its conception it trained its students to obtain undergraduate degrees (license in French) in various scientific disciplines, such as Mathematics, Physics, Chemistry and Natural Sciences. In 1978, FST created the first Department of Engineering program in North Africa. Relying on cooperation with foreign countries at first, FST started to gradually become self-sufficient in some research areas, due in part to successful acquisition of heavy equipment, except for Biology, which was always the more advanced research areas of FST.

Dubai Healthcare City (DHCC)
Dubai Healthcare City was launched in 2002 by the UAE Vice President, Prime Minister and Ruler of Dubai, His Highness Sheikh Mohammed Bin Rashid Al Maktoum, to meet the demand for high-quality, patient-centered healthcare. Today, DHCC is home to two hospitals, over 100 outpatient medical centers and diagnostic laboratories, with over 3000 licensed professionals, in the heart of Dubai. DHCC combines the leading expertise of medical institutions and pre-eminent healthcare providers to deliver the full range of medical services.

To be at the forefront of healthcare in the region and internationally, DHCC is constantly expanding to offer new services and expertise. They have grown in a short space of time into a major medical community and have more plans to deliver health and wellness services that compete on an international scale. Their approach is simple, to attract the best healthcare providers, deliver the best service, and lead best practice.
Appendix B

Key Acronyms

AAALAC- Association for the Assessment and Accreditation of Laboratory Animal Care International
AAAS- American Association for the Advancement of Science
AUB - American University Beirut
BMENA- Broader Middle East and North Africa
CDC- U.S. Center for Disease Control and Prevention
CSTSP- Center for Science, Technology, and Security Policy
CTR- Comprehensive Threat Reduction
DoD- Department of Defense
DOE- Department of Energy
DoS – Department of State
FST- Faculty of Science, Tunis
FSU- Former Soviet Union
GDD- Global Disease Detection
GDP- Gross Domestic Product
IPT- Institute Pasteur de Tunis
IT- Information Technology
JUST- Jordan University of Faculty of Science
KISR- Kuwait Institute for Scientific Research
KSA- Kingdom of Saudi Arabia
LANL- Los Alamos National Institute
MBDS- Mekong Basin Disease Surveillance
MECIDS- Middle East Consortium of Infectious Disease Surveillance
MENA- Middle East and North Africa
NIAID- U.S. National Institute of Allergy and Infectious Disease
NIH- National Institutes of Health
NPRP- National Priorities Research Program
QNRF- Qatar National Research Fund
R&D- Research and Development
SARS- Severe Acute Respiratory Syndrome
S&T- Science and Technology
STCEID- South Texas Center for Emerging Infectious Diseases
WHO- World Health Organization
WMD- Weapons of Mass Destruction
UNESCO- United Nations Educational, Scientific and Cultural Organization
UTSA- University Texas San Antonio
Appendix C

International Scientific Collaboration and Exchanges

This appendix provides some examples of relevant issues discussed at the meeting, including the role of collaboration in health and agriculture, scientific networks, diplomacy, and international security. Encouraging international collaboration and global scientific capacity will contribute to broad economic and social benefits for everyone, including the United States and partner countries. Examples of international scientific collaboration that have contributed to peace and security are briefly described below.

**Health and Agriculture**

A number of recent examples illustrate the contribution of international scientific collaboration to public health and agriculture. In 2003, when the deadly lower respiratory tract infection Severe Acute Respiratory Syndrome (SARS) emerged in Asia, an international group of scientists characterized the previously unknown coronavirus in months. A similar international response was mounted against the 2009 H1N1 influenza virus and resulted in the rapid development of a safe and effective vaccine. International collaboration is critical for combating malaria and the human immunodeficiency virus (HIV)/acquired immune deficiency syndrome (AIDS). Efforts to counter malaria have recently benefited from the establishment of the Multilateral Initiative on Malaria (MIM). This group not only performs outreach and communication with governments and nongovernmental organizations, but encourages sustainable research capacity in Africa through scientific training and partnerships.

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Efforts to identify effective mechanisms for combating the global HIV/AIDS pandemic rely on active research and international collaboration. Although efforts to develop an effective HIV vaccine have been fairly unsuccessful, more progress has been made in the use of antiretroviral therapy (and more recently, microbicides) and education. Development and use of these mechanisms rely on cooperation of scientists from several countries.⁹⁰

In agriculture, the Global Rust Initiative has been established to help fight the Ug99 strain of stem rust that has infected and destroyed previously resistant wheat crops.⁹¹ In addition to scientific collaboration, this initiative also benefits from tremendous cooperation among agricultural companies and private charities. All efforts to combat Ug99 outbreaks would have been impossible without the combined resources and expertise provided by international collaborations.

Connecting Health Organizations for Regional Disease Surveillance (CHORDS) is a network of networks that focuses on building trust among scientists from different (sometimes unfriendly) countries to address critical societal and health issues, namely infectious disease surveillance.⁹² One member of CHORDS, the Middle East Consortium on Infectious Disease Surveillance (MECIDS), focuses on information-sharing within the region on water-borne disease surveillance.⁹³ These systems are effective diplomatic tools because they engage countries on issues that are mutually beneficial and allows for a greater degree of communication.

**Science and Technology Cooperation**

Attempts are underway in the Broader Middle East and North African region (BMENA) to encourage the development of science and technology research through networks. The most prominent is the Ministerial Standing Committee on Scientific and Technological Cooperation (COMSTECH) of the Organization of the Islamic Conference (OIC). COMSTECH's mission is to “…help strengthen the individual and collective capacity of Organization of the Islamic Conference member states in science and technology through mutual cooperation, collaboration, and networking of resources.”⁹⁴ COMSTECH accomplishes this by working as an intermediary for connecting likeminded scientists who have an interest in professional collaboration.

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The U.S. Department of State and the U.S. Agency for International Development (USAID) run grant programs with the Egyptian and Pakistani governments and distribute millions of dollars annually for grants. Both programs fund projects that are deemed to improve the capacity and collaborative environment in participant countries while simultaneously pursuing research for peaceful purposes. The most recent Pakistani-U.S. program is specifically geared for biology projects focused on infectious disease and best practices in laboratory management. Examples of funded projects include removing arsenic from drinking water, rapid detection of multidrug-resistant tuberculosis, and improving quality assurance at medicinal plants.

Several nongovernmental organizations facilitate collaborative efforts within the BMENA region. According to their website, Scientists Without Borders is a web-based collaborative community that seeks to address global issues. Users from across the world can cooperate on projects, offer or solicit advice, and donate resources to projects. Similarly, The World Economic Forum sponsored the establishment of the Society for Advancement of Science and Technology in the Arab World (SASTA) in May 2009. SASTA is charged with “…promoting networking and collaboration among Arab scientists as means for human capacity building and advancing science and research in the Arab world.” The group seeks to engage Arab expatriate scientists to further the development of science, research, and education in the BMENA region.

Diplomacy
In attrition to collaboration to advance science, international cooperation can build relationships between peoples from countries that have poor diplomatic relations. Encouraging scientists from different countries to work in partnership on a common goal can promote trust and active dialogue among these scientists, and demonstrate to their governments the value of working together.

In June 2009 in Cairo, President Obama committed to seek “a new beginning” between the United States and Muslim-majority countries around the world. He proposed programs that would leverage U.S. scientific and technological capacity to improve education, scientific capacity, and economic development throughout the MENA region.

US-Soviet Relations
Despite their major political differences and hostile security relationship, the United States and the Soviet Union (USSR) were able to work together to fight infectious diseases. For example,

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the American scientist Albert Sabin developed a polio vaccine but was unable to test it in the U.S. With the help of the Soviet Union’s leading polio researcher, Mikhail Chumakov, Sabin’s vaccine was tested in the USSR and eventually saved millions of lives. The polio experience paved the way for U.S.-USSR cooperation under the World Health Organization (WHO) to eliminate smallpox disease in the 1970s.

**Scientific Exchanges and Nonproliferation**

The Biological and Toxin Weapons Convention and other security instruments have included scientific exchanges, assistance, or collaboration to address nonproliferation concerns. Scientist-to-scientist interactions have contributed to the security agenda (i.e., deterrence, transparency, monitoring, treaty compliance, and establishment of norms). Similarly, United Nations Security Council Resolution 1540, which prohibits spreading weapons of mass destruction to non-state actors, encourages countries to assist one another in formalizing and establishing laws and regulations.

In the BMENA region, the Middle East Scientific Institute for Security (MESIS) has been established in Amman, Jordan. This independent, nongovernmental organization has the objective of promoting regional cooperation in border, environmental, and energy security. The organization aims to provide training workshops, assess training needs, and promote science and technology in regional stability. This organization was originally established in 2002 as the Cooperative Monitoring Center and sought to promote science and technology to support nonproliferation, develop a cooperative monitoring culture, deploy monitoring technology projects, and help regional security officials bridge the gap between technical and political issues. Recently, this center has started to explore security issues associated with biology and biotechnology.

**Scientific Exchanges and International Health Regulations**

One mechanism that emphasizes international exchange is the International Health Regulations 2005 (IHR2005). This legally binding agreement, which has recently been revised, aims to reduce the spread of infectious diseases across national borders while simultaneously avoiding unnecessary restrictions on trade and travel. The agreement includes a decision instrument to identify infectious disease outbreaks that could constitute a public health emergency of international concern (PHEIC) and that should be reported to the WHO. It also requires that decisions about PHEIC be based on sound scientific evidence. The IHR encourage collaborative

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response to public health events and state that all members must work together to diagnose and characterize PHEICs. It also establishes a baseline level of competency that countries must achieve. Relationships that are developed during this process could set the stage for future collaboration.
Agreeing on shared principles and standards of laboratory practice (i.e., ethics, safety, and security) can facilitate scientist-to-scientist collaboration and increase confidence (and trust) in collaborating partners. Common understanding of standards of legal and operational practices, such as export controls and intellectual property, also facilitate scientific collaboration. This section provides a brief introduction to responsible stewardship and relevant legal and operational issues that are involved in international scientific collaboration. However, this section is not intended to provide an exhaustive set of ethical, legal, and operational issues associated with successful international scientific collaboration.

Responsible Science

Bioethics
The 2nd World Conference on Research Integrity, held in Singapore in July 2010, sought ways to gain public trust and support while ensuring high fidelity in scientific endeavors.\(^{103}\) It led to the Singapore Statement on Research Integrity, a succinct summary of the basic principles and responsibilities for scientists to follow during the course of conducting research: the statement did not result in an internationally-agreed upon ethical framework. Nevertheless, achieving a shared understanding of bioethical principles would facilitate collaboration.

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) established an International Bioethics Committee (IBC) in 1993 to spur discussions on the ethical implications of advanced biological research (e.g., genetic engineering, human genomics, and cloning) and to

disseminate these principles to a wide audience. In 1998, the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) was created by UNESCO. The Commission was mandated to formulate ethical principles that could provide decision-makers with criteria that extend beyond purely economic considerations. The UNESCO bioethics pronouncements provide guidance to those countries that seek to promote ethical conduct in biological research.

The International Council for Life Sciences (ICLS) and COMSTECH held meetings in Islamabad, Pakistan in 2010 and 2011 to discuss the conduct of responsible science. The meeting merged the principles of responsible science (i.e., ethics and safety), cognizance of security, and respect for culture. This meeting focused on younger scientists and promoted respect for scientific professions in a manner that respects Islamic culture. ICLS has established a branch office in Pakistan and is currently expanding to Qatar.

Another international forum in which codes of conduct for the life sciences have been discussed is the intersessional process of the Biological and Toxin Weapons Convention (BTWC). Intersessional meetings are held annually in between the 5-year review conferences of the BTWC to address issues critical to implementation of the treaty. The 2005 intersessional meeting focused on a “common understanding and effective action on codes of conduct for scientists.” The 2008 meeting addressed codes of conduct within the context of oversight, awareness, and education about the dual use dilemma (see below). Within the security context, bioethics forms a base for encouraging safe and secure research conduct.

**Laboratory Biosafety and Biosecurity**

In the United States, the term biosafety is used to describe efforts conducted to minimize accidental exposure to biological pathogens or toxins, and laboratory biosecurity refers to efforts to minimize theft of pathogens or toxins, or their intentional release to cause harm. However, in many languages, “biosafety” and “biosecurity” translate to the same word. Consequently, groups have started using the term “biorisk management,” which describes laboratory biosafety and biosecurity measures, to avoid the confusing linguistic and definitional problems. Shared biosafety and biosecurity principles could facilitate collaboration. If all scientists are familiar with a foundational set of procedures, communication becomes simpler and experimental designs

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more transferable. The U.S. Centers for Disease Control and Prevention (CDC) and the U.S. National Institutes of Health (NIH) publish “Biosafety in Microbiological and Biomedical Laboratories” (BMBL), which provides guidelines on risk assessment of pathogens or toxins and associated experimental procedures, and information about equipping laboratories with and training personnel on appropriate safety measures.\(^{109}\) The newest version of this guidance includes an entire section on biosecurity. Compliance with BMBL guidelines is mandated for recipients of NIH funding and for institutions participating in the U.S. Select Agent Program.\(^{110}\)

In addition, the BMBL has been used as biosafety guidance by other countries.

Several international groups have taken an interest in promoting laboratory biosafety and biosecurity. The World Health Organization (WHO) publishes two laboratory manuals – Laboratory Biosafety Manual and Laboratory Biosecurity Guidance.\(^{111}\) The biosafety manual provides guidance on the safe conduct of research in a biological laboratory environment. The biosecurity manual extends the biosafety practices and encourages implementation of measures that could prevent the theft or loss of pathogens or toxins, or misuse of equipment and laboratory materials. The International Federation of Biosafety Associations (IFBA) is comprised of 20 biosafety associations from around the world and provides member organizations a forum in which to discuss biosafety measures and lessons learned.\(^{112}\) Sandia National Laboratories cooperated with the European Committee for Standardization (CEN) to develop voluntary standards for managing biological risks in the laboratory. The standards are currently under review for possible renewal. The International Council for the Life Sciences (ICLS) has established a regional Biosafety and Biosecurity International Conference (BBIC) that consists of a network of national biosafety associations from several BMENA countries.\(^{113}\) Governed by regional members, this program meets annually and contributes to several international activities, including the BWC intersessional process and the IFBA.

**Dual-use Research in the Life Sciences**

Dual use research is defined as beneficial scientific research that could be used by ill-intended individuals to deliberately cause harm. This concept was initially described in the 2004 U.S. National Research Council (NRC) report “Biotechnology Research in an Age of Terrorism.”\(^{114}\)

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107 The „Select Agent Regulations” includes several regulatory measures to prevent unauthorized access to a set of over 80 dangerous infectious diseases, referred to as „select agents”. The pathogens and toxins currently on the list affect human, animal, and/or plant health and may be a risk to national security and public health. K.M. Berger. Select Agent Rules. Encyclopedia of Bioterrorism Defense. Edited by Rebecca Katz and Raymond A. Zilinskas. 2011.
This report stated that although current regulations successfully protected the scientist and laboratory environment from unintentional release of dangerous pathogens, measures to prevent or curtail the deliberate misuse of knowledge, tools, and techniques by ill-intended individuals was not adequate. As examples, the report identified seven microbiological experiments that had higher potential to be directly misused. Three of these experiments involved increasing pathogen virulence, conferring antibiotic resistance to reduce the efficacy of medical interventions, and expanding the host range of a pathogen. The report also recommended that an advisory group be created to identify dual use research and consider options for minimizing the risk that biological results, techniques, or knowledge could be misused.

In response to the NRC report, the U.S. government established the National Science Advisory Board for Biosecurity (NSABB) under the auspices of the NIH. This group, made up of experts from the scientific and security communities, has released reports on the identification, communication, oversight, and education of dual use life sciences research. The NSABB released a short video describing the dual use issue for life scientists. It has also released recommendations on synthesis of select agents and personnel reliability. The NSABB has engaged in international outreach.

Several non-governmental organizations have initiated activities to educate scientists about the dual use dilemma. The Federation of American Scientists has developed online education modules, which were expanded to include agricultural experiments. In 2008, biosecurity experts from the Landau Network-Centro Volta and the University of Bradford published a survey of dual use education programs in Europe. Later that year, the AAAS CSTSP published a report, “Professional and Graduate-Level Programs on Dual Use Research and Biosecurity for Scientists Working in the Biological Sciences,” which evaluated existing training programs in the United States. Experts from the University of Exeter and the University of Bradford have worked with research institutions in several countries to develop educational tools for their students. In 2009, the AAAS and NRC published a report describing the relative level of awareness of dual use issues and surveying attitudes of proposed policies to minimize the risk of misuse within the U.S. biological sciences community. In addition, the 2009 BWC intersessional meeting addressed awareness, education, and oversight for the prevention of

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misuse of biotechnology.\textsuperscript{120} The IAP (formerly, the InterAcademy Panel), which is an association of national academies of science, and international biological sciences organizations have hosted meetings on dual use education.\textsuperscript{121}

\textit{International Legal and Operational Issues}

The cross-cutting issues of visas, export controls, and intellectual property and technology transfer pose significant and persistent difficulties to international cooperation. Obtaining visas to enter the United States has become more difficult since 2001. Although these visa policies have subsequently somewhat improved in recent years, they continue to limit the contributions of foreign scientists to U.S. education and research. In addition, limiting temporary visas to foreign scientists can affect international scientific collaboration, which may result in decreased innovation, trust, and security.

\textit{Export Controls}

Export control regulations (both nationally and internationally) can constrain sharing of knowledge, tools, and/or biological materials between scientists from different countries. Export controls are designed to enhance national security by preventing products or services that could contribute to military or terrorist capabilities from being acquired by potentially hostile entities. Since controls by individual countries would be ineffective unless all potential exporters adopt equivalent controls, a number of multilateral agreements exist through which like-minded countries harmonize their export control policies. These include the Wassenaar Agreement (which addresses conventional weapons and relevant technologies), the Australia Group (which addresses technologies and products relevant to the manufacture of chemical or biological weapons), the Missile Technology Control Regime, and the Nuclear Suppliers Group. In some cases, where relatively clear distinctions exist between technologies of particular relevance to weapons applications and those used in research laboratories, restricting technology may have little effect on legitimate research. For example, controls placed on highly specialized centrifuges, bearings, specialty steels, and vacuum pumps that might be used to produce uranium for nuclear weapons have little effect on scientific research because these items are not widely used in other fields. However in biology, where the same equipment can be used for legitimate or illegitimate purposes, restricting the sale or shipment of equipment, services, or materials may have unintended effects on legitimate scientific research.


The U.S. government is currently revising and harmonizing its national export control regulations and lists. In addition to facilitating trade and commerce, these changes may also facilitate international collaboration between American scientists and foreign counterparts. The export control reform seeks to simplify the regime while still addressing security concerns. These efforts do not affect multilateral export control agreements.

**Intellectual Property and Technology Transfer**

Intellectual property rights (IPR) are necessary for innovators to realize the benefits of their inventions. For a prescribed period of time, IPR prevents others from copying an innovation without permission from (and possibly payments to) the innovator and ensures that the economic rewards from an invention are returned to the innovator. “Technology transfer,” the licensing of ideas or products from one entity to another, has now come to represent primarily the transfer of technology from an innovator (e.g., patent holder) to a firm or other entity that can provide the necessary investments to develop the invention to market. Technology transfers are important for companies and research institutions looking to transition basic research discoveries into viable commercial products. Such activities may also contribute to economic development by creating new industries and employment opportunities.

Internationally, intellectual property (IP) protections are codified in the Paris Convention, the World Trade Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), and the Madrid Union.122 Within the BMENA region, membership in these treaties is far from universal. Because of concerns over IP violations, private industry has been wary to enter into collaborative research with scientists in these countries. If a country produces novel technology but loses the exclusive rights to that invention through unauthorized copying - either within its own borders or with a research partner in another country - the full financial benefits will not be realized. Management of IP to realize the economic benefits of an invention is important for developing countries or conflict-ridden countries where legal regimes for securing patents and maintaining patent protection may be lacking. Two possible mechanisms to effectively manage IP and promote commercialization for economic and societal benefit include licensing and “bundling” of IP into commercially attractive portfolios.

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Appendix E

Delphi Questions from Kuwait Meeting

In advance of the Kuwait meeting, AAAS and its colleagues at Georgetown University and Indiana University conducted a two-round process to identify national priorities, research priorities, and capacity needs.

The first set of questions sent to meeting participants:

1. What top five societal priorities in your country can be addressed through biological sciences research and biotechnology? Examples of societal priorities can include, but are not limited to: health and health related needs, including non-communicable, hereditary, or infectious diseases; energy research (e.g. biofuels); the environment (e.g. water pollution, waste treatment); and agriculture.

2. What biological or biotechnological research is currently being carried out in your country to address your five priorities? Please provide one or two examples for each of the five priorities as appropriate.

3. What additional biological or biotechnological research is useful to address these top five societal priorities? Please provide one or two examples for each priority, as appropriate.

4. Generally, what are the strengths or opportunities in your country and region regarding biological and biotechnological research? These can include, for example, expertise, research facilities, scientific capacity, and/or political support for biological research or region-specific biodiversity. You are welcome to comment on these strengths.

5. What are the challenges or facilitating factors in your country or region that affect the translation of results of biological or biotechnological research into societal benefits? You are welcome to comment on these challenges and facilitating factors.
The second set of questions sent to meeting participants:

1. What current research activities in the biological or biotechnological sectors can be leveraged to address societal priorities? How might existing or new scientific collaboration contribute to addressing these priorities?

2. What risks are associated with the biological or biotechnological research conducted in the region? How have those risks been minimized and integrated into education and research programs?

3. What are the most effective practices in and opportunities for intraregional and international collaborative biological or biotechnological research?
Appendix F

Organizations of Regional Interest

This appendix, in alphabetical order, provides additional information about organizations or examples that were discussed at the meeting. It goes on to describe other relevant organizations (also in alphabetical order).

Organizations Mentioned during the Kuwait Meeting

*Biosafety and Biosecurity International Conference (BBIC)*
“The BBIC process aims to promote the development of biosafety and biosecurity strategies in MENA. The overall goal of the first conference was to promote the development of biosafety and biosecurity in the Middle East and North Africa. The partners are working to: create a regional biosafety and biosecurity network for the MENA, develop a regional biosafety and biosecurity strategy, and connect scientists and decision-makers within the region.”

*Biosecurity Engagement Program*
http://www.bepstate.net/ (accessed on May 17, 2011)
“The Biosecurity Engagement Program (BEP) is committed to developing cooperative international programs that promote the safe, secure and responsible use of biological materials that are at risk of accidental release or intentional misuse. Fundamental BEP objectives include:

- Assisting partner countries in maintaining a balance between developing sustainable public and agricultural health infrastructure, and ensuring safe and secure pathogen collections.
- Training in biosafety and pathogen security to promote sound laboratory management practices. Engaging bioscience laboratories in collaborative pathogen security and biosafety projects, including assistance in risk assessment, safety and security consultations, design and implementation.
• Training in infectious disease surveillance and molecular diagnostics, and laboratory capacity building activities.
• Integrating advances in international biosafety and pathogen security into efforts to enhance international infectious disease surveillance, diagnostics, response and control.”

**Defense Threat Reduction Agency (DTRA)**

“DTRA is the U.S. Department of Defense’s official Combat Support Agency for countering weapons of mass destruction. Our people are Subject Matter Experts on 21 WMD, and we address the entire spectrum of chemical, biological, radiological, nuclear and high yield explosive threats. DTRA’s “programs include basic science research and development, operational support to U.S. warfighters on the front line, and an in-house WMD think tank that aims to anticipate and mitigate future threats long before they have a chance to harm the United States and our allies. SCC-WMD, the U.S. Strategic Command Center for Combating Weapons of Mass Destruction, synchronizes Combating Weapons of Mass Destruction efforts across our military’s geographic commands and leverages the people, programs and interagency relationships of DTRA at a strategic level. We work with the military services, other elements of the United States government, and countries across the planet on counterproliferation, nonproliferation and WMD reduction issues with one goal in mind: Making the World Safer.”

**InterAcademy Panel (IAP)**

“IAP is a global network of the world's science academies, launched in 1993. Its primary goal is to help member academies work together to advise citizens and public officials on the scientific aspects of critical global issues. IAP is particularly interested in assisting young and small academies achieve these goals and, through the communication links and networks created by IAP activities, all academies will be able to raise both their public profile among citizens and their influence among policy makers.”

**International Centre for Genetic Engineering and Biotechnology (ICGEB)**

“The International Centre for Genetic Engineering and Biotechnology provides a scientific and educational environment of the highest standard and conducts innovative research in life sciences for the benefit of developing countries. It strengthens the research capability of its Members through training and funding programmes and advisory services and represents a comprehensive approach to promoting biotechnology internationally. The Centre is dedicated to advanced research and training in molecular biology and biotechnology and holds out the prospect of advancing knowledge and applying the latest techniques in the fields of: biomedicine, crop improvement, environmental protection/remediation, biopharmaceuticals and biopesticide production.”
**Kuwait Foundation for the Advancement of Science**
“KFAS/Research Directorate provides research grants to Kuwaiti institutions and organizations in furtherance of scientific purposes for the benefit of Kuwait and the region. Grants may also be awarded to non-Kuwaiti institutions provided the research project is undertaken in cooperation with a Kuwaiti institution.”

**Leishdrug Network**
“[The consortium] proposes to build upon complementary expertise in cutting edge bio-imaging and phospho-proteomic analysis to develop and use innovative drug screening concepts that have not been applied previously on parasitic systems. The consortium is based on 6 interactive scientific work packages that together propose a dual strategy for anti-leishmanial drug development.”

**Organization of the Islamic Conference (OIC)**
“The Organization of the Islamic Conference (OIC) is the second largest inter-governmental organization after the United Nations which has membership of 57 states spread over four continents. The Organization is the collective voice of the Muslim world and ensuring to safeguard and protect the interests of the Muslim world in the spirit of promoting international peace and harmony among various people of the world.”

**Committee on Scientific and Technological Cooperation (COMSTECH)**
http://www.comstech.org/ (accessed on May 17, 2011)
“COMSTECH is a Ministerial Standing Committee on Scientific and Technological Cooperation established by the Third Summit Islamic of OIC held at Makkah, Saudi Arabia in January 1981. Its mission is to help strengthen the individual and collective capacity of OIC member states in science and technology through mutual cooperation, collaboration, and networking of resources. COMSTECH enables the OIC member states to use science and technology as a major contributor towards socio-economic development and rapid industrialization in the OIC region. It is entrusted with the follow up actions on science and technology related decisions of the Summit and creating successful implementation strategies. All of the OIC member states are members of COMSTECH.”

**Network of Academies of Science in Countries of the Organization of Islamic Conference**
“The OIC member countries represent 57 countries with a population of about 1.2 billion. The Network of Academies of Sciences in the countries of the Organization of Islamic Conference (NASIC) was established in 17th March 2004. This historic event brought
together 16 founder Academies of Sciences. The NASIC has been constituted with the purpose of catalyzing the development of collaborative programs among OIC member countries. Within a month of its establishment, NASIC has succeeded in distributing MIT open course materials to 21 Sciences Academies of OIC member countries, and within three months of its establishment its first newsletter is being circulated among member academies.”

Islamic Educational, Scientific and Cultural (ISESCO)
“The Islamic Educational, Scientific and Cultural Organization (ISESCO) was established by the Organization of the Islamic Conference (OIC) in 1979 and its headquarters are in Rabat, Morocco. One of the main goals of ISESCO is to promote collaboration between its members through education, science, culture and communication.”

Qatar Foundation
http://www.qnrf.org/ (accessed on May 17, 2011)
“Established in 2006, Qatar National Research Fund (QNRF) aims to advance knowledge and education by providing support to researchers. It administers funding for original, competitively selected research and fosters collaborations within academia, and through public/private partnership. Although QNRF actively seeks internationally recognized researchers, it is dedicated to funding research that meets the needs of Qatar. QNRF is a member of Qatar Foundation for Education, Science and Community Development (Qatar Foundation), established by his Highness Sheikh Hamad Bin Khalifa Al-Thani, Amir of Qatar and chaired by Her Highness Sheikha Moza bint Nasser.”

The Academy of Sciences for the Developing World (TWAS)
http://www.twas.org/ (accessed on May 17, 2011)
“TWAS is an autonomous international organization based in Trieste, Italy. Its principal aim is to promote scientific capacity and excellence for sustainable development in the South. TWAS, the academy of sciences for the developing world, is an autonomous international organization, founded in 1983 in Trieste, Italy, by a distinguished group of scientists from the South under the leadership of the late Nobel laureate Abdus Salam of Pakistan. It was officially launched by the secretary-general of the United Nations in 1985. TWAS represents the best of science in developing countries. Its main mission is to promote scientific excellence and capacity in the South for science-based sustainable development.”

Virtual Biosecurity Center
http://virtualbiosecuritycenter.org/ (accessed on May 17, 2011)
“The Virtual Biosecurity Center (VBC), founded in 2011, is a global multi-organizational initiative spearheaded by the Federation of American Scientists (FAS) committed to countering
the threat posed by the development or use of biological weapons and the responsible use of science and technology. The VBC is the “one stop shop” for biosecurity information, education, best practices, and collaboration.”

Other organizations

*Center for Disease Control and prevention (CDC)*


“For over 60 years, CDC has been dedicated to protecting health and promoting quality of life through the prevention and control of disease, injury, and disability. We are committed to programs that reduce the health and economic consequences of the leading causes of death and disability, thereby ensuring a long, productive, healthy life for all people.” CDC offers many training programs, including ones on safety and security.

*Field Epidemiology Training Program*


“The Field Epidemiology Training Program (FETP) and the Field Epidemiology and Laboratory Training Program (FELTP), which offers an added laboratory component, are applied epidemiology programs offered by CDC to help foreign countries develop, set up, and implement dynamic public health strategies to improve and strengthen their public health system and infrastructure.”

*Biosafety*

CDC’s Office of Safety, Health, and Environment serves as a leader in the field of biosafety. “CDC partners with the U.S. National Institutes of Health to publish biosafety guidelines for protecting workers and preventing exposures in biological laboratories. CDC’s Office of Safety, Health, and Environment serves as the World Health Organization’s Centre for Applies Biosafety Programmes and Training. CDC partners with renowned organizations to sponsor a biennial International Symposium on Biosafety and other occupational health and safety conferences. In addition, CDC’s Office of Safety, Health, and Environment has produced online training on laboratory biosecurity and offers other downloadable materials that may be useful to laboratorians nationally, or around the world.”

*Center for Global Health, Global Heath Security Branch*


The Global Health Security Branch of the Center for Global Health is the CDC’s “office for partnership engagement with other U.S. government entities, multilateral institutes, and international organizations to promote mutual strategies, research, and policies aimed at improving global health security. The branch provides global health security leadership and coordination in over 50 countries, with the end goal of improving a
country’s capacity to detect and effectively respond to public health emergencies of international concern.”

Global Disease Detection Program
The Global Disease Detection Program “is CDC’s principal and most visible program for developing and strengthening global capacity to rapidly detect, accurately identify, and promptly contain emerging infectious disease and bioterrorist threats that occur internationally.” It enhances global health security and protects health through cooperation.

CHORDS
“CHORDS is a non-governmental platform where regional infectious disease surveillance networks around the world interact not only with each other, but with other global partners to strengthen international health security. Learning to manage infectious diseases that involve a great deal of uncertainty and often require cooperation across borders in conflict is an ongoing challenge for these networks. CHORDS gives developing countries a novel tool for meeting the daunting challenges of the World Health Organization (WHO) International Health Regulations (2005) obligations by facilitating the sharing of information and standards and serving as a forum for communication between WHO and Member States.”

Middle East Consortium on Infectious Disease Surveillance (MECIDS)
“The Middle East Consortium on Infectious Disease Surveillance (MECIDS) brings together public health experts and Ministry of Health officials from Jordan, Israel, and the Palestinian Authority. The goal of MECIDS is to improve the ability of partners in the Middle East to detect and respond more effectively to infectious disease threats through cross-border collaboration on surveillance and joint epidemiologic and laboratory training. The Consortium manages its affairs through an Executive Board composed of members drawn from the partner countries.”

Institut Pasteur Network
“The Institut Pasteur International Network brings together 32 institutes, united by the same missions, the same culture, and the same values. Since its inception, the Institut Pasteur has located near pandemic areas, which offers a real capacity of reaction and analysis to the Network. The Network institutes contribute to the prevention and treatment of infectious diseases by: Research activities, Public health activities, and Training activities.”

Middle East Scientific Institute for Security (MESIS)
“The Middle East Consortium on Infectious Disease Surveillance (MECIDS) brings together public health experts and Ministry of Health officials from Jordan, Israel, and the Palestinian Authority. The goal of MECIDS is to improve the ability of partners in the Middle East to detect and respond more effectively to infectious disease threats through cross border collaboration on surveillance and joint epidemiologic and laboratory training. The Consortium manages its affairs through an Executive Board composed of members drawn from partner countries.”

**U.S. National Institute of Allergy and Infectious Diseases (NIAID)**
http://www.niaid.nih.gov/about/Pages/default.aspx (accessed on May 26, 2011)

“The National Institute of Allergy and Infectious Diseases (NIAID) conducts and supports basic and applied research to better understand, treat, and ultimately prevent infectious, immunologic, and allergic diseases. For more than 60 years, NIAID research has led to new therapies, vaccines, diagnostic tests, and other technologies that have improved the health of millions of people in the United States and around the world.”
The objectives of the exercise were:

- To discuss and identify key legal, social, behavioral, and ethical issues which may arise during the course of a research project;
- To facilitate the identification of similarities and differences between countries and scientists about the main research principles and day-to-day practices; and
- To stimulate conversation between participants on mechanisms of international scientific collaboration related to biological sciences and infectious diseases.

There were no right and no wrong answers. There were several different pathways and outcomes that could have been reached for this exercise.

**Background Scenario and Exercise Description**

While this scenario was not based on real events, it was designed to mimic possible real life situations. Helen was an American scientist researching drug therapies and Halim was a North African scientist studying infectious diseases. An outbreak of Pathogen Y occurred in 2009 in North Africa, where it was endemic at low levels. Halim studied pathogen Y and Helen was studying a potential drug target for pathogen Y. Helen and Halim met at an annual Conference on Retroviruses and Opportunistic Infections and began to explore the possibility of collaborating.

The exercise was designed to elicit discussion on legal, operational, ethical, safety, and security issues that may or may not arise in a research project. The pathogen was not listed on the U.S.
select agent list though it did cause significant health consequences to the affected population. All laboratory procedures and materials were consistent with standard molecular biology, microbiology, and immunology methods and in standard laboratory facilities with standard laboratory equipment. Only tissue culture cells and mice were used in the experiments; the research project did not include a clinical trial or clinical studies, but the project did include use of human serum samples. This was intentionally done to encourage discussion about ethical and regulatory issues associated with animal subjects and use of samples derived from humans, but not to focus the discussion on clinical trials, which involves much more complex issues that were not pertinent to the overall objectives of the exercise.

The research questions and specific aims of Halim and Helen's prospective project were:

- **HYPOTHESIS**: The drug inhibits post-translational modification of the pathogen’s binding protein, which decreases the infectivity of pathogen Y.
- **SPECIFIC AIM 1**: To study pathogen replication in tissue culture cells infected with purified pathogen and human serum containing pathogen Y in the presence or absence of drug.
- **SPECIFIC AIM 2**: To study pathogen replication, transmission rates, and immune responses in serum from mice infected with purified wild-type and genetically modified strains of pathogen Y in the presence and absence drug administration.

**Exercise Choices**
Throughout the scenario, Helen and Halim needed to make decisions about how to proceed with joint or independent projects. The exercise included 13 different pathways.

Each of these pathways ended in one of three ways:
1 – Collaborative work with submission of an abstract to an international conference.
2 – Independent research of mutual interest. This is not a true collaboration. Instead, it resembles situations wherein researchers ask for published strains, reagents, compounds, or other laboratory materials from another colleague.
3 – Independent research with no mutual interest.