

Future Opportunities for Bioengagement in the MENA Region

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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 AAAS Board of Directors, Council, or membership.

About AAAS

The American Association for the Advancement of Science (AAAS) is the world's largest general scientific society and publisher of the journal, *Science* (www.sciencemag.org). AAAS was founded in 1848 and serves 262 affiliated societies and academies of science, reaching 10 million individuals. *Science* has the largest paid circulation of any peer-reviewed general science journal in the world, with an estimated total readership of 1 million. The non-profit AAAS (www.aaas.org) is open to all and fulfills its mission to “advance science and serve society” through initiatives in science and policy, international activities, science education, and more.

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About the AAAS Project

The American Association for the Advancement of Science (AAAS) Center for Science, Technology, and Security Policy (CSTSP) received a grant from the Naval Postgraduate School, a part of the Department of Defense, to identify new opportunities and approaches for future bioengagement in the MENA region based on regional consultations with scientific and health experts. AAAS held regional consultations in Morocco (with North African participants)¹ and Jordan (with Middle East participants) wherein regional and U.S. experts discussed gaps in bioengagement, suggested opportunities for future engagement, and explored metrics of effectiveness and long-term impact of bioengagement efforts. To facilitate these discussions, AAAS supported a collaborative grant that evaluated the impact of regional laboratory biosafety and biosecurity efforts, and commissioned two papers to identify lessons learned from past and current regional efforts and suggest new approaches for future bioengagement.² The collaborative grant and commissioned papers were discussed and/or presented in Morocco and Jordan.

During the implementation of AAAS's project, the Middle East Respiratory Syndrome (MERS) coronavirus emerged in Saudi Arabia, Somalia saw its first case of polio since the 1970s, H7N9 influenza virus emerged in Southeast Asia, Syrian refugees entered Jordan and other neighboring countries bringing unknown infections, and chemical weapons were used on Syrian citizens. Scientific and health experts from MENA countries expressed concern about these occurrences and identified opportunities for engagement that minimized these and other socio-political concerns.

AAAS carried out this project as DTRA explored cooperative bioengagement in MENA countries and as the U.S. Congress wrote and introduced a bill on cooperative threat reduction in the Middle East and North Africa. These policy and programmatic developments offered a unique opportunity to provide regional input in U.S.- MENA cooperative bioengagement.

¹ The first consultation was held in Morocco and involved scientists and health experts from Morocco, Tunisia, Algeria, and Egypt.

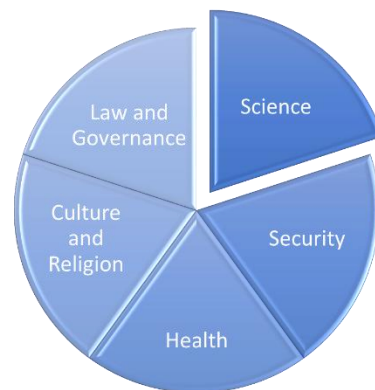
² In 2010, AAAS sponsored a collaborative grant competition between U.S. and MENA scientists. The collaborative grant supported in the current study is not related to the 2010 competition.

Future Opportunities for U.S.-MENA Cooperative Bioengagement

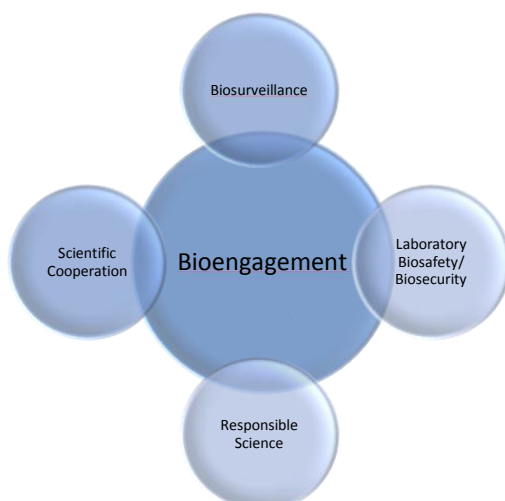
Countering biological threats presents a complexity not seen with either nuclear or chemical weapons. The pathogens and toxins used to develop biological weapons in past offensive weapons programs could be found naturally. The scientific knowledge, skills, equipment, and facilities needed to develop biological weapons are the same as those needed for "peaceful, prophylactic" research and diagnostic uses. Being able to distinguish between malicious and peaceful uses is the most difficult challenge to identifying illicit activities and developing programs to counter possible illicit activities.

Despite this challenge, several efforts have and can be undertaken to counter biological threats caused by nations, terrorist organizations, or individuals with malicious intent. For over two decades, the security community has advocated a *web of prevention* approach, which involves the use of several complementary activities to counter biological threats. As the focus of concern transitioned to terrorism, this *web of prevention* approach has taken on a wider scope - to include activities that build on security, science, culture and religion, health, and law and governance. All of these approaches are equally as important for countering biological threats.

This report focuses on scientific engagement to counter biological threats. It recognizes the important role that scientists can play in preventing and responding to biological risks and threats. The report builds on years of cooperative threat reduction and cooperative engagement to identify new opportunities and approaches for future engagement in the Middle East and North Africa (MENA) region.



Modern Bioengagement Programs



Cooperative biological engagement emerged in the 2000s as a new way to engage scientists who might not be involved with biological weapons development or use, but who might be working in and around unsafe environments, which might include the presence of terrorist organizations. Today, bioengagement efforts largely focus on four main areas: infectious disease surveillance, laboratory biosafety and biosecurity, responsible science, and scientific

cooperation. Within each of these broad areas are numerous, more targeted efforts.

In the area of infectious disease surveillance, bioengagement activities include strengthening of health systems to rapidly detect and report outbreaks of potential international concern; animal-human health disease surveillance and management (commonly referred to as “one health”³); enhancing detection of potential outbreaks at the community level; and upgrading the biosafety and biosecurity of diagnostic laboratories. Many bioengagement programs, which focus on infectious disease surveillance (also referred to as “biosurveillance”), use the International Health Regulations (2005), and the associated core competencies, as their primary guidance.

In the area of laboratory biosafety and biosecurity,⁴ bioengagement programs primarily focus on laboratory personnel training to encourage that safe procedures are followed; biorisk management to establish or enhance the laboratory management system to promote risk mitigation; development of national biosafety associations to provide local leadership on laboratory biosafety and biosecurity; and upgrades to laboratories to consolidate “especially dangerous” pathogens into a single (or fewer than what might currently exist) facility, enhance physical safety and security measures, and improve accountability of laboratory stocks of pathogens. “Biorisk management”, which was initially developed in 2008 and subsequently revised in 2011, is a management guideline for enhancing laboratory biosafety and biosecurity initially developed by the European standardization organization in 2008. (The biorisk management standards were subsequently revised in 2011. Efforts are currently underway to gain support for making the biorisk management an ISO standard.)

The broad area of responsible science is relatively new to the bioengagement sphere. This area primarily includes education and training of “dual use research of concern” within the broader context of responsible science. However, efforts to improve bioethics, including research involving human and animal subjects, have begun. This approach emerged from numerous attempts to communicate and educate scientists about “dual use research of concern” and ways to minimize those risks. “Dual use research of concern” is the idea that legitimate, beneficial research could be directly used by malicious individuals to cause harm. Initial communication about “dual use research of concern” unintentionally caused scientists within the region to feel as though they were the threat. By placing the “dual use” issue within the broader concept of responsible science, scientists understood the risk as an ethical dilemma affecting all scientists.

Though bioengagement programs tend to focus on these major areas, on occasion research collaboration and scientific exchanges are supported. (Several U.S. government agencies support international scientific collaborations but most of these collaborations are not funded through cooperative threat reduction (CTR)-derived biological engagement

³ Although the concept of One Health is typically used to describe the link between the health of wild and domestic animal populations and humans, it should link the health of plants, the environment, wild and domestic animals, and humans.

⁴ The use of language is extremely important when referring to biosafety and biosecurity. For years, security experts have cited the numerous definitions that both terms have. However, the term “biosafety” might elicit different conceptual understanding depending on the overarching framework under which it is addressed. The Cartagena Protocol discusses biosafety as preventing genetically modified, laboratory adapted organisms from being released into the environment and broader population. Whereas the Biological and Weapons Toxins Convention, a nonproliferation treaty, defines laboratory biosafety as measures to prevent accidental release of dangerous pathogens. Efforts focused on biosafety and biosecurity must account for the different definitions and conceptual understanding of the terms as they design and implement their programs.

programs.) However over the past decade, scientific cooperation in the context of bioengagement has decreased significantly because measuring its effectiveness at reducing biological risks through research cooperation is extremely difficult. The result is that scientific engagement now tends to focus more on those programs that can be measured more easily rather than those programs that might promote trust, open communication, and transparency.

The primary countries that support scientific engagement include the United States, Canada, and the European Union with the United States leading many of the efforts. The relevant funding agencies (in the U.S., the primary agencies are the Departments of State and Defense) support both governmental and non-governmental organizations to carry out the aforementioned programs.

Challenges of Bioengagement Programs

Bioengagement programs – i.e., scientific engagement with biological sciences experts and human and animal health experts – face several challenges. The challenges include limited funding, inadequate means to evaluate program success, lack of sustainability of programs, and lack of coordination among funding agencies.

Funding, evaluation measures, and sustainability of programs are interconnected and lead to the development of short-term goals for bioengagement activities. Funding for bioengagement activities is allocated on a yearly basis, preventing implementers from developing long-term goals or strategies for their activities. In addition, funding agencies tend to support programs that have tangible outcomes that contribute to nonproliferation goals of the country funding the activity. Although funders work with foreign governments to identify activities of mutual interest, bioengagement programs are often developed to meet the donor country's security interests. Further complicating this situation is the reality that the U.S. Congress continues to perceive cooperative scientific engagement through the same lens as cooperative threat reduction (CTR) programs – which included dismantling weapons programs and redirecting weapons scientists – and to hold relevant agencies accountable for their funding decisions based on this perception.

Demonstrating success of bioengagement programs is inherently difficult because no evaluation criteria exist to measure the ultimate goal of the programs, which is to prevent terrorist acquisition of tools and expertise and identify possible uses quickly. No definitive measures exist to measure the effectiveness of programs focused on the prevention goals. During the past few years, several organizations have attempted to develop evaluation criteria or metrics for scientific engagement programs. The 2012 National Research Council report on CTR metrics for the Department of Defense recommended tailored evaluation criteria based on specific program objectives. In another effort, metrics are being developed that align closely with CTR nonproliferation goals. In this report, a leading security expert recommends the use of participatory metrics in which partners develop the evaluation criteria jointly. While participatory evaluation might work for cooperative programs, many of the current bioengagement programs are not partnership-based.

Coordination among funding agencies and donor countries is a separate challenge that affects the long-term implementation of bioengagement programs in certain regions. A

large number of funding agencies and implementers support or carry out bioengagement activities, particularly in regions where terrorist concerns and/or biological weapons concerns are high. Independent efforts on infectious disease surveillance, laboratory biosafety and biosecurity, scientific responsibility, and scientific cooperation further complicate the bioengagement landscape in the MENA region. Bioengagement programs convey the biosafety/bioethics/biosecurity messages differently depending on the mission and expertise of funding and implementing organization. Although some agencies and implementers do discuss and try to coordinate their efforts, duplication of bioengagement programs persists. Coordination problems will continue to grow as the number of donor countries and funding agencies grows.

Specifically focusing on bioengagement efforts in the Middle East and North Africa, differences in scientific capacity across the region (in part caused by access to materials, local investment in science and technology, or laws governing or restricting certain types of research) further complicate the development of programs. For example, experience with laboratory biosafety and biosecurity programs varies greatly across the region. In some countries, scientists are well-versed in biosafety and desire more evolved or advanced engagement efforts on laboratory biosafety and biosecurity. However in other countries, the basic laboratory biosafety and biosecurity training activities are important for raising local awareness of the issues; scientists in these countries often face problems in implementing procedures that reflect the biosafety and biosecurity training received. Yet in other countries, the basic infrastructure (e.g., continuous or reliable electricity or access to the internet) prevents full implementation of laboratory biosafety and biosecurity procedures. In addition, the harsh environmental conditions in the countries require different types of procedures and equipment to fully implement containment of harmful pathogens. Beyond laboratory biosafety and biosecurity, efforts on infectious disease surveillance are complicated with concerns about sample sharing and access to vaccines and drugs developed from pathogens that emerged in the region, and responsible science efforts are complicated by the different understandings of research risks and ethical concerns.

Recommendations for Future Bioengagement in the Middle East and North Africa

Local ownership and sustainability of activities initially introduced through bioengagement efforts are highly dependent on the active participation of regional scientists and tailored approaches based on the legal and social environment in different countries. The following section describes new opportunities for bioengagement and specific improvements to the process of bioengagement that account for differences in capacity and need throughout the Middle East and North African region.

The recommendations build on current challenges, gaps, and needs in addressing biological risks as identified by experts from the U.S. and Middle East and North Africa (MENA) region. Of importance, the opportunities and approaches described below contribute to the decades-long concept of *web of prevention* in which a variety of programs are carried out to address security concerns.

Opportunities for Future Bioengagement

1. Facilitate the development of national strategies and implementation plans for addressing biological risks.

Nearly all of the government funded efforts focus on very discrete activities to reduce biological risks in research and diagnostic laboratories in biosafety, biosecurity, and ethics. These efforts involve education and training, development of biosafety associations, and facility upgrades.

More recently, the Biosafety and Biosecurity International Consortium – a regional organization initiated by the International Council for the Life Sciences and fully adopted and maintained by regional scientists in health, research, and the environment – began an effort to engage ministerial-level experts to develop a national strategy for addressing biological risks. With U.S. government support, scientists from the American University of Beirut have initiated a parallel effort to develop biosafety and biosecurity policies and procedures for the major Lebanese universities.

Scientists and health officials in Morocco advocated for foreign assistance in developing a national framework that incorporates biological risk mitigation and involves experts from government, universities, and civil society.

Scientists from Tunisia and Oman supported the development of national level strategies that promote science and technology innovation and simultaneously address associated safety, security, ethical, and environmental risks. These strategies would promote science and technology advancement to help address national and regional problems while embedding safety and security into the fabric of the life science enterprise.

2. Encourage regional efforts to address biological risks through cooperation, regional resource development, and strategy development.

Scientists and health officials advocated for the development of regional efforts to address biological risks. These experts recognize the importance of national strategy development and implementation is a necessary first step. The significant changes and turmoil currently affecting scientists and stressing health systems in several countries in the region – in part because of the social political change, the threat of terrorism, and the events in Syria – suggest that regional efforts to address biological risks could promote sharing of expertise, experiences, and practices to minimize potential harm caused by natural or man-made events. Through regional efforts, scientists could help each other develop policies and procedures and implement practices to identify, assess, and mitigate common biological risks. This regional approach would result in local ownership, buy-in, and long-term sustainability.

3. Enhance regional capacity to manage and dispose of hazardous biological waste and ensure the safe transportation of hazardous biological materials.

Despite efforts to enhance laboratory biosafety and biosecurity, regional scientists and health experts stated that significant gaps exist in waste management and transportation of hazardous biological materials.

Bioengagement activities that focus on developing policies and procedures, training laboratory staff, and implementing practices to reduce risks associated with disposal of laboratory waste and transportation of harmful pathogens would address regional needs.

4. Revive the bilateral Science and Technology Agreements and support for scientific cooperation.

Prior to 2001, the United States signed a bilateral Science and Technology Agreement (S&T Agreements) with Egypt and funded scientific cooperation between U.S. and Egypt for over twenty years under this Agreement; in 2011, the U.S. stopped supporting these cooperative programs

After 2001, the United States established bilateral S&T Agreements with several MENA countries to promote scientific cooperation and reduce the influence of terrorism. However, the U.S. did not provide financial support for bilateral S&T Agreements with the other countries. The lack of funding for science cooperation prompted a lack of confidence in the U.S. government's commitment to develop strong scientific ties with countries across the MENA region.

Support for scientific cooperation breeds trust, transparency, and open lines of communication between MENA countries and the United States. Scientific partnerships built on mutual interest and trust could withstand social political changes in the U.S. or MENA countries. The U.S. Naval Medical Research Unit -3 in Cairo, Egypt is an example of a robust partnership strong enough to endure changes in the socio-political environment. However without the recognition of how scientific cooperation could address biological risks, governments are unlikely to dedicate resources and support for these activities.

5. Support cooperative research in areas that affect the research environment, including the behavioral sciences.

Much of the biological threat reduction and bioengagement efforts have focused on research in the natural sciences, particularly microbiology. However, research in the behavioral and social sciences can provide important solutions to addressing biological risks and enhancing the environment in which research is done. These solutions could be extended to diagnostic laboratories, in addition to research laboratories, to align with capacity-building efforts for biosurveillance.

6. Support scientific exchanges with U.S. and regional scientists to transfer knowledge about how to address biological risks.

Rarely, bioengagement programs enable scientific exchanges. However, these programs could improve understanding of differences in risk perception, share policies and practices to prevent or mitigate biological risks, and enhance trust and the foundation for future scientific cooperation.

Approaches for Future Bioengagement

1. Support bioengagement programs that promote scientific leadership and address biological risks as part of the entire scientific system.

Leadership is assumed by those who hold high-level positions and those who have the skills to lead peer groups. Bioengagement activities that recruit both types of individuals to lead by example and address biological risks as part of their routine conduct of science will result in long-term adoption of risk reduction measures and greater awareness among a larger group of regional scientists.

During the past decade, several "young leaders" groups have emerged throughout the world, some of which address biological risks as a core mission. These groups should be encouraged to take on more leadership opportunities to counter biological threats as part of the overall science and technology enterprise.

2. Support programs whose sole purpose is to build trust and transparency between U.S. implementers and regional scientists.

Trust and transparency is critically important in the Middle East and North Africa. Funding agencies and implementers of bioengagement programs must demonstrate their trustworthiness to MENA scientists, health officials, and regional government officials by consistently and openly describing their motivations, intentions, and prospect of future interaction. In addition, implementers must take great care in not over-promising on what they can provide to regional scientists.

3. Tailor training and other activities to meet the actual needs within the region.

Bioengagement programs that could be applied to any country and any scientist do not take into account the unique socio-cultural issues, governing frameworks, scientific infrastructures, and capacity needs of different countries. Tailoring training programs and capacity-building efforts to the particular environment and needs of different countries would enhance adoption and implementation of these activities.

4. Support programs that develop and maintain scientific partnerships in research, behavioral training, and capacity building.

Partnerships between scientists from the U.S. and MENA countries could be important vehicles to conducting research of mutual interest, developing and

carrying out training programs to identify and mitigate biological risks, and improving the scientific environment to characterize and address biological risks.

5. Increase local ownership of activities by involving local scientists in the development of programs and evaluation criteria for programs.

Bioengagement programs that involve regional scientists as partners ensure that the activities are designed to meet the particular needs of the country, can be implemented in the country, and incorporate particular cultural and social sensitivities existing in the country.

Involving scientific partners in the development of evaluation criteria (participatory evaluations) might promote local ownership of bioengagement programs and increase their likelihood of success.

6. Develop programs that build on local knowledge and expertise in addressing biological risks.

Scientists and health experts in several MENA countries are well-versed in laboratory biosafety, biosecurity, and bioethics. Current programs tend to use the same training materials for all scientists in the region regardless of their degree of awareness of biosecurity and biosafety issues. This has resulted in several scientists carrying out independent partnerships and programs to address infrastructure or training gaps and design more sophisticated efforts to address biological risks.

U.S. bioengagement programs should build on local expertise and experiences to ensure that local needs are being addressed and efforts reflect the level of expertise resident in the country.

Process Improvements

The following lists potential improvements to the broader initiative of scientific engagement to address biological risks. This list draws from the themes gleaned from evaluating the lessons learned from past and current bioengagement efforts – in general and specifically focusing on biosafety – and consulting with leading regional scientists, health experts, and government experts. If bioengagement efforts are to become sustainable, adopted in the region, and address unaddressed needs, funding agencies and implementers should incorporate the following process improvements.

- 1. Increase coordination of bioengagement efforts in the region.**
- 2. Design initiatives that engage both government and nongovernmental scientists to promote both top down and bottom up approaches to addressing biological risks.**
- 3. Design bioengagement programs that can easily exist within the broader scientific environment in recipient countries and built on existing governing frameworks.**

-
4. **Encourage donor and recipient countries to contribute to the funding and developing of bioengagement programs.**
 5. **Develop a tiered system of evaluation which include broader criteria to assess the entire program, metrics to assess individual activities, and measures for scientists to demonstrate value of their participation to their superiors.**

Brief History of Biological Engagement

Cooperative bioengagement is rooted in cooperative threat reduction (CTR). In the early 1990s, the United States and several other countries created cooperative threat reduction programs to prevent the spread of nuclear, chemical, and biological materials from Soviet weapons facilities to rouge countries or terrorist organizations. Initially, the program focused on securing and dismantling nuclear weapons and associated facilities from the former Soviet Union. In 1994, the program expanded to secure chemical and biological materials, dismantling chemical and biological weapons facilities, and redirecting former weapons scientists. In the United States, the first U.S. government agency involved in cooperative threat reduction was the Defense Threat Reduction Agency; a few years after the establishment of the program, the Department of State began supporting CTR activities, particularly those involving scientist redirection.

The CTR programs expanded beyond the countries of the former Soviet Union to Iraq and Libya in 2003. Although Iraq had ended its chemical and biological weapons program before 2003, its scientists who had weapons expertise were discretely placed in military and civilian companies, universities, and ministries.⁵ Consequently, the program in Iraq primarily involved securing chemical and biological weapons expertise. Unlike Iraq, Libya had an active nuclear and chemical weapons programs until December 2003 at which time they announced they were ending their program.⁶ CTR programs in Libya focused more on securing and dismantlement of the nuclear materials and chemical weapons.

Beginning in 2006, the Department of State expanded its biological cooperative threat reduction programs beyond former weapons scientists to scientists who work in countries and regions fraught with terrorism threats. These newer programs engaged non-weapons scientists to minimize the risk that their expertise, knowledge, and skills could be inappropriately used by a terrorist or that their laboratories, pathogens, materials, and equipment could be acquired by terrorists. In 2009, the U.S. National Research Council recommended that the Defense Threat Reduction Agency transform its biological CTR program to engage non-weapons scientists on topics of infectious disease surveillance, capacity-building, and scientific partnerships in addition to securing harmful pathogens.⁷

During the past 7 years, the Departments of State and Defense have expanded their CTR programs to non-weapons scientists; to countries in Africa, South Asia, Southeast Asia, the

⁵ Smallwood and Liimatainen. *Securing WMD Expertise: Lessons Learned from Iraq*. (2011) Arms Control Association. Available at:

⁶ National Research Council. *Global Security Engagement: A New Model for Cooperative Threat Reduction*. (2009) National Academies Press (Washington, DC). P. 35.

⁷ National Research Council. *Global Security Engagement: A New Model for Cooperative Threat Reduction*. (2009) National Academies Press (Washington, DC).

Middle East and North Africa; and to capacity-building in biosurveillance, biosecurity and biosafety, and scientific responsibility.

U.S. Bioengagement Programs

The Department of State Biosecurity Engagement Program (BEP) was among the first U.S. government agencies to transform threat reduction to engagement. Initially, efforts included broad scientific cooperation efforts and now, the focus is on safeguarding laboratories, managing laboratory biosafety and biosecurity risks, and strengthening public and animal health systems. To a lesser degree, BEP supports education of scientists about responsible science.

With financial and Congressional pressure, along with assessed threats, BEP has focused on efforts in three major areas: 1) compliance with the Biological and Toxins Weapons Convention, United National Security Council Resolution 1540, and International Health Regulations; 2) laboratory biosafety and biosecurity (i.e., biorisk management); and 3) surveillance of infectious disease outbreaks. BEP achieves these goals through the specific objectives of:

- “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.”⁸

BEP works through several government agencies, including the U.S. National Institutes of Health and Centers for Disease Control and Prevention; Sandia National Laboratories; CRDF Global; and non-governmental implementers.

The 2009 U.S. National Research Council report on new approaches of global threat reduction programs recommended a significant shift in biological programs from threat reduction to engagement to reduce shared biological risks and threats, including chronic diseases, infectious diseases, and deliberate attacks. Based on this report, the Department of Defense’s Defense Threat Reduction Agency (DTRA) began supporting cooperative biological partnerships (i.e., bioengagement) to achieve its regional and bilateral goals of:

- “Improvements to partner country capabilities in biosafety and biosecurity, and to detect, diagnose and report WMD-significant disease outbreaks;...

⁸ <http://www.bepstate.net/index.html>

- Cooperation in surveillance, detection and interdiction technology projects to stop global WMD trafficking;
- Collaborate in fundamental research with partner country scientists and institutions.”⁹

DTRA’s strategic goals for bioengagement are carried out by its Cooperative Biological Engagement Program (CBEP). Until now, CBEP has concentrated its investments and efforts in Sub-Saharan Africa and Southeast Asia; now, CBEP is beginning to conduct bioengagement activities in the MENA region, focusing primarily on health security.¹⁰

In addition to the Departments of State and Defense, the U.S. Agency for International Development, Environmental Protection Agency, Department of Energy, National Institutes of Health, and other U.S. government and non-governmental organizations engage scientists in the MENA region to address development, health, science, and security issues to varying degrees. Whereas the number of different agencies in the region might lead to confusion and possible resentment among local scientists,¹¹ the agencies nevertheless have the potential to address biological risks with a broad range of organizations and using a wide array of approaches.¹²

⁹ <http://www.dtra.mil/Missions/nunn-lugar/nunn-lugar-home.aspx>

¹⁰ CBEP programs differ from other DoD investments in the MENA region, which includes support for infectious disease research.

¹¹ Resentment has resulted among local scientists when foreign organizations have established new expert centers or supported competing efforts. While competition is considered healthy in the U.S. and other countries in the West, in many parts of the world such competition vies for the attention of possible funders, government officials, and local scientists. In many cases, engagement programs invite the same individuals to participate in sponsored activities causing an overload of engagement toward some scientists and no engagement towards others.

¹² A list of possible approaches for bioengagement is included in this summary report in the *Approaches for Future Bioengagement* section.

Regional Consultations

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Morocco

May 18-19, 2013

The first of the consultations was held in Casablanca, Morocco, in May 2013 and included scientists and health experts from the U.S., Morocco, Algeria, Tunisia, and Egypt. AAAS and its local collaborator – the Moroccan Biological Safety Association (MOBSA) – invited several experts from Libya without success. The outcomes presented in this summary paper are based entirely on the views of the meeting participants, which included a diverse set of experts in the research and health sectors, government and non-governmental sectors, and human and environmental health sectors.

Over the two days of facilitated, participatory discussion, participants were encouraged to consider: 1) past and current bioengagement efforts and whether those efforts are sufficient for addressing extant biological risks or threats in the region; 2) measures of success for effectiveness and long-term implementation; and 3) the regional environment in which future bioengagement will be occurring, including the socio-political situation in individual countries and the entire region, the current security risks and threats facing the region, and the regional benefits of biological sciences to address these security risks and/or threats.

Based on meeting discussions, participants developed a framework for bioengagement within which security and safety exists. This framework relies heavily on leadership promoting success in science, health, responsibility, and security. Building on this framework, regional experts identified the following gaps, opportunities, and approaches for bioengagement and considered the following sustainability options and metrics.

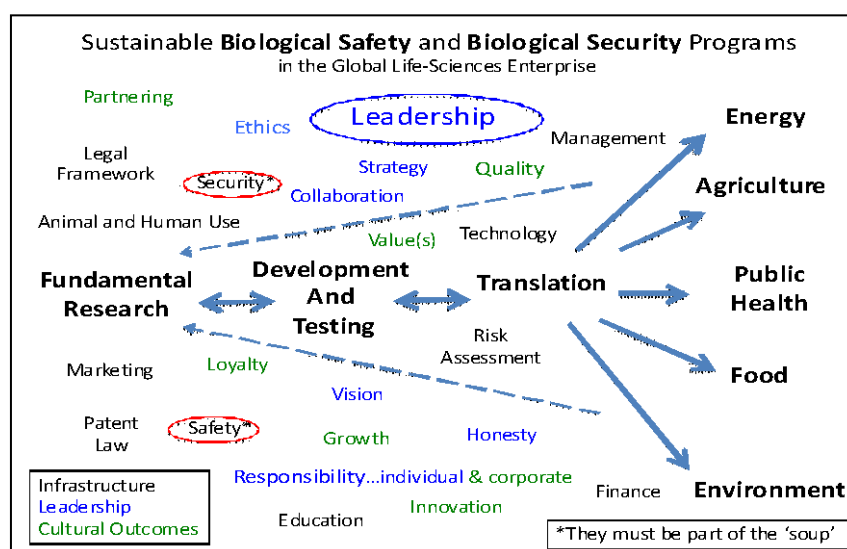


Figure 1. Sustainable Biological Safety and Biological Security Program. The “soup” refers to the delicate balance of biological safety and security in the global life science enterprise. Developed during the meeting.

Top Opportunities for Bioengagement in North Africa

Participants stated that the U.S. can be most helpful in:

- 1) **Supporting North African countries in developing national and regional frameworks for addressing biological risks.** These frameworks would incorporate reciprocal communication between the research and health ministries, academic organizations and other non-governmental organizations. Although only a part of the overall framework for addressing biological risks, policies and practices for promoting laboratory biosafety and biosecurity in both research and health services laboratories would be included. In addition, these frameworks could be layered onto more general frameworks for science, technology, and innovation.

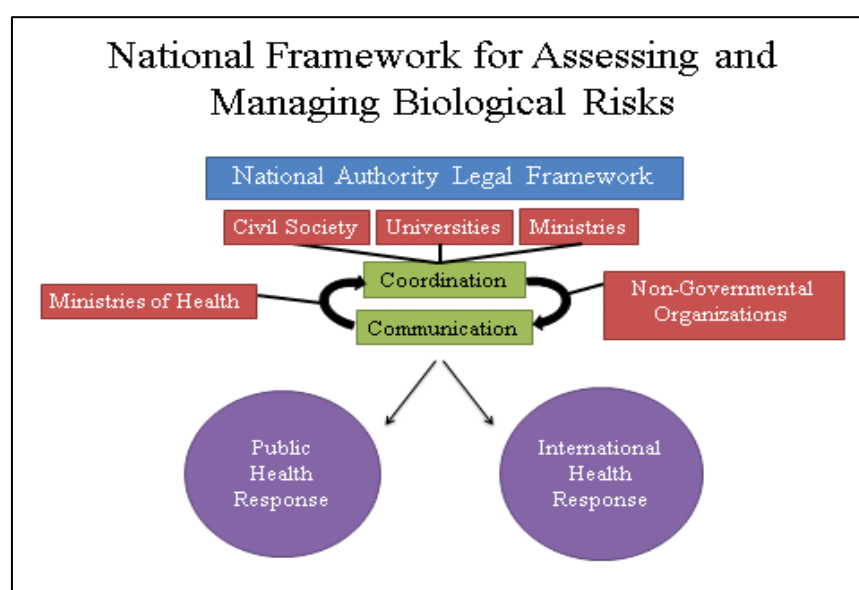


Figure 2. National Framework for Assessing and Managing Biological Risks.

- 2) **Reviving bilateral Science and Technology Agreements and supporting cooperative scientific research between the U.S. and North African countries.** During the meeting, participants discussed several existing efforts for bioengagement and scientific engagement, broadly. Participants from each country highlighted their positive experiences in cooperative programs that focused on laboratory biosafety and biosecurity and infectious disease surveillance. However, participants from all countries described their disappointment with the lack of implementation of the bilateral science and technology agreements between their countries and the U.S.¹³ Determining the effectiveness of bilateral Science and Technologies (S&T) agreements to promoting scientific partnerships and reducing concerns about terrorism is challenging but should be considered nonetheless.

¹³ For nearly 20 years and until recently, the U.S. and Egyptian scientists have cooperated on a number of research projects under the broader umbrella of the bilateral Science and Technology Cooperative Agreement. However, bilateral scientific cooperation under the auspices of the U.S.-Egypt S&T Agreement seems to have ended in 2011. Over the past decade, the U.S. signed bilateral S&T Agreements with several North African countries, including Morocco, Algeria, Tunisia, and Libya, to curb the threat of terrorism and build partnerships between the U.S. and Muslim-majority countries. Dolan, B.M. (2012) Science and Technology Agreements as Tools for Science Diplomacy. Science & Diplomacy. <http://www.sciencediplomacy.org/article/2012/science-and-technology-agreements-tools-for-science-diplomacy>.

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- 3) **Supporting cooperative research on behavioral sciences to identify scientists and engineers who might intend to cause harm.** This research would draw from current research efforts in the behavioral, psychological, and social sciences to help describe characteristics of individuals who pursue activities that cause harm to, rather than benefit, all society.
 - 4) **Developing procedures to effectively dispose of laboratory wastes.** North African universities and public health laboratories struggle with management of waste from high containment laboratories (i.e., biosafety level 3 laboratories) because the region has few, if any, companies that can safely dispose of laboratory waste.

While these opportunities were among the most highly discussed possibilities for future bioengagement between the U.S. and North African countries, participants listed several other possible areas in which cooperation can occur. These areas often addressed gaps in current bioengagements efforts, which focus heavily on laboratory biosafety and biosecurity, infectious disease surveillance, and responsible science.

Gaps, Opportunities, and Approaches for Bioengagement Programs

The following sections provide the gaps in cooperation which lead to the identification of gaps in bioengagement, possible areas for future bioengagement between the U.S. and North African countries, and suggested approaches to carry out joint activities.

Gaps in Bioengagement

- The concepts of laboratory biosafety and biosecurity are not well understood or implemented in all research and public health laboratories.
- Laboratories are old and are in need of improvement. The region does not need new laboratories; it simply needs to upgrade existing laboratories, train a knowledgeable and capable workforce, and implement best laboratory practices.
- The link between laboratories, universities, civil society, and government offices is not strong in the region. However, participants believed that civil society plays a critical role in promoting safe and secure research and health practice, and linking the laboratory infrastructure and relevant government offices.
- Coordination among U.S. government offices supporting bioengagement activities is poor.
- University scientists and engineers might have extremist views posing possible threats to scientific advancement and safety in society. Research leadership needs to be well-equipped to conduct behavioral profiles of scientists to minimize risks of misuse or theft of biological materials.
- In-person communication about laboratory risks is not optimal and could be improved.
- The legal framework for addressing biological risks is inadequate in each North African country and the entire region.
- North African countries lack a comprehensive approach for addressing biological risks (i.e., a vision and roadmap to address biological risks). This approach would

build on efforts focused on building capacity to respond to public health emergencies and to improve biorisk management.

- North African countries have sub-optimal investments in building scientific capacity while minimizing biological risks in food, human health, and research.
- Biological risks and risk assessment tools have not been adequately defined for regional scientists. North African scientists tend to minimize risks before engaging in the research activity.
- Scientists might not acknowledge their responsibility to address security risks of biological research.
- University research laboratories lack the capacity to develop animal and human vaccines. Vaccine research is typically conducted by the private sector and not university researchers.
- North African countries lack waste management companies who can safely dispose of waste from laboratories with biosafety level 3 capabilities.
- North African research institutions are ill-equipped and poorly set-up to encourage and facilitate cross-disciplinary research, which is important for science and technology progress and innovation.
- No single resource exists to inform scientists about available grants to which North African scientists can apply.
- North African countries might spend significant resources to counter terrorism within their borders, which leaves little to support research, education, and responsible science (including laboratory biosafety and biosecurity, ethics, and scientists and engineers with malicious intent).

Opportunities for Future Bioengagement

The U.S. could help North African countries to:

- **Provide cooperative grants and reduce barriers to fully implement the bilateral Science and Technology Agreements.¹⁴**
- **Engage high-level, well-connected organizations and officials to develop national and regional strategies to address biological risks.**
- **Support the development of national legal frameworks to address biological risks that clearly defines the roles and responsibilities of relevant sectors and government agencies.**
- **Assist North African governments in developing plans to coordinate across relevant ministries to address biological risks and threats.**
- **Support joint behavioral research to help regional scientists identify approaches to assess whether scientists and engineers have intentions to cause harm.**
- **Assist in development and implementation of a waste management plans in North Africa.**
- Establish infectious disease surveillance networks that include wildlife conservation, domestic and experimental animal health, human health, and plant health.
- Empower civil societies to become more involved in addressing laboratory biosafety and biosecurity risks.

¹⁴ The opportunities highlighted in bold are the top areas for future bioengagement identified by participants.

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- Develop programs whereby scientists and health official can effectively communicate with and educate the public about complex scientific and security issues.
 - Develop a system in which scientists can provide input into the policy-making process in North African countries. This input could come in the form of scientific advice or advocacy on a given issue.
 - Encourage greater involvement of the private sector to drive efforts to prevent or minimize biological risks.
 - Conduct forensic analysis to identify perpetrators of terrorist attacks.
 - Establish national and regional biosafety associations to strengthen the role of civil society and trade associations in addressing laboratory biosafety and biosecurity.
 - Upgrade and safeguard biological laboratories to improve security at these facilities.
 - Establish new journals with the Springer publication group to allow scientists from the region to publish in peer-reviewed, international journals. The Springer publishing group has a program that allows scientists from underdeveloped countries to establish a journal under its auspices to allow them to share their research with the international scientific community.
 - Promote regional collaboration to address biosecurity risks and conduct high-consequence research and diagnostics, if necessary.
 - Engage policy-makers to develop a national strategic management plan to promote national innovation in science and technology.
 - Develop the national and regional capacity to translate basic research into applied services for society. Examples of these service sectors include the public health and biotechnology sectors.
 - Build private sector capacity in the region and incorporate good laboratory practices during development efforts.
 - Conduct exercises with regional scientists to identify barriers to international collaboration, which need to be addressed to promote scientific cooperation.
 - Establish training sessions, train-the-trainer programs, or full training centers to educate scientists and health practitioners about biological risk management and transportation of infectious agents.
 - Promote bioengagement efforts that seek to raise awareness of biosecurity concerns.
 - Support more collaboration in the biological sciences with a focus on medical and microbiological research.
 - Support the development of national academies of sciences and efforts to link these academies with the InterAcademy Panel.
 - Promote the development of the Libyan scientific and educational infrastructure by providing young Libyan scientists with education and training in the life sciences and responsible science, and enabling senior scientists to continue working in the laboratory.
 - Conduct an impact assessment of past and current bioengagement efforts in North Africa to identify special gaps which scientific cooperation could address.
 - Facilitate linkages between university research efforts and public health needs to strengthen the scientific foundation for identification and control of local health challenges.
 - Develop a laboratory management committee to help scientists identify and assess biological risks and promote good laboratory practices.

During the discussion, participants suggested several approaches which could help efforts to promote engagement between scientists from the U.S. and North African countries. These approaches include:

- Treating bioengagement efforts as a development effort rather than a security activity.
- Including a wide range of scientific disciplines in bioengagement efforts, including non-microbiological sciences disciplines, non-research and non-public health sectors, and research involving any biological materials.
- Developing bioengagement programs that have a broader health focus than pathogens, such as cancer.
- Focusing on scientist responsibility and contribution to society to promote good laboratory practices, including ethics, safety, and security.
- Including individuals that have access to policymakers and researchers to help bridge differences and communication gaps between these sectors.
- Developing programs that promote building of trust between international partners and researchers within the same institution.
- Ensuring that projects and partnerships take into account regional cultures, political environments, and social systems when developing projects and choosing partners.
- Designing projects jointly with partners to encourage co-ownership of project activities, responsibilities, and results.
- Integrating the identification and mitigation of laboratory risks with research and health practice.
- Building on the global efforts undertaken in response to the 2001 anthrax letters and other infectious disease outbreaks of international concern.
- Addressing biological risks and inappropriate use of biological research and results through social responsibility and development.
- Assembling global teams to conduct external evaluations or support self-assessment of scientific engagement programs.
- Developing projects on a foundation of common interests, concerns, and vulnerabilities.
- Build on existing programs when developing new bioengagement programs and projects.
- Preparing peer-review papers that encourage scientists to participate in science engagement programs.
- Involving professors, who might be able to communicate with both researchers and regulators.

Sustainability and Evaluation of Bioengagement Programs

Participants were asked to consider effectiveness and longer term impact of bioengagement programs. The following sections list ways for encouraging long-term implementation of programs or maintenance of scientific partnerships, and possible criteria for evaluating specific engagement activities.

Participants were asked how to sustain programs or partnerships initiated through bioengagement efforts. The following list comprises suggestions provided by meeting participants about possible ways in which to gain long-term benefit from bioengagement efforts:

- Legal frameworks help define the roles and responsibilities of all relevant stakeholders in the governance and implementation of programs that promote science innovation, bioengagement, and risk management.
- Institutional policies, practices, standards, and accreditation demonstrate to potential partners that their counterparts are held to identical or similar standards of laboratory practice, which facilitates cooperation.
- Trust, honesty, and friendship between scientists are crucial for promoting long-lasting scientific partnerships and open sharing of information.
- Transparency between scientists and funding agencies is important for gaining partners for engagement and facilitating local buy-in and follow-on implementation of project activities.
- Government, citizen, and stakeholder ownership of engagement activities might ensure that the activities are designed according to local interests and needs and accepted by local scientists.
- Engagement activities that incorporate plans for transferring information learned or replicating the activities might facilitate broader exposure to engagement efforts.
- Governments involved in scientific engagement activities that have a shared vision of the strategies, needs, and expected outcomes of the efforts could facilitate local buy-in and long-term implementation of activities.
- A shared understanding of project objectives between partners could facilitate further implementation of project activities and development of follow-on activities.
- Train-the-trainer programs are designed to enable the development of follow-on training activities.
- Although unrealistic, funding priorities that remain consistent over time would promote long-term implementation of scientific engagement programs.
- Support from several funding organizations and philanthropic organizations would enable scientists to continue science engagement activities.
- Training programs that include accreditation or certificates of participation could offer sufficient benefit to participants that other scientists might want to participate in future training sessions.
- Strong scientific partnerships built on open communication, mutual interest, and trust would enable follow-on scientific projects.
- Training programs, project audits, and development of services to private industry incorporated into the design of projects to promote future interest in engagement efforts.
- Programs that fulfill the missions of recipient organizations have a higher likelihood of persisting beyond the initial program and investment.
- The prospect of employment opportunities for participants of science engagement programs might encourage additional scientists to participate in future programs.
- Sustainability measures developed and incorporated into the design of science engagement programs could help identify measures to promote sustainability of

activities. The International Atomic Energy Agency paper on indicators for sustainable energy development is an example of such indicators.¹⁵

- Develop engagement initiatives that support more than one project, training program, or other activity.

Evaluation for Effectiveness and Long-term Sustainability of Bioengagement Efforts

Bioengagement programs can be evaluated for successful achievement of specific program objectives, the benefits to individual participants, and the contributions to address societal and national concerns.

Participants were asked to consider measures to evaluate the effectiveness and long-term impact of bioengagement efforts. In doing so, participants focused on measures of success of individual projects rather than the overall initiative under which the project was developed and supported. Participants stressed the importance of developing evaluation criteria based on the objectives of the bioengagement program and program milestones. They suggested several ways to assess the impact of programs, including surveys and questionnaires.

The following list itemizes specific information that could indicate success with specific bioengagement activities:

- The number of new people involved in activities and training programs.
- The number of joint publications. However, publication number does not demonstrate quality of the research or the scientific partnership.
- The number of biosafety associations that were established through regional collaboration.
- The degree to which regional collaboration occurs.
- The richness of communication between scientific partners and funding agencies.
- The level and quality of email communication between scientific partners
- The degree of transparency between scientific partners and funding agencies.
- The number of laboratories involved in scientific engagement activities.
- The number of laboratories and scientists receiving accreditation for management of biological risks.
- The number of students safely, ethically, and securely working in innovative scientific fields.
- The number of new viral sequences added to Genbank.
- The number of viral strains identified.
- The number of recommendations from bioengagement programs that have been locally implemented.
- The number of new programs or activities created and implemented in response to bioengagement efforts.
- The number of patents resulting from joint research.

¹⁵ International Atomic Energy Agency. (2005) Energy Indicators for Sustainable Development: Guidelines and Methodologies. Available at: www.pub-iaea.org/MTCD/publications/PDF/Pub1222_web.pdf. Accessed on June 27, 2013; International Atomic Energy Agency. Indicators for Sustainable Energy Development. Available at: www.iaea.org/Publications/Factsheets/English/indicators.pdf. Accessed on June 27, 2013.

Some participants highlighted the need for individuals involved in bioengagement programs to demonstrate value of the program activity to their supervisors. They suggested publication of articles and certificates of training as two possible ways individuals can demonstrate their benefit from participating in bioengagement programs to their supervisors and colleagues.

Conclusion

Priority areas for future bioengagement in the North African region tended to focus on integration of laboratory biosafety and biosecurity processes into the larger context of biological risk mitigation and promotion of science innovation. Participants, who represented human health and life science practitioners, generally agreed on the importance of regional collaboration and civil society involvement to minimizing the harmful consequences of biological risks, which include any risks on the spectrum of naturally occurring outbreaks to intentional use of pathogens and toxins. They believed that harnessing local abilities and interests could promote local ownership and enhance feasibility and sustainability of efforts to reduce biological risks. The challenges scientists and health practitioners face during this time of significant social and political change can provide a common basis for future partnerships and cooperation between the U.S. and North African countries. The suggestions presented in this paper are just a few possible opportunities for future bioengagement; ongoing dialogue with regional experts might enhance trust between U.S. and North African scientists and uncover additional areas of possible bioengagement.

Acknowledgements

We would like to thank the panelists and meeting attendees who provided valuable and robust discussion and helpful comments on the report. We thank Dr. Khalid Temsamani from the Moroccan Biological Safety Association, who helped us organize and host the meeting in Morocco.

Middle East Regional Consultation

Jordan

June 9-10, 2013

The second of the consultations was held in Amman, Jordan, in June 2013 in collaboration with the Jordan University of Science and Technology (JUST) and included scientists and health experts from the Afghanistan, Pakistan, Jordan, Lebanon, Iraq, United Arab Emirates, Saudi Arabia, Kuwait, Oman, Yemen, the United Kingdom, and the United States, including an official from the Jordanian office of the World Health Organization. The suggestions presented in this summary paper are based entirely on the views of the meeting participants, which included experts in the research and health sectors, government and non-governmental sectors, and human and environmental health sectors. The suggestions reflect the broad range of ideas and interests of the participants; consensus suggestions are highlighted.

Over the two days of facilitated, participatory discussion, participants were encouraged to consider: 1) past and current bioengagement efforts and whether those efforts are sufficient for addressing extant biological risks or threats in the region; 2) measures of success for effectiveness and long-term implementation; and 3) the regional environment in which future bioengagement will be occurring, including the socio-political situation in individual countries and the entire region, the current security risks and threats facing the region, and the regional benefits of biological sciences to address these security risks and/or threats.

Local governance frameworks, social norms, and cultural differences might contribute to the relative success or failure of science cooperation between U.S. and MENA scientists.

During the meeting, participants stressed the importance of **trust and transparency** throughout any interaction. Some participants questioned the motives of the meeting and AAAS's role during the meeting. Specifically, these participants inquired about the underlying purpose of the meeting and direct funding opportunities resulting from the discussions. In response to these questions, AAAS stressed that the goal in this and the previous meeting in Morocco was to empower scientists to voice their opinions about the regional and national needs for addressing biological risks, which could provide a basis for positive future bioengagement. This interaction emphasized the importance of honesty, openness, and genuine communication among regional experts. Even though trust and transparency are equally as important in North America, similar questions were not raised during the meeting in Morocco.

In addition to trust, local government support for development and implementation of scientific engagement is critically important for promoting international collaboration in research and responsible science. Without strong support from local governments, scientists from the region might encounter significant challenges and resistance to the pursuit of scientific cooperation and research innovation.

Based on the meeting discussions, experts from the broader MENA region identified the following gaps, opportunities, and approaches for bioengagement and considered the following sustainability options and metrics. The suggestions in bold reflect topics that

received significant discussion and consensus agreement during the meeting. Statements that were considered particularly important by several participants are italicized.

The meeting discussion resulted in a number of possible opportunities for future engagement. At least one participant suggested creating a "roadmap" to assist possible funders in navigating the possible future bioengagement efforts. This roadmap could facilitate initial and ongoing communication and coordination among interested U.S. agencies and local government entities.

Top Opportunities for Bioengagement in Middle East

Participants stated that the U.S. can be most helpful in:

- 1) **Supporting the development of national strategies and plans to address biological risks, including zoonotic, human, and environmental health risks.** These plans would include roles and responsibilities for the health, science, and emergency response sectors. Efforts towards developing national strategies have begun in at least one country (Lebanon¹⁶), but more work could be done with experts throughout the region to develop national plans and strategies for addressing the wide spectrum of biological risks.
- 2) **Supporting the creation of a regional committee that would identify resources and expertise throughout the Middle East.** Identification of regional capacity for crucial scientific and health needs would help countries develop national plans and promote regional cooperation that builds on existing resources (including human, facility, and financial resources). Several groups currently active in the Middle East region could convene the regional committee and facilitate data collection.¹⁷ *Ultimately, regional plans and strategies could be developed to promote responsible scientific advancement to meet regional needs.*
- 3) **Developing scientific exchange programs through non-governmental organizations to address biological risks in the laboratory setting.** Scientific exchange programs offer regional scientists and health practitioners with opportunities to learn different approaches and best practices for identifying and addressing a broad range of biological risks. Although national-level policies are developed by government officials and/or government assigned scientific experts, individual scientists and institutional administrators play important roles in identifying and reducing risks as they design, conduct, and communicate their research or diagnostic work. *Non-governmental organizations might have greater access to regional and U.S.-based scientists than individual government agencies and existing programs to offer such professional development opportunities.*

¹⁶ Two efforts to develop a nationwide program to address biosafety and biosecurity risks have begun in Lebanon. The Biosafety and Biosecurity International Conference has initiated a dialogue with officials from relevant Lebanese ministries to develop a national framework for addressing biological risks. The U.S. Department of State has funded a project by a leading Lebanese scientist, with the help of experts in the U.S., to develop a biosafety and biosecurity program among universities in the country.

¹⁷ Existing groups that could convene a regional committee include the Biosafety and Biosecurity International Conference, the Middle East Scientific Institute for Security, and the BMENA BioScience Forum, which is currently being developed.

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- 4) Developing robust policies and procedures for transporting hazardous materials.** Although those individuals involved with “transportation of dangerous goods” receive certification from the International Air Transport Association (IATA), many of their employers (i.e., research institutions or diagnostic laboratories) might not have adequate policies and procedures in place to ensure that all staff follow the same rules for transportation of biological materials.

The regional World Health Organization (WHO) offices could provide a forum in which scientists and health experts from individual countries could convene, discuss scientific capacities and expertise, and develop partnerships to address national level identification and response to infectious disease outbreaks. The Jordan office of the WHO offered to set up such a meeting for Jordanian stakeholders from the research and health sectors. Although the U.S. does not have a direct role in this type of meeting, it could provide subject matter expertise and financial support if requested.¹⁸

Participants advocated the involvement of young scientists in all bioengagement activities. They stated that this could promote sustainability of programs.

Gaps, Opportunities, and Approaches for Bioengagement Programs

The following sections provide the gaps in cooperation which lead to the identification of possible areas for future bioengagement between the U.S. and Middle Eastern countries, and suggested approaches to carry out joint activities. The activities are not listed in any particular rank order. The listed activities do not reflect official government views but rather demonstrate the broad range of gaps in bioengagement and possible future engagement opportunities that could be pursued in the region.

Gaps in Bioengagement

- Periodic evaluation of programs is essential for assessing the effectiveness of program activities and implementing course corrections to improve the outcomes of the activities. However, no such evaluation has been undertaken to assess investments to improve public health for rapid detection and reporting of infectious disease outbreaks.
- *Coordination among U.S. government offices supporting bioengagement activities is poor.*
- *Past and current bioengagement efforts seem to be fragmented and have little follow-up leading regional scientists to question whether sponsors are committed to addressing biological risks in the Middle East.*
- *Past and current bioengagement approaches are very U.S.-focused and often prompt regional scientists to ask: what is the U.S. concerned about, how can regional experts address those concerns, and can those solutions be implemented feasibly and sustainably in the region.*

¹⁸ The 2005 International Health Regulations allows the World Health Organization to inquire about possible outbreaks of international significance based on unofficial reports as well as official communications.

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- Past and current bioengagement efforts do not include training on developing and writing grant proposals. In addition, no single resource of available funding opportunities exists.
 - Laboratory biosafety and biosecurity is not currently integrated into the broader context of research or diagnostic activities.
 - Laboratory biosafety and biosecurity practices do not accurately reflect research and health risks in the region and do not keep pace with research advances.
 - Although current bioengagement efforts support laboratory capacity building and scientist training on biorisk management, many research and diagnostic facilities are still in need of physical upgrades, usable equipment, and laboratory biosafety and biosecurity education and training of the scientific workforce.
 - Middle Eastern countries do not have laboratories and equipment that can function reliably in harsh conditions, such as the dry desert.
 - A strong tension exists between promoting collaborative research and enhancing laboratory biosafety and biosecurity. Often, laboratory biosafety and biosecurity measures are developed and implemented in ways that hamper research and increase difficulties in initiating and maintaining scientific cooperation.¹⁹
 - *Regional scientists and health practitioners are not well-equipped and trained to rapidly identify, characterize, and reduce outbreaks of unknown agents or origin.*
 - The influx of Syrian refugees in at least three countries has caused public health, environmental, and social problems, including outbreaks of infectious diseases such as measles, water shortages, problematic waste management in the refugee areas and medical outposts, and increased costs of living near the refugee encampments.
 - Engagement with Syrian students to promote education in biology and responsible science is extremely difficult to carry out. However, such engagement might help limit the negative effects of the current environment in Syria.
 - The effects of the social-political changes across the Middle East region on research are not known.
 - No education programs exist to counter and reduce the influence of harmful ideologies on scientists.
 - Communication between research partners and with the international scientific community is poor, in part because the predominant language of science is English. In fact, scientists communicate with the global research community through scientific publication in English-language, internationally recognized journals.
 - Many scientists are using older technologies to carry out their research. Newer technologies could transform the research efforts in the region to address local, national, and/or regional challenges.
 - *National frameworks for addressing biological risks are rare in the Middle East.*
 - *Partnerships between regional scientists and between the academic and health sectors are absent in much of the region. In addition, regional partnerships between scientists, journalists, and experts from other sectors are poor.*
 - Translation of science and technology advancements to everyday applications to promote economic development in Middle Eastern countries is extremely poor.

¹⁹ In recent years, the recognition that responsible science – including laboratory biosafety and biosecurity – can increase the level of confidence in the way that collaborative research activities are carried out, has enhanced efforts in promoting safe and secure laboratory practice. This approach has increased the interest of scientists around the world to consider biosafety and biosecurity as two of many important concepts to address scientific progress and achieve international recognition. However, many security programs focus solely on physical and personnel security and safety measures, rather than taking this approach.

Similarly, translating environmental biotechnology to address environmental problems is challenging, but needed in the region.

- Government support for science and technology research, development, and innovation is limited (or even lacking) in some countries, which limits the development of new products and services to address national needs.
- More education of the populous and scientific community about the benefits of science to address a broad range of national problems while minimizing potential risks associated with the research and development is needed.
- Naturally-occurring radioactive materials and chemicals are prevalent throughout the Middle East and could pose significant environmental, safety, and security risks in the region.

Opportunities for Future Bioengagement

Based on the gaps identified during the meeting, participants listed several possible activities with which the U. S. could assist. The top five opportunities for future bioengagement, which are described in detail earlier in this summary, are highlighted in this section. The other activities are listed to reflect the discussion of the meeting accurately.

The U.S. could engage with Middle Eastern countries in public health, laboratory safety and security, education of responsible science, laboratory capacity building, communication, development of national strategies and public health priorities, and several additional areas. Within each of these areas, participants suggested specific opportunities for cooperation between the U.S. and Middle Eastern countries.

In the area of public health, the U.S. could assist Middle Eastern countries to:

- Conduct a systems assessment of past and current health engagement efforts.
- Develop plans to prepare for and respond to a broad range of disasters, including natural and man-made disasters.
- *Teach research and diagnostic laboratories how to identify, characterize, and mitigate outbreaks of unknown origin.*
- Implement programs to assist in rebuilding Syria by promoting education and training in biology, public health practices, and responsible science.
- Characterize reemerging infectious diseases.
- Build local capacity for conducting biosurveillance of infectious diseases.
- Develop more efficient diagnostic tools for detecting infectious diseases in the region.
- Collaborate with NAMRU3²⁰ and other regional laboratories to build public health capacity.
- *Support research on antimicrobial resistance of pathogens in the region by building on existing expertise and experience.*²¹

²⁰ NAMRU3 is the U.S. Naval Medical Research Unit- 3 located in Cairo, Egypt.

²¹ Lebanon has studied and tested for antimicrobial resistance of locally important infectious diseases for years.

The WHO could convene meetings to promote science and health organizations to coordinate efforts and communicate for enhancing health response to infectious disease outbreaks and/or crisis management.

In the area of laboratory safety and security, the U.S. could assist Middle Eastern countries to:

- **Develop robust policies and procedures for transporting hazardous materials, including analysis of global distribution of the goods and documentation of transfer of materials, for diagnostic and research laboratories.**²²
- *Establish and maintain regional training centers.*
- Promote regional biosafety consortiums.
- Develop a regional website to share best practices in laboratory biosafety and biosecurity.
- Develop training programs on laboratory biosafety and biosecurity and evaluation criteria to assess effectiveness of the programs.
- Upgrade laboratory facilities and technologies to safeguard dangerous materials and minimize the risks of misuse or theft.
- Integrate laboratory biosafety and biosecurity practices into research and public health practice to facilitate research and response to any hazard.

In the area of responsible science, the U.S. could assist Middle Eastern countries to:

- Clarify and document existing codes of conduct and laboratory practice to promote safe, ethical, and secure research.
- Educate and train regional scientists on shared principles of responsible science.

In the area of laboratory capacity building, the U.S. could assist Middle Eastern countries to:

- Equip scientists and public health experts to facilitate field and laboratory research and diagnostic tests.
- Train scientists to conduct laboratory and field research and public health investigations.

In the area of communication between scientific colleagues, the U.S. could assist Middle Eastern countries to:

- *Develop and maintain scientific networks to facilitate communication.*

In the area of national strategies for scientific research and health priorities, the U.S. can assist Middle Eastern countries to:

- **Support the development of national strategies and plans to address biological risks, including zoonotic, human, and environmental health risks.**
- **Develop scientific exchange programs through non-governmental organizations to address biological risks.**

²² The opportunities highlighted in bold are the top areas for future bioengagement identified by participants.

- Develop strategic plans to promote research across the region.
- Facilitate the implementation of policies to promote safe, ethical, and secure research and health practice.
- Examine how the recent socio-political changes have influenced or been influenced by research conducted in the region.
- Promote stronger links between entrepreneurship, academia, and the health sector to encourage application of research efforts to address regional and national health challenges.
- Develop rules and regulations to promote safe, ethical, and secure practices for research, health, and transportation of dangerous goods.
- Raise awareness about the importance of research to addressing national and regional problems, including infectious disease outbreaks and high-risk research and/or diagnostic activities.

Additional opportunities with which the U.S. can help Middle East countries include:

- **Support the creation of a regional committee that would identify resources and expertise throughout the Middle East.**
- Develop a strong community-based scientific and health network.
- Support workshops to train scientists develop grant proposals.
- Provide a single resource of available funding sources, including government agencies and philanthropic organizations, for scientists to identify possible funders that support bioengagement and research activities.
- Encourage the next generation of scientists to: 1) address safety, ethical, and security risks of research and health practice; and 2) conduct research and diagnostic activities to address national and regional problems.
- Support research on the health and environmental effects of naturally occurring chemical and radiological compounds.
- Strengthen international cooperation between law enforcement and the scientific community to detect, deter, and interdict illicit trafficking of biological materials.

Approaches for Future Bioengagement

During the discussion, participants suggested several approaches which could help promote and strengthen engagement between scientists from the U.S. and Middle Eastern countries. These approaches include:

- Coordinating bioengagement activities among U.S. agencies and with other countries that support similar, if not identical, efforts in the Middle East.
- Promoting trust between funders, regional scientists, and cooperative partners and improving open communication about intentions and objectives for the bioengagement activity (i.e., transparency). Bioengagement efforts greatly benefit from regional organizations learning about new organizations and experts who are interested in partnering with them on various bioengagement activities.
- Defining the problem(s) which engagement efforts seek to address prior to initiation of any projects and in a clear manner. This includes answering all questions regional scientists and health practitioners might have about the project rationale, activities, and outcomes before engagement begins.

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- Encouraging trust-building between the general public and regional scientists.
 - *Designing engagement activities that build on the practical challenges of the region rather than focusing on addressing the problems of the U.S.*
 - Involving early-career scientists in bioengagement activities.
 - Supporting associations of early-career scientists and health practitioners who implement the International Health Regulations, address laboratory biosafety and biosecurity risks, and conduct biosurveillance activities.
 - Coordinating networks of regional scientists to encourage maximal benefit to regional scientists and health professionals, particularly if the networks are complementary and not duplicative.
 - Learning about new organizations and experts to encourage expansion of bioengagement efforts.
 - Encouraging global scientific partnerships to promote research progress and responsible science.
 - *Building on common concerns, problems, and needs across the MENA region.*
 - *Promoting regional scientific collaboration to encourage sharing of experiences in conducting certain types of research, engaging in cooperative activities, and responding to public health problems.*
 - Designing bioengagement activities based on local, national, and international needs.
 - Incorporating entrepreneurship into activities to enable translation of research results to practical application and develop a business foundation for training programs, capacity building, diagnostic testing, and other similar efforts.
 - *Including private sector (i.e., industry) in bioengagement activities to: 1) build regional commercial research and development (R&D) capacity to address local health and environmental problems; and 2) connect regional industry to international business partners, including biotechnology and pharmaceutical companies and venture capital firms.* Explicitly, this approach could assist in the economic development of some countries in the region. Implicitly, this approach could promote implementation of industry standards of practice, industrial security measures to prevent unauthorized access and inappropriate use of commercial R&D, transparency, and international linkages between regional biotechnology industry and the global scientific and commercial sectors.
 - *Focusing on biological materials that do not exist in the U.S. This provides a strong scientific incentive for U.S. researchers to participate in cooperative activities.* However, care should be taken to share intellectual property and results among all relevant partners, particularly local partners.
 - Supporting biosurveillance efforts that include assessing the health of wild animal populations to facilitate early warning of infectious disease outbreaks in humans or domesticated animals.
 - Integrating evaluation methodologies into the design and implementation of bioengagement activities.

Sustainability and Evaluation of Bioengagement Programs

Participants were asked to consider the effectiveness and longer term impact of bioengagement programs. The following sections list suggested ways for encouraging

long-term implementation of programs or maintenance of scientific partnerships, and possible criteria for evaluating specific engagement activities.

Sustainability of Programs and Partnerships

Participants were asked about ways in which to sustain programs or partnerships initiated through bioengagement efforts and gain long-term benefit from those programs. The following list comprises suggestions provided by meeting participants:

- Use of evaluation criteria and metrics for projects that are developed jointly with all principal partners and the funding organization have a higher likelihood of demonstrating value for the project activities.
- Open communication among project partners and funding organizations increases the levels of trust and transparency between these individuals and organizations, potentially leading to long-term partnerships.
- Cooperative projects that are designed jointly with regional scientists and health professionals might encourage local ownership of the project activities.
- Projects that address local needs, build on local interest in the project idea, and are initiated and developed by regional scientists have a higher likelihood of promoting local ownership of and commitment for project activities.
- *Bioengagement activities that strengthen institutional infrastructure – including management, standard of practice, and resources to navigate legal, ethical, safety, and security issues – provide a strong foundation upon which regional scientists can continue the activities.*
- Scientists that develop business plans to maintain engagement activities beyond initial funding might enable the continuation and growth of partnerships and programs.
- Project partners that include plans for transitioning ownership of engagement activities to local scientists might increase the likelihood of sustaining those activities.
- The U.S. government and other governmental sponsors that maintain steady, continued commitment and funding for bioengagement efforts might demonstrate to regional governments and scientific partners that the activities are of sufficient value to maintain and strengthen.²³
- Projects that provide unique skills and/or knowledge to regional scientists through education and training might demonstrate local value and need for the project activities.
- Programs that promote equal partnership between project partners as an end, rather than a means to an end, might increase the likelihood of maintaining, expanding, and evolving bioengagement efforts.
- *Forums in which scientists can share their experiences, best practices, problems, and corrective actions might enable the design of more effective and longer-lasting engagement efforts.*
- Projects that provide broad sets of tools, skills, and/or knowledge to regional scientists might promote repeated use of those tools, skills, and expertise in their workplace and future engagement activities.

²³ Continued funding generally demonstrates a country's interest in a given issue or program.

Bioengagement Programs can be evaluated for successful achievement of specific program objectives, the benefits to individual participants, and the contributions to address societal and national concerns.

Participants were asked to consider measures to evaluate the effectiveness and long-term impact of bioengagement efforts. In doing so, participants focused on measures of success of individual projects rather than the overall initiative under which the project was developed and supported. Participants stressed the importance of developing evaluation criteria based on the objectives of the bioengagement program and program milestones. They suggested several ways to assess the impact of programs, including surveys and questionnaires.

The following list itemizes specific information that could indicate success with specific bioengagement activities.

Possible quantitative outcome measures might include:

- The number of laboratory accidents during the engagement program.
- The number of people trained.
- The level of capacity-building of laboratories, workforce, institutional infrastructure, and/or commercial facilities.
- The degree to which training programs enhance reliability, accuracy, and credibility of regional scientists as tested by proficiency exams.
- Development of networks or databases to facilitate conversation between regional scientists.
- The amount of international collaboration resulting from programs.
- The business outcomes resulting from cooperative programs.

Possible qualitative outcome measures might include:

- The level of transparency between project partners.
- The degree to which scientific partnerships continue.
- The degree of commitment by project partners.
- The degree to which knowledge is transferred.
- The degree to which key concepts and practices from engagement activities are integrated into regional training programs and facility management.

Possible evaluation measures that would require detailed analysis might include:

- The type and level of impact that individuals have enhancing safety and security in the region.
- The weaknesses and strengths of activities and the feasibility of implementation of future activities.
- Implementation of self-assessments and discussions about project failures.
- Benefit of the project activity to the local, national, or regional population.

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- *The degree to which local needs are met.*

Some participants highlighted the need for individuals involved in bioengagement programs to demonstrate the value of the program activity to their supervisors. They suggested publication of articles, initiation of new collaborations, and transfer of technologies as possible ways that individuals can demonstrate the benefit of participating in bioengagement programs to their supervisors and colleagues.

Conclusion

Priority areas for future bioengagement in the Middle East focused on the development of national and regional strategies for addressing biological risks, policies and procedures for transportation of dangerous goods, scientific exchange programs to build partnerships and transfer knowledge and skills, and laboratory biosafety and biosecurity. Meeting participants, who included scientific and health experts from countries across the broader Middle East, stressed the importance of trust and transparency among scientific partners, local government support, and inclusion of early-career scientists when developing and implementing bioengagement activities. Finally, meeting participants provided valuable insight into the outcome and evaluation measures that could be used to assess the success and effectiveness of individual bioengagement activities. Building on the years of engagement in the MENA region and the meeting described in this summary, participants advocated for continued dialogue among regional and U.S. scientists to enable the evolution of bioengagement activities from a focus on U.S. interests to regional needs.

Acknowledgements

We would like to thank the panelists and meeting attendees who provided valuable and robust discussion and helpful comments on the report. We thank Dr. Saied Jaradat from the Jordan University of Science and Technology, who helped us organize and host the meeting in Jordan. We thank Dr. Wajih Owais, former President of JUST and former Minister of Higher Education in Jordan for opening the meeting with such insightful comments about regional changes and importance of scientific cooperation.

Consultation Agenda

Day 1: Setting the Context

8:30-9:00	Registration and Breakfast
9:00-9:30	Welcome and Meeting Goals
9:30-11:00	Current Efforts in Cooperative Scientific Engagement and Mechanisms for Sustainability of the Programs and Relationships
11:00-11:30	Break
11:30-12:30	Historical and Current Metrics of Success and Sustainability
12:30-1:30	Lunch
1:30-2:30	The Changing Landscape in the Middle East: The Future of Scientific Cooperation
2:30-3:30	Risks and Threats Posed by the Biological Sciences
3:30-4:00	Break
4:00-5:00	Benefits and Contributions of Biological Sciences to Addressing Security Risks and Threats
5:00	Adjourn
6:00-9:00	Dinner

Day 2: Open Discussion: Opportunities for Engagement

9:00-9:30	Breakfast
9:30-11:30	Defining Scientific Engagement <ul style="list-style-type: none">• What gaps in regional scientific infrastructure, capability, and expertise exist to effectively conduct surveillance of dangerous pathogens or unusual biological incidents?• What should it encompass?• What are the scientific and workforce gaps in achieving these goals?
11:30-12:30	Lunch
12:30-2:30	Sustainability of Programs and Measures of Success <ul style="list-style-type: none">• How can biosafety and biosecurity training programs and physical security programs be developed or implemented to ensure ongoing implementation and adaptation to evolving threats?• How can activities be developed to continue beyond U.S. government investment and adapt with evolving threats?

2:30-3:00	Break
3:00-5:00	Opportunities for Engagement <ul style="list-style-type: none">• What opportunities exist that provide entry points for bioengagement?
5:00	Adjourn

Commissioned Paper: Lessons Learned in Cooperative Bioengagement in the MENA Region

LESSONS LEARNED AND UNLEARNED: U.S. COOPERATIVE BIOENGAGEMENT IN THE BMENA REGION

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This paper is intended to provide a review of the lessons that can be learned from the decade of engagement by U.S. biological cooperative threat reduction (CTR or bio-CTR) programs in the broader Middle East—North Africa (BMENA) region.²⁵ The specific charge is to

...assess past efforts for cooperative bioengagement in the MENA region and identify key lessons learned that affected local acceptance and long-term sustainability of past programs. The paper should be written within the broader context of cooperative bioengagement efforts in the Middle East/North Africa (MENA) region, noting the continuation of scientist redirection efforts (i.e., in Iraq and Libya) and transition to bioengagement with scientists not formally part of biological weapons programs (i.e., most other countries in the region).

In order to do so, I believe it is necessary to understand a more general set of lessons that apply across all U.S. bio-CTR activities and then address how these apply in the BMENA. There are also a few lessons that reflect the particular circumstances of the region. The “learned/unlearned” in the paper’s title refers both to initial lessons whose precepts have changed over time in response to experience and evolving conditions, and to some which I believe have not yet been fully absorbed or effectively implemented. Few if any of these lessons will be a surprise to those who design and fund, implement, or follow bio-CTR, or “bioengagement” as it is now frequently called. But I believe that, taken together, they help explain many of the current realities for bioengagement efforts and the substantial challenges that remain for their effective and sustainable implementation. But if those challenges can be overcome – and I see hopeful signs from a number of quarters – I also believe there are important opportunities for bioengagement in the BMENA to benefit U.S., regional, and global security and well-being.

²⁴ Any opinions, findings, conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the Naval Postgraduate School, under Grant No. N00244-12-1-0039, the United States Government, or the AAAS Board of Directors, Council, or membership. In addition, although this paper draws heavily upon reports and activities of the National Academies, ultimately the product is the author’s own, independent analysis, and does not necessarily reflect the views of the National Academies.

²⁵ In addition to the countries traditionally counted as part of the Middle East/North Africa, the BMENA includes Afghanistan and Pakistan.

Much of my analysis reflects the experience with cooperative threat reduction, nonproliferation, and disarmament that I and my colleagues at the National Academies have accumulated over the last 25 years, including the final days of the Soviet Union and the beginnings of CTR programs in the former Soviet Union (FSU) and continuing to the present.²⁶ The studies and projects that provide the basis for my own assessments are cited; Appendix A contains a longer list of reports reflecting the larger body of work. It is worth noting how many of the reports were produced by joint committees from more than one academy or through other forms of partnership with counterpart organizations.

The focus of my paper is on current bioengagement programs with explicit security goals. I am not including the classic Track II activities on nonproliferation and disarmament in which scientists take advantage of the relationships built through their scientific work to address other problems (De Cerreno and Keynan, 1998; Evangelista, 1999), and in which the National Academies and others have a long and distinguished history.²⁷ At present, such activities are not a significant element in U.S. government bio-CTR programs. Nor am I including more general scientific engagement, except to the extent that it involves or overlaps with individuals and institutions that are part of bio-CTR efforts. The project for which this paper serves as background, for example, makes the argument that many forms of collaboration, such as support for research in the life sciences beyond infectious diseases relevant to WMD, ultimately serve U.S. and global security because of the relationships they build and the good will they engender through joint activities that fulfill important needs for our partners. They may also be more palatable in regions where U.S. security relations are difficult and initiatives are likely to be viewed with at least initial suspicion. Proponents of “science diplomacy” make the argument explicitly (Royal Society, 2010).²⁸ AAAS has a Center for Science Diplomacy that promotes its role in foreign policy and carries out both general and security-related exchanges and other activities.²⁹ The State Department’s bio-CTR program has supported a few projects that take this broader approach, but it has not yet taken hold across the U.S. government nor among other governments and international organizations (see next section). My exclusion is not intended as a judgment about a broader framing of bioengagement; the National Academies also carry out many activities, including in the BMENA, which reflect these wider forms of engagement. My goal is to examine a particular set of activities and the implementation challenges they face within their own security-focused context.

LESSON #1: CONTINUING, FUNDAMENTAL DISAGREEMENTS ABOUT THE PROBLEM AND THE APPROPRIATE REMEDIES

One of the remarkable features of bio-nonproliferation and disarmament over the last 10-15 years is the degree to which both conceptual frameworks and policy choices are disputed. These disagreements take place within and between governments and with international organizations. They also take place between the U.S. government and the key

²⁶ The National Academies is the collective name for four nongovernmental organizations: the National Academy of Sciences (NAS), the National Academy of Engineering (NAE), the Institute of Medicine, and the National Research Council, which is the operating arm for the NAS and the NAE. For anyone interested in the work done on CTR, these and all the reports from the National Academies are available as free pdfs at <http://www.nap.edu>.

²⁷ For example, for information about the work of the Committee on International Security and Arms Control over 30 years with partners in Russia, China, India, and Europe, see <http://sites.nationalacademies.org/pga/cisac/index.htm>; for an account of a decade’s work with Iran, see Scwheitzer (2010).

²⁸ In June 2013, the Royal Society hosted the first meeting of the presidents of the G8 academies of science and G8 science ministers as a contribution to the G8 Summit during UK’s presidency (Royal Society, 2013).

²⁹ More information is available at <http://diplomacy.aaas.org/>.

stakeholders who are essential to the success of its threat reduction efforts. Some of the most intense disagreements are rooted in the fundamentally different outlooks of the security and scientific communities, as discussed further below.

To me, the sheer variety of disagreements surpass the arguments associated with both nuclear and chemical weapons nonproliferation and disarmament, and even the issues related to conventional weapons that surfaced during the Arms Trade Treaty negotiations.³⁰ This is ironic, since the norm embodied by the Biological Weapons Convention (BWC), the first multilateral agreement to ban an entire class of weapons, is arguably the strongest of those associated with weapons of mass destruction (WMD). In the words of the president of the 6th BWC Review Conference, Ambassador Masood Khan of Pakistan:

The BWC has had marked success in defining a clear and unambiguous global norm, completely prohibiting the acquisition and use of biological and toxin weapons under any circumstances. The preamble to the Convention so forcefully states: the use of disease as a weapon would be "repugnant to the conscience of mankind." It captures the solemn undertaking of the states parties "never in any circumstances to develop, produce, stockpile or otherwise acquire or retain" such weapons. With 155 states parties,³¹ the treaty is not universal, but no country dares argue that biological weapons can ever have a legitimate role in national defense. Such is the force of the treaty (Khan 2006).

The rest of this section contains examples that illustrate the range and variety of disputes. Taken together, the lack of consensus significantly affects current bioengagement activities.

What is the Threat?

Current bioengagement programs are focused primarily on the threats posed by non-state actors and bioterrorism. This reflects the development and evolution of a broader concern with WMD risks that accompanied the end of the Cold War. The uncertain and unstable security situation that emerged from the fall of the Soviet Union prompted a major U.S. effort to help its former adversary and the newly emerging successor states cope with their legacies of nuclear materials, weapons, and delivery systems.

In the realm of biorisks, U.S. policy makers feared that so-called "rogue states" would seek WMD as a way to counter the overwhelming superiority of U.S. military forces. In early 1992, after years of denying accusations, President Yeltsin admitted the existence of a huge clandestine biological weapons program in violation of the BWC (*Rossiskiy Vesti*, 1992). The admission came as the revelations about Iraq's efforts to create biological weapons – and its general success in evading export controls to achieve this and other WMD capabilities – were unfolding in the wake of the first Gulf War. There were also reports that Iran and North Korea were seeking to recruit scientists from the now destitute illicit bioweapons facilities (see, for example, Miller et al., 2001). By the mid-1990s, the United States had decided to expand its CTR programs to include the former Soviet bioweapons program. The initial expansion took place through support for collaborative research projects that linked U.S. scientists in government and academic laboratories with

³⁰ Again, my point is about variety, reflecting the landscape of modern biology. The intensity and longevity of disputes over nuclear weapons policy would be hard to match.

³¹ As of August 2013, the BWC had 170 states parties; 10 more states have signed but not ratified the agreement.

former bioweapons scientists (NRC, 1997). Collaborative research projects, which focused on topics relevant to biodefense, remained a major part of bio-CTR work in the FSU.

At the same time, the first World Trade Center bombings in 1993, the Oklahoma City bombings in 1995, and the 1995 Aum Shinrikyo attacks in Tokyo with chemical agents combined with the awareness of the vulnerability of vast stocks of fissile materials in the former Soviet Union (FSU) sparked growing concern about potential “catastrophic” terrorism (Carter et al., 1998). It is important to remember that worries about bioterrorism predated the terrorist attacks of September 11, 2001 and the subsequent anthrax letters in October.³² But those events turned the already existing threat perceptions and relatively modest activities into the highest national security priority receiving tens of billions of dollars in funding. As President George W. Bush framed the issue in a speech at West Point in June 2002:

The gravest danger to freedom lies at the perilous crossroads of radicalism and technology. When the spread of chemical and biological and nuclear weapons, along with ballistic missile technology—when that occurs, even weak states and small groups could attain a catastrophic power to strike great nations. (Bush, 2002)

While perceptions of these new biological threats grew, the publication of a number of scientific articles early in the 2000s sparked debates about whether the published methods and results of certain types of experiments could provide a “blueprint” or “roadmap” for those who sought to cause harm.³³ This led in turn to a variety of policies and proposals to govern the potential risks posed by such “dual use” research.³⁴

It would be an understatement to say that the potential risks of bioterrorism are not universally accepted, within or outside the United States. On the level of general policy, critics argue that concerns about bioterrorism reflect a general U.S. tendency to “hype” the threat of WMD and terrorism (see, for example, Leitenberg, 2006). Some argue that investments in biodefense research, since they focus on the pathogens most likely to be misused, may actually increase the risks rather than enhance protection (Klotz and Sylvester, 2009). Also on a general level, there are arguments that the potential risks of bioterrorism pale relative to the day-to-day risks of global infectious disease. In such cases, efforts to limit the security risks may restrict or damage the research enterprise that is vital to public health, especially if they lead to limits or controls on the conduct of research or its dissemination (see, for example, WHO, 2013). The continuing controversies over so-

³² The initial “select agent” program in the United States, which provided a regulatory structure to govern the transfer of dangerous pathogens, was created in 1996 in response to a domestic incident (NRC 2009a).

³³ Some of the key articles are discussed in *Biotechnology Research in an Age of Terrorism* (NRC 2004:25-29). Epstein (2001) reviews the issues and policy options under discussion at the time; Zilinskas and Tucker (2002) reflect the concerns in the security policy community. These discussions have not abated. For example, many similar concerns were raised more recently about publications related to the sequencing of the influenza virus from the 1918 pandemic (van Aken, 2006; CDC, 2006) and gain of function experiments with the H5N1 avian influenza virus. (*Science*, 2012).

³⁴ This is a different use of the term than its traditional definition as science, technology, and equipment with both civilian and military applications (e.g., helicopters or high-performance computers). As the U.S. National Science Advisory Board for Biosecurity explains the newer concept of dual use:

Life sciences research is vital to improving public health, agriculture, and the environment, and to strengthening our national security and economy. Yet the very research designed to find ways to better the health, welfare and safety of mankind can also yield information or technologies that could potentially be misused for harmful purposes. For instance, information from certain life sciences research can be misapplied to create dangerous pathogens for employment as weapons, bypass or diminish the effectiveness of medical countermeasures, or threaten in other ways the health and safety of humans, animals, plants, and the environment. Research yielding new technologies or information with the potential for both benevolent and malevolent applications is referred to as “dual use research” (Available at http://oba.od.nih.gov/biosecurity/nsabb_faqs.html#NSABB_FAQ001).

called gain-of-function research with influenza (first H5N1 and then H7N9) illustrate these tensions (*Science*, 2012).

There are also more technical disputes. Some argue that “Mother Nature is the best terrorist,” so why should terrorists or even less technologically-advanced countries do anything more than use the highly dangerous pathogens already abundantly available in nature? Others question the capacity of such entities to take advantage of the cutting edge research, either because the information contained in journal articles does not provide sufficient information to recreate experiments or, more broadly, because absorbing and using new technology may require substantial tacit knowledge that is not easily transferred (Vogel, 2013). These continuing debates directly affect the design and implementation of bioengagement programs.

What is the Appropriate Response?

Among the international regimes devoted to WMD nonproliferation and disarmament, developments in the life sciences pose some of the greatest challenges to core elements of traditional non-proliferation strategies. A report prepared by several national and international scientific organizations as an independent contribution to the BWC’s 7th Review Conference identified three major trends that were fundamentally affecting the implementation of the Convention:

- The rapid pace of change in the life sciences and related fields;
- The increasing diffusion of life sciences research capacity and its applications, both internationally and beyond traditional research institutions; and
- The extent to which additional scientific and technical disciplines beyond biology are increasingly involved in life sciences research (NRC, 2011: 4).

Of these trends, diffusion of capacity is particularly relevant to bio-CTR.

All the major nonproliferation treaties contain a fundamental bargain in which signatories agree to forego acquiring or helping others to acquire a particular weapons capability.³⁵ In return, states in good standing are to have access to technology for peaceful applications. Article X of the BWC, for example, states that

The States Parties to this Convention undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the use of bacteriological (biological) agents and toxins for peaceful purposes (BWC, 1972).

At the same time, efforts to limit risks by denying or controlling access to tangible or intangible technology are a staple tool of nonproliferation. The report cited above, however, concluded that “The continuing, rapid diffusion of research capacity and knowledge makes the commitments of [BWC] States Parties in Article III to restrict access to knowledge, materials, and technologies for anything other than purposes permitted by the Convention more challenging.” It went on to note that “...there is little hope of reversing this trend—and multiple reasons beyond the commitments in Article X to see the

³⁵ In the case of nuclear weapons, in addition to the standard bargain, the five declared nuclear powers at the time the Nuclear Nonproliferation Treaty was signed made a commitment to pursue nuclear disarmament in good faith. UN Security Council Resolution 1540, adopted in 2004, addresses terrorism by adding an explicit obligation to prevent non-state actors from acquiring WMD or the means to deliver them.

diffusion as positive and beneficial...” (NRC 2011:5).³⁶ This assessment suggests that greater attention to cooperation, because it better reflects current realities, can be a promising path to meeting the challenges posed by advances in science and technology (S&T).³⁷

As discussed further below with regard to the BMENA, the diffusion of capacity is not simply a wave washing over all parts of the world equally. For reasons of poverty, political or economic isolation (by choice or imposition from outside), or other factors, some countries and the scientists within them still have difficulty gaining access to the knowledge and tools of modern life sciences. But these are increasingly the exception, especially in areas such as public health research, where concerns about new and reemerging infectious disease have sparked research partnerships in a number of poor countries where highly dangerous pathogens are endemic.

Cooperation can also help address the sheer complexity of the landscape of modern biology. For example, the concept of a “web of prevention,” introduced by the International Committee of the Red Cross in its 2002 initiative on “Biotechnology, Weapons, and Humanity” emphasizes the wide array of stakeholders needed to address biorisks. The potential contributions of many communities are necessary to the successful implementation of the BWC and it seems logical to suggest that engaging them will require a mix of policies (International Committee of the Red Cross, 2004).

What would be new would be acceptance by the security community that a focus on cooperation is genuinely a good thing, an opportunity as much as a necessity. At present, there is still a decided preference among many involved in cooperative threat reduction for “hard” security responses, in part reflecting the history of the programs and in part a more general mindset. As a National Research Council (NRC) report that examined the metrics the Department of Defense (DOD) was using to assess its CTR programs noted

Some national security constituencies question whether CBEP [Cooperative Biological Engagement Program], which resides in a gray mission space that sometimes overlaps with public health, serves their national security goals and whether it should be carried out by DoD. These skeptics have seen the Biological Threat Reduction Program shift from efforts to redirect weapons scientists and Biopreparat (the Soviet biowarfare agency) to legitimate commercial ventures, to efforts to engage nonweapons bioscientists in Central Asia, Africa, and even India, and ask DoD to define the *security* value of today’s capacity building health and biology related programs today (NRC, 2012:15).

In making the argument for a greater emphasis on cooperation, and genuine acceptance of its importance, I want to underscore those efforts to limit access to proliferation-relevant knowledge, technologies, and equipment will and should continue. Recent stories about the success of the Syrian government in evading export controls and other restrictions in amassing its chemical weapons stockpiles are sadly reminiscent of similar Iraqi efforts and accomplishments in the 1980s (see, for example, Muller et al., 1993; NTI, 2013; Sanger et

³⁶ Another NRC report (NRC, 2012) commented that, in support of bio-CTR: “DoD argues that biological threats have changed greatly in the last 20 years. Proliferation of ability to create dangerous biological agents has already happened globally, threats are asymmetric, and only a small amount of material is needed to create a biological weapon that could cause billions of dollars of damage to our economy (one expert said that amount could even be “pocket-sized”). With the capability already spread widely, intent is more important now, and to know and affect intent the program must communicate with capable and knowledgeable individuals with whom we have built some degree of understanding and, in some cases, even trust” (NRC, 2012:15-16).

³⁷ A recent edited volume, *Technology Transfers and Non-Proliferation: Between Control and Cooperation* (Meier, 2013) examines these issues across the nuclear, chemical and biological nonproliferation regimes.

al., 2013). But my experience with the combination of debates over Article X in the BWC, the huge (if perhaps sometimes overly optimistic) hopes being invested in biotechnology for development, and the genuine diffusion of capacity to a surprising share of the world have persuaded me that there needs to be a better and more strategic mix of tools employed to support bio-nonproliferation. The ideas and capabilities are there, but for all the reasons addressed in this paper, implementation of a broader approach, for example in “scientist engagement,” has not yet fully taken hold.

The “Curse of the Nuclear Model”

As mentioned above, the roots of the current biosecurity engagement programs lie in efforts to cope with “loose nukes” after the fall of the Soviet Union. From the earliest attempts to extend these cooperative threat reduction programs from nuclear to biological nonproliferation, the programs have struggled against simple or inappropriate applications of models and policy prescriptions from one WMD regime to another. This has a number of implications, including one with immediate practical consequences for program design and one that reflects more fundamental tensions about the nature of “security” as it defines biorisk management strategies.

The relative availability of “technical chokepoints” that can provide a focus for nonproliferation efforts based on control of essential materials or knowledge is a good illustration of the impact of inappropriate analogies. For nuclear nonproliferation, plutonium and highly enriched uranium remain the keys to a weapons capability and effectively controlling those materials goes a long way toward reducing proliferation risks. In 2000, the Congressionally-mandated National Commission on Terrorism (the Bremer Commission) recommended that: “The Secretary of Health and Human Services should strengthen physical security standards applicable to the storage, creation, and transport of pathogens in research laboratories and other certified facilities in order to protect against theft or diversion. These standards should be as rigorous as the physical protection and security measures applicable to critical nuclear materials” (National Commission on Terrorism, 2000:44). Bipartisan legislation to impose such restrictions, introduced in the Senate in late 2000, did not pass the House. The current U.S. Select Agent program, however, which developed in its current form in response to the October 2001 anthrax letter attacks, includes detailed requirements for inventory controls and accounting for quantities of pathogens.

Internationally, UN Security Council Resolution 1540, passed in 2004, makes no distinction among nuclear, chemical, or biological materials when it calls on states to “develop and maintain appropriate effective measures to *account for* and secure such items in production, use, storage or transport” (UN, 2004; emphasis added). Inventory of biological agents have become an important part of cooperative threat reduction/bioengagement programs. For example, the guidelines issued in 2012 for implementing the voluntary International Laboratory Biorisk Management Standard, which was initially developed as a bioengagement activity and subsequently adopted by the European Committee for Standardization (CEN 2008), include “records of quantities and volumes at an appropriate level and based on risk” (CEN, 2012:33).

There are profound differences, however, between man-made fissile materials and naturally occurring, self-replicating biological materials (see Table 1 for a comparison of some key differences).

Table 1
Characteristics of Fissile Materials and Pathogens

Fissile Materials	Biological Pathogens
Do not exist in nature	Generally found in nature
Nonliving, synthetic	Living, replicative
Difficult and costly to produce	Easy and cheap to produce
Not diverse: plutonium and highly enriched uranium are the only fissile materials used in nuclear weapons	Highly diverse: more than 20 pathogens are suitable for biological warfare
Can be inventoried and tracked in a quantitative manner	Because pathogens reproduce, inventory control is unreliable
Can be detected at a distance from the emission of ionizing radiation	Cannot be detected at a distance with available technologies
Weapons-grade fissile materials are stored at a limited number of military nuclear sites.	Pathogens are present in many types of facilities and at multiple locations within a facility
Few nonmilitary applications (such as research reactors, thermo-electric generators, and production of radioisotopes)	Many legitimate applications in biomedical research and the pharmaceutical/ biotechnology industry

Source: Tucker (2003).

As a National Research Council review of the U.S. Select Agent Program³⁸ commented

“Unlike nuclear materials, biological organisms have the ability to replicate.”³⁹ Because a new culture can be prepared with as little as a single microorganism, an individual would need only a miniscule—and undetectable—amount from a single vial to establish a new culture and grow up large volumes of the agent in a matter of hours or a day. Therefore, determining that the number of vials is the same from one moment to another provides no guarantee that agents have not been removed from the laboratory since the original number of vials or tubes could remain the same while the agent itself has been removed. Also unlike nuclear materials, it is possible to completely inactivate BSAT materials: microorganisms can be autoclaved and even toxins can be denatured so that they no longer pose a risk. As convenient as it might be to count vials, volumes, or number of organisms, it is not a biologically relevant means of inventory. For these reasons, **the committee concluded that undue reliance on accounting practices, including counting vials, leads to false security and is counter-productive.**” (NRC, 2009a:115; emphasis in original).

I want to underscore that my point is about inappropriate analogies to the value of detailed accounting for exact quantities of biological materials. The NRC committee argued that

It is prudent and appropriate for entities with the responsibility for BSAT laboratories to know what types of select agents and toxins are present in their facilities. In addition to maintaining records of materials in a facility for security purposes, such listings serve an important safety function in detailing materials of concern for laboratory personnel, as well as for first responders in emergencies (NRC, 2009:113).

The committee went on to recommend that

Because biological agents have an ability to replicate, accountability is best achieved by controlling access to archived stocks and working materials. Requirements for counting the number of vials or

³⁸ “The Federal Select Agent Program oversees the possession, use and transfer of biological select agents and toxins, which have the potential to pose a severe threat to public, animal or plant health or to animal or plant products” (<http://www.selectagents.gov/>). The program website contains detailed information about the program and its requirements.

³⁹ Toxins do not generally present the same difficulty as they cannot replicate.

other such measures of the quantity of biological select agents (other than when an agent is transported from one laboratory site to another) should not be employed because they are both unreliable and counter-productive, yielding a false sense of security. A registered entity should record the identity of all biological select agents and toxins within that entity, where such agents are stored, who has access and when that access is available, and the intended use(s) of the materials (NRC, 2009:115).

To the extent that stringent accounting practices rather than overall inventory and access control are included or encouraged in efforts to upgrade laboratories as part of bio-CTR activities, which they commonly are, they can have significant practical impact on program design and implementation. And problems in meeting such accounting standards could negatively affect assessments of program success.⁴⁰

What Counts as “Success”?

For a number of reasons, including the urgent challenges of the vulnerability of actual WMD programs and continued Congressional skepticism about the value of investing billions of dollars in cooperating with a former adversary whose compliance with its nonproliferation and disarmament treaty obligations was disputed, many CTR projects focused on problems with an apparent and tangible positive impact on WMD threats. A classic example is the Nunn-Lugar Scorecard, which maintains a continually updated list of the weapons and WMD-related materials that have been destroyed worldwide through cooperative activities. Although it began and remains largely about nuclear warheads and materials, for a number of years the Scorecard has included some chemical and biological weapons-related accomplishments. The January 2013 Scorecard, for example, reports that 47 (57.3%) of the 82 “Cooperative Biological Engagement Laboratories” on the program’s 2017 target list have been “secured” (DTRA, 2013).⁴¹ Another example is the Megatons to Megawatts project, a “government-industry partnership in which bomb-grade uranium from dismantled Russian nuclear warheads is being recycled into low enriched uranium (LEU) used to produce fuel for American nuclear power plants” (USEC, 2013).⁴²

CTR programs certainly have invested in projects with less obvious and tangible nonproliferation impacts, particularly the cooperative research programs managed by the International Science and Technology Center and the Science and Technology Center in Ukraine.⁴³ And over time the stated measures of the program evolved from the tangible, hard security “weapons and systems destroyed” to include “nonproliferation capabilities enhanced” (NRC, 2009b:7). But cooperative research and similar programs, such as efforts in Russia to redirect former WMD facilities and personnel (including entire cities that had been closed to Western contact) toward peaceful enterprises, were and remain a “hard sell” (Smallwood and Liimatainen, 2011).

⁴⁰ A note on the CEN website, for example, states that: “The free download of this CWA has been made possible through funding provided by the Government of Canada’s Global Partnership Program” (<http://www.cen.eu/CEN/sectors/technicalcommitteesworkshops/workshops/Pages/ws31.aspx>; accessed August 3, 2013).

⁴¹ Information about the Scorecard may be found at <http://www.dtra.mil/Missions/Nunn-Lugar/scorecards.aspx>. Links to accomplishments reports going back to 2000 may be found in Mella (2013).

⁴² According to the USEC website, “475.2 metric tons of bomb-grade HEU have been recycled into 13,723 metric tons of LEU, equivalent to 19,008 nuclear warheads eliminated (<http://www.usec.com/russian-contracts/megatons-megawatts>; accessed August 4, 2013).

⁴³ For further information, see the ISTC and STCU websites at http://www.istc.ru/istc/istc.nsf/fa_MainPageMultiLang?OpenForm&lang=Eng and <http://www.stcu.int/> respectively. The first activities in cooperative biological threat reduction were in fact cooperative research projects; for accounts, see NRC (1997 and 2007).

As the Cooperative Threat Reduction programs evolved and began to look beyond the borders of the FSU, they faced fundamental questions about the appropriate scope of activities. A Congressionally mandated NRC study of the future of CTR pondered the questions and recommended a different approach, “CTR 2.0.” As the report explains

CTR 2.0, an expression borrowed from the software industry, refers to a more advanced and comprehensive approach to cooperative threat reduction. It comprises a set of programs and projects undertaken by the United States, as part of a cooperative network that includes a wide range of countries, international organizations, and nongovernment partners, to prevent, reduce, mitigate, or eliminate common threats to U.S. national security and global stability that have emerged in particular since the end of the Cold War. **The preferred mechanism and long-term goal for the cooperation is partnership, which means that the countries participating should be ready to share responsibilities for project definition, organization, management, and financing according to a rational division of labor, capacity (including budget capacity), or technical capability. Although CTR 2.0 engagements may have to begin under less than ideal circumstances, the goal for countries engaged under CTR 2.0 is shared responsibility through engagement and partnership** [emphasis added]. CTR 2.0 should be capable of rapid response as well as longer-term programmatic engagement (NRC, 2009b:8).

The report also argued that

The USG [U.S. government] CTR programs also have produced equally important *intangible* benefits. The human relationships that have been formed at multiple levels are among the most important, enduring, and underrecognized benefits of these programs. Working from a basis of shared priorities, strategies, goals, and responsibilities in a truly cooperative environment produces more than just tangible program success. The concept of long-term engagement, the development of lasting ties based on trust built through shared experience, defies the hard metrics that have become such an ingrained part of measuring program value, but can be the critical link to success of an immediate project and, perhaps more importantly, be the foundation for working together in future endeavors. These links have been major contributors to success in the former Soviet Union, and time and effort must be invested in each new environment to develop these relationships. Perhaps most importantly, these relationships have helped the United States gain insights into personalities and government structures that make it possible to design more effective approaches to cooperation. This is true not only for the partner or recipient countries but also for the countries with which the United States collaborates through the G8 GP [Global Partnership Against the Spread of Weapons and Materials of Mass Destruction] and other international or multilateral structures (NRC, 2009b:33-34).

I have quoted the report at length because (1) “CTR 2.0” has become a catchphrase about the new directions in which the U.S. CTR programs are endeavoring to move; and (2) the argument for the importance of relationships and other intangible benefits remains the subject of substantial controversy with both U.S. programs and the wider community of those engaged in CTR.

How Do We Define “Engagement”?

Are Scientists Part of the Solution or Part of the Problem?

The roots of bioengagement programs in the “redirection” of former weapons scientists, combined with the concerns about “insider threats” for bioterrorism have an understandable but unfortunate tendency to provide ambiguous messages to those participating in bioengagement programs. A tendency to describe program goals as “creating” or “fostering” a culture of responsibility among scientists, rather than “expanding” one that already exists but may need to address new issues and challenges, can exacerbate the problem. A 2009 document, for example, offering recommendations for how the G8’s Global Partnership Against the Spread of Weapons and Materials of Mass

Destruction (hereinafter, the GP and described further below) could better address “knowledge proliferation and scientist engagement” across all areas of WMD, concluded

Closer attention is now needed to engaging scientists and raising awareness and responsibility among them, to prevent their knowledge in legitimate scientific disciplines to be diverted for unintended malicious purposes, and to strengthen frameworks within which to prevent the spread of sensitive information and to promote collaborations to advance common nonproliferation objectives.

It is expected that an increasing number of projects in new geographical areas will be directed toward fostering awareness of the multiple uses of high risk materials and sensitive know-how and technologies, thereby contributing to a risk-conscious culture among scientists at all levels. (GP, 2009:3)⁴⁴

This becomes particularly important for programs that attempt to reach a broader swath of the life sciences community than those working in high containment laboratories or with dangerous pathogens. In the latter situations, some messages about personnel reliability can be included as part of the need for more active biosafety procedures and precautions. But one has only to consider the strong negative reactions that scientists in the United States have had to the personnel reliability programs introduced through the Select Agent Program to appreciate how similar efforts might be perceived in regions like the BMENA.⁴⁵

When one also considers the continuing controversies about the nature and extent of biothreats, and the role of traditional approaches such as restrictions on access to knowledge and technology, the challenges for making genuine partnership a foundation of engagement are apparent.

Responsibilities or Requirements?

Broadly speaking, in thinking about how to approach engagement, especially with scientists, as part of CTR, there are two ways to frame the issues. The first begins with the legal *requirements* and the obligations that follow from them, whether through national law and regulations or from international treaties.⁴⁶ In a few cases, in particular the European Union, one may also encounter significant regional regulatory requirements as well. Not surprisingly, the natural instinct for most of those in the security community is to start from legal obligations, from what one “must” do.

The other approach seeks to take advantage of growing international attention to issues related to “research integrity” and responsible conduct of science” to place nonproliferation and disarmament within the broader context of the social responsibility of science. In this case, the emphasis is more on *responsibilities* – on what one “should” do as part of the scientific community – and may come as much from norms as laws and regulations. Efforts to promote responsible conduct of science are not new, but they have received increased attention in recent years, in part because of the global diffusion of scientific capacity. The efforts reflect a fundamental assumption that science is not conducted in a social vacuum; the conduct of science itself may also be shaped by

⁴⁴ Awareness is defined as “a set of measures aimed at promoting a culture of awareness and responsibility among scientists, as defined above, in order to prevent the use of their knowledge for unintended and illegal purposes; enhancing the safety and security of scientific facilities and installations, including access to them.”

⁴⁵ See, for example, the reports of studies examining personnel reliability issues in response to various proposals to increase U.S. requirements in 2008 and 2009 (NSABB, 2009; NRC, 2009a).

⁴⁶ Since the BWC requires states parties to enact national implementing legislation, there are clear and obvious links between the levels.

changing social attitudes.⁴⁷ The attention devoted to social responsibility by scientific societies, advocacy groups, and academic communities has helped to establish norms for scientific conduct, as well as a conceptual grounding for training and education. A number of high-level declarations and statements in recent years have reinforced the ethical imperatives involved in scientific research across the global scientific community.⁴⁸ Examples of some of these statements may be found in Appendix B.

A recent example that directly addresses biorisks is a project undertaken by the InterAcademy Council (IAC) and IAP — The Global Network of Science Academies to address issues of research integrity and scientific responsibility.⁴⁹ In the first phase of the project, IAC and IAP collaborated in developing a short policy report on research integrity (IAC and IAP, 2012). The report addresses research practices and management, the reward structure for scientists, principles of scientific integrity, and culture. The report is intended to be useful throughout the global science community, including the member academies of IAC and IAP, research institutions, government agencies, research sponsors, professional and scientific unions, and individual scientists. With regard to “Social Responsibility in Research Plans,” the report notes

Science and other forms of scholarship have been incredibly productive by seeking knowledge unfettered by tradition, ideology, and external pressure. At the same time, research can have a profound influence on the environment, human health and well-being, economic development, national security, and many other facets of human life. Many areas of science and technology can be used for destructive as well as constructive purposes, and researchers have a special responsibility to understand and address issues of “dual use.” Research on biological pathogens, for example, poses both risks and benefits for human health (IAC—IAP, 2012:15)

This leads to the conclusion that “researchers should bear in mind the possible consequences of their work, including harmful consequences, in planning research projects” (IAC—IAP, 2012:16).

In the second phase, the IAC Expert Committee is developing an educational handbook intended for individual scientists, educators, and institutional managers. The handbook addresses principles and guidelines for scientific responsibility, including scientific ethics, integrity, and responsibility for avoiding misuse of science. Discussions of the BWC and the Chemical Weapons Convention are included, along with references to available educational materials, as part of a chapter addressing prevention of the misuse of science. The handbook, which is scheduled for release late in 2013, is intended for use throughout the global science community.

It is important to stress that these two approaches are not mutually exclusive. Many laws have a normative basis and bioengagement programs based in a framing as responsible

⁴⁷ A clear example is the development of standards for the treatment of human subjects in experiments, which developed over time, particularly during the twentieth century in response to egregious abuses by researchers. The standards for the treatment of laboratory animals have continued to evolve as well.

⁴⁸ A number of examples, along with relevant history, are discussed in a report on a National Academies project in the BMENA (NRC, 2013).

⁴⁹ IAP is a global network of more than 100 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. More information is available at <http://www.interacademies.net/>. The IAC produces reports on scientific, technological, and health issues related to the great global challenges of our time to provide knowledge and advice to national governments and international organizations. More information is available at <http://www.interacademycouncil.net/>.

science address the legal and regulatory structures, including the BWC and other efforts to address biorisks, that support good scientific conduct (see, for example, NRC, 2013). But where to begin is a fundamental program choice that can have significant consequences. My experience with biosecurity issues over the last 10 years, particularly in the context of education about dual use issue, suggests that a preference for stressing legal obligations usually prevails. More generally, one increasingly hears discussions about a “culture of responsibility” in discussions of bioengagement. Again, however, there seems to be a preference for stressing a culture of compliance rather than personal responsibility, which includes but is not confined to meeting legal responsibilities.

LESSON #2: PRACTICAL CHALLENGES FOR BIOENGAGEMENT IN THE BMENA

The Landscape Is Crowded

U.S. Bioengagement Programs Are Not the Only Ones

Just as the original U.S. CTR program quickly expanded to engage other countries in addressing the urgent nuclear security threats caused by the break-up of the Soviet Union, and then the legacies of its chemical and biological weapons programs, the international collaboration continues as the focus has expanded beyond the FSU to concerns about the threats to global security posed by state or non-state actors’ pursuit of WMD. At their 2002 summit in Kananaskis, Canada, the G8 countries created the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction. The initial focus of the 10-year, \$20 billion Global Partnership (GP) was still on the FSU, but in 2008 the GP expanded its scope to cover WMD-related threats around the world. At the 2011 summit, in Deauville, France, the leaders of the G8 agreed to continue the GP past its original 2012 end. They also agreed to continue expanding its membership to become more international and more of a partnership. The GP includes Russia, Ukraine, and Kazakhstan; the addition of Mexico in December 2012 and the Philippines in June 2013 brings the current membership to 26 and makes the GP a more genuinely international coalition.

In addition to the collective activities of the GP, most of the individual member countries have their own bilateral programs. And the European Union, which is also a GP member, is an active presence in its own right through its Joint Actions in support of the BWC and its new Centers of Excellence, one of which is devoted to the BMENA.⁵⁰ The GP attempts to foster communication and where possible coordination among the many players and programs. In 2012, for example, as part of its presidency of the G8 and hence the GP, the U.S. produced a compendium of GP member projects across all its WMD areas (GP, 2012). Appendix C, prepared by Peter Smallwood, provides summary information about biological programs in the BMENA drawn from the report.

Bioengagement in the BMENA Is Not Alone

As bioengagement programs expand beyond their traditional venues in the Former Soviet Union (FSU) into new countries and new subjects, they frequently find they are not the dominant actors or the largest funders. Bio-CTR is entering already well-occupied territory where the initiatives and funds they bring must compete for the attention of potential

⁵⁰ For more information the Centers of Excellence, see <http://www.cbrn-coe.eu/>. Information about current and past Joint Actions may be found at [http://www.unog.ch/unog/website/disarmament.nsf/\(httpPages\)/F502359025E15537C1257AC40046060E?OpenDocument&unid=73E0091854F01F93C1257AC3003D12AB](http://www.unog.ch/unog/website/disarmament.nsf/(httpPages)/F502359025E15537C1257AC40046060E?OpenDocument&unid=73E0091854F01F93C1257AC3003D12AB).

partners. This is particularly true for biosecurity programs devoted to health security or WMD-relevant disaster preparedness and response, but it affects essentially all aspects of the new CTR initiatives. For example, assistance with developing national biosafety and biosecurity legislation to strengthen biorisk management and support national implementation of the Biological Weapons Convention, one of the priorities for the latest EU Joint Action in support of the BWC, must operate alongside programs devoted to other specific legislative needs, as well as to improving the overall functioning of the legislative process.

To get a sense of just how crowded the territory is, one can turn to the results of several surveys to assess the impact of recent declarations by aid donors and recipients on improving aid effectiveness. The most recent data come from a 2010 survey of 78 aid recipients about the implementation of commitments made in the 2005 Paris Declaration on Aid Effectiveness and the 2008 Accra Agenda for Action carried out by the Development Advisory Committee of the Organization for Economic Cooperation and Development (OECD). Two questions in the survey asked about the number of separate donor visits and how many of them were coordinated with other donors. Across all forms of Official Development Assistance, the 78 countries enjoyed more than *20,200 individual donor missions* in 2010 (emphasis added), of which only about 1 in 5 was coordinated with another donor (OECD, 2011). For the six BMENA entities covered by the survey, in 2010 there were 2,333 donor visits related to all forms of assistance, of which 284 (12%) were coordinated.

Afghanistan – 786 visits /47 coordinated
Egypt – 331 visits /67 coordinated
Jordan – 174 visits /19 coordinated
Morocco – 277 visits /54 coordinated
Pakistan – 487 visits /83 coordinated
West Bank & Gaza 278 visits /14 coordinated (OECD, 2011).

The sheer number and variety of funders and programs presents major challenges, which are discussed further below. One obvious challenge is the potential for overlap and duplication of effort, with the accompanying potential waste of funds. This can occur both within specific national efforts and across multiple donors. Another is the strain that so many separate programs place on the capacities of recipient countries and the organizations within them to absorb and manage the additional resources and the administrative requirements that come with them. Few if any of the target countries are in a position to turn down additional funds. And some current programs have a short-term focus; in spite of goals that suggest the contrary, projects may not have meaningful plans or provisions for sustainability.⁵¹

In this environment, communication and, where feasible, coordination and cooperation within countries and among donors is not simply a good thing, it may be essential for realizing programs' hopes of impact. To date, however, the bioengagement programs have generally seen themselves as different from "ordinary" foreign assistance programs. Some of this, as discussed above, may reflect a perceived need to make clear to skeptics that bio-

⁵¹ There are also deliberately short-term efforts. One U.S. program, the State Department's Nonproliferation and Disarmament Fund, is specifically intended to respond rapidly to short notice, one-off opportunities. The quintessential examples are its support for secret missions to remove vulnerable stocks of fissile materials from sites in Kazakhstan and the former Yugoslavia. Further information may be found at <http://www.state.gov/t/isn/ndf/>. DOD has programs that, for example, would enable quick responses to disasters that could include biorisks; the presentations at an NRC workshop in June 2013 provide an illustration (see <http://www.tvworldwide.com/events/nas/130620/>).

CTR, especially some of its “softer” activities, is a genuine security program. Some may reflect an understandable reluctance to become embroiled in the vastly more complicated politics – and unpopularity -- of broader foreign assistance activities. At the moment the GP probably has all it can handle in its efforts to foster communication and coordination about bioengagement. The traditional inclusion of foreign assistance issues during G8 summits, however, suggests that over time the GP has the potential to become a forum for a broader dialogue.

It’s Crowded in the U.S. Too

At present two programs are the primary funders of U.S bio-CTR programs: the State Department’s Biosecurity Engagement Program (BEP), funded in the range of \$35 million annually (although that has been shrinking under the general pressures of the ongoing budget crisis) and the Cooperative Biological Engagement Program (CBEP) operated by the Defense Threat Reduction Agency of DOD, which has annual budgets in the range of \$250 million.⁵² Other projects and activities that would qualify as bio-CTR are supported by other parts of DOD, the Centers for Disease Control and Prevention, the National Institutes of Health (NIH), USAID, the Department of Energy and its national laboratories, and the U.S. Department of Agriculture. Since a significant portion of BEP’s funds go to support the work of other U.S. government agencies, this list of agencies does not necessarily reflect substantial additional funding. But it certainly means more U.S. government players in the bioengagement mix.

In addition, depending on how generously one defines “bioengagement,” there are potentially relevant programs to be found in other parts of the same U.S. agencies. Perhaps the largest single set of activities would be the programs devoted to building capacity for global disease surveillance (Katz et al., 2010).⁵³ The NIH, through the National Institute for Allergy and Infectious Disease, which receives the bulk of U.S. funds for biodefense research, also carries out relevant projects in the BMENA for laboratory capacity-building and collaborative research, while the Fogarty International Center supports programs for responsible conduct of research that, although they do not address biosecurity, provide education in responsible conduct of science. The Office of Oceans, Environment, and Science in the State Department has responsibility for bilateral S&T agreements that may address general biotechnology research capacity building and exchanges. The Global Innovation through Science & Technology (GIST) program, for example, encourages entrepreneurship in the MENA. It is administered by CRDF Global, which is also a major BEP implementer. More generally, the Office of the Science Advisor is active in the diplomacy related to bilateral S&T cooperation, including in the BMENA.⁵⁴ Another initiative for science cooperation, focused largely on the Muslim world, is the White House Science Envoys, a program that grew out of President Obama’s speech in Cairo in 2009. The third group of science envoys was appointed in 2012 and their ranks include a number of prominent life scientists.

⁵² CBEP now accounts for more than half of the total DOD funding for CTR and has encountered some skepticism from Capitol Hill about the shift from the traditional nuclear nonproliferation mission (Philipidis, 2012).

⁵³ The supplement of which the Katz et al. article is a part, “Disease surveillance, capacity building and implementation of the International Health Regulations [IHR(2005)],” contains a number of relevant articles.

⁵⁴ The doubling in the number of agreements worldwide over the last ten years has not been accompanied by an expansion of the resources to implement them, however. “Some science diplomacy practitioners and academics in the United States and abroad are concerned that an S&T agreement with the United States, while once considered an important tool, is no longer taken seriously” (Dolan, 2012).

Goals and Resources Don't Match

All too often after the development of national or international strategies to address security (or other) challenges, the resources actually available to carry out the strategic goals may not be sufficient to meet the challenges. Bio-CTR is no exception. In 2009 the White House released its *U.S. National Strategy for Countering Biological Threats*. Several of its seven goals – in particular “Reinforce norms of safe and responsible conduct” and “Transform the international dialogue on biological threats” – contain commitments that held out the prospect of changing the fundamental framing of bioengagement and also expanding its scope significantly (White House, 2009). Encouragingly, the document also states that

Life scientists are best positioned to develop, document, and reinforce norms regarding the beneficial intent of their contribution to the global community as well as those activities that are fundamentally intolerable. Although other communities can make meaningful contributions, only the concerted and deliberate effort of distinguished and respected life scientists to develop, document, and ultimately promulgate such norms will enable them to be fully endorsed by their peers and colleagues. (White House, 2009:8)

After the Strategy was released at the BWC in December 2009, the White House undertook an extensive interagency review to try to identify the resources available to carry out the commitments and to map them against the objectives.⁵⁵ The results were never made public, but it was obvious to most observers that objectives like “Promote global health security” and “Expand our capability to prevent, attribute, and apprehend,” which are expensive to pursue, were receiving the lion’s share of funding. Funds to support other forms of scientist engagement were relatively modest and remain so.

The GP also struggles with similar issues. As discussed above, scientist engagement is a priority. Under the U.S. presidency of the G8 in 2012, a Biological Security Working Group was created, which decided to pursue five deliverables:

- Secure and account for materials that represent biological proliferation risks.
- Develop and maintain appropriate and effective measures to prevent, prepare for, and respond to the deliberate misuse of biological agents.
- Strengthen national and global networks to rapidly identify, confirm and respond to biological attacks.
- Reinforce and strengthen biological nonproliferation principles, practices and instruments.
- Reduce proliferation risks through the advancement and promotion of safe and responsible conduct in the biological sciences.⁵⁶

As of the end of 2012, the Working Group had been able to agree on support for OIE’s efforts to complete its rinderpest eradication program and on support for World Health Organization to implement the International Health Regulations.⁵⁷ The goals carried over into 2013 and the United Kingdom’s the G8 presidency. To date, however, no further initiatives have been announced, and certainly no collective investments in “the advancement and promotion of safe and responsible conduct in the biological sciences” have materialized.

⁵⁵ Personal communications, early 2010.

⁵⁶ The deliverable document is available at <http://geneva.USmission.gov/wp-content/uploads/2012/12/GP-Deliverables.pdf>.

⁵⁷ For further information see <http://geneva.USmission.gov/2012/12/17/highlighting-the-work-of-the-global-partnership-in-countering-biological-threats/>.

Current Bioengagement Programs Have Potentially Negative Impacts on Partners

The growth of U.S. and other bioengagement programs in the BMENA reflects the importance of the region for overall efforts to address biorisks. The expansion of bioengagement efforts, however, can have consequences for partners in the region that would be familiar to anyone who has dealt with other types of assistance and engagement programs. The two major U.S. programs do make systematic efforts to communicate and coordinate, but how well those efforts extend into the broader landscape of international donors and the narrower landscape among program implementers still seems to be work in progress.

At this stage it is probably inevitable that there will be duplication of effort. In the area I know best, dual use issues and education, the community of implementers is relatively small and largely consists of nongovernmental organizations (NGOs). Communication among the NGOs doing the work is good and one finds a number of collaborative efforts.⁵⁸ Even so, in Pakistan, for example, the University of Bradford, Landau Network Centro Volta, the International Council for the Life Sciences (ICLS), and now the National Academies are engaging many of the same Pakistani scientists in various aspects of education about general biosafety and biosecurity, biological weapons and bioterrorism, including dual use issues, and responsible conduct of science. Sandia National Laboratories also does training in biosafety and biosecurity. Each program serves a somewhat different purpose with somewhat different approaches and these may be complementary. It is quite common to find the same people serving as major partners for multiple projects. This can promote a greater cumulative impact; the level of experience that Pakistani scientists have with many issues related to biorisks was a major advantage for the August 2013 National Academies Education Institute in Malaysia that brought together scientists from Pakistan, India, and Malaysia. It appears likely that follow up activities there could usefully focus on pedagogy to support the Pakistanis' ability to implement more effectively the substantive knowledge they acquired through other efforts. The National Academies introduces a number of approaches to "active learning;" the University of Bradford is currently developing a specific technique to complement its extensive online curriculum materials (NRC, 2013; Novossiolova et al., 2013).

But these multiple programs can also risk overloading partners who may not be in a position to say no to funding opportunities.⁵⁹ In some cases, groups that are successful in gaining multiple awards may have trouble carrying out projects. Sometimes this is because they do not have the organizational capacity to undertake so many tasks, but sometime the administrative burdens imposed by the reporting requirements of multiple funders make it difficult to find time to do the work.⁶⁰ It also can lead to the phenomenon of what a distinguished BMENA scientist called "biotourism," in which the same people attend multiple meetings, often with similar purposes and sometimes with limited outcomes.⁶¹

⁵⁸ See, for example, the information provided in Sture (2013) and Rappert (2010).

⁵⁹ It should be pointed out that this is a problem that can apply equally to implementers in the United States and Europe, especially NGOs and in particular if there are few sources of sustained funding. This became a subject of discussion during the U.S. presidency of the GP in 2012 and led to suggestions for a "framework" program to support NGOs that worked to support implementation of the BWC. To date, nothing has come of the discussions.

⁶⁰ This is not just an issue for implementers in the BMENA. The increasing administrative burden on university researchers in the United States is a subject of growing concern for the health of the research enterprise. This is relevant to U.S. bioengagement to the extent that projects might seek to foster collaborations, such as laboratory "twinning" between universities in the United States and the BMENA, for example, in areas related to disease surveillance or infectious diseases.

⁶¹ Personal communication, August 2013.

This is one reason that BEP has implemented a reporting system for its grantees to try to track attendance at meetings.

Another potentially problematic issue is competition among local organizations and implementers, who may suddenly be confronted with new funding opportunities. Competition is healthy and necessary in principle, but it does not always work well in assistance programs. For example, there is a history of NGOs springing up because of funding possibilities that do not necessarily have much chance of survival and sustainable growth.⁶² This could be a particular problem in the BMENA, where the civil society organizations, including scientific bodies that would normally be expected to sustain engagement efforts, are generally weaker and more limited. There can also be issues if different funders begin to “pick winners” and foster competition between organizations in settings where communication and even cooperation and coordination would be more desirable. Funder-forced collaborations rarely work well, but that is not the same as building in incentives for communication and coordination. Simply bringing different implementers together to give them the chance to share experiences and perhaps discover common ground can be very helpful, especially if the convening can be done under a relatively neutral tent and everyone gets some chance at the spotlight.

Evaluation and Assessment Dilemmas

Issues arising from the need for tangible products from bioengagement programs were discussed above. But the programs face more significant challenges when it comes to assessment and evaluation.⁶³ The most fundamental challenge is existential: for nonproliferation, demonstrating success ultimately requires proving a negative. Failure may be obvious but if nothing bad happens, can the program claim credit? When coupled with the disagreements over the nature and extent of the threat already discussed, questions about defining success extend well beyond methodology.

On another, more practical level, the bioengagement programs are unlikely ever to be evaluated in ways that would meet the “gold standard” of impact evaluations.⁶⁴ They are

⁶² One of the worst of these types, so-called “briefcase NGOs,” consists of a “briefcase” carrying a well-written proposal and little else.” For a list of other, equally perceptive and derogatory labels, see Fowler (1997).

⁶³ I am using these terms as they would be used in the field of program evaluation, not their more specific meanings in the context of education. See, for example, Wholey et al. (2010).

⁶⁴ The World Bank offers a useful discussion of impact evaluations.

An impact evaluation assesses changes in the well-being of individuals, households, communities or firms that can be attributed to a particular project, program or policy. The central impact evaluation question is what would have happened to those receiving the intervention if they had not in fact received the program. Since we cannot observe this group both with and without the intervention, the key challenge is to develop a counterfactual – that is, a group which is as similar as possible (in observable and unobservable dimensions) to those receiving the intervention. This comparison allows for the establishment of definitive causality – attributing observed changes in welfare to the program, while removing confounding factors.

Impact evaluation is aimed at providing feedback to help improve the design of programs and policies. In addition to providing for improved accountability, impact evaluations are a tool for dynamic learning, allowing policymakers to improve ongoing programs and ultimately better allocate funds across programs. There are other types of program assessments including organizational reviews and process monitoring, but these do not estimate the magnitude of effects with clear causation. Such a causal analysis is essential for understanding the relative role of alternative interventions in reducing poverty (What is Impact Evaluation? Available at <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTISPMA/0,,menuPK:384339~pagePK:162100~piPK:159310~theSitePK:384329,00.html#whatis.>)

The website also notes: “Impact evaluations demand a substantial amount of information, time and resources. Therefore, it is important to select carefully the interventions that will be evaluated. One of the important considerations that could govern the selection of interventions (whether they be projects, programs or policies) for impact evaluation is the potential of evaluation results for learning.”

not alone; in reality, many domestic or international programs cannot meet the ideal.⁶⁵ Nonproliferation programs face additional challenges, such as the potential inability to establish the baseline that is an essential part of good program evaluation, because parts of that baseline may include classified information about the threat that cannot be shared. Interestingly, public health is one area where rigorous evaluation and assessment methods are widely understood and routinely practiced, at least in comparison with other areas of foreign assistance. To the best of my knowledge, however, these methods have not been applied to the projects to improve disease surveillance capacity that are a key component of current bioengagement work.

To their credit, both the State Department and DOD have been working to implement more assessment, although at relatively modest levels that seem appropriate to the nature of their programming. At present, the efforts focus on developing metrics, including a welcome attempt to move from simple outputs (e.g., number of people trained, number of trainings conducted) to outcomes (e.g., did people retain what they learned, were changes in procedures implemented). But they will continue to struggle with finding ways to identify whether some of the desired outcomes – and the even more desirable impacts – took place. This is especially true for those efforts that are aimed at achieving longer term behavioral change or fostering “leadership,” which are among the key goals of engaging scientists (NRC, 2012).

Given this inevitable problem, I want to suggest that one approach for assessing bioengagement would be to accept the inevitable problems they face with evaluation and consider a different methodology that could help enhance the goals of fostering partnership. The general approach is “participatory evaluation,” which is used by the World Bank and the UN Development Program, as well as many organizations in the United States and elsewhere that put a premium on partnerships.⁶⁶ A hallmark of such methods is that partners and participants play a central role in defining what “success” would mean and how it would be manifest for the project. This often includes the cooperative development of project metrics. Table 2 contains information from the World Bank that answers three important questions about the approach.

⁶⁵ See, for example NRC (2008) on the struggles of USAID to evaluate the effectiveness of its democracy assistance programs.

⁶⁶ Information from the World Bank may be found at <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTISPM/0,,contentMDK:20190347~menuPK:412148~pagePK:148956~piPK:216618~theSitePK:384329,00.html> and <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSOCIALDEVELOPMENT/EXTPCENG/0,,contentMDK:20509352~menuPK:1278203~pagePK:148956~piPK:216618~theSitePK:410306,00.html>. Information from UNDP may be found at <http://web.undp.org/evaluation/documents/whop4.htm>.

Table 2
Participatory Evaluation

What is Participatory Monitoring & Evaluation?

Participatory monitoring & evaluation (PM&E) is a process through which stakeholders at various levels engage in monitoring or evaluating a particular project, program or policy, share control over the content, the process and the results of the M&E activity and engage in taking or identifying corrective actions. PM&E focuses on the active engagement of primary stakeholders.

Why is Participatory Monitoring and Evaluation important?

Participation is increasingly being recognized as being integral to the M&E process, since it offers new ways of assessing and learning from change that are more inclusive, and more responsive to the needs and aspirations of those most directly affected. PM&E is geared towards not only measuring the effectiveness of a project, but also towards building ownership and empowering beneficiaries; building accountability and transparency; and taking corrective actions to improve performance and outcomes.

What are the principles of Participatory Monitoring & Evaluation?

Conventionally, monitoring and evaluation has involved outside experts coming in to measure performance against pre-set indicators, using standardized procedures and tools. PM&E differs from more conventional approaches in that it seeks to engage key project stakeholders more actively in reflecting and assessing the progress of their project and in particular the achievement of results.

Core principles of PM&E are:

- primary stakeholders are active participants – not just sources of information
- building capacity of local people to analyze, reflect and take action
- joint learning of stakeholders at various levels
- catalyzes commitment to taking corrective actions

Source: World Bank

<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSOCIALDEVELOPMENT/EXTPCENG/0,,contentMDK:20509352~menuPK:1278203~pagePK:148956~piPK:216618~theSitePK:410306,00.html>

Such an approach can never satisfy the objective standards of classic impact evaluation, but as already discussed, it seems unlikely that nonproliferation programs would adopt such methods. Even if programs did not undertake full-scale participatory evaluations the philosophy of working together on key aspects of evaluation seems compatible with CTR 2.0 and greater partnerships and might yield significant benefits.⁶⁷

Challenges for Sustainability

An obvious goal for bioengagement programs is to have the results of the programs be sustainable by the targeted audiences and organizations after the projects end and the implementers depart. In general, the results of any assistance effort are vulnerable to

⁶⁷ The NRC report for the DOD CTR programs focused on improving the development and implementation of metrics, such as a methodology for setting priorities to avoid overloading the assessment effort. Its inclusion of support for a cooperative approach to developing metrics seems compatible with the ideas presented here. ,

broader political trends and conditions, which in the BMENA at the moment are impossible to forecast. In more specific programmatic terms, sometimes sustainability is relatively simple to measure; going back to the earliest days of CTR in the FSU, there was always the question of whether the equipment that was provided or security and other upgrades to laboratories were maintained and used. Other desired impacts, such as confidence that the scientists with whom a project has engaged not only would never personally engage in bioterrorism but would actively assist in preventing others from doing so, are far harder to judge. Assessing whether those sorts of efforts have resulted in something sustainable is complicated by all the factors just discussed. As for the programs themselves, the nature of the funding, especially the limits on BEP to support largely annual versus multi-year grants, and the shifting of country priorities from year to year, make it difficult to plan and fund strategically. This tends to put an emphasis on identifying projects that offer shorter-term solutions and the possibility of getting in and out within a relatively limited time. This can be particularly challenging for scientist engagement programs, but it also affects staples of bioengagement such as train-the-trainer programs that need at least some level of follow-up and continued support to have real hopes of taking hold.

LESSON #3: CHALLENGES FOR OPERATING IN THE BMENA

The previous sections of this paper have addressed lessons that apply in varying degrees wherever the United States and other donors are carrying out bioengagement programs, including the BMENA. This section focuses on some of the specific lessons from the BMENA, although some of them also could apply in other parts of the world.

Continuing WMD Threats and Issues

The BMENA region was the site of the first expansion of U.S. bioengagement beyond the FSU, with initiatives to address the biological weapons (and other WMD) programs of Iraq and Libya. U.S. engagement in the BMENA thus began as classic scientist redirection efforts (Smallwood and Liimainten, 2011). Over the years, the Iraqi and Libyan programs have evolved to become more genuine engagement. And newer efforts in other countries are premised on the fact that the scientists involved have not been and are likely never to become involved in weapons-related activities, although they may face bioterrorism risks and dilemmas. But the programs' roots in former weapons programs may color their current activities. There are reports that, as the bioengagement programs reach out, they sometimes encounter questions about whether the interest means the new partners are considered suspect or potential security risks (AAAS, 2010, 2011a, 2011b, 2013).

More importantly, WMD issues are immediate and urgent in the BMENA and they extend beyond terrorism. A number of states are known or presumed to have nuclear, chemical, or biological weapons or weapons programs, and a number either remain outside of or are not in good standing with the major WMD nonproliferation regimes (see, for example, ODNI, 2012). Some of the efforts to promote a WMD free zone in the Middle East, either through formal diplomacy or via nongovernmental channels, have explored whether to begin with biological weapons and terrorism (Arms Control Association, 2013). This may be the most promising channel but it may also underscore potential biorisks. As this paper was being finished, the evolving story of efforts to eliminate Syria's chemical weapons stockpiles suggested that classic CTR approaches might once again have a role to play. Given these realities, it seems understandable that activities reflecting a traditional

nonproliferation focus and appearing to offer a more direct security payoff had an advantage relative to “softer” approaches.

S&T Capacity

There is considerable variation in the S&T capacity of the countries in the BMENA, in part reflecting their very different levels of economic development and in part reflecting the consequences of recent conflicts and political instability for existing infrastructure and capabilities. It is nonetheless acknowledged that, as a region, the BMENA lags behind (UNESCO, 2010).⁶⁸ The general diffusion of S&T capacity discussed earlier has not reached all parts of the BMENA and is certainly not evenly distributed.

One effect of this status is that, particularly in the poorer countries, it is harder to employ dual use issues as part of the framework for bioengagement. The National Academies experience with its Education Institutes suggests that one can successfully introduce the concept of dual use as part of a broader discussion of the responsible conduct of science (NRC, 2013). The difficulty is practical: scientists will not see dual use as relevant because they do not have the capacity to perform the cutting edge research that is the focus of such concerns. Sometimes the lack of capacity reflects poverty; some countries cannot even provide the basics of reliable electricity or minimal infrastructure. In other cases, conditions reflect actual or perceived attempts to restrain capacity, such as through export controls or “biopiracy.”

That said, as with other parts of the world, there are big ambitions and great hopes for what science and technology, including and sometimes especially, biotechnology can mean for the region’s development (see, for example, Bibliotheca Alexandrina, 2012). A number of the wealthier countries in the region are making substantial investments in developing capacity in biotechnology. These ambitions also extend to investments in capacity, such as workforce or higher education, that could also support broader political and economic reform. This ties back to the earlier discussion of how bioengagement programs should treat the diffusion of S&T capacity. The recent National Academies experience (NRC, 2013) suggests that framing its Education Institutes as providing capacity-building for participation in the global research enterprise through both responsible conduct and the best pedagogy has a strong appeal.

Security Situation

One impact of the current realities on the ground in the BMENA is that there are genuine and significant barriers to collaboration. Conditions vary widely but the situation in a number of the countries that are priorities for U.S. and broader Western engagement means that program implementers face serious security risks. Afghanistan, Pakistan, Yemen, Iraq, and Libya all remain hazardous. Even if travel is permitted – and in a number of these countries it is severely restricted – Western scientists are understandably reluctant to face personal risks to their safety. This affects all those implementing programs, but it seems reasonable to think that it would be likely to have a greater impact on nongovernmental organizations and on projects that involve U.S. or other Western participants without a security background, not to mention the beneficiaries of such programs in those nations.

⁶⁸ Various editions of the Arab Human Development Report, for example, address aspects of the problems and current capacities in the region; see <http://www.arab-hdr.org/>.

In some cases, travel restrictions mean that cooperative programs must be carried out via meetings in third countries, which inevitably affects the nature of the collaboration. More generally, continuing political uncertainties make planning and implementing activities difficult, and can mean substantial delays in activities. For example, two of the National Academies' BEP-funded activities in the region, the Education Institute and the facilitation of a national bioethics curriculum in Algeria, faced delays of many months and needed to make a number of major adjustments in their plans; in the case of the Institute, this included changing the venue. Fortunately, the delays and difficulties did not affect the ultimate successful outcomes, but they certainly made the work harder.

Finally, anyone involved in these sorts of activities also has to think about the potential consequences for collaborators in the region if the political situation shifts or deteriorates. At the time of this writing, there is substantial uncertainty about the future political course of several BMENA countries. What will happen and how the developments in particular countries will affect broader conditions in the region is unknown and unknowable at this point, but one has to assume there will be consequences for future U.S. bioengagement activities.

SUMMING UP

Engagement is Possible: Signs and Seeds of Success

The larger report to which this paper is contributing will draw on the results of a range of bioengagement work in the BMENA. Here I simply want to highlight a few lessons that we have drawn from our bioengagement work in the BMENA in the last several years. A number of these are also lessons from decades of other work by the National Academies in CTR or general scientific engagement, in the BMENA and elsewhere. Some of the general lessons include:

- There is genuine and continuing interest among scientists in the region in collaborating with the United States and with each other. With regard to the latter, it is very common to find that participants in a meeting will want to find a way to stay in touch with one another. Even with the difficulties of access to modern communications that still exist in some parts of the BMENA, the new technologies provide a number of opportunities. Connecting younger scientists is particularly appealing, with its promise of immediate gains for research, as well as long-term payoffs as they advance in their careers. And, as a generalization, they may be more comfortable with relationships that are largely carried out online. Sometimes the connections are simply a listserv or perhaps a portal for sharing information and experiences. On other occasions, they may develop into a substantial organization led by those in the region; an obvious example would be the Biosafety and Biosecurity International Consortium (BBIC) fostered by the International Council for the Life Sciences (ICLS). Creating structures like the BBIC is one of the main organizational goals of the ICLS, but BBIC is now very much "owned" by the partners in the region.
- The opportunity to be engaged in the broader international scientific community, through exchanges, research collaborations, and publications, is a powerful lure for scientists. This turned out to have an unexpectedly strong appeal for scientists from the FSU bioweapons program and has been true in the BMENA redirection programs as well. But this is a much broader and more general motivation for engagement, and can be used to promote adherence to international expectations,

norms, and standards. Part of the design of the National Academies work on the Education Institutes is to use the appeal of being part of the community to address responsible conduct in general along with specific issues biosafety and biosecurity. This is also another reflection of the growing diffusion of research collaborations and capacity in the life sciences (NRC, 2011). Not surprisingly, the growth in collaboration is particularly true for research related to public health.⁶⁹

- As mentioned above, the concept of dual use research in the life sciences can be controversial and sometimes does not seem relevant to bioengagement participants. I believe those objections can be relatively easily overcome with planning and appropriate framing, as our Education Institutes demonstrate. But it also may be possible to find different ways of framing the dual use problem in the first place that still serve the original purpose. As the report on the first Education Institute concluded:

Through the case studies presented and the discussions held, it became apparent that "multiple uses" might be a preferable descriptor since virtually all scientific activities are on a continuum from exemplary to malicious conduct.⁷⁰ Given the differences between cultural norms, perspectives, and levels of scientific research among countries, scientists may be uncertain about boundaries of ethical/unethical behavior that "dual use" connotes because these behaviors are more complex than these two categories imply. There could, therefore, be value in emphasizing a continuum rather than a starker dichotomy of research and behavior as part of the discussions at the institutes (NRC, 2013:82).

- Finally, all of the work on dual use issues and bioengagement in which I have been involved over the last decade has persuaded me that using responsible conduct of science is the best approach for framing scientist engagement related to biosecurity and dual use issues. I want to emphasize that this does not mean avoiding discussions of relevant laws and regulations, particularly the BWC as the legal embodiment of the fundamental international norm. This is about where one begins and how best to reach one group of essential stakeholders for efforts to reduce biorisks. Responsible conduct is the foundation on which one builds and should be seen as complementary to the more detailed attention to security issues and legal requirements that those in certain areas of research will need.

⁶⁹ See, for example, work done by the Harvard-Sussex Program as a contribution to the 7th BWC review conference (Ilchmann et al., 2011).

⁷⁰ The term was adopted by the International Union of Pure and Applied Chemistry for the educational materials on *Multiple Uses of Chemicals* that it developed in 2007 cooperation with the Organization for the Prohibition of Chemical Weapons. The material, which was being updated when this report went to press, may be found at <http://multiple.kcvs.ca/>. The IAC-IAP project on Responsible Conduct in the Global Research Enterprise chose the term "misuse" (IAC—IAP, 2012).

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APPENDIX A:
Reports from the National Academies Relevant to Bio-CTR

Developing Capacities for Teaching Responsible Science in the MENA Region:
Refashioning Scientific Dialogue (2013)

Developing Capacities for Teaching Responsible Science in the MENA Region:
Refashioning Scientific Dialogue (2013) – Summary in English and Arabic available at

The Unique U.S.-Russian Relationship in Biological Science and Biotechnology: Recent
Experience and Future Directions (2013)

Improving Metrics for the Department of Defense Cooperative Threat Reduction Program
(2012)

Biosecurity Challenges of the Global Expansion of High Containment Biological
Laboratories (2102)

Challenges and Opportunities for Education about Dual Use Issues in the Life Sciences
(2011)

Life Sciences and Related Fields: Trends Relevant to the Biological Weapons Convention
(2011)

U.S.-Iran Engagement in Science, Engineering, and Health (2000-2009): Opportunities,
Constraints, and Impacts (2010)

Responsible Research with Biological Select Agents and Toxins (2009)

Global Security Engagement: A New Method for Cooperative Threat Reduction (2009)

Countering Biological Threats: Challenges for the Department of Defense's
Nonproliferation Program Beyond the Former Soviet Union (2009)

Russian Views on Countering Terrorism During Eight Years of Dialogue: Extracts from
Proceedings of Four Workshops (2009)

Countering Terrorism: Biological Agents, Transportation Networks, and Energy Systems:
Summary of a U.S.-Russian Workshop (2009)

Improving Democracy Assistance: Building Knowledge through Evaluations and Research
(2008)

The Biological Threat Reduction Program of the Department of Defense: From Foreign
Assistance to Sustainable Partnerships (2007)

Globalization, Biosecurity, and the Future of the Life Sciences (2006)

Letter Report on the Threat Agent Detection Response System Database (2006)

Biological Science and Biotechnology in Russia: Controlling Diseases and Enhancing Security (2005)

Biotechnology Research in an Age of Terrorism (2004)

Terrorism: Reducing Vulnerabilities and Improving Responses: U.S.-Russian Workshop Proceedings (2004)

High-Impact Terrorism: Proceedings of a Russian-American Workshop (2002)

Controlling Dangerous Pathogens: A Blueprint for U.S.-Russian Cooperation (1997)

An Assessment of the International Science and Technology Center: Redirecting Expertise in Weapons of Mass Destruction in the Former Soviet Union (1996)

APPENDIX B:

Examples of Statements Related to Responsible Conduct of Science from U.S. and International Science Organizations and Forums

Researchers have learned that they cannot dissociate themselves from the uses of the new knowledge they generate. They need to take into consideration the reasonably foreseeable consequences of their own activities. They also have an obligation to participate in the social mechanisms, both within the research community and in the broader society, that explore the implications of research and impose constraints on research if those constraints are justified. (IAC and IAP, 2012:15)

In this era of global science, the scientific establishment needs to implement continuous self-reflection to appropriately evaluate its responsibilities, duties and rules of conduct in research and innovation. A universal code of conduct addressing the rights, freedoms and responsibilities of scientific researchers, and the universal rules of scientific research should be shared by the world's scientific community. Furthermore, these rules and policies should be respected by the states and adopted by their national legislations.

Scientists should strengthen their individual and institutional responsibilities to avoid possible harm to society due to ignorance or misjudgment of the consequences of new discoveries and applications of scientific knowledge.

It is the responsibility of those who promote science and scientists to maintain the primacy of moral and social concerns over short-term economic interest in the selection and implementation of industrialized research projects. (World Science Forum, 2011)

Such practice [of science], in all its aspects, requires freedom of movement, association, expression and communication for scientists, as well as equitable access to data, information, and other resources for research. It requires responsibility at all levels to carry out and communicate scientific work with integrity, respect, fairness, trustworthiness, and transparency, recognising its benefits and possible harms (ICSU, 2011).

Researchers and research institutions should recognize that they have an ethical obligation to weigh societal benefits against risks inherent in their work” (2nd WCRI, 2010)

The practice of scientific research and the use of knowledge from that research should always aim at the welfare of humankind, including the reduction of poverty, be respectful of the dignity and rights of human beings, and of the global environment, and take fully into account our responsibility towards present and future generations, and further that

All scientists should commit themselves to high ethical standards, and a code of ethics based on relevant norms enshrined in international human rights instruments should be established for scientific professions. The social responsibility of scientists requires that they maintain high standards of scientific integrity and quality control, share their knowledge, communicate with the public and educate the younger generation. Political authorities should respect such action by scientists. Science curricula should include science ethics, as well as training in the history and philosophy of science and its cultural impact. (UNESCO, 1999)

Even scientists conducting the most fundamental research need to be aware that their work can ultimately have a great impact on society. Construction of the atomic bomb and the development of recombinant DNA—events that grew out of basic research on the nucleus of the atom and investigations of certain bacterial enzymes, respectively—are two examples of how seemingly arcane areas of science can have tremendous societal consequences. The occurrence and consequences of discoveries in basic research are virtually impossible to foresee. Nevertheless, the scientific community must recognize the potential for such discoveries and be prepared to address the questions that they raise. If scientists do find that their discoveries have implications for some important aspect of public affairs, they have a responsibility to call attention to the public issues involved. . . . science and technology have become such integral parts of society that scientists can no longer isolate themselves from societal concerns. (NRC, 1995:20-21)

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Collaborative Subgrant



Scientific Engagement Defining Gaps and Creating Opportunities
for Cooperative Research and Global Security in the Broader
Middle East and North Africa (BMENA) Region

Final Report Submitted To:

The American Association for the Advancement of Science

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EXECUTIVE SUMMARY

The objectives of the Scientific Engagement Defining Gaps and Creating Opportunities for Cooperative Research and Global Security in the Broader Middle East and North Africa (BMENA) Region project were to identify and assess the overall impact of global biosecurity capacity-building initiatives undertaken in recent years in the BMENA region, and to then apply the knowledge gained from this assessment to suggest ways to build cooperative regional biosafety opportunities.

The project had three specific aims:

1. To assess the impact of existing initiatives;
2. To identify and evaluate gaps in biosurveillance and implementation of biosafety practices from individual country perspectives; and
3. To recommend sustainable biosurveillance and biosafety programs from a regional perspective.

The principal investigators and research team used a five-stage methodology to reach these specific aims, including completing the following activities:

Stage 1: Conducted a thorough desktop review of recent international initiatives in the region using commercial search engines and interviews with scientific thought-leaders;

Stage 2: Developed a statistically representative survey database to distribute via a web-portal and using the information acquired in the desktop review;

Stage 3: Activated regional networks by engaging biosafety and other scientific associations, working groups, and active forums in the region via e-mails, personal calls, letters etc. The chairs/presidents of these forums and associations received an initial briefing on the survey and then reviewed the full survey via a webinar;

Stage 4: Surveyed the members of these scientific associations /forums of the region, which was facilitated by their respective presidents/ chairs; and

Stage 5: Provided this Final Report of the trends identified in the desktop review and outcomes of the survey analysis, comparisons of gaps and opportunities among countries in the region, and conclusions/recommendations for sustainable regional cooperative research and global biosecurity.

The project also included three pilot innovations to incentivize survey participation as well as enhance the long-term impact of the project. The innovations were funded through privately donated funds to the Frontline Foundation:

1. An annual scholarship program for a BMENA scientist to study at the biosafety and biosecurity training course at Colorado State University (the project Regional Coordinator from Egypt attended the program in July 2013);
2. A visiting international scholar award for a BMENA scientist to participate in an annual biosecurity conference in the U.S. (the project country leader from Morocco won a “lucky draw” to attend the Centers for Disease Control and Prevention (CDC) Biosafety Symposium in January 2014); and

-
3. A web-based regional biosafety training network/resource center for fully accredited continuing education, patterned after a similar successful program developed by Frontline Foundation with the National Institutes of Health (NIH) for the Asia-Pacific region (<http://www.apbtn.org/apbtn/>). Frontline Foundation will be providing at no cost to survey respondents up to three distance-learning courses on proper selection and use of biosafety cabinets to initiate this network.

INTRODUCTION

TASK 1: Desktop Review

The emergence of biotechnology and biodiversity gave rise to multiple international concerns including how to perform risk assessment and risk mitigation of the impacts of new research products. Arising from these concerns, biosafety and biosecurity became hot topics for scientists and policy makers throughout the region.

These international concerns, at the forefront in the United Nations Conference on Environment and Development (UNCED), were formally recognized in what became the Earth Summit, which was held in Rio de Janeiro in June 1992[1]. This resulted in the Convention on Biological Diversity, from which came the 1993 Cartagena Protocol of Biosafety. With the ratification of the Cartagena Protocol, member countries initiated biosafety efforts focusing on the effects of conservation and sustainable use of biological diversity on the earth[2].

The possibility of biotechnology being used for malicious purposes by non-state actors is generating new anxieties among biosafety and biosecurity experts. This concern has been raised globally, since the events of 9/11 and the mailed anthrax bioterrorism of 2001. The added scrutiny to prevent additional bio events helped promote an international focus in biosafety and biosecurity on how to combat bio-terrorism, especially in countries with the backdrop of dynamic or unstable geopolitical circumstances [3-6]. With the support of international organizations that focus on preventing bioterrorism, a number of biosafety initiatives have developed and/or been deployed in the BMENA region to help build institutional capacity of individual countries and develop skilled senior personnel in this field.

The goals of the “Scientific Engagement: Defining Gaps and Creating Opportunities for Co-operative Research and Global Security in the Broader Middle East and North Africa (BMENA) Region” project were to identify the biosafety initiatives and programs in BMENA region over the last decade and to assess the overall regional impact of these initiatives. In addition, the project attempted to highlight existing biosafety practices that are adequately developed and biosafety practices that are underdeveloped and require further attention. The project, funded by the American Association for the Advancement of Science (AAAS), has been a collaborative effort between Aga Khan University Hospital (Karachi, Pakistan) and the Frontline Healthcare Workers Safety Foundation. Ltd. (USA).

The co-Principal Investigator, Dr. Erum Khan at Aga Kahn University Hospital, and support staff conducted a literature review of the biosafety / biosecurity initiatives conducted in BMENA during the past ten years in order to assess the infrastructure for biorisk management at national levels for BMENA countries. Her staff did not restrict collection of those practices focused on preventing bioterrorism; instead, Dr. Khan’s staff

included all biosafety efforts, including those initiated in response to the Cartagena Protocol and those begun to prevent malicious use of biology and biotechnology. The research team conducted a desktop review using various commercial search engines, and consulted with those individuals in various BMENA countries who collaborated on recent biosafety initiatives.

TASK 2: Statistical Survey

The co-PIs recruited a team of country leaders and selected two regional coordinators to serve as “conduits” to life scientists in each BMENA country. These life scientists would be surveyed regarding their experiences and opinions about biosafety capacity building in their country. The project concept was to have the country leaders obtain mailing lists of members of a biosafety association or other relevant life sciences professional associations, and then select a random sample of 30 members to receive the survey questionnaire by email. Either the country leaders would distribute the questionnaires by email or the country leaders would provide a sample list of email addresses to the Co-PIs, who would in turn distribute the questionnaires.

The Co-PIs, project team members, and country leaders finalized plans to conduct the surveys during two separate webinars, conducted via GoToMeeting, an online meeting platform. The team members and country leaders are identified in Appendix C.

The CO-PIs and the Frontline Foundation survey statistician used the information gathered during the desktop review to build a survey instrument in the commercially available Survey Monkey platform. Great care was taken to develop a sampling system that would protect the confidentiality of survey participants and their responses from concerns about local government interference, particularly if government officials perceived the responses to be less than complementary. The survey instrument is provided in Appendix D.

The survey was administered to the life scientists identified for each participating country either by the country leaders, or by the Frontline team using the commercially available Mail Chimp software program within the Survey Monkey platform.

The survey sought to make broad observations about capacity needs or gaps in biological risk management in the BMENA region. It also included questions about challenges (e.g., lack of human resource, monetary funds, skills etc.) and success of capacity building initiatives taken by the native governments / international agencies. Comments were solicited to assess if the international initiatives were demand driven and sustainable, and if a regional body to facilitate greater coordination is needed.

METHODOLOGY

TASK 1: Desktop Review

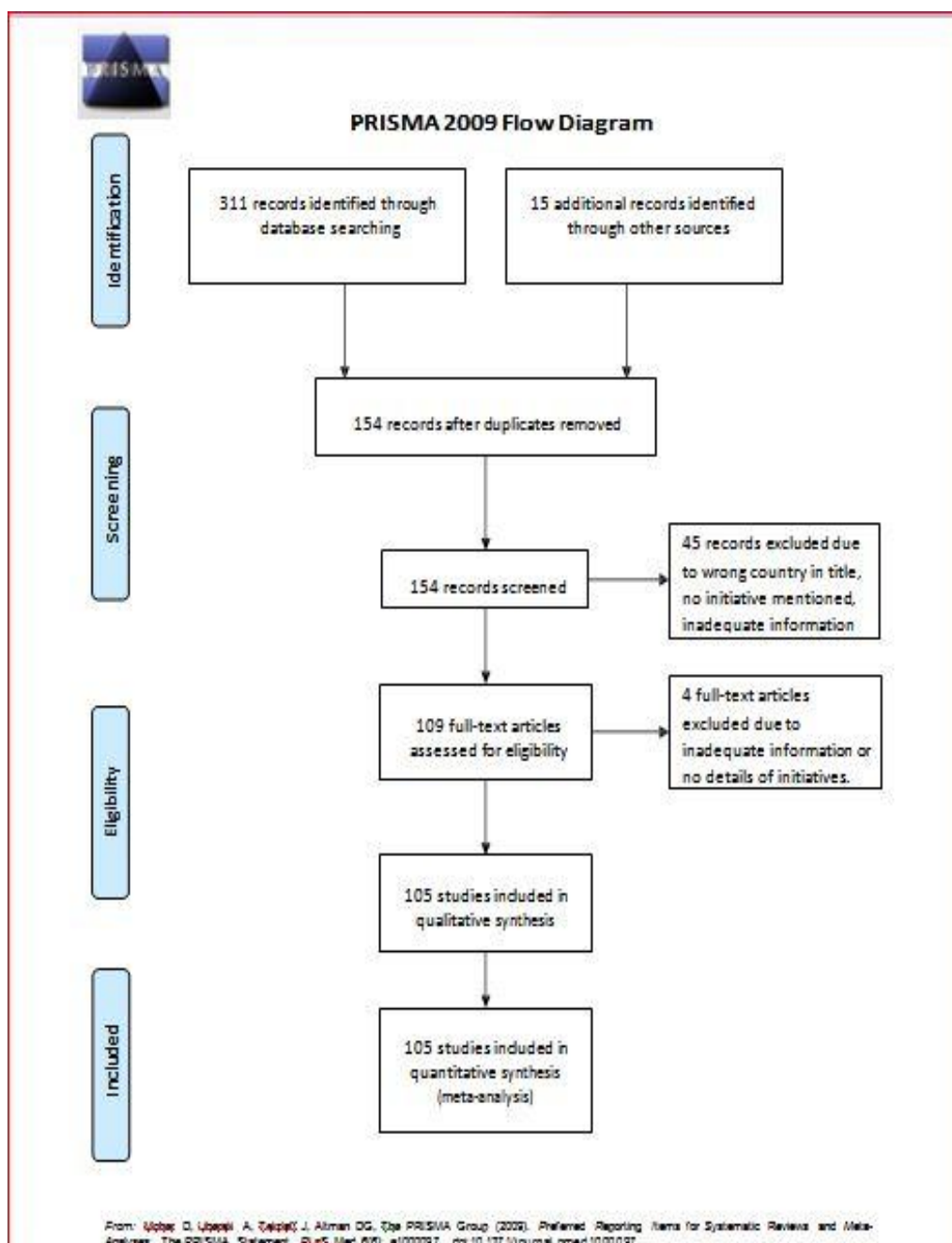
The data on existing infrastructure for biorisk management (biosafety and biosecurity) in the BMENA countries was assessed via a review of past training events, seminars, conferences, and policy documents collected through consultation with regional collaborators from each of the BMENA countries. In addition, a desktop review was conducted by two research staff using the commercial search engines Google, Yahoo!, PubMed, and the Cochrane Database. To enhance the search, the researchers also explored

additional databases including the World Bank and the Biosafety Clearing House, which was developed after the Cartagena Protocol. Searches were exhaustive, but due to the lack of publically available information, the existence of other projects cannot be ruled out. For example, numerous small-scale projects conducted at academic institutions may not have been highlighted in the desktop review if they did not appear in any of the above-mentioned search engines or databases. Despite this limitation, the researchers recorded and studied a significant number of biosafety initiatives in the BMENA region.

The researchers found a total of 326 items using the following keywords: biosafety, biosecurity, biorisk management, biotechnology, Bioterrorism, living modified organisms, genetically modified organisms, broader Middle East and North Africa (BMENA), Afghanistan, Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Pakistan, Qatar, Saudi, Sudan, Syria, Tunisia, Turkey, UAE, and Yemen. The results returned were: 202 items from Google, 43 items from Yahoo!, one item from PubMed, and zero items from the Cochrane Review⁷¹. Based on the primary key words, a total of 154 references were eventually found to be relevant to the study and researchers determined 15 more relevant search terms based on these references. The desktop review database includes lead organizations, funding organizations, and the biosafety and biosecurity aspects of each initiative.

⁷¹ Cochrane Reviews “are systematic reviews of primary research in health care and health policy, and are international recognized as the highest in evidence-based health care.” See <http://www.cochrane.org/cochrane-reviews>. Accessed on: October 11, 2013.

Fig1: Desktop Literature Search Methodology (PRISMA 2009 style flowsheet)



TASK 2: Statistical Survey

The data from the desktop review was compiled in a systematic manner on a standardized format. The survey instrument was generated to assess the awareness of scientists in the BMENA region (i.e., members of biosafety or similar professional associations) regarding biological risk management activities and capacity-building initiatives carried out by their government and/or national or international organizations in their country and the region. It was also aimed at assessing BMENA scientists' understanding of the current deficiencies in biological risk management activities and the best possible solutions to address these problems. This survey was distributed to randomly selected scientists,

biologists, and members of the biosafety associations in the BMENA region who had been identified by individual BMENA country leaders.

The sampling strategy was to use a two-stage stratified, then simple-random design and a sample size designed to achieve accuracy and precision sufficient to be useful and meaningful. The survey instrument was designed and pilot tested for readability, proper interpretability, and inclusion of quantifiable measures. Questions on the survey instrument covered successes and gaps in biosurveillance and biosafety practices, ideas for sustainable cooperative research, and generalizable training opportunities. The sample size was to be 30 from each of 12 national associations. Thirty is a classical statistical sample size for invocation of the Central Limit Theorem and approximation of Normal distributions, and is also the WHO's recommendation for stratified design in their "30 by 7" guideline.

RESULTS

TASK 1: Desktop Review

Although the desktop review was successfully completed for all BMENA countries, we were only successful in recruiting eleven country leaders for the study survey. The BMENA countries for which we had a country leader are underlined in the report below.

AFGHANISTAN:

The Islamic Republic of Afghanistan is a landlocked sovereign state in the Middle East and has a rich cultural heritage. Recently in the news as a war-torn state, it has begun rebuilding its infrastructure in many aspects, including biosafety and biosecurity. Afghanistan recently joined the Cartagena Protocol of Biosafety in January 2013 and the agreement went into force in May 2013[7]. Afghanistan has been an active member in biosafety in the region and Afghan scientists have attended a number of regional conferences on biosafety since 2010[8-15]. Afghanistan has been actively involved in workshops and conferences focusing on risk assessment and risk management. More recently, Afghan scientists were involved in meetings that included biosecurity as part of the overall system in which science is conducted; these meetings, which were held by AAAS through a grant by the U.S. Department of State Biosecurity Engagement Program (BEP), included topics on responsible science, information sharing, and science's contributions to addressing socio-economic issues. However, further attention could be provided to human resource development, institutional building, and professional development.

ALGERIA:

Algeria became a member of the Cartagena protocol in 2000[104]. Very little published information on biosafety is available after the development of a National Biosafety Framework in 2004[105]. However, Algerian delegates have regularly attended a number of regional and international conferences on biosafety [8, 9, 12, 17, 106], which indicates a healthy interest of the professionals in that field to better the country's infrastructure. A workshop titled "Introduction to Bio-risk Management" was conducted in 2011 with the aid of the Sandia National Laboratory International Biological Threat Reduction Program (IBTR).

BAHRAIN:

The kingdom of Bahrain is an archipelago of 33 countries making up an island in the Middle East. Bahrain participated in the Biological Weapons and Toxins Convention 2008 intersessional meeting on biosafety and biosecurity. Subsequently, Bahrain has become a member of the Cartagena Protocol of Biosafety[16].

Bahraini representatives have attended a number of international conferences on biosafety in the BMENA region [14, 15, 17], which were sponsored by International Federation of Biosafety Associations (IFBA), International Conference of the Life Sciences (ICLS), Biological Weapons Convention, and the relevant government institutions of the countries. These conferences have involved lecture-based, educational sessions on a broad set of biosafety topics. However, hands-on training of individuals has not been provided. This is a vulnerability which must be addressed to better equip the Biosafety initiative in the country.

EGYPT:

In Egypt, which became a signatory to the Cartagena Protocol in 2000 [70] and an active member in 2004, work on biosafety began comparatively earlier than other countries in the region. The degree to which biosafety work progressed varied; Egypt experienced periods of latency in carrying out the work. Various national and international agencies such as the International Society for Chemotherapy Infection and Cancer (ISC), Sandia National Laboratory IBTR, Egyptian Environmental Agency, and the Agricultural Genetic Engineering Research Institute (AGERI) have organized biosafety conferences that took place in Cairo and Alexandria[71] and covered a wide range of topics, including education and awareness, risk management, technology transfer, and information exchange[72-74]. In addition, several conferences focused on the topic of identification of living modified organisms; these conferences should be encouraged to continue [75-77]. Another aspect that should be encouraged is institutional building and human resource development, and dissemination of information about biosafety to Egyptian institutes outside of Cairo and Alexandria.

IRAN:

The situation of conducting workshops, seminars, and conferences in Iran is not very different to that of other countries. Iran became a signatory member of the Cartagena protocol in 2001[99] and was actively pursuing biosafety activities between 2003-2004 [100]. Following this initial period of activity, biosafety efforts in Iran fell dormant until 2011. In 2004, Iran developed a “National Biosafety Framework Of Iran” [101] and had a conference on “Implementation of the Cartagena Protocol on Biosafety: National Experiences and Perspectives” [102]. In 2011, Iran held an event on biosafety in Tehran, which was organized by National Institute of Genetic Engineering & Biotechnology (NIGEB, Tehran, Iran) and the International Centre for Genetic Engineering and Biotechnology (ICGEB)[103] and focused on bioethics, risk management and identification of living modified organisms. This seminar seems to be a ray of hope for further development of biosafety in Iran and should be encouraged.

IRAQ:

By 2004, a framework [86] on biosafety was established in Iraq, which is not yet a signatory to the Cartagena protocol. Following the framework development, not

much work was done in the field of biosafety until 2010 when a “Laboratory Biosafety & Bio-security Seminar” was held in Baghdad with the support of Sandia National Laboratory’s IBTR [87]. Since 2010, Iraqi delegates have been attending a number of international conferences on biosafety and security [8, 13, 15]. However a lot of work still remains to be done on risk awareness, education, human resource training, risk management, and identification of living modified organisms. Efforts on these issues should be encouraged in the future.

ISRAEL:

The European Biological Safety Association (EBSA) founded an association on biosafety called Israel Biosafety Association (IBSA) in Israel in 2007 [108] to increase biosafety awareness, education and risk management among professionals in this field. However, no workshop or conference proceedings were retrievable from Israel in this field.

JORDAN:

Jordan became a signatory to the Cartagena protocol in 2000 [78] and during the past 8 years, Jordan has done a significant amount of work on biosafety with the help of a number of organizations such as Princess Haya Biotechnology Center (Jordan University of Science and Technology), American Biological Safety Association, Sandia National Laboratory’s IBTR, Biosafety and Biosecurity International Consortium, European Commission Joint Research Centre, and Royal Scientific Society [79-82]. All the workshops have taken place in Amman but awareness-raising and educational workshops should also be held in other Jordanian cities to expand the reach of these programs. [65, 80, 83, 84]. In addition, Jordanian delegates have attended a number of regional and international conferences on biosafety and bio-security [14, 34, 43, 85]. However, no appreciable work has been done in certain key aspects of biosafety such as identification of laboratory modified organisms [83, 84], technology transfer, and human resource development [83]. Future efforts should address these issues.

KUWAIT:

Kuwait is not a signatory of the Cartagena Protocol, but is very active in biosafety. Kuwaitis have actively participated in many national and international biosafety and biosecurity conferences. The Kuwait Institute of Scientific Research (KISR) organized an event in Kuwait City, Kuwait in 2010 with the support of the International Centre for Genetics and Biotechnology (ICGEB); this event focused on risk assessment and management and living modified organisms. In 2011, KISR co-hosted a conference with AAAS-CSTSP on safe and secure biological research, which included a video-teleconference for regional countries that focused on bioethics, biosafety, and the dual use dilemma [8, 18]. Kuwaiti delegates have attended a number of international and regional conferences that include sessions on biosafety awareness and education, and information transfer [11-15, 17, 19]. Additional topics to include in future efforts are human resource training and institutional building, both of which has not been considered.

LEBANON:

The Lebanese Republic has been an active member of the Cartagena protocol since 2013[20] and has played an active role in international in biosafety and biosecurity

since 2008. It is a progressive state in biosafety and biosecurity and has participated actively in many regional and international conferences focused on these topics.

Lebanon hosted national workshops in 2007 on “Organic culture in Lebanon” with the support of Association for Lebanese Organic Agriculture (ALOA). Following that, Lebanon did not host any conferences until 2013, but Lebanese delegates have attended a number of regional and international conferences on various aspects of biosafety, especially information exchange, awareness, and socio-economic considerations.

In 2013, Lebanon hosted a national workshop on “Biosecurity & Biosafety Strategy in Case of a Biological, Chemical or Nuclear Crisis” with the support of WHO, ICLS, World Organization for Animal Health (OIE), and the Ministry of Agriculture of Lebanon. Although this workshop included sessions on human resource development, this topic should be addressed in greater detail in the future.

LIBYA:

Libya has been party to the Cartagena Protocol on Biosafety since 2005[21], but it has been a more active participant in international biosafety since 2009. Libyan representatives have attended the latest two Biosafety and Biosecurity International Consortium conferences [15, 17] and other regional and international conferences focusing on various aspects of biosafety.

The Environment General Authority, a government agency, has recently conducted a national training workshop in 2012 with the sponsorship of the Biosafety Clearing House and assistance of the United Nations Environmental Programme-Division of Environmental Law and Conventions Regional Advisor[22]. This should be encouraged in the future.

Libyan representatives have attended conferences discussing living and genetically modified organisms [18, 23]. However, more emphasis should be placed on institutional capacity building and human resource training in future biosafety activities.

MAURITANIA:

The Islamic Republic of Mauritania has not held any conventions or national symposiums on the biosafety, but its scientists have attended international conferences since 2008[14]. Attendance at international conferences has increased since it became a signatory to the Cartagena Protocol on Biosafety in 2005[24]. Most of these conferences have focused on risk assessment and management, information handling, and human resource development, with a focus on developing the biosafety skills of local professionals [15, 25]. Involvement of Mauritanian delegates’ in international biosafety activities should be encouraged further.

MOROCCO:

The Kingdom of Morocco became a signatory to the Cartagena Protocol on Biosafety in May 2000, but it did not fully implement the Protocol until July 2011[26]. Morocco also ratified and acceded as a state party the Biological and Toxins Weapon Convention on 21 March 2002.

Since 2007, Moroccan representatives have been very active in regional and international forums [8, 9, 11-15, 25, 27, 28]. In 2007, Morocco participated in the Biosafety and Biosecurity International Conference process and became a founding member of the group.

In 2009, the Moroccan Biosafety Association (MOBSA) was created by a group of Moroccan scientists concerned with the dissemination of information that poses biological risks and its impact on public health, animals, agriculture, plants and the environment.[112] In 2011, MOBSA partnered with the Faculty of Sciences of Tétouan and established a University Master's Degree on chemical, biological, and radiological security; this graduate degree includes a full module on biosafety and biosecurity. This curriculum, which is approved by the Ministry of Higher Education, has been gradually distributed to other academic institutions through training courses held at several Moroccan state universities.

The Ministry of Health is considering a Proposal of a National Biosafety Guide for Biosafety in the Laboratories. In addition, the Ministry has shared a draft of the future Pathogens Law with MOBSA.

Morocco hosted international conferences on biosafety [17, 29-31] in 2001, 2009 and 2012, with the support of the Islamic Academy of Science and the Ministry of Education, Higher Education, Training and Scientific Research. Organizations such as International Council for the Life Sciences, Islamic Educational, Scientific and Cultural Organization (IESCO), and the Standing Committee on Scientific and Technological Cooperation of the Organization of the Islamic Conference (COMSTECH) have assisted Morocco's conferences. The focus of the national and international conferences has been on raising awareness of biological risks, information transfer, and socio-economic considerations. Future conferences should focus on human resource development and institutional building.

In 2012, MOBSA contributed to the development and implementation of the International Federation of Biosafety Associations' biosafety advocacy strategy.

OMAN:

The Sultanate of Oman hosted an "International Conference on Biosafety" in 2005 with the support of the Ministry of Regional Municipalities, Environment and Water Resources[32]. This conference, the first and only since Oman became a party to the Cartagena Protocol of Biosafety in 2003[33], focused on various issues such as risk assessment and management, and identification of genetically and living modified organisms.

Following that conference, Omani delegates were not active in the field of biosafety until 2008, when they resumed regular participation in regional and international conferences [14, 15, 17, 18, 34]. These conferences have focused on information exchange, risk assessment and management, and socio-economic considerations. Conferences that focus on human resource development and institutional building should be encouraged.

PAKISTAN:

The Islamic Republic of Pakistan became a signatory to the Cartagena protocol in 2001 and an active member in 2009[47]. Since 2008, Pakistan has carried out a lot of work on biosafety. Pakistan has established two nongovernmental organizations to address biosafety - the Pakistan Biological Safety Association (PBSA), which is a nationwide group, and the Biosafety Association of Pakistan (BSAP), which is a university-based group primarily involving scientists from the southern part of the country. Most initiatives have concentrated on raising awareness and education [48-56], risk assessment [16, 57-60], risk management, and human resource and personnel training [15, 20, 61-65]. Rarely have these efforts focused on identification of living modified organisms[51].

In 2009, PBSA, in collaboration with the U.S. Department of State Biosecurity Engagement Program, developed the *Master Trainers Program* to develop professional resources. Unfortunately, the project halted prematurely because of the political situation between the donor agency and the recipient country.

PBSA has conducted workshops in different cities of Pakistan since 2008, which is a good indicator of the dedication to dissemination of information throughout the country[67-69]. Pakistani delegates have attended a number of international and regional seminars on biosafety [8, 12, 13, 65]. Further work on developing the Pakistani infrastructure and institutions should be encouraged.

PALESTINE:

Palestine is not a signatory of the Cartagena Protocol on Biosafety. However in 2009, Palestinian representatives in the field of biosafety attended the 2nd Biosafety and Biosecurity International Conference[17]. In addition, they have been relatively active in organizing conferences at home on Biotechnology Research and Application.

Biosafety initiatives have taken place on the university-level with conferences organized by Al Najah University in Nablus in 2010 and Al-Quds University in Abu Dies in 2012. No efforts have taken place at the national and international levels. [35, 36]. However, biosecurity issues and socio-economic considerations have not been addressed adequately as a part of these initiatives and should be considered in the future.

QATAR:

Qatar became a member of the Cartagena protocol in 2007[109]. However since then, very little information is available on biosafety in Qatar. In 2013, a “Biorisk Management Workshop” was conducted and fully supported by Hamdard Medical Centre in Doha[110]. In this workshop, human resource development, education, risk awareness and risk management were addressed. No international agencies were involved in the planning or implementing of the conference.

SAUDI ARABIA:

The Kingdom of Saudi Arabia, a signatory to the Cartagena Protocol on Biosafety since 2007[37], has been an active member of biosafety conferences between 2009-2012. The Saudi delegates have been active primarily at the regional level; Saudi Arabia hosted the First International Conference on Biotechnology in 2009 at the

King Saud University[38].

Saudi delegates have attended a number of international conferences, which focused on most aspects of biosafety and biosecurity except for human resource development and technology transfer, both of which should receive greater focus in the future[8, 14, 15, 17, 18]. However since 2011, Saudis have not participated in many national or international conferences. Saudis should be encouraged to participate in international biosafety conferences.

SUDAN:

The Republic of Sudan has been a signatory to the Cartagena Protocol on Biosafety since 2005[39], and hosted international biosafety conferences in 2005, 2007 and 2010[40-42]. All of these conferences were held in Khartoum with the support of the Ministry of Science and Technology and various collaborative organizations such as the International Service for National Agricultural Research, International Food Policy Research Institute, World Animal Health Organization, Regional Commission for Africa, Food and Agriculture Organizations, and African Union Interafrican Bureau for Animal Resources.

Sudanese representatives have attended various regional biosafety conferences and seminars, which primarily focused on identification of genetically and living modified organisms [18, 34, 43], socio-economic considerations, raising awareness, and information transfer [14, 15, 17, 42]. Aspects of biosafety that have been neglected are the development of human resources in Sudan, and the development of framework to regulate and monitor biosafety in Sudan.

SYRIA:

The Syrian Arab Republic became a signatory to the Cartagena Protocol on Biosafety in 2004[44]. Syria has received more attention because of concerns about bioterrorism[45] rather than because of its presence at national and international biosafety conferences. Syria joined the international biosafety scene in August 2008 in Geneva and since then, Syrians have attended a number of regional conferences on the topic, albeit without any focus on training of individuals or institutions [14, 15].

Syrian delegates have conducted a conference in Aleppo, Syria on “Detection of genetically modified organisms and biosafety for food and agriculture” in 2010 under the supervision of the (Food and Agriculture Organization, International Center for Agricultural Research in the Dry Areas, and the General Commission for Scientific and Agricultural Research [18, 43]. This conference focused on socio-economic factors and biosafety.

TUNISIA:

The Republic of Tunisia has been a signatory of the Cartagena Protocol on Biosafety since 2001[46]. It has been an active member since 2003 and regularly involved in various regional events on biosafety since 2009[8, 12-15, 17, 34]. Their involvement was especially evident in 2011, when the AAAS-CSTSP collaborated with the Institut Pasteur de Tunis and the University El Manar, Faculty of Science of Tunis to host a workshop entitled “Infectious Disease and International Engagement: Responsible Bioscience for a Safe and Secure Society - Workshop

Three.” [11]. The emphasis in this conference was on human resource building and technology transfer.

TURKEY:

Turkey signed the Cartagena protocol in 2000 and developed a National Biosafety Framework in 2002-2004 [91]. Turkey resumed their involvement in biosafety in 2009, according to their participation in publically available references. Beginning in 2009, Turkey held biosafety conferences with the help of a number of international agencies such as Sandia National Laboratories’ IBTR program and the European Union Reference Laboratory for GM Food and Feed [92-94]. These conferences mostly focused on risk assessment and management, education, and information exchange. Future topics to include should be identification of living modified organisms, institutional building, and human resource development.

UAE:

During the past 5 years, a tremendous amount of work has been done in the UAE in the field of biosafety. A number of workshops and conferences have been arranged, mainly in Dubai and Abu Dhabi [38, 88, 89]. Sandia National Laboratories’ IBTR program, with funding from the U.S. Department of State Biosecurity Engagement Program, is the primary organization involved in holding the events. [40, 90]. The events focused on raising awareness, risk assessment, and risk management; however, future events should include identification of laboratory modified organisms, human resource training, and technology transfer to improve the existing infrastructure. UAE delegates actively attend regional biosafety conferences in Jordan, Syria, and other countries [13, 15, 85].

YEMEN:

Yemen began addressing biosafety in 2003 by preparing a National Progress Report [95]. In 2005, Yemen formed a National Development Framework and [96], became a signatory to the Cartagena protocol [97]. In 2011, Sandia National Laboratories IBTR program held a conference entitled “Introduction to Laboratory Bio-risk Management” in Sana’a [98]. Yemeni delegates have attended a number of regional and international biosafety conferences [12, 15, 17, 19, 43] that focused on risk assessment and management, education and awareness, and identification of living modified organisms. In addition to these topics, institutional and human resource development should be encouraged further.

Table 1. NGO's / Institutes Conducting Biosafety / Biosecurity Activities in the BMENA region (listed by country)

S#	COUNTRY	ORGANISATION	YEAR FOUNDED
1	Afghanistan	Afghan Biorisk Association	2010
2	Jordan	El Hassan Science City (EHSC)/Royal Scientific Society (RSS)	1970
		Middle East Scientific Institute For Security (MESIS) (earlier known as Cooperative Monitoring Centre (CMC)	2002
		Higher Council for Science and Technology	1987
		Jordan University of Science and Technology/Princess Haya Biotechnology Centre	2005
		University of Jordan/Hamdi Mango Center for Scientific Research (HMCSR)	1999
S#	COUNTRY	ORGANISATION	YEAR FOUNDED
3	Lebanon	Lebanese Agricultural Research Institute	1945
		American University of Beirut	1866
		Lebanese National Council for Scientific Research	1962
4	Libya	Environment General Authority (EGA)	2000
		Libyan Association for Biotechnology	?
		Libyan National Committee for Bioethics, Biosafety and Biosecurity	2004
5	Morocco	Moroccan Biosafety Association (MOBSA/AMABIOS)	2009
6	Oman	-	-
7	Algeria	-	-
8	Tunisia	Ministry of Higher Education and Scientific Research in Tunisia Center of Biotechnology of Sfax	1983
		The Tunisian Association of Biotechnology	1999
9	Pakistan	Pakistan Biological Safety Association (PBSA)	2008
		Biological Safety Association of Pakistan (BSAP)	1974
10	Israel	Israel Biological Safety Association (EBSA-IBSA)	2007

S#	COUNTRY	ORGANISATION	YEAR FOUNDED
11	Qatar	-	-
13	Bahrain	-	-
15	Kuwait	-	-
18	Saudi Arabia	-	-
20	Syria	-	-
12	Turkey	Biotechnology Association of Turkey	1986
		Biosafety and Bio Economy Association of Turkey	?
14	Mauritania	-	-
16	Iran	Iranian Biosafety Association (NGO)	?2003
22	Iraq	-	-
17	Palestine	-	-
19	Sudan	-	-
21	Egypt	Egyptian Biological Safety Association (EGBSA)	2009
23	UAE	-	-
24	Yemen	Yemen Biosafety Association	Establishment in progress

FIG 2: Timeline Of Countries Joining the Cartagena Protocol:

The following timeline details the order in which various BMENA countries joined the Cartagena Protocol after its establishment in 1993.

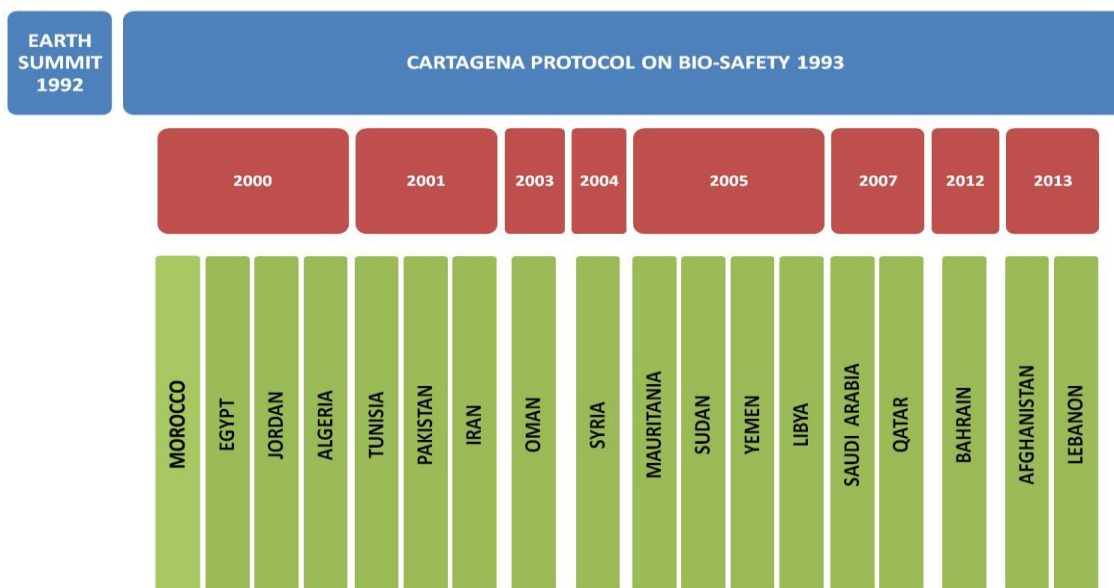


Fig 3: General Awareness and Education Workshops in the BMENA Region from 2001-2013 (by country)

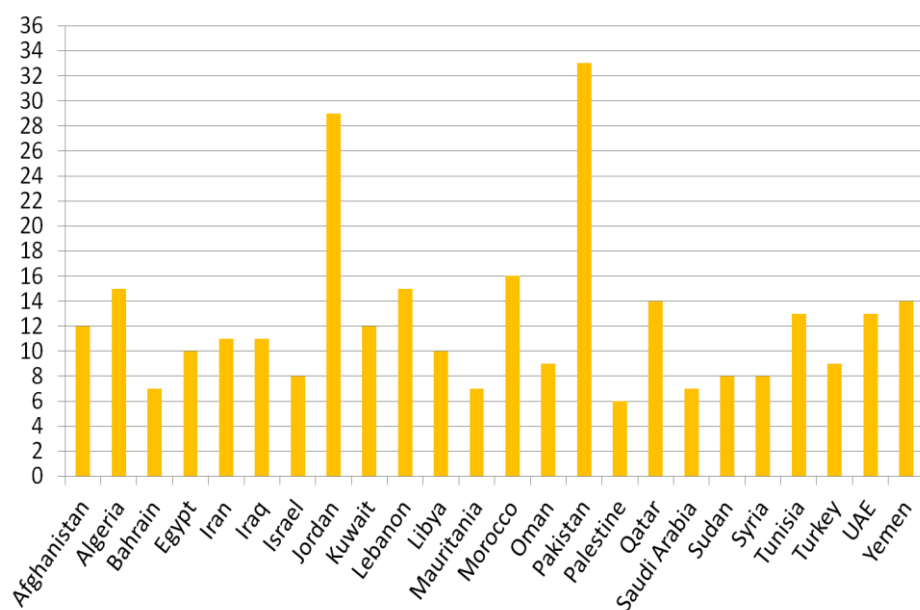
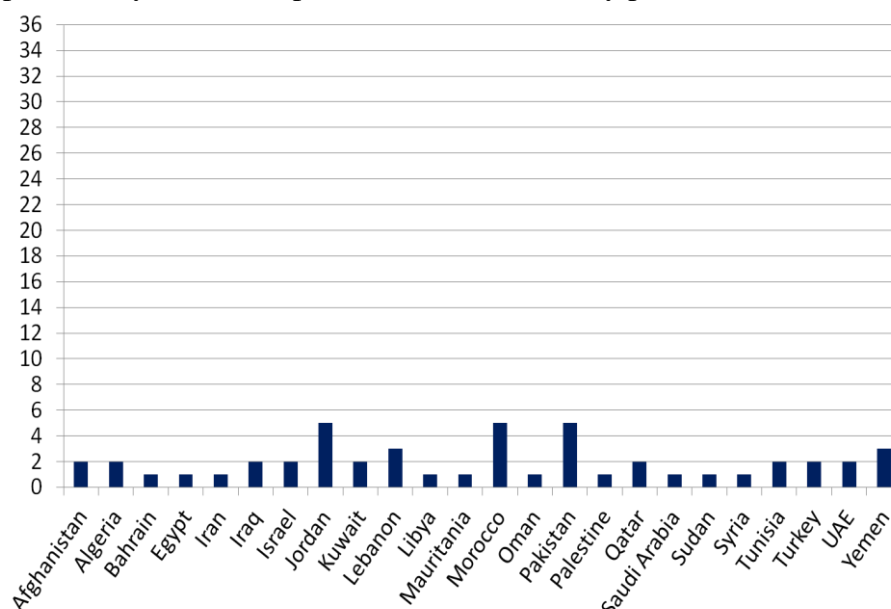


Fig. 4: Technology Transfer: 2001-2013

We considered technology transfer as any activity involving the introduction of a new technology to any country or institution, or any activity involved in increasing the proficiency of various professionals in biosafety practices.



TASK 2: Statistical Survey

The survey instrument is attached as Appendix D, and the raw survey response data are available as noted in Appendix E. The country coordinators, regional coordinators and/or the principal investigators generated lists of potential survey participants from membership rosters of biosafety or similar scientific societies from several BMENA countries. The original survey design called for country coordinators to send out survey participation

requests, which in practice was followed by some coordinators. In countries in which the internet was not sufficiently reliable, the Frontline Foundation staff created and sent survey participation requests at the behest of the country coordinators. In both distribution processes, the country coordinators' names, institutional affiliation, and title appeared as "recommending" survey participation. This was done to minimize fear of reprisal for offering comments or points of view that might be at odds with existing national or regional policies. This was done in addition to stating that all survey comments were anonymous and confidential.

The survey software used was SurveyMonkey (SM), an internationally recognized leader in online surveying technology. SM offers state-of-the-art features in both survey design and delivery capabilities. To help manage panels of potential survey respondents, SM has a dedicated email service called MailChimp, which allows for targeted delivery of requests for survey participation.

The survey was initially released as a pilot, using Pakistan as the test group. The pilot survey was released on 5 June 2013. Fifty requests were sent out, 25 individuals reviewed the survey, and 23 individuals agreed to participate. (The survey, as part of Institutional Review Board (IRB) protocol, requires respondents to agree to take the survey once they have read and understood the statement about any potential harm caused by participating in the survey. Only after they agreed were individual able to proceed to the questionnaire. After agreeing to participate and having the ability to read the survey questions, some respondents stopped participating. This step of gaining access to the body of survey questions is referred to as "reviewing" the survey.) The 50% participation rate was exceedingly high and probably due to the respect and personal relationship that respondents have with the co-PI in Pakistan.

The final survey was released on 30 June 2013. Approximately 215 invitations were sent out among 11 countries (some country associations had less than 30 members). Twenty-eight participants reviewed the survey and 23 agreed to participate. The 11% participation rate was slightly below our expectations. Generally, online survey requests are expected to receive a 15% to 20% response rate, but cultural differences and possible fear of responding (despite statements declaring that all data were confidential and anonymous) might have contributed to the slightly lower rate. Also, the increasing availability and use of online surveying might have adversely affected the response rate by contributing to "survey fatigue" among potential respondents. The survey results in this study may or may not indicate this type of fatigue or other possible circumstances might have affected this population sample. However AAAS conducted a separate survey with the same pool of potential participants and at the same time as the current survey.

Some of the country coordinators requested viewing the survey questions in hard copy before sending out the requests for participation. Because of the number of surveys that were reviewed but not completed, future surveys in the region might result in higher response rates if hard copies of the questions are provided to potential respondents allowing individuals determine if they feel the survey is too risky for participation. Within the pilot group, almost everyone who opened and reviewed the survey terms and objectives agreed to participate. During the main release of the survey, 18% of respondents who opened and reviewed the survey terms and objectives opted out; that is, they chose to not complete the survey.

CONCLUSIONS

The project objective was to assess the overall impact of biosafety capacity building initiatives undertaken in recent years in the BMENA region. The specific aims of the project were to help assess the impact of existing initiatives, identify and evaluate gaps in biosurveillance and implementation of biosafety practices from individual country perspectives, and recommend sustainable biosurveillance and biosafety programs from regional perspectives.

The Cartagena Protocol has been a catalyst for serious biosafety and biosecurity initiatives and capacity building efforts globally (excluding the United States, a non-signatory of the Cartagena Protocol). Most of the initiatives in the international arena have focused on developing national frameworks for biotechnology and practices such as control of genetically modified organisms and living modified organisms, and environmental effects of agricultural products such as Bt Cotton. However after September 11, 2001, the global focus of biosafety broadened to include fields such as biomedical, veterinary medicine, bioengineering and agriculture largely due to United States government initiatives. Specifically focusing on the BMENA region, biosafety priorities have concentrated on agricultural, biodiversity, and animal health issues rather than the biomedical and zoonotic concerns of the West. The terms “select agent,” “bio-threat reduction,” and “non-proliferation” were seen as U.S.-centric.

The general trend over the past 10-12 years has focused on donor agency interests in the region to promote biosafety and biosecurity, and local initiatives to create and sustain the high levels of technical competence in laboratory biosafety and biosecurity. However, **donor efforts have been seen by regional thought leaders and survey respondents as uncoordinated, duplicative, insufficient to effect much change toward safer laboratory practice, and largely unsustainable. Such views, real or merely perceived, can be best avoided by donors working more closely with regional groups such as the International Federation of Biosafety Associations, the African Biological Safety Association, or the Biosafety and Biosecurity International Consortium (BBIC) Process to coordinate efforts according to both regional and specific local needs.**

Certainly more sophisticated analysis and planning for capacity building needs is required in the region, as needs are different across the region and local solutions are more necessary than global solutions. **Donors need to develop more effective methods for promoting locally tailored, demand driven programs and projects. Developing common initiatives across BMENA regional networks would be an effective way to reduce duplication of efforts and resources.**

Various international organizations such as AAAS-CSTSP International Council for the Life Sciences, World Health Organization, U.S. Department of State Biosecurity Engagement Program, International Federation of Biosafety Associations, American Biological Safety Association, and U.N. Environment Program have provided funding for biosafety activities carried out in the BMENA region. Some funding organizations worked primarily with university scientists, but most collaborations were with local government authorities such as Ministry of Agriculture of Lebanon, Ministry of Regional Municipalities Environment and Water Resources of Oman, or National task force Pakistan. Successful completion of projects involving government agencies was often dependent on the political relationship between the donor and recipient country.

Collaboration with local nongovernmental organizations and universities – including the Kuwait Institute for Scientific Research, International Center for Genetic Engineering and Biotechnology, Al Najah University, Al Quds University, Aga Khan University Hospital, and Jordan University of Science and Technology - was primarily limited to seminars and training workshops.

Donors have largely limited training efforts to general or introductory courses on biosafety, apparently not recognizing the breadth and sophistication of the biosafety expertise that already exists in the region, or lacking coordination of program efforts with local thought leaders. **Future training efforts should focus on more in-depth and sustainable training, and include measurement of effectiveness through demonstrated competencies linked to the various specific professional responsibilities that make up the extremely broad range of agricultural and biomedical laboratory research, diagnostics, and forensics.** As in the rest of the world, individuals and institutions in the BMENA region must acquire capabilities across a range of laboratory biosafety functions with enhanced emphasis on learning-by-doing approaches. **More innovative yet targeted approaches for training and capacity building programs such as train-the-trainer, distance learning, and accredited training need to replace the heavy reliance on workshops as delivery mechanisms.**

Government-based projects have often been subject to premature halt or delay, mostly due to the fluid political scenarios in the region. **A serious exploration of potential roles for private sector donors to support capacity building activities in the region is needed as well.**

One challenge of this project was the various listings of the BMENA Region countries, and communicating “the region” with local thought leaders. A total of 24 countries - based on a World Health Organization listing - were included in this review. Table 1 outlined the initiatives undertaken by individual member countries in the BMENA region. Almost all countries listed in this BMENA region had some biosafety and biosecurity activity that was posted or announced on the internet, which was encouraging.

Countries with active functional nongovernmental biosafety associations had far more initiatives than those without such associations. Nonetheless, all of these countries hosted biosafety programs, reflecting the heightened concern in the region. Jordan appeared to be the regional hub for biosafety, biosecurity and biorisk activities, followed by Morocco, Pakistan and Egypt. These countries have organized and hosted national and international conferences, seminars and training workshops on various aspects of both agricultural and biomedical laboratory biosafety.

The desktop review showed an overall trend towards biosafety issues in biotechnology, risk assessment and mitigation, identification of living modified organisms, and biomedical laboratory sciences. Very little data were available for initiatives in other sectors associated with significant biosafety concerns such as veterinary and animal health sciences, chemical industry, or radiological industry.

Most of the initiatives have been in the form of general awareness and information exchange workshops at the country level, with very little cross talk at a broader regional level. The topics most commonly addressed in these awareness sessions included basic biosafety, biosecurity, bio-containment, and biorisk management. Other aspects included

bioterrorism and means to combat it, and bio-ethics and ethical dilemmas of dual use research.

Capacity building activities were difficult to assess, as they vary country-to-country depending on the local needs for successful execution of the biosafety and biosecurity practices. In this project, capacity building was defined as: 1) any initiative that was focused on technology transfer, hands-on training, assistance in the development of a national framework; or 2) sustainable projects with long term measureable outcome such as infectious disease surveillance, laboratory diagnosis, etc. in the region. Unfortunately very few initiatives were identified using key words “hands-on training” and “student exchange program, training centers, and disease surveillance.”

Conducting the survey proved to be much more difficult than anticipated, with the lessons learned about doing such a project probably being more valuable than the actual data collected. Although country leaders were enthusiastic about the project and felt empowered to be engaged, each individual country had so many specific requirements and special needs that it was not possible to launch the survey in a manner other than country by country. For example, some countries had more than one “biosafety association,” which was confusing at best, impeding the identification of relevant populations to survey, and being a source of considerable enmity throughout the region. Other countries actually had laws against “assembly” and therefore did not have professional societies as we know them in the West; however, social media has served as a means to create collegial interest groups of scientists that serve a similar function as professional societies.

This process was very slow, and prevented launching follow-up with non-responders during the project time period. We anticipate additional surveys coming in over the next few months after the official completion of the project, and the co-PIs and country leaders plan to continue following up with non-responders with the hopes of achieving statistically relevant results on a country-by-country basis that can be published in appropriate scientific journals.

To foster sustainable regional biosurveillance, cooperative research, and biosafety programs, the co-PIs plan to present more broadly the findings, opportunities, and strategies for cooperative regional engagement to the scientific and policy-making communities in the region through publication of results on the internet and in appropriate scientific journals.

In addition, three innovations were piloted with privately donated funds to Frontline Foundation. As participation incentives for the project’s country leaders, Frontline Foundation provided each country leader with a new iPad-mini, plus the opportunity for one country leader to attend the 2013 Annual Biosafety and Biosecurity Training Course (BBTC) at Colorado State University (USA) from July 11 to 18, 2013. The sponsorship included round trip coach airfare, the training course tuition, lodging, and per diem funds for meals not included in the course registration fee. Topics presented at this prestigious meeting included general biosafety, biosafety and biosecurity in animal research and veterinary clinics; plant research and diagnostics (including a plant research facility tour); Select Agent regulation updates (Tier 1); laboratory and Select Agent inspection preparations; and building design and operations. The 2013 BBTC program was approved for the American Biological Safety Association (ABSA) Certification Maintenance Points (CM Points) for biosafety professionals as well as for American Association of Veterinary

State Boards (AAVSB) Registry of Approved Continuing Education (RACE) credits for veterinarians and veterinary technicians.

Frontline Foundation also provided a sponsorship for a project country leader to participate in the CDC Biosafety Symposium in January 2014. This sponsorship will include round trip coach airfare, symposium registration, lodging, and per diem funds for meals not included in the registration fee.

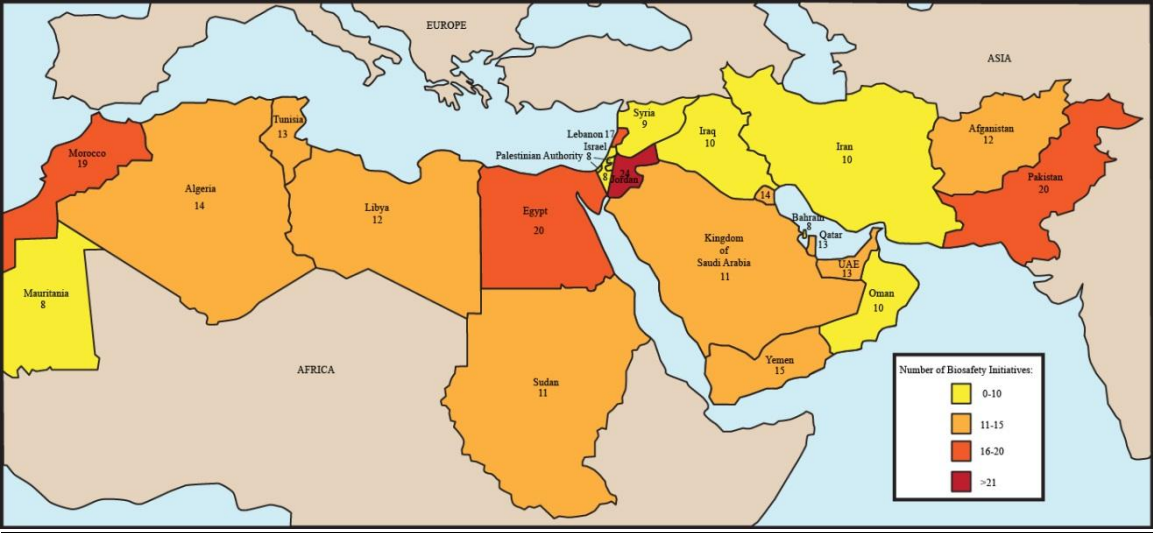
Finally, through its Global Biorisk Management Institute, Frontline Foundation will provide to all survey respondents the opportunity to take three of its on-line, internationally accredited training courses at no cost.

The project benefits for the BMENA region that were achieved include:

- Cataloguing biosafety engagement activities throughout the region, thereby identifying significant duplication of efforts;
- Demonstrating the need for more advanced training and collaborative engagement activities in biosafety;
- Identifying successful regional nongovernmental organizations for conducting more advanced training and collaborative engagement activities in biosafety;
- Building a team of country leaders for continuing collaborative research opportunities;
- Demonstrating a successful model for conducting regional survey sampling; and
- Piloting internationally accredited distance-learning courses in the region.

End

APPENDIX A: BMENA REGION MAP



APPENDIX B: BIOSAFETY INITIATIVES BY COUNTRY

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APPENDIX C: PROJECT TEAM

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APPENDIX D: SURVEY INSTRUMENT

BMENA Survey

Capacity Building /Gap Analysis Questionnaire

Thank you for agreeing to take part in this landmark survey. We estimate that the survey should take no longer than 20 minutes to complete. Please be aware of the following limitations of the online survey tool. The survey tool does not allow for completion in more than one session, that is, the survey tool does not allow for saving responses and allowing you to resume at another time. Please make certain that you have reserved an occasion when you have sufficient time to complete the survey in a single session.

In order to participate, you are required to read and agree to the terms of the Institutional Review Board (IRB) policy on human subject testing, as described below:

Investigators:

Dr Erum Khan (Associate Professor), Department of Pathology/Microbiology, Aga Khan University, Pakistan
Dr Murray Cohen (Director), Frontline Foundation USA

Funding Agency: American Association for Advancement of Science USA

Purpose of the study: The project objectives are to assess the overall impact of global biosecurity capacity building initiatives undertaken in recent years in the Broader MENA region, and to build regional cooperative opportunities. The project will help assess the impact of existing initiatives, identify and evaluate gaps in biosurveillance and implementation of biosafety practices from individual country perspectives and recommend sustainable biosurveillance and biosafety programs from regional perspectives.

You are being asked to voluntarily join this research as a subject expert, to review and give your input.

Procedure: If you agree to enter the study, you will be invited to attend a webinar to discuss the report and questionnaire.

Risk: None.

Benefits: There is no direct benefit of this research for you however the outcomes will help in identifying gaps in laboratory biosafety in the Broader MENA region and help policy makers with future strategies

Compensation: Whether or not you agree to fill out the survey, you will be allowed to take up to four on-line biosafety programs from Frontline Foundation (which is a USD \$100 value). This is offered simply for being selected in the sample of life scientists in your country.

Confidentiality: Investigators and researcher involved in this project will ensure confidentiality of your identity. Your identity will not be disclosed to anyone other than investigators. However, Aga Khan University Ethical Review Committee (AKU-ERC) may inspect any records/questionnaire obtained as a result of your participation in this study.

Alternative to participation: You may decide to withdraw from this study at any time by informing research team without any reimbursement or repercussions.

Contact: You can contact the following should you have any questions regarding your participation.

Dr Erum Khan (Phone): 9221-34861605; (Email): erum.khan@aku.edu

Dr Murray Cohen (Phone): 678-781-5241; (Email): mcohen@frontlinefoundation.org

BMENA Survey

***By selecting the "Yes" button below, I confirm that I have read all the IRB information carefully and that I agree to all of its terms. I understand that I can request clarification from the study's principal investigators should I have any questions.**

- ☐ Yes
- ☐ No, I decline to participate in the survey.

Please be aware of the following limitations of the online survey tool.

The survey tool does **not** allow for completion in more than one session, that is, the survey tool does not allow for saving responses and allowing you to resume at another time. Please make certain that you have reserved an occasion when you have sufficient time to complete the survey in a single session.

If you should experience technical difficulties that do not allow you to complete the survey in a single session, please contact either Dr Khan or Dr Cohen for instructions on how to retake the survey.

Glossary of terms used in survey:

- Biological Safety Cabinet (BSC)
- Genetically Modified Organism (GMO)
- Heating, Ventilation, and Air conditioning (HVAC)
- Non-Governmental Organization(s) (NGO)
- Safe Operating Procedure(s) (SOP)

Demographic Identification

You may have worked in the biorisk field in more than one BMENA country. Please list the country in which you are currently working.

- ☐ Algeria
- ☐ Egypt
- ☐ Jordan
- ☐ Kuwait
- ☐ Morocco
- ☐ Pakistan
- ☐ Saudi Arabia
- ☐ Sudan
- ☐ Tunisia
- ☐ UAE
- ☐ Yemen

Other (please specify)

BMENA Survey

Have you had any experience as a laboratory worker in [Q2] in biology laboratories?

- ☐ Yes
☐ No

Have you had any experience in [Q2] as a laboratory director or manager in biology laboratories?

- ☐ Yes
☐ No

Have you had any experience in [Q2] in a job where your responsibilities included biosafety or biorisk management?

- ☐ Yes
☐ No

Have you had any experience in [Q2] as a professor, teacher, or instructor in biosafety or biorisk management?

- ☐ Yes
☐ No

Have you had any experience in [Q2] as an elected or appointed government official with any responsibilities in biosafety or biorisk management?

- ☐ Yes
☐ No

Biosafety

Are you aware of any programs for the development of biorisk management in [Q2]?

- ☐ Yes
☐ No

BMENA Survey

Are these programs for the development of biorisk management systems made available by: (Choose as many as apply)

- ☐ Government
- ☐ Universities
- ☐ Non-Governmental Organization(s) ([NGOs](#))
- ☐ Private companies
- ☐ Professional or Scientific Societies

Other (please specify)

Are you aware of any existing or pending legislation or government regulations in the area of biorisk management in [Q2]?

- ☐ Yes
- ☐ No

BMENA Survey

Please give your professional opinion related to [Q2] on the following issues using the scale provided below:

	Excellent	Good	Average	Poor	Very Poor	N/A
Availability of technically skilled laboratory workers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of skilled biosafety professionals, or biorisk managers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of scientists skilled in risk assessment for biohazards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of technicians skilled in overseeing effective engineering controls: (HVAC , BSC , etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of technically skilled professionals to oversee laboratory design	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of technically skilled workers for laboratory operation and maintenance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of technically skilled workers for handling/transfer of GMO	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of technically skilled workers for handling/transfer of potentially infectious material	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of technically skilled animal handling workers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of technically skilled workers with bloodborne pathogens	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of infrastructure and professional staff to implement biorisk management programs, including SOP	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of accredited biorisk training for senior scientists	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of accredited biorisk training for lab directors or managers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of accredited biorisk training for university and graduate students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of accredited biorisk training/teaching resources and materials	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of institutional biorisk management oversight, such as laboratory audits or regulatory compliance assistance, or institutional biorisk management committees	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Are you aware of any international initiatives or programs on biorisk management that have been conducted in [Q2] or your region over the past five years?

☐ Yes

☐ No

BMENA Survey

Please list the name(s) of sponsor agency/agencies?

- ☐ American Association for the Advancement of Science Center for Science, Technology and Security Policy (AAAS)
- ☐ AGERI
- ☐ Alfred P Sloan Foundation of New York
- ☐ Al-Quds University
- ☐ An-Najah National University
- ☐ Association for Lebanese Organic Agriculture (ALOA)
- ☐ BEC
- ☐ BBIC
- ☐ BIBC
- ☐ Biological Safety Associations (e.g., African, American, Asia Pacific, Egypt, Moroccan, Pakistan, Philippines)
- ☐ Canadian Biosafety Symposium
- ☐ CDRF Global
- ☐ Committee on Scientific and Technological Cooperation of the Organisation of the Islamic Conference (COMSTech)
- ☐ EAD
- ☐ Edmund A. Walsh School of Foreign Service's Science and Technology & International Affairs Program (TIA)
- ☐ Egyptian Environmental Affair Agency
- ☐ Environment Agency of Abu Dhabi
- ☐ EU-RL GMFF
- ☐ Government of the United Arab Emirates
- ☐ HEC,AKU
- ☐ International Federation of Biosafety Associations (IFBA)
- ☐ International Council for the Life Sciences (ICLS)
- ☐ Institut Pasteur de Tunis
- ☐ ISC
- ☐ Islamic Academy of Sciences
- ☐ Islamic Educational, Scientific, and Cultural Organization
- ☐ International Service for National Agricultural Research, International Food Policy Research Institute (ISNAR)
- ☐ Jordan University of Sciences and Technology, H.R.H. Princess Haya Biotechnology Center (JUST)
- ☐ Karachi Institute for Biotechnology and Genetic Engineering (KIBGE)
- ☐ King Saud University
- ☐ Kuwait Institute of Scientific Research (KISR)
- ☐ Landau Network-Centro Volta

BMENA Survey

- ☐ Middle East Scientific Institute for Security
- ☐ Ministry of Agriculture, Lebanon
- ☐ Ministry of Science and Technology, Khartoum, Sudan
- ☐ Moroccan Ministry of Education, Higher Education, Training and Scientific Research
- ☐ National Committee for Biosafety, Ministry of Environment, Qatar
- ☐ OIE Regional Commission for Africa
- ☐ PHBC
- ☐ Qatar Foundation for Education, Science, and Community Development
- ☐ Robert and Ardis James Foundation of New York
- ☐ Sandia Lab/IBTR
- ☐ UK HPA
- ☐ United Nations: UNESCO, WHO
- ☐ U.S. Department of State's Biosecurity Engagement Program (BEP)

Others (please specify)

In your opinion, is the international initiative or program sustainable at your local level?

- ☐ Yes
- ☐ No
- ☐ Do not know

Do you know of any follow up program(s) or organizations to sustain the initiatives or programs in [Q2]?

- ☐ Yes
- ☐ No

In your opinion, are any projects to build biosafety or biorisk management capacity in [Q2] or your region established according to the local needs or demands?

- ☐ Yes
- ☐ No
- ☐ Do not know

BMENA Survey

If you are aware of any outcomes of these local or regional or international initiatives or capacity building projects, please explain below. If you are not aware, or if you don't want to elaborate, please leave this question blank.

Are there any other scientific collaborative projects in the region in which [Q2] participates?

- ☐ Yes
- ☐ No
- ☐ Do not know

Please list project names or agency sponsors. If you are not aware, or if you don't want to elaborate, please leave this question blank.

Project1	<input type="text"/>
Project2	<input type="text"/>
Project3	<input type="text"/>
Project4	<input type="text"/>
Project5	<input type="text"/>

Should biorisk management projects be linked with other regional scientific networks such as biosafety, Infectious disease, biotechnology, or environmental societies, etc.? If you think so, please explain why. If you are not aware, or if you don't want to elaborate, please leave this question blank.

BMENA Survey

Please list the name(s) of sponsor agency/agencies?

- ☐ American Association for the Advancement of Science Center for Science, Technology and Security Policy (AAAS)
- ☐ AGERI
- ☐ Alfred P Sloan Foundation of New York
- ☐ Al-Quds University
- ☐ An-Najah National University
- ☐ Association for Lebanese Organic Agriculture (ALOA)
- ☐ BEC
- ☐ BBIC
- ☐ BIBC
- ☐ Biological Safety Associations (e.g., African, American, Asia Pacific, Egypt, Moroccan, Pakistan, Philippines)
- ☐ Canadian Biosafety Symposium
- ☐ CDRF Global
- ☐ Committee on Scientific and Technological Cooperation of the Organisation of the Islamic Conference (COMSTech)
- ☐ EAD
- ☐ Edmund A. Walsh School of Foreign Service's Science and Technology & International Affairs Program (TIA)
- ☐ Egyptian Environmental Affair Agency
- ☐ Environment Agency of Abu Dhabi
- ☐ EU-RL GMFF
- ☐ Government of the United Arab Emirates
- ☐ HEC,AKU
- ☐ International Federation of Biosafety Associations (IFBA)
- ☐ International Council for the Life Sciences (ICLS)
- ☐ Institut Pasteur de Tunis
- ☐ ISC
- ☐ Islamic Academy of Sciences
- ☐ Islamic Educational, Scientific, and Cultural Organization
- ☐ International Service for National Agricultural Research, International Food Policy Research Institute (ISNAR)
- ☐ Jordan University of Sciences and Technology, H.R.H. Princess Haya Biotechnology Center (JUST)
- ☐ Karachi Institute for Biotechnology and Genetic Engineering (KIBGE)
- ☐ King Saud University
- ☐ Kuwait Institute of Scientific Research (KISR)
- ☐ Landau Network-Centro Volta

BMENA Survey

- ☐ Middle East Scientific Institute for Security
- ☐ Ministry of Agriculture, Lebanon
- ☐ Ministry of Science and Technology, Khartoum, Sudan
- ☐ Moroccan Ministry of Education, Higher Education, Training and Scientific Research
- ☐ National Committee for Biosafety, Ministry of Environment, Qatar
- ☐ OIE Regional Commission for Africa
- ☐ PHBC
- ☐ Qatar Foundation for Education, Science, and Community Development
- ☐ Robert and Ardis James Foundation of New York
- ☐ Sandia Lab/IBTR
- ☐ UK HPA
- ☐ United Nations: UNESCO, WHO
- ☐ U.S. Department of State's Biosecurity Engagement Program (BEP)

Others (please specify)

From your perspective, what are the opportunities in [Q2] for developing regional or international collaborations in biorisk management and/or life sciences research? If you are not aware, or if you don't want to elaborate, please leave this question blank.

Do you know of any agencies or programs or organizations in [Q2] that might be interested in investing or participating in regional or international collaborations in biorisk management and/or life sciences research? If yes, please respond below. If not, please leave blank.

If you would like to make suggestions or add comments to issues not appearing in this survey, please add them below. If you do not want to elaborate, please leave this question blank.

BMENA Survey

If you would like to take part in additional discussions relating biosafety or biorisk management to circumstances in [Q2], please provide your email below. (Your email will NOT be stored or reported in ANY WAY with your answers to this survey; your email will simply be provided to Aga Khan University for follow up research, workshops, or biorisk management programs.)

Thank you for participating in this important research project!

APPENDIX E: RAW SURVEY DATA

The complete survey data are compiled into sixty three pages, in two separate files - the pilot data and actual survey data. These files can be previewed and/or downloaded from Frontline Foundation's cloud-based data storage at:

<https://www.filesanywhere.com/fs/v.aspx?v=8b6b638b5b6772acabad>

Commissioned Paper: New Approaches for Future Bioengagement in the MENA Region

*International Biosecurity:
Engagement between American and BMENA Scientists*

Judi Sture

Bradford Disarmament Research Centre

“I just don’t know why they’re shooting at us. All we want to do is bring them democracy and white bread. Transplant the American dream: freedom, achievement, hyper-acidity, affluence, flatulence, technology, tension, the inalienable right to an early coronary sitting at your desk while plotting to stab your boss in the back.”

**Captain Benjamin Franklin "Hawkeye" Pierce, BS, MD,
Mobile Army Surgical Hospital (MASH) 4077th, Korean
War⁷²**

Introduction

Science and scientific practice cannot be viewed as existing in a technological bubble, or in terms of it being a culture of its own – it always exists and is practiced in cultural settings that dictate values and norms about social organization, economics, technology, religious ideals and linguistics to those who live and grow up within those settings. To be a scientist is not an identity that supersedes a scientist’s cultural identity – s/he is a scientist *in terms of what that means in his/her culture*. And that may be a very different identity to being a scientist in the U.S. or in the UK. Scientists who belong to non-Western cultures are subject to the pressures, benefits and drawbacks of those cultures. We in the West tend to assume that our overseas colleagues will use the same decision-making processes, the same values and determine priorities in exactly the same way that we do. Sometimes they do, sometimes they don’t. Our cultural background drives the ways in which we make decisions and value-judgments, and it is arguably the principal driver behind our ways of prioritizing needs and actions. This is perhaps the major way in which scientists from various cultures differ. We need to acquire awareness, knowledge and understanding about these determining factors, and only then can we use these to apply ourselves in a skillful way to work with overseas colleagues effectively. We don’t need to fully understand in detail what lies behind the motivations of our overseas colleagues, but as long as we recognize that their personal and professional motivations are driven and influenced by significantly different pressures than those that apply to us, then we will be more than halfway to meeting them.

⁷² Hawkeye Pierce was a fictional surgeon in the 20th Century Fox/CBS TV series *M*A*S*H*, who memorably encountered many of the cultural difficulties of war, in an effort to “bring peace”. See: <http://www.imdb.com/title/tt0068098/>

This paper seeks to introduce a number of cultural and inter-cultural concepts and ideas, as a foundation on which to construct a culturally-sensitive and responsive approach to the issue of bio-engagement between scientists, science educators, science policy makers and other science stakeholders in the BMENA region and partners from the U.S. The concepts introduced here could be applied in any international context, but given the remit of the project for which this paper is being prepared, I will refer largely to the BMENA region.

It is not my intention to come up with a “grand plan” of how future collaborations and interventions should be carried out. Rather, I will use this opportunity to consider what we know of cultural differences between what we typically refer to as “the West” and other regions of the world, and go on to suggest a model that could be used in planning any work involving collaboration between Western and non-Western partners. In my opinion and experience, there is no “method” of intercultural cooperation, rather, successful relationships and outcomes depend on an increased *understanding* of “the other”. If understanding is increased, changes in action can follow, and success is more likely to result. So most of this paper will be given over to increasing readers’ understanding of what culture is and is not, and how it affects the individual living in it. From there, it is not difficult to effect change.

It is, or should be, patently obvious that there is no “one size fits all” approach to working with multi-cultural partners, although sometimes one would be hard pressed to argue this perspective when looking around at current and past efforts in this direction. I have chosen not to present this piece as a standard academic paper, but rather as a discussion of ideas about how we might best think about cultural differences in the practical forum of bio-engagement. My aim is, after all, to encourage readers to adapt their thoughts and attitudes, and the best way to do that is to enthuse rather than to lecture. Hopefully, changed thoughts will lead to changed attitudes and understanding, and then to changed actions. I have included some citations as necessary in the course of writing, but these are not meant to be comprehensive or exhaustive, more as guides for interested readers to follow up.

My personal views on this subject, based on a moderate record of bio-engagement interaction prior to writing this paper⁷³, are bolstered by my background in anthropology, which has provided me with a set of skills and insights that enable me to comment on this topic with a degree of understanding of cultural relationships that others in the bio-engagement field may not have. This is not a criticism of colleagues, merely an observation. I cannot comment on deep and intricate aspects of science, but I defer to those who have such skills. Let’s contribute what insightful expertise we have.

As I frequently instruct my PhD students, it is usually helpful for readers to know where the author of a paper is “coming from”, so I should therefore identify my own academic and social background at the beginning of this paper, so that readers may interpret my thoughts in the light of their own views of my qualifications and experience (and, of course, their own cultural background). I have done this in Section One of the paper, so that having nailed my colors to the mast, I hope that readers can have at least some understanding of my perspective on inter-cultural issues.

⁷³ I have worked on bio-engagement in and with partners in Iraq, Jordan, Tunisia, Dubai, Algeria, Morocco, Libya, Kazakhstan, Tajikistan, Azerbaijan, Pakistan, Georgia, Ukraine, Armenia, Egypt, Kyrgyz Republic, Saudi Arabia and other countries, and have been working for several years on activities to support the Biological and Toxin Weapons Convention; I have presented my work on numerous occasions at the United Nations in Geneva; my work has been funded by several UK and international agencies and funding councils.

The second part of the paper introduces some cultural theories and research, highlighting ways to increase our understanding of our own cultures as well as those of other people. I include here some points that we can take from these culture theories in the context of bio-engagement practice. In this section, I have chosen to present in some detail two frameworks of culture. The first is an archaeological theory of culture, derived from the study of the material remains left behind by past societies. This approach is a useful one, in my opinion, and although it comes from archaeology, don't let this put you off. Archaeology is classified, in the U.S., as a branch of anthropology; in the UK and elsewhere it is considered to be more closely related to history. Either way, the discipline is heavily involved in trying to understand unfamiliar cultures, so it's a good starting point for us. The model of culture that archaeologists employ looks at five domains of culture, and these provide both an explanation in themselves, but also serve further as a lens, or group of five lenses, through which to investigate all the abstract concepts of culture, such as politics, work, health, knowledge, and so on. The second framework I introduce is that of Geert Hofstede, a Dutch social psychologist who has worked in academia since the 1970s, following his work and organizational culture research with IBM in Europe in the late 1960s. His influential works include *Culture's Consequences* (1980, reprint 2001) and *Cultures and Organizations: Software of the Mind* (2010). Perhaps his leading idea is that of "cultural dimensions", a theory that proposes, and identifies, a range of cultural concepts that are common across all human communities, but which can differ significantly according to nationality or national culture. His ideas have been aimed at, and taken up by, the world of management and organizational studies primarily, but his insights also offer much to those working in other dimensions – development, security, aid, healthcare, education and more. His theories work by comparing cultures with other cultures and involve quantification of cultural concepts.

I must admit that the social scientist in me is not too happy with the notion of "measuring" and categorizing human reactions and experiences, which Hofstede appears to have accomplished to a high degree. However, given that we are, in the context of bio-engagement, working with scientists and as scientists, not to mention, policy-makers, funding bodies and politicians, like a good statistic, Hofstede seems to fit the bill. As getting people to engage with the idea of cultural issues in science partnerships is one of the key aims of this project, it seems a good idea to use a framework that will appeal to scientists. Further, Hofstede's findings have been repeated and built on by others, lending an authenticity to his theories that indicate a degree of reliability in his work. The only caveat that I would highlight is this: please read work by Hofstede (and others following his ideas) in the correct manner. Hofstede is talking about national cultures and dimensions of culture in the national context: this means he is talking about national culture *at a population level* not at an individual level. *We cannot infer national characteristics in an individual just because s/he "belongs" to such and such a national group.* I cannot emphasize that point enough. Just consider how different many of your U.S. friends are in their views, habits and beliefs. It would be very unhelpful if we bunched all U.S. folks into a single cultural category, so why should we do this when thinking about better ways to understand our overseas colleagues and their cultures? This avoidance of "cultural labeling" has major implications for our bio-engagement practice, and I will talk about this in some detail in the paper. As long as we bear this in mind, I think Hofstede's ideas can offer useful suggestions to us. To balance the quantitative elements of Hofstede, I have also included in the first section some theories from Intercultural Relations and from the archaeological concept of culture, which I have used very successfully for years with my social science PhD students. These are far more "loose" in terms of theory and offer a good balance to the "if we can't measure it, it doesn't exist" approach.

Finally in the second part of the paper, I introduce, very briefly, Maslow's *Hierarchy of Needs*, a psychological model that deals with personal development, motivation and achievement of potential. I follow this with a very brief, but important, introduction to Cultural Competence Theory. This model is derived from the healthcare system in the U.S. It draws heavily on the work of Hoftsedde, and I propose that it is also a useful tool for us to use when planning, carrying out and evaluating biosecurity support work overseas.

In the third part of the paper, I start by providing some examples of problematic inter-cultural communications; I only do this to give some examples in which better cultural awareness preparation would have minimized the problematic behavior, not as a judgment call. I then build on the two main frameworks introduced in Section Two by showing how we may use some of them to improve our understanding of where our bio-engagement partners are "coming from", both as individuals (to some extent) and as members of "other" societies. One of my principal points throughout this paper is that just because "we are all scientists", we cannot assume that being a scientist somehow washes away all of our existing cultural baggage. *Being a scientist is not a culture-neutral occupation – it is an educated occupation based on the cultural foundations on which the individual scientist grew up and became an adult.* This means that every scientist is a product of his original, or dominant, culture, and this can result in each scientist having different views on the same issue depending on his cultural background. Of course, differing views can lead to differing practice and choice of scientific activity. Often, the cultural background is invisible and onlookers cannot see what the foundations are underneath any given view or practice, leading to questioning, disagreement and confusion. This recognition of cultural difference in *thinking* (often leading to different *behaving*) is a challenge to the common view that I encounter fairly regularly – "all scientists are scientists first, and being a scientist over-rides everything else". It doesn't. And we need to get over that if we want to work effectively with partners in other countries. I trust that this paper will have some practical uses.

SECTION ONE - CULTURAL BACKGROUND AS A MAJOR DRIVER OF WORLDVIEW

What qualifications do I have to write this paper?

Ignatius Loyola, founder of the Jesuits, famously said (allegedly) "Give me the child until he is seven years old and I will give you the man". This just about describes my experience as a child and then as an adult. It's also good to think of this in all of our interactions with friends and colleagues who come from different backgrounds. As I said in the introduction, it is useful to explain my own cultural background so that readers can interpret what I say, knowing "where I am coming from".

My background as an "intercultural" person

I am currently Head of the Graduate School and a tenured academic at a northern UK university⁷⁴ working in both postgraduate social sciences and in international biosecurity and biorisk management. My BSc (Hons) is in Archaeology (a branch of anthropology) and my PhD is in Biological Anthropology. Before I entered academia, I was a registered nurse for some years. I grew up with two social workers for parents, and spent my early years in Australia, where my life course as an anthropologist was laid out for me from childhood onwards when my parents took me to live in the Western Desert with a community of

⁷⁴ Head of the Graduate School, University of Bradford, UK; senior lecturer in Research Methods and Research Ethics; Research Fellow in Bradford Disarmament Research Centre, University of Bradford. See: www.brad.ac.uk/bioethics

Aboriginal people who had been displaced by the policies of the then Australian government. For some time, I was the only white child in our tiny mission school (around 50 children). Our healthcare was provided by the flying doctor and we had only a shortwave radio to connect us with the rest of the world. We really did live in the “back of beyond”. The nearest town was 200 miles away in one direction, and well over 1000 miles in the other direction.

We had an anthropologist living with us, and his regular questions to me - “have you seen this?”, “do you know the word for this?”, “what do you think this means?” and “can you find this out for me?” (kids get better access to secrets) - quickly illustrated to me how three cultures living together can have vastly differing views and interpretations of exactly the same event or processes. We were British and our tame anthropologist was American. We lived with an ancient aboriginal culture that was being decimated by the efforts of “whitefellas” as they tried to “integrate” the Aborigines into the Australian nation. The fact that the Aborigines *were* the original Australian nation did not seem to register at that time on a significant scale to many people.

From an early age I saw first-hand what damage cultural misunderstandings could do. For example: try explaining what a government old-age pension is to an elderly Aboriginal man who does not speak English, has never worked (in the Western sense), does not know his age (was he eligible for a pension or not?), has no Western name and cannot spell his Aboriginal name, does not understand the concept of money (there were no proper shops in the desert anyway), and has lived as a nomadic hunter-gatherer all his life until one day aliens rounded up him and his family and transported them to a place called a sheep station where he and his family had to live in a permanent camp with other people all the time. From his pension, the only place he could spend his money was in the station store, where he could buy clothes (second hand, and why should he wear them anyway), tea, sugar, flour and one or two other food items depending on what was available. As he does not understand what money is, he expects change at every transaction, even if he is not owed any – then he gets annoyed. Some of his money is saved for him in a named account, but how can you explain what “saving money” means to our old Aboriginal man? We give him money, but as he can’t spend most of it, we keep some of it in a magical secret place where it will live safely, while he returns to his camp, no better off in many ways, but apparently integrated in some way into “being an Australian”. And then we repeat it all next week or next month. Amazingly, this did not seem to upset our elderly Aboriginal man, as he just let the “whitefellas” get on with whatever kept them happy, returning to camp to hunt his own meat and engage in activities that actually meant something to him. His younger relatives would be engaged intermittently in seasonal work on the station and occasionally managed to acquire alcohol and cigarettes if they got hold of any from folks who had walked to other settlements. When work was not available, the young folks were unemployed and therefore had no income. The whole set-up was very colonial in nature, and led to much cultural misunderstanding, of which we had plenty. Add in the owners of neighboring stations who believed it was acceptable to shoot Aborigines when they strayed onto “their” land, and you get the picture.

Different start, different skills, different perspective

Consequently, I was hooked on understanding how “others” feel and see life. While my future British school friends were playing hop-sotch on paved UK streets, I was helping my parents with all sorts of crazy things in the desert that opened my eyes to a wider world than that of children’s television and seaside holidays. Of course, when my parents decided to return “home” to the UK, I was actually going to live in a foreign country. I arrived in the

UK thinking that it was cruel to keep budgerigars in cages as pets because where I came from, they were wild birds; I did not know what a Kit Kat was; I had no knowledge of popular culture; I did not understand English slang or how to make friends with English kids. I just didn't understand how it worked to be English in England. Had I spoken a foreign language, I would have had an easier time as people would have recognized how "foreign" I actually was. *Because* I was a native English speaker, in the old mission school I had been ahead of the rest of the two classes, so I educated myself by reading encyclopedias while sitting in a large cupboard. In England, however, I had to sit at a desk and do proper lessons and I hated it for a long time. I also hated wearing shoes because I never wore them in Australia – only sandals to stop my feet from burning on the sand. I had a strange accent and was pestered as a zoo-specimen by other kids prodding me and saying "say something in Australian then". This really endeared English people to me.

It is hardly surprising that I have never felt British in the same way that my friends do and I still experience culture shock years later. This strange personal identity was further compounded by the fact that my mother's family originate from Norway, so there was another addition to the mix – I wasn't even properly "English" (you will note that my name is Swedish-Norwegian – I use my mother's family name).

Third Culture Kids

I was relieved, eventually, to find out that I am what is known as a "third culture kid", a TCK – one of those children who was raised in one country and returned by their parents to their "own" passport country – only to find that they don't actually belong to it⁷⁵. Neither, of course, do third culture kids belong to the country of their early upbringing – they just lived there for a few years. So – forgive my self-indulgence here – it does have a purpose – I think I have a built-in cultural awareness that I suspect is not as common among educated adults as we often like to think. It is apparently a fairly common characteristic among third culture kids to have a wide understanding, and rapport with, a range of other global cultures⁷⁶. I guess this is what fitted me to be an anthropologist. I was awarded my degree in Biological Anthropology in 2002 at the University of Durham, England, and since then I have branched into research ethics, research methods and now biosecurity studies. A long way around! However, it is interesting to me to see how many of my colleagues in the field of biosecurity education are also from non-standard academic backgrounds – I guess that experience in the "real world" outside the ivory towers of academia has its uses.

Finally in this introductory section, I just want to say that I recognize that those of you reading this who are also TCKs, or who have multi-cultural parents, or who have studied in the West or anywhere outside your own country, or who have lived in a country other than your own for some significant length of time as an adult - *you* will really "get" what I am talking about here. Great. For those of you have been fairly monocultural so far, simply as a factor of your upbringing and life to date, *please* do bear with me when some of this sounds strange, illogical or completely ridiculous. There is a point to my lengthy introduction and focus on a third culture here.

⁷⁵ Pollock, DC. and van Reken, RE., 2009 *Third Culture Kids: growing up among worlds* London: Nicholas Brearley

⁷⁶ Davis, P., Headley, K., Bazemore, T., Cervo, J., Sinkinger, P., Windham, M. Rehfuss, M., 2010 Evaluating Impact Of Transition Seminars On Missionary Kids' Depression, Anxiety, Stress, And Well-Being. *Journal of Psychology & Theology*, 38(3), 186-194.

Third Culture Biosecurity

I feel very strongly that this concept of a “third culture” is also highly relevant to our biosecurity community. We all come from our own cultural background. We are all stakeholders in science and biosecurity. We are also aiming to meet one another in some central spot where it all makes sense to everyone and where we can all communicate and share ideas *on an equal footing*. It seems to me that this central spot is actually a third culture too – the biosecurity culture – and to join it, we all need to recognize that we are, first and foremost, members of our own culture - Arab, European, American, Hispanic, Far Eastern, Asian and so on. Of course, within these cultural identities we have sub-groups who may love or hate each other, adding a further level to the mix. And secondly, we are scientists, educators, science managers, policy makers and the like. This second level of identity has typically been assumed, in the past, to overcome or to remove our first identity – our “home” identity. It doesn’t. We really need to get past this idea that being a scientist somehow makes you into a different being from the rest of your friends and family. Thirdly, in my opinion, we are seeking to be members of a third level, or a third culture, where we are *both* home culture individuals *and* scientists (or whatever type of stakeholder you are).

It is only in this central, third culture, that we can really have a chance to effectively communicate with our colleagues, and for both of us to truly appreciate the challenges that we face as *people* (in our roles as marriage partner, parent, child, home owner, food-provider, and so on) and as *professionals* (scientist, educator, employee, boss, manager, budget-holder, planner, policy-maker and so on).

We can start by recognizing that to our overseas colleagues, *we* are the “others” – and although we belong to a domineering culture, to them, we may be the odd ones, the weird ones and the awkward, problematic ones. The biggest goal, in my opinion, that we can achieve personally when working with colleagues from different cultures, whether in our own country or in theirs, or in someone else’s, is the ability to step outside of our own version of “normal – that is, our own cultural space - into the “third culture” space where we can truly recognize and accept that what is strange, odd, crazy or unbelievable to us is actually entirely normal to our colleagues and has a role to play in making them the scientist or educator that they are. We do not have to “get into” the other culture – in fact, some may say that it is impossible to truly get into another culture once you have reached adulthood, or maybe earlier – but by meeting in the mid-space, the third culture of science in our case, we can get close enough. Once we reach a state of awareness, then we find that knowledge and understanding are not far behind. The more we work with folks from the culture(s) about which we have an increased awareness, the more knowledge we acquire about them – then comes understanding – then skills to deal with the various situations in which we find ourselves in that third culture space alongside our “other” cultural colleagues. It’s not that hard once you start.

SECTION TWO: CULTURE AND CULTURAL THEORIES

Cultural theories relevant to bio-engagement

What is culture”?

We really need to begin with a definition of “culture” before we try to understand it and discuss it. There are many different ways to use the word “culture”. It may refer to high art, civilization, or other lofty, elite aspirations, but it may also refer to material culture, music, food, architecture and so on, or even – appropriately for us - to a colony of growing bacteria. As well as being a noun, it is also a verb. When we engage in culture (noun), we are

culturing (verb) our relationships with others. For the purposes of this paper, we need to look at the social meanings of culture, and while there is no single definition of the word, here are a few to be thinking about:

Culture is defined as the shared patterns of behaviors and interactions, cognitive constructs, and affective understanding that are learned through a process of socialization. These shared patterns identify the members of a culture group while also distinguishing those of another group.⁷⁷

"...that complex whole which includes knowledge, belief, art, law, morals, custom, and any other capabilities and habits acquired by man as a member of society."⁷⁸ [*Forgive the use of "man" in this quote – they didn't have political correctness in the 19th century*].

One key point to remember is that while a culture can define its members, as well as its members defining *it*, culture can also, crucially, define who *does not* belong to it. This is an aspect that is often forgotten. One glimpse of a different cultural behavior can open a whole new world, if embraced without fear, but can also close every door if fear of "the different" is allowed to take a position of power.

My own attempt at defining culture is here:

The conscious and subconscious expression of the norms within which an individual or a group of people have been raised or have been significantly influenced by, which are perpetuated by and through a range of beliefs, attitudes and acts.

The reason I refer to culture as an *expression* is that I don't accept that culture exists "out there" as a defined entity – it can only exist by its expression *through people* and people can only express themselves through their words and actions (practical, visible expressions), and through their attitudes and beliefs (underlying viewpoints that drive visible expressions). You might argue that *buildings*, for example, can express culture, and that is true – but the building came from the mind of a culturally-influenced architect, and s/he designed it that way for a purpose.

Norms

The attitudes and beliefs of a group of people are formed and sustained by the development and maintenance of *norms*. A norm is simply an expected standard of behavior or belief within a group – in our case, a group of scientists (which may be the staff at a single lab, or the entire science population of a country). The principal aim of all overseas support for science offered in the area of biorisk management and bioethics and practical science is *the introduction of new norms* - norms of biosafety, biosecurity, the responsible conduct of science, and so on. These norms may be taken up in their entirety, just as they are, or they may be adapted to fit in with local norms that already exist. For example, the uptake of Standard Operating Procedures is a norm – it is a value-driven set of procedures that govern behavior, and result in a safe and secure working environment not only for the laboratory

⁷⁷ CARLA Centre for Advanced Research on Language Acquisition, University of Minnesota, see: <http://www.carla.umn.edu/culture/definitions.html>

⁷⁸ Edward Tylor, 1871, 2010, *Primitive Culture*, Cambridge University Press: Cambridge.

staff, but also for the wider community. While many of our overseas colleagues do not have agreed national standard operating procedures in place, all labs have some form of operating procedures, usually driven by the head of the unit, although these may not be in written form. So a norm of standard procedure already exists in some form – it is just not fully developed, formulated and established in writing.

So offering support, teaching and knowledge is only half of the equation – the West is offering guidance in new norms, but recipients have to play their part and *recognize the need to adopt these new norms, make a decision to work towards embedding those new norms into their thinking, planning and regular practice and **then implement the new norms***. This is the key outcome of all of our in-country activities that will provide evidence that we have made a difference. A colleague of mine says that in biosecurity education we are “norm entrepreneurs” and I can see what he means. I will return to this point later, as I have found that even though our overseas colleagues typically recognize the need for new norms of activity, and want to implement them, there are often other issues getting in the way – and we need to be aware of these and be prepared to assist in overcoming the obstacles where possible.

This business of introducing new perspectives and norms of scientific activity introduces our first conundrum. When we introduce new norms, or propose adapting existing norms, in overseas settings, we must be very careful not to give the wrong impression. Many recipients, I believe, have been left feeling as if the West is implying that they are *initiating* or *instilling* norms in the overseas region. This unfortunately implies that there were not already any (good) norms present in the region, which is, of course, a ridiculous proposition. If someone came to teach me from a foreign country and made me feel like that, I would not want to listen to them. I would feel insulted. Of course our colleagues in BMENA countries have norms in place. As visitors and guests in BMENA countries, we need to be clear that we are *not* there to *implant* norms. We are there to *share* some of ours (for example, a biosafety model that will inform good practice. Further, we are there to demonstrate how *adopting* these norms into, or alongside the *existing* norms will assist in improvements in the focus area. Note I use the word “adopting” rather than “imposing” – adopting has to be done by the hosts, whereas imposing is done by the incomers – and as we want to see uptake, we *need to facilitate **adoption** rather than implementing **imposition***. There’s a very big difference.

Respect, not judgment

Whenever I have taught research ethics (and I have taught thousands of students and professionals to date), whether in the UK or overseas, the opening minutes of the first session are always taken up in assuring the participants that when I tell them that they need to learn research ethics, I do *not* mean that I am implying that their personal values are being criticized, belittled or ignored, or worse, being assumed as non-existent. All we are doing is introducing some new skills, some new knowledge, some new ideas, or some new frameworks, that can be either added to what our overseas colleagues are already doing, or may be used by them to replace, or partly replace what they are already doing, or may help them to devise new and relevant processes for them. But we need to be clear about this ourselves, and make it clear to our overseas colleagues that this is what we *know* we are doing – and that we respect the work they have already been doing before we arrived.

I have never met an overseas scientist who did not know that s/he needed to implement some form of biosafety practice in the lab. Many of the people with whom I have been privileged

to work overseas have had to work in very limiting circumstances, yet they have all applied what knowledge and skills they had available to them, in an effort to meet biosafety needs. The fact that some of their efforts were not as effective as ours in the West is simply a factor of the knowledge, skills, understanding and resources available to them at the time. *We are now trying to bring in more knowledge, skills, understanding and resources so that our colleagues can learn from **our** mistakes and protect themselves and others more effectively. But crucially, we need to also accept that **we** can learn from our hosts.* Folks working with reduced resources or other limitations are experts at thinking laterally when it comes to getting the most out of what they have. We should be open to this.

Old norms, changing norms and strange norms

As I said earlier, a norm is simply an expected standard of behavior or belief within a group. This could be at a national level, or at a family level, or even an individual level. Even a single individual can maintain a norm on his own: there is an amusing English story about how a “gentleman” (an upper-class man) can identify another “real gentleman” – he will still use a separate knife for his butter even when he is dining alone! Only in England.....In my own case, I had a norm of dressing safely embedded in me as a child so now I still cannot put on my shoes without shaking them upside down first to dislodge any wildlife that may be hiding in them (I have not yet found any scorpions in my shoes in the UK). So norms can persist even when they serve no useful purpose. The idea behind a norm is that it has developed over time, or been imposed, and has been accepted by the group or individual within the group. When you see a McDonald’s or a Coca Cola sign in the middle of a poverty-stricken neighborhood in the developing world (or in the U.S. for that matter) where people claim that they cannot afford to buy good-quality groceries, then you are looking at changing norms – it is still cheaper to buy basic vegetables than to buy fast food, but by accessing fast food and junk drinks, people are making a public statement about their status as being “rich enough” to buy these things and to align themselves with the cool image of Western culture – even if it is further impoverishing them. If McDonald’s and Coke were not selling enough, they would not be there. So the norm of eating a nourishing but basic diet is lost in pursuit of chasing a poor-quality Western lifestyle – the first step in the new norm of Westernization via access to material goods, with all the health issues that follow.

A simple example of a norm is the practice of shaking hands when greeting friends. This norm is widespread around the world, but is also heavily mitigated by national or religious custom. For example, in some countries or religious groups, it is unacceptable for a woman to shake the hand of a man. In others, the hand shake is extended to a kiss on the cheek; in Italy and France there are social norms around how many kisses to give, depending on how friendly you are with the person, or how important they are; in these cases, saying hello to a good friend can become a lengthy business and there is plenty of scope for being offended if you did not receive the correct number of kisses on the cheek. In some countries, such as the UK until recently, the idea of kissing as a greeting between non-relatives is completely unacceptable and even viewed with fear or disgust. Increasingly, however, it is becoming common in the UK, for example, for friends to greet and say goodbye with a proper hug. Who would have thought this fifty years ago in England? I have Japanese colleagues whose norms of greeting involve bowing to each other – who bows first and lowest, and the depth and timing of the bow is crucially important. This means that walking down the street meeting a string of friends in Tokyo can become quite a good aerobic workout. All of these behaviors are norms, and they all mean the same thing but are totally different - and in some cases, quite amusing to non-culture members.

Norm transgressions as a cultural indicator

It is the familiarity, or not, of a person with the norms of a culture that is the clue to his or her belonging to that culture. I did not know what a Kit Kat was on my arrival in England, so my school peers immediately treated me as an outsider – because I *should have known* at my age. Norm-transgressions can, of course, be big mistakes in some cases. I remember hearing a story from my grandfather about the Second World War in which some German spies were caught in England because they did not understand the opening times of the British pub (a bar) and tried to get into one to buy beer during closing time. Fast-thinking British folk immediately spotted them as “foreign”! So while we are thinking about how to identify other cultural norms, we also need to remember that we should look for norm transgressions too. They can be just as important. These are usually easiest to notice when the “transgression” is visible, such as in clothing worn, or in hairstyles or in the kind of food eaten or avoided.

While these things sound very innocuous, we only need to think of the religious implications (for example) of clothing, food and hair to see how important they can be. In science too? Yes – you wear a lab coat at the bench, don’t you? And you have to tie up your hair if it is long to keep it out of your work, don’t you? And you know not to keep your sandwiches in the same fridge as the samples, don’t you? But these are all simple examples of cultural norms for the scientist – they are all biosafety norms. Of course, this brings us back to norm transgressions again. When a member of one culture transgresses one of his culture’s norms in order to “fit in” with, or align himself with the norms of another culture, this can have a negative impact on him, or on those around him. Let’s say that a young science graduate student in a developing country really grasps the need for effective biosafety activities, and he wants to always wear his lab coat in the lab. His friends don’t see the need for this as the senior tutors don’t always wear their lab coats. We, from the safety of our Western labs, may think that this is a simple issue – in fact, a non-problem – let him wear his lab coat and ignore what the others do. Ok. Sounds good. However, what about the negative implications that may arise for him? Teasing? Probably. Bullying? Probably. Social isolation? Possibly. No job on graduation? Possibly. Death? What?

On a recent work visit to Iraq I heard the worst possible accounts of the effects of scientific norm transgressions. A senior female academic told me that some of her science students refused to wear lab coats for bench work as, they stated to her and her two fellow-tutors that ‘under democracy it is their “human right” to refuse to do so’. The two other academics who challenged them on this, demanding that the students wear lab coats or they could not enter the lab, were *attacked and killed* by the students. The students’ families were rich and influential. No repercussions followed...A science tutor spills possibly infected samples onto his hair and does not bother to wash it out, with no follow-up testing to see if he has become infected...People fall seriously ill due to contamination of their lunch in the fridge... A female lab technician loses her baby through miscarriage when she drinks from an unlabeled plastic water bottle containing sodium hydroxide instead of water, having taken it from the shelf where it had been placed *in the fridge with the staff drinking water bottles....* Had proper, appropriate scientific behavioral norms been accepted and followed by all, these situations would not have occurred.

Now that we have thought about definitions of culture and how it may be identified and maintained, let’s look at two theories that can help us to understand culture – including our own.

The archaeological model of culture

Don't be put off because this model originates in archaeology. Anyone who has studied archaeology is actually well-educated about human societies and knows a lot of sociological theory. This conceptual model simply seeks to understand culture in terms of *material* culture or *what is left behind by past cultures to be excavated*. Of course, the principles can be applied to material culture today as well⁷⁹. The discipline of archaeology can only infer social norms, behaviors and so on from the material objects that archaeologists dig up. Accordingly, it describes culture in these terms, as these categories can be used to cover all aspects of human activity:

- *Social organization* (from the high level of political structures and systems down to the lower levels of the nuclear family structure and the value of the individual and the group)
- *Economics* (how people made a living; diet, subsistence, trade, industry, money systems and so on)
- *Technology* (tools, equipment and production methods to enhance life processes; access to and use of these)
- *Religious beliefs* (worldviews, cosmologies, spirituality and so on)
- *Language and linguistics* (language as a method of communication and expression of beliefs and attitudes)

With a little thought, it is quite easy to see that while this model was developed for the interpretation of material culture, it can also be used to assess and understand all aspects of non-material culture as well. Let me illustrate how this model can apply to understanding cultures today.



An archaeological model of culture

All specific elements of day to day life may be superimposed onto this model and assessed according to each of these categories. For example, abstract concepts such as

⁷⁹ See the Arizona Garbage Project, an archaeological investigation begun in 1973 by William Rathje and colleagues at the University of Arizona. They used a questionnaire to gather information from residents of Tucson, Arizona, on their consumption habits and then checked the questionnaire answers against their other form of gathered data – the rubbish in the respondents' bins. Surprisingly enough, the rubbish thrown out revealed quite a different picture to the answers provided on the questionnaires. An example of this was around alcohol consumption – people did not admit on the questionnaire to the actual amount they were really drinking. See Rathje, W. and Murphy, C. (2001) *Rubbish!: the archaeology of garbage* Tucson: University of Arizona Press.

politics, healthcare, leisure, information and knowledge, gender issues, housing, ability to travel, or access to work may all be applied across this model and assessed according to the contribution of the five elements to it.

Firstly, let's look at *social organization*. Does your culture operate around the nuclear family or the extended family? The form of the family is important – it is a source of wealth and is very influential in all aspects of society – and of course, it is the framework in which the next generation is raised and influenced, making it even more important as a social artifact. There is a considerable literature available on the family, derived from a number of different disciplines, but all of these show clearly how the nature of the family affects all aspects of life and society. For example, what is the role of the individual in the family and in society? Is the individual more important than the family, or is the family the primary unit? This is the difference between the *individualist* and the *collectivist* types of society. Western society is highly individualist, whereas Arab culture is still very collectivist in nature. In individualist societies, the individual is typically allowed to be different, to follow his/her own path, with fewer demands that s/he conforms to the values, behaviors and norms of the rest of that society. In collectivist societies, the group, often the family, is the unit of significance, with conformity to the needs of the group being one of the main drivers in that society, and this tends to limit the freedom of choice of the individual to be different or to follow his personal preference. Interestingly, we find that behavior in public tends to be the opposite of this in each type of culture. In individualist societies, people tend to hold back in public and give way to others. Thus the wider community benefits. In collectivist societies, the individual tends to “go for it” in public – every man for himself. Try driving through the middle of a BMENA city in rush hour, or fighting your way through many interesting airports in the developing world and emerging unscathed. On the other hand, it is said that more British people died on the *Titanic* than any other nationality because they all queued politely for the lifeboats. What does this say about how we might go about achieving personal advancement in our professional lives?

The economic potential of a nuclear family is very different from that of an extended family which may marry off the children in a strict order, or may have to pay dowries for daughters. Gender issues are also a big factor of social organization. What is the role of women in the family and in society? Do women have equal access to all levels of work and to the social status that goes with this? Are the sexes viewed as equal, or is the talk not matched by the reality? (Issues of gender in bio-engagement are actually going to be issues of biological sex, not gender, which can be assigned or chosen rather than being a biological state). What impact does this have on the individual and on the group? What impact does this all have on science, the scientific profession and biosecurity? At various biosecurity education events that I have attended, one or more women have been present because their influential husbands were there. This resulted in places lost to other scientists who could not attend, because the preferential treatment of the wives of influential men had resulted in their places being taken – and the wives were not scientists. The husbands had sufficient influence to make this happen – and chose to prioritize their own needs and wishes over the greater need for a wide diffusion of the content of the event. Is it right? On the other hand, I know of a female colleague from a BMENA county who, until recently, had to get her husband's written permission to leave the country every time she had to go to a conference. If my husband suggested this, he would need hospital treatment, but she just puts up with it as “normal”.

How does the family fit into a wider clan or tribe or ethnic group? Who defines the ethnic group? Is it self-defined or is it defined by outsiders? For example, in the UK it is common to refer to “Asians” when meaning people from the Asian sub-continent (India, Bangladesh and Pakistan). In reality, the term “Asian” is meaningless, as the various populations that make up the so-called group referred to as Asians are so different in their cultures that any blanket term is Useless. Further, the various groups typically feel insulted when they are confused for one another by white people. Then, of course, we travel to the U.S. or to Australia or Canada, and the term “Asian” refers to people from the Far East – China, Japan, and the Asia-Pacific region. This is also related to the category of linguistics as an element of culture – language can help, but it can also confuse. And of course, there is the Canadian-American issue – how many Canadian tourists flash their maple leaves around so as not be called “American”? Likewise, Scots and Welsh people get annoyed when they are referred to as “English” when the speakers mean “British”. We’ve all got something to be offended by.

Does your culture operate under democracy or some other form of state-level or high-level government? If your culture is not a democratic one, what is it? Do you have a hereditary ruling family? Do you have a caste system? Can you move between castes? One of my Indian students proudly told me one day that I was like him – Brahmin – the top caste (wow! I made it at last).....when I voiced some concern over the plight of those stuck in the “bottom” castes, he immediately assured me that a person can move from one caste to another with the greatest of ease. I found this somewhat difficult to accept, but he was adamant that the system was fair – although when I asked him if he wanted to voluntarily move downwards into a lower caste, he pretended not to hear me, which is maybe a cultural norm in a high caste.....

Let’s now briefly look at *economics* as it is expressed in culture. This term does not simply refer to money and the stock market. In anthropological terms it refers to the way in which a group or society makes a living. Thus, in archaeology, the hunter-gatherer lifestyle employs a form of economy based on moving seasonally around a landscape foraging, scavenging and hunting, and on exchange with other groups doing the same. At the other end of the scale, we have the level of the so-called “nation state” in our “civilized” developed world of today, our economy is based on capitalism, in which people own goods and hold assets. People buy and sell on a more or less open market and acquire what they need to survive, plus a range of goods and assets that are above and beyond the level of survival. This system replaced feudalism, which was a dominant system in the past that linked social organization into hereditary systems and was built around, and sustained, a hierarchy in society. Some forms of feudalism remain in place today while being mixed with more modern forms of economy. In the UK we no longer have feudalism, but we still have the person at the top of the feudal heap – the Queen – although she no longer presides over the same sort of economy or social organization that her ancestors did. In large parts of the developing world today, in contrast to capitalism, an agricultural economy is practiced at various levels – whether state-sponsored and subsidized, or at a local subsistence level in villages where no other way of living is possible. This is not the place to go into this in detail, but *the notion of the survival-mode type of economy is a relevant point for this paper.*

I have a colleague in a former Soviet state who is a leading scientist in her country’s engagement with science internationally. Following the revolution in her country, she and her colleagues lost their salaries as there was no longer a system in place to pay them. She and her colleagues continued going to work for several years without pay. This was not

abnormal in such economies, as under the Soviet system it had been quite usual to have to work without pay for months at a time until bureaucracy got around to sending money down the pipeline to the workers. Once salaries dried up completely after the regime change, she and her colleagues continued to work as best they could, with no formal income. She had to support herself and an elderly parent. She did this for two years by getting up at dawn, making a batch of biscuits with cream and eggs, and selling them on the way to work to a shopkeeper friend, who sold them on at a profit himself. That was her income. I asked her where she got the cream, and she told me it came from the farm of a friend outside the city each day. When I asked how she got so many eggs each day (24) she just said, looking at the floor, “I got them”, so I left it at that. And we complain about our pay!

Now how can we expect people who have struggled like this to see life in any other mode than that of “survival”, for a long time to come yet? If you have seen first-hand how precarious or corrupted your state’s economic system is, how would you trust it? And if we go in to this country and start talking about long term norm changes and necessary changes in values and behavior, which could compromise this individual’s position, why on earth would s/he want to listen and do anything that may upset his/her delicate economic position? Even in BMENA countries that have been doing well economically, in the profession of science, there is often still the awareness of the limitations under which one has to work, and this in itself is stressful. *When people have been used to running in a kind of survival mode, they cannot make decisions based on any other driver than that of what is best for them, right now and maybe tomorrow.* This is a simple fact that we tend to overlook when interacting with colleagues who have been working under circumstances of extreme change and stresses, or of long term corruption or stagnation. *Trust has to be rebuilt between this individual and his country’s political leadership, his bosses, and with us.* We arrive, promising money and status through his/her cooperation with U.S., neither of which s/he can acquire right now from his own country itself. The survivalist does not take a long term view, and if he says he does, he is probably saying what he thinks we want to hear. When we turn up with offers of money, access to international events, new equipment and so on, why should we be surprised if s/he chooses to take advantage of all of this on a personal level? And why should we be surprised when s/he chooses to keep the new knowledge and skills to him or herself, and not share them with colleagues? Knowledge is power, and if cooperating with us enables him/her to acquire this, then we need to be aware of the likely results in-country. I was at a major meeting in the UK recently with sections of the UK government; we were reviewing recent support activities in various countries. When I explained that certain areas in a particular country had expressed to me their need for help in implementing biorisk management frameworks and skills, I was met with the response “*But we’ve already done biosafety there*”. There was a failure to recognize the fact that overseas colleagues view interactions with us as a form of social and professional capital that they need to guard for their own personal advancement. Of course, this does not apply in every case, but I have seen plenty of evidence of it in practice.

I don’t mean any disrespect whatsoever to individuals in such difficult circumstances – I have the highest regard for the tenacity and strength of character shown by many of our overseas colleagues who have come through extremely testing times – but we do need to recognize that we need to spread the net wide when seeking opinions, decisions and planning ideas from people in such circumstances, as personal gain and advantage are typically key drivers to such economically-battered folks, and while being entirely understandable, opinions and decisions taken in these contexts may not be the best ones to build on for the long term.

Technology is, of course, the publically-stated driver for all of the interventions and support that we are seeking to give to our colleagues overseas in our sector. But we often fail to see technology from the bird's eye view, and focus instead of each individual aspect of it. In the West we are privileged to have access to more technology, and to keep up to date with it, than in the developing areas of the world. We take this for granted almost completely. However, we also forget what technology actually *is*. Most of us tend to think of technology as machinery, or as systems such as the national grid that supplies our electricity or gas, or communications networks, for example. But in its purest form, technology simply means *tools*. A chimpanzee uses technology when he picks up a small stick and pokes it into a hole to retrieve ants to eat. A sea otter uses technology when he lies on his back with a flat stone on his chest and smashes eggs or sea shells on it to get at the contents. Interestingly, “poor” people tend to target technology at the expense of other things that may be more helpful to them in the long term – typically related to entertainment technology. We have already mentioned the McDonalds versus vegetables argument (above), but we might also look at the way that relatively poor people in all societies like to get as much access to technology as possible in other domains too. This applies heavily to scientists in particular. To have the latest biosafety cabinet or BSL3 lab is seen as a status symbol – *the fact that there is no money to run any of it, or that it is impossible to move into the new facility because nobody has been trained in running it, is occasionally a secondary consideration.*

Let's start with non-science access to technology first. Entertainment technology is key in all poor communities, both in the developed and developing worlds. Those at the poorest end of the social scale in the UK, for example, are still highly likely to have mobile telephones and iPods, which are expensive. In the UK “poor” people will spend significant amounts on satellite TV and on DVD players and live on junk food that costs more than good food. In the developing world there is an old anthropologists' joke about how “the villagers” respond when they know the anthropologists are coming - they hide the TV and the telephones quickly so as to look “more native”. Interestingly, we tend to see the opposite in science contexts – people like to show off their lab equipment and the kind of work they are doing, as it is thought to indicate a socio-economic level that approaches the desired “status” of Western science. On the other hand, how many times do we see on the news an impoverished African or Indian village full of kids with no shoes and old clothes, all gathered around a big TV in the village open area, watching Manchester United play a big game? Why do people spend precious and scarce resources on entertainment instead of vital supplies? Well, people use technology to entertain themselves to forget the situation they are in, and to them, entertainment *is* a vital supply. There's nothing wrong with this in itself, and I don't blame people for doing this, I'm just making the point that *when folks are at the lower end of the economic scale, long term thinking tends to go down the drain.* This goes for scientists too – they are not seeking entertainment, but *they are seeking the recognition and the perceived status that comes with access to “big” technology – and all the benefits this association brings to them personally.* This approach needs to be tackled.

Access to technology has reached a stage where it is seen as an indicator of being “advanced” and “rich” and “powerful”, whether this is really the case or not. Plus, it is often used as a comparison tool to be seen to be “bigger” or more powerful than others. We only need to think back to the days of the Soviet May Day parades and the procession of tanks and missiles going through Red Square in Moscow to see this in action. Likewise in the West, we had, and still do have, air shows, for example, where we show off our current air power, and we play war games with each other at sea to say “ours is bigger than yours” as

much as to see how well we can actually work together in practice. When the first signs of tension arise in some distant (to us in the West) geographical area of the world, one of the first things we Westerners do is to send an aircraft carrier to the area to concentrate the mind of the “troublemakers” by cruising up and down the nearest waterway. Alternatively, we make films about machines and equipment that show us being masters of advanced technology – even technology that we have not yet actually invented – all to show our status as masters of advanced technology. Yet sometimes this is pointless – there is a story, I don’t know if it is true or not – about the race to find a suitable writing implement for astronauts to use in space during the 1960s “space race”. The Americans were said to have spent vast amounts of money designing the ballpoint pen, but the Russians just took a pencil! Go figure.

Interestingly, we can also show our power by using and displaying *old* technology as it can “prove” our status as “old power” and therefore “lasting power”. A quick look at any royal event in the UK shows us the use of old technology as a representation of our old power – the use of horses, horse-drawn carriages and old fashioned uniforms all enhance the picture of old, but ongoing, power even if it is not real. The Queen does not actually have the power that the monarch had in previous centuries, but in the UK, the monarchy is still treated, to some extent, by the public as if it does. Even the dead bodies of our monarchs can be used as tools. When a major royal figure dies, we have an old-fashioned “lying in state” where the coffin is placed on a bier for display purposes in a public building. People file past to pay their respects, but this is also a subtle way of connecting the people with the passing of the old and the coming into power of the new. We might say that the coffin, and the body within it, becomes a tool for the representation of our old –and crucially – *continuing* power. *Today, “power” is seen to rest in the acquisition of a BSL 3 lab, or a fancy new air filtration system, even if they are not needed or built or maintained appropriately.* These artifacts confer what looks like power on individuals and groups in-country, yet that is not what they are *for*. In fact, there is an argument to say that such new infrastructure can cause more problems than it solves, due to the human relationships, working practices and networks that are spoiled or interfered with, as a result.

Again, this is important for biosecurity because of the effects access to effective technology has on scientists. We need to start looking more carefully at basic realities here. One of the key issues in advancing technology in the developing world is the access to affordable and reliable electricity. *We see many cases of countries asking for BSL3 labs (for example) to be “given” to them, even though there is no reliable electricity supply available to maintain the infrastructure once built. Neither is there sufficient money to pay for the running costs of the lab, or the staff, or to maintain the equipment. On top of this, there is no sufficient throughput of work available to make such a lab viable – the staff will not be using their skills and knowledge (assuming they have them) sufficiently often to become, and remain, skilled to the right levels. The lab has been built before the field operations necessary to supply the lab with work have been developed.* In other words, to coin a technology-based phrase, the cart has been put in front of the horse. Yet many countries see the installation of a national BSL 3 lab as a sign that they have reached some level of status on the international scene. This is not a reflection on the capabilities of the staff in that country, rather it is a limitation placed upon them by the circumstances in which they operate.

We need to be aware of such limitations and act accordingly, and recognize that our overseas colleagues may need something other than that which they *think* they need right now. Too many infrastructure projects have been provided, I would argue, without consideration of

sustainability, and all this has done in the long term is increase frustration, waste resources and demotivate people. A colleague of mine in the UK Ministry of Defence was asked recently, on a visit to a very poor former Soviet state, if the UK would provide them with a BSL 3 lab because all the neighboring countries had “got one” and this country was feeling embarrassed and left behind. My colleague asked these friends how much they thought it would cost – they said “about one million pounds”. When he told them that one million pounds would not even cover their power bills for a year, they went quiet, and when he told them that their neighbors’ BSL 3 labs had cost tens of millions *each*, they started to get the picture. This needs to be handled tactfully and in consultation with overseas colleagues, so that together we can identify achievable responses to high-priority needs that can be met and *maintained* until such countries gain in economic terms, have a sufficiently developed infrastructure and can move ahead to bigger things. It is, however, a difficult task as technology is deemed to be such a status - proclaimer and aid-trophy. When we tackle these realities, we *must* avoid being patronizing and taking a parent-child attitude to our overseas colleagues. Difficult, I know, but we must do this, as to give in to the aid-game and to engage in competitive donating and receiving is a short-cut to failure. *We need to find ways to match technological support to countries at the level at which they find themselves, not at the level at which they want to be seen to be.*

Religious beliefs tend, in the West, to be treated as something totally separate from scientific activity in the West. However, I personally think that we can make use of religious ideals *where they can help us*, especially in the developing world, where religion still plays a much greater role in everyday and public life. I also think that we need to be more honest about the degree to which religious values already inform our own practice. We need to acknowledge that our Western values have most of their origins in Judeo-Christian religious ideals. We may be moving away from these publically, in some areas of life, but in general, our social, legal, medical, and other norms have been driven and guided massively by these two ancient religions, whether we like it or not.

In the UK, religion tends to get put together with ethics a lot, and this is arguably an easy way today of managing what might have previously been called “religious” values in a more scientific world. There is, I would say, a generally negative view of religious belief among the majority of scientists working in the West. Of course, scientists can be practicing Christians, Muslims, Jews, Hindus and so on, but there tends to be an unspoken expectation that these values will be hung up with the coats at the door, and once in the lab, the religious person “turns into” a scientist. Of course, this is nonsense, as nobody can really do this. We all have a view, for example, on start-of-life and end-of-life technologies (assisted reproduction technologies, euthanasia issues) but these tend to be highly debatable in wider society, as they are so visible and so all-encompassing – we are all born and we all die. But it would be wrong to say that religious views do not have a place in public debates around these issues. Much public debate is couched, in the West, in terms of “you can’t mess with nature” or “it’s God’s will” or “this is just how it is meant to be”. In some countries, for example, a woman cannot choose or request a termination of pregnancy unless certain life-threatening criteria are present. This is a law led by a religious value – and it affects all people in the country, whether they share that value or not; it results in restricted access to technology based on religious values. Typical responses to this and similar value-led debates tend to invoke the presence or role of a higher power, whatever you may wish to call it, but even if we “educated” people think that these are just ill-informed views, we cannot ignore them, as people do have rights and must be allowed to express their views (without resorting to violence, of course). Beyond the medical arena, we also tend to see significant value-led

public debate around GM crops (“we need to be in control of what we eat” – no irony there with the McDonalds situation), and issues such as DNA records being held by law-enforcement agencies, or organ donation (“I own my own body and you cannot have bits of it or information about it”). These things touch on human rights, and once we start talking about the value of the human, or of the environment, it is only a short hop to religious or ethical values.

On a wider, global level, it is probably reasonable to suggest that as socioeconomic development rises, the influence of religious values tend to decrease, especially among those who are actively engaged in that socioeconomic advance. This does not mean that religious values disappear or actually decrease in terms of prevalence in society but rather, they may tend to lose their status as the first point of reference when seeking a value to underpin an advance. This need not always be the case, of course, and science and religion can be seen to mix effectively in some ways.

At a workshop in Baghdad in 2012, when working with a range of Iraqi science experts (scientists, educators, graduate students) from Baghdad universities, the links between religious values and scientific ideals and advances were clear. Having grown up in a relatively fundamentalist Christian household, I was comfortable speaking about the role of religious values in life in general and in science as well. The participants of the workshop were quite openly surprised by this, as their experience with international visitors up until then had indicated to them that overseas scientists were generally “unreligious”. *Once I had suggested that religious values may have a role to play in explaining and supporting scientific values, many participants engaged with the sessions by referring to verses from the Koran when we were discussing scientific principles.*

For example, when we discussed public health measures, such as quarantine, participants quoted or referred to verses in the Koran in which the Prophet had instructed that those suffering from disease were to keep away from those people and places where the disease had not reached. To Western ears, this sounds “crazy”, unscientific and unnecessary. *However, to some of the Iraqi participants, experts in their field and accomplished educators, this was a useful sociocultural tool to enhance the uptake of scientific ideals and to support their implementation in public life.*

When I reported this positively at a meeting in the U.S. in 2013, I was met with some hostile reactions from U.S. government and education colleagues. It was suggested that I was promoting “Islamic biosecurity” and that I was “playing a dangerous game” by linking Islamic values and teaching to the promotion of science and scientific values. I find this attitude to be very security-focused and based on fear rather than on reality. I could have asked in return, “are we promoting Catholic science by restricting embryonic stem cell research in the U.S.?” (but I didn’t). However, in the context of this presentation in Washington DC, and in the discussions that played a part in it, I was delighted to hear from one colleague working in the U.S. who told me, after my talk, of his own experience with science and religious values in the U.S. Notably, this colleague, although working in the U.S. for years, was not originally a U.S. national, but from another Western country, and he had (in my opinion) a more global view of values.

He explained to me how he supported what I was saying about linking religious values to scientific values and illustrated this with an anecdote from his own experience. While speaking on biosecurity in one of the southern states a year or two ago (part of the “Bible

Belt”), he had ended a talk by stating “Where there is no hope, there is no future”. This final line had then met with a loud response from a man at the back of the room, who called out “Jeremiah 29!” (Jeremiah is a book of the Old Testament). I then caused further laughter following this anecdote when I was able to immediately supply the verse to this chapter – Jeremiah 29:11. I was not raised in a fundamentalist Christian household for nothing....so I find it quite hard to criticize colleagues in developing and non-Western countries for relating religious ideals and values to science, when it goes on in some areas of the West as well. Are we saying that scientists from the southern “Bible Belt” states of the U.S. are not really scientists, because many of them like to quote the Bible? Of course not. So why should we object when Muslim scientists want to quote verses from the Koran when they discuss their work?

Our objections to Islamic views on science stem from our misunderstanding of what we see in the news. The vast majority of Muslims want to live peacefully with the rest of the world – but we only see the activities of the extremists on the news. How would we feel if all Christians (or those who come from “Christian” areas of the world) were thought of as extremists, based on the activities of a few so-called Christians who have bombed abortion clinics or shot doctors who carry out abortions? Western society is, as I said above, founded on Judeo-Christian values, and despite the Enlightenment of the 17th and 18th centuries, we still hold too many of these values unwittingly, as the foundations of our own world views and perspectives...and they are not all bad. Having said that, there is still considerable disagreement within western Christian circles about values and interpretations of history, and we need to be honest and open with ourselves about these as well as casting judgments on non-Christian populations. I was once at a meeting with some Catholic friends, including some very elderly, and lovely, Irish Catholic ladies. These ladies had been brought up in Ireland to believe that the English, and their Protestantism, were “doing the devil’s work”. One of these old ladies was ranting about the English Queen Elizabeth I, because “she had burned so many Catholic martyrs”. When I pointed out that Elizabeth’s sister, Queen Mary, had burned many Protestants, her justification was “Yes, but not as many”. I often think that our arguments and prejudices against all Muslims, based on the activities of a few, are pretty much like the old Catholic lady who hated Elizabeth I because “she killed more than we did”. When will we get over this misguided attitude? Before any U.S. colleagues take offense at this view, please remember that the UK (my country) has also suffered from terrorism for many decades, and we in the UK know what it is like to be subject to religious and political attacks. We just need to get a sense of proportion and be prepared to re-think our natural responses, which are often of the knee-jerk variety rather than the result of considered, rational thought.

I should note at this point that I am *not* in favor of “approving” science or scientific values by reference to religious ideals, values and writings. *I am merely suggesting that where a religious ideal, value or writing seems to support a scientific point, then let us be open to use it if it helps the promotion of that scientific issue.* The converse is, of course, always a problem – we may find that some religious ideals actually contradict some scientific activities – but this is an *opportunity for debate*, not a cut-off point for scientific activity. Ongoing debates on embryonic stem cell research, abortion, reproductive technologies and euthanasia are all cases in point and are subject to social scrutiny at the highest levels, so I do not feel that my “let’s use it if it is useful” approach is any more “dangerous” than the current ethical topics under debate in the West. The fact that I “lost” some of my Washington DC audience in early 2013 because they saw the words *science* and *religion* on the same slide says more about them than it does about my approach.

In short, I think that religious values should be embraced where they help in science, and debated rigorously when they seem to raise challenges – or are we afraid that we cannot “win” the debate? As scientists, surely we should be seeking the best ways forward, and seeking various aspects of “truth” and fact. Religious values may not be credited as *fact* but they are certainly held as versions of *truth* by many scientists, and if this can help us promote core human and environmental values, let’s use them. *We simply cannot expect scientists to leave their religious values at the lab door – if we do, we are opening ourselves up to the possibility of cheating, internal conflict, poor work and problems in working practices and relationships.* It’s no good putting a Catholic in charge of the abortion unit – and the same thing applies to any scientific work that may cause a value-conflict in those expected to carry out the work. We need to be open about this and not pretend it doesn’t have a role in our combined efforts to promote good science. *A scientist who is required to work on projects with which s/he has ethical or religious disagreements is a dangerous person to have in that role. The conflict that is set up between the demands of his work and those of his religious beliefs or ethical stance will eventually lead to negative outcome – either by a loss of commitment to the work, or of some action taken against the work, or of loss of the job.* All of these bring adverse outcomes not only to the employer but also to the individual. They need to be avoided, but we can’t identify them at all if we don’t discuss openly religious and ethical views at work.

Linguistics, or how we speak about issues and realities, is a big subject, but I will just introduce some ideas about it here, followed by some cautionary points. The area of language includes not only the words we use, but the concept of *discourse*, or how we frame concepts and ideas with words, and the *way* we speak of issues and people. It is closely allied to our religious, social, technological and economic status, and as speaking is “visible” to others, it is often used as a status signifier, or at least as a signifier of the status we would like to be seen to have. An example of language as a status signifier would be when people deliberately try to lose their natural accent in order to take on another, for reasons of social or economic advancement. An example of the use of language as religious discourse would be the Islamic tradition of blessing the Prophet (“peace be upon him”) whenever his name is mentioned in discussion; this indicates that the speaker is either a devout Muslim, or he at least wishes to appear so, and he is declaring his religious values through his words. We tend to forget, of course, that millions of Americans think it is ok to pepper their conversation with “Praise the Lord” but we get edgy when we hear a Muslim bless the Prophet.

In the West, especially in the UK, it is easy to discern what part of the country someone comes from due to their accent – in our country, with its big population, there can be three or four different accents in just a few square miles. And we all know that your accent says a lot about it – whether it should or not. As well as accent, we can listen to the way that people construct their sentences; do they use a lot of slang? Do they shorten words, or do they invent new words for their own group? In the East End of London (the traditionally poor area around the old docks) the accent is the Cockney accent – and some people use “rhyming slang”. It is said that this developed among criminal gangs so that they could talk without fear of being understood by law enforcement people or “others” outside their circle. So in rhyming slang, “apples and pears” means “stairs” and the “trouble and strife” means “wife”. A thief is a “tea leaf”. In Yorkshire, where I live, it is normal to call another person “love”, without any sexual connotation at all. You could be served by a man or a woman in a shop and they will pass the bag of goodies to you and say “there you are, love”. Many confused

old Yorkshire-men have been slapped in the face by outraged southern old ladies who thought they were “getting fresh”. Cultural miscommunication can have its problems.

In the UK, traditionally, accents have been associated with social “class” – and the British have been bound by class for hundreds of years. This has been changing now since the early 20th century, but the attitudes will take generations to disappear. Until recent decades, it was not possible to get a broadcasting job on TV or radio in the UK if you had a regional accent and did not “speak BBC”. Typically, we could say, however, that your class, or social background, or whatever you want to call it, may be associated with your speech patterns and style.

So what impact can language and the way that we use it have on science practice? Today, some overseas colleagues use language as a means to advance themselves – entering a “westernized” (supposedly “advanced”) class. They engage with us in support activities, and then have access to a whole new discourse, and all the jargon that goes with it. This then becomes, for them, a form of social and professional capital that they can use to help themselves, and hopefully, their colleagues. The discourse we use is a major component of our social and economic standing, and is often directly related to our potential for advancement.

In terms of biosecurity education, the onus is on us to make sure that we can be understood clearly. Not everyone has 100% excellent English – why should they? Does language use or lack of skills prevent certain individuals or groups accessing jobs or study in science? How do we use language to impress, manipulate, deceive, or cut people out?

This brings us to professional groups. The ability to speak the “lingo” is key to belonging to a professional group. Medical people are notorious for speaking in medical jargon and making heavy use of abbreviations. Anyone who has watched a medical drama series will be familiar with this. Arguably, this use of language and medical discourse serves to maintain the mystique of medical knowledge and to divide the insiders from the outsiders, while making the jargon-speakers seem to be important, clever, and of a higher social status, somehow, than the poor ignorant patient on the bed. In science contexts, we tend to speak also in jargon, although probably more to other insiders with fewer outsiders hearing us. We all know of the likes of PCR, ESR, DNA, GC-MS, IAT, and so on (look them up), but we also tend to keep our jargon to ourselves in public more than happens in the medical field.

Where we do tend to have our own discourse, it often relates to an anti-religious one (in the West), in which Darwinism is favored over traditional religious views underpinning “old” pre-Enlightenment science. Interestingly, however, I would suggest that some ardent Darwinists are actually beginning to pass into the realms of religion and religious discourse themselves, not seeming to be aware that Darwinism is taking on many of the characteristics of a fundamentalist religion.

In general, I would suggest that the category of linguistics and language is perhaps the easiest cultural domain to improve in terms of science and science culture, when compared to the influences of social organization, economics and so on *in our science context*. We might not be able to fix the problems that our BMENA colleagues are experiencing, but we can use language better to help them. However, it is important to remember that we can use words and discourse to hide things, to intimidate, to keep others out, to belittle and to influence, without even knowing it. All of these outcomes can be reached, wittingly or

unwittingly, in the context of overseas science support, and I would suggest that we, as visitors to other countries, need to be reflective and consider how we speak, when we speak, to whom we speak, and the effect of our words and discourse on those with whom we are working from the host country.

Perhaps the most important aspect of language and linguistics that we need to take on board is that of *communication* in general (which is, after all, the purpose of our visits). And this leads me to a sensitive point, but one that needs to be made. As my grandmother used to say – “you have two ears and one mouth for a purpose: you need to *listen* more than you *talk*”. I think that we definitely need to take this on board in our role as overseas visitors – we need to remember to *LISTEN*. *And to do this more and more often*. We tend to get so carried away with the sound of our own expert voices that *we miss all of the depth and richness that our overseas colleagues can offer to the debate if we would only let them get a word in sideways*. I know that we in the UK tend to talk too much when we get the chance, but I have to say that some of my U.S. colleagues (not you, friends) seem to seek out ways to say the simplest thing in the most long-winded, wordy way possible. Be brief! (I need to remind myself of this too). If English is not the first language for the audience, keep it easy to understand. And please bear in mind that the lovely American accent, which allows a torrent of words to flow out quickly, can be very hard to understand by a non-English speaker (I even have trouble myself sometimes) because it is very easy to let the words all run into each other, making it hard to understand. I work regularly at the UN in Geneva and you can see the interpreters in their glass cubicles tearing their hair out at the speed with which many Americans speak in public. Please speak more clearly by clarifying words with some space in between, and enunciate your words more clearly. If you have something to say, you need people to understand it. Not all U.S. folks speak fast of course – but think about this if you do.....

The penultimate point I want to make here about language is also a cautionary one. *Just because someone uses the jargon, or seems to be able to engage in the “in” discourse quite well, don’t assume that they really understand what they are talking about (which goes for us too)*. An easy way to acquire advancement and status is to “talk the talk”. Many of my PhD candidates do this all the time when they arrive at my class – they think they can impress me with lots of postmodern jargon: “*I’m taking a postdialectic socialist-feminist approach to my data collection*” [really?]; “*I’m intending to make a critical use of capitalist post-textual theory to read society in my home country*” [but you clearly don’t speak the language]; “*I tend to find that the ideology of teleological narrative can easily be made compatible with the invention of process*” [good for you].....to which my response is *Fail* – until you can tell me what this actually *means* in terms of *what you will do* in plain English. If anyone comes to me “speaking postmodern”, I immediately smell a rat – although that’s just my bias – but we need to watch out for this in practice too. Sending individuals who speak in jargon only to teach folks whose first language is not English is not good. Second (or third or fourth) language communication is hard enough as it is without blinding our participants with science, literally. If we can’t understand what our fellow-tutor is talking about, what hope is there for the participants, who will be too polite to ask for further translation?!

My final point is this. If and when you make language-based mistakes - as long as they are not truly dire and likely to start a war – just laugh it off. In my experience, participants have loved it when I make a mistake – and they love it even more when I laugh at myself. My best one to date was in Iraq – when I had had to jiggle some Arabic slides around myself (I don’t

speak Arabic). I was teaching about a U.S. scientist who had been prosecuted for serious illegal and unethical activities when I put up one slide only to see a tiny wave of something flitting across the class. At a coffee break, I knew I would be confronted by the most senior person present, who would be deemed sufficiently senior to ask me about whatever it was. This duly happened, so with all eyes on me in the coffee room, I asked Mr. Senior Professor what was wrong on the slide. He said “Dr. Judi, I think you wanted to say that Dr --- was an ‘eminent’ scientist”. Yes. “But you got the letters mixed up in the word for “eminent” and it said ‘Dr --- is a sh*t scientist”. The whole class dissolved into raucous laughter, especially when I joined in and said “Well it’s still right then”. *This opened the door for much more class interaction, honesty and discussion in the following sessions – all because I had not taken myself too seriously and not been afraid to laugh at myself.* These were also the folks who quoted the Koran to me. The language slip-up helped open the door to this. We all need to be able to get over ourselves. Laughter over silly mistakes is a great “way in”, and language probably offers us the best opportunities to achieve this.

Hofstede’s Cultural Dimensions Theory

In this section I have selected some quotes, quite lengthy ones, from Hofstede’s 2010 book, *Cultures and Organizations: Software of the Mind –Intercultural Cooperation and Its Importance for Survival*. I recommend it to anyone who wants to pursue inter-cultural understanding more deeply. I have chosen to Use direct quotes because as Hofstede puts his points across so well, there is little benefit in me trying to paraphrase them. I have chosen a few points relevant to our discussion here, starting first with a quote from an internet interview that he gave not too long ago:

“It is difficult to explain to people that I am talking about societies and not individuals. I run into this problem a lot in North America, if I might say so, which tends to be very individualistic. Society is to an individual like a forest is to a tree and you cannot describe a forest as just a bunch of trees. The mistake was made by Margaret Mead. She talked about culture as personality writ large. It is not so. It is a society with all kinds of personalities interacting. It is true that personality tests partly reflect the culture of origin. The formative time is actually before puberty, and the environment you grow up in influences certain aspects of your personality. Only part of it, but if you have enough people who have grown up in that same environment, then their personalities will have common elements. Lots of people ask me, particularly Americans, if they can have culture tests for their students so they can see their culture. This is absolute nonsense because a student can only describe his or her personality. If you want to talk about culture, you should take a group of people and see what they have in common. This is difficult to explain in an individualist culture.”⁸⁰

Different minds, common problems⁸¹

“Understanding the differences in the ways [people] think, feel and act is a condition for bring about worldwide solutions that work. *Questions of economic, technological, medical, or biological cooperation have too often been considered as merely technical. One of the reasons why so many solutions do not work or cannot be implemented is that differences in thinking among the partners have been ignored* [emphasis mine].The objective of this book is help in dealing with the

⁸⁰ Hofstede, 2011, interview at <http://www.international.gc.ca/cfsi-icse/cil-cai/magazine/v02n03/1-3-eng.asp>

⁸¹ Hofstede, G., Hofstede, G.J., Minkov, M. (2010) *Cultures and Organizations: Software of the Mind –Intercultural Cooperation and Its Importance for Survival* McGraw Hill: New York, p. 4

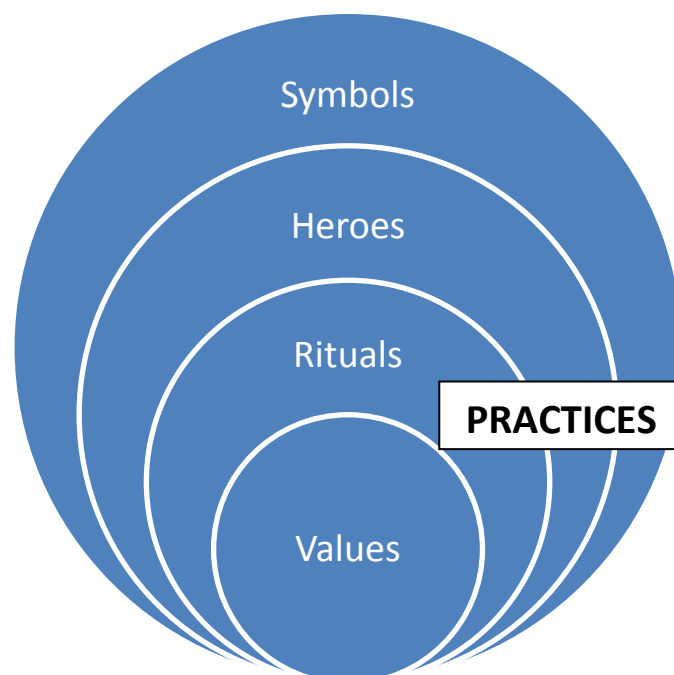
differences in thinking, feeling and acting of people around the globe. It will show that although the variety in people's minds is enormous, there is a structure in this variety that can serve as a basis for mutual understanding."

Culture as mental programming⁸²

"Every person carries within him- or herself patterns of thinking, feeling and potential acting that were learned throughout the person's lifetime. Much of it was acquired in early childhood, because at that time a person is most susceptible to learning and assimilating. *As soon as certain patterns of thinking, feeling and acting have established themselves within a person's mind, he or she must unlearn these patterns before being able to learn something different, and unlearning is more difficult than learning for the first time.*" [Emphasis mine].

Symbols, heroes, rituals and values⁸³

"Cultural differences manifest themselves in several ways. From the many terms used to describe manifestations of culture, the following four together cover the total concept rather neatly: symbols, heroes, rituals and values. ...symbols are words, gestures, pictures or objects that carry a particular meaning that is recognized as such by only those who share the culture. The words in a language or jargon belong to this category, as do dress, hairstyles, flags, and status symbols. New symbols are developed and old ones disappear; symbols from one cultural group are regularly copied by others. This is why symbols are on the outer, most superficial layer of [the onion diagram].



The onion diagram, representing four manifestations of culture
(After Hofstede et al, 2010, p. 8)

⁸² Ibid, p. 4

⁸³ Ibid, p. 7

“Heroes are persons, alive or dead, real or imaginary, who possess characteristics that are highly prized in a culture and thus serve as models for behavior. Even Barbie, Batman....or Snoopy [a cartoon dog in the U.S.]...have served as cultural heroes. In the age of television, outward appearances have become more important in the choice of heroes than they were before.

“Rituals are collective activities that are technically superfluous to reach desired ends, but that, with a culture, are considered socially essential. They are therefore carried out for their own sake.business and political meetings organized for seemingly rational reasons often serve merely ritual purposes, such as reinforcing group cohesion or allowing leaders to assert themselves. Rituals include discourse, the way language is used in text and talk, in daily interaction, and in communicating beliefs.

“In [the onion diagram] symbols, heroes and rituals have been subsumed under the term *practices*. As such, they are visible to an outside observer; their cultural meaning, however, is invisible and lies precisely and only in the ways these practices are interpreted by insiders.

“The core of culture according to [the onion diagram] is formed by *values*. Values are broad tendencies to prefer certain states of affairs over others. Values are feelings with an added arrow indicating a plus and a minus side. They deal with pairings such as the following:

Evil versus good
Dirty versus clean
Dangerous versus safe
Forbidden versus permitted
Decent versus indecent
Moral versus immoral
Ugly versus beautiful
Unnatural versus natural
Abnormal versus normal
Paradoxical versus logical
Irrational versus rational

Culture reproduces itself⁸⁴

“There is a powerful stabilizing force in [cultural patterns of upbringing] that biologists call *homeostasis*. Parents tend to reproduce the education that they received, whether they want to or not. And there is only a modest role for technology. The most salient learning in your tender years is all about the body and about relationships with people. Not coincidentally, these are also sources of intense taboos.....Because they are acquired so early in our lives, many values remain unconscious to those who hold them. Therefore they cannot be discussed nor can they be directly observed by outsiders. They can only be inferred from the way people act under various circumstances. If one asks people why they act as they do, they may say that they just “know” or “feel” how to do the right thing. Their heart or their conscience tells them.”

No group can escape culture⁸⁵

“There normally is continuity in culture. But what if you were [stranded on a desert island] with twenty nine unknown others, what would you do? If you [all] are from different parts of the world, you would lack a common language and shared habits. Your first task would be to develop an embryonic common language and some shared rules for behavior, cooperation and leadership. Role divisions would emerge between young and old, men and women. Conflicts would arise and somehow be handled. Whose responsibility would it be ...[to] take care of the sick, the dead, and children born on the island?...The point of this example is to show that no group can escape culture. *Creating shared rules, even if they are never written down, is a precondition for group survival* [emphasis mine]. This pioneer group of thirty people united at random will have to create a new culture. The particulars of that culture will largely depend on chance, inheriting from existing values, particularly those of the most prominent group members. However, once the culture is set, and supposing children are born into the group, the culture will reproduce itself.”

Boundaries of the Moral Circle: Religion and Philosophy⁸⁶

“Philosophy, spirituality and religion are ways of sorting out the difference between good and bad. For 2,500 years, philosophers in the east and West have taught the Golden Rule: “Do to others as you would wish them to do to you” – which reads like an affirmation of the moral circle. Religious prescriptions such as “Love thy neighbor as thyself” serve the same purpose. Religious sects tend to draw their moral circle around member of their own community. Moral rights and duties, as well as rewards in the afterlife, are granted only to members of the faith. Religion, in essence, and whatever the specific beliefs of a particular one, plays an important role in creating and delineating moral circles....Nations and religions can come into competition if they both attempt to delineate a society-level moral circle in the same country.....the violence of these conflicts testifies to the importance of belonging to a moral circle. It also shows how great a prerogative it is to be the one who defines its boundaries.”

⁸⁴ Ibid, p. 10-11

⁸⁵ Ibid, p. 11

⁸⁶ Ibid, p. 13

National cultural differences⁸⁷

“The invention of *nations*, political units into which the entire world is divided and to one of which every human being is supposed to belong – as manifested by his or her passport – is a recent phenomenon in human history. Earlier, there were states, but not everybody belonged to one of these or identified with one. The nation system was introduced worldwide only in the mid-twentieth century. It followed the colonial system that had developed during the preceding three centuries. On this colonial period the technologically advanced countries of Western Europe divided among themselves virtually all territories of the globe that were not held by another strong political power. ...*Nations*, therefore, should not be equated to *societies*. *Societies are historically, organically developed forms of social organization. Strictly speaking, the concept of a common culture applies to societies, not to nations* [emphasis mine]....Within nations....[there are] usually one dominant national language, common mass media, a national education system, a national army, a national political system...a national market for certain skills, products and services....they are the source of a considerable amount of common mental programming of their citizens.

“In research on cultural differences, nationality – the passport one holds – should be used with care. Yet it is often the only feasible criterion for classification. Rightly or wrongly, collective properties are ascribed to citizens of certain countries: people refer to “typically American”, “typically German”, “typically Japanese” behavior. [But] using nationality as a criterion is a matter of expediency, because it is immensely easier to obtain data for nations than for organic homogeneous societies. Nations as political bodies supply all kinds of statistics about their populations....[but] where it is possible to separate results by regional, ethnic, or linguistic group, this is useful.”

National Identities, Values and Institutions⁸⁸

“Countries and regions differ in more than their cultures...[there are] three kinds of differences between countries: identities, values and institutions. Identity answers the question “To which group do I belong?” It is often rooted in language and/or religious affiliation....identity, however, is not a core part of national cultures....identity differences are rooted in practices (symbols, heroes and rituals), not necessarily in values...Identity is explicit: it can be expressed, such as “woman”, “a bicultural individual”, “and American citizen”. In fact, the same person could report being any of these three things, depending on the setting in which you asked. *Individualistic environments such as modern cities, academia, and modern business allow people to have several identities and to easily change their identity portfolio. In collectivistic societies, in which most of the world’s population still lives, one conceives as oneself much more as belonging to a community, whether this be ethnic, regional or national, and one’s sense of identity derives mainly from that group affiliation* [emphasis mine].

Values are implicit: they belong to the invisible software of our minds. Talking about our values is difficult, because it implies questioning our motives, emotions and taboos. Our own culture is like the air we breathe, while another culture is like water – and it takes special skills to be able to survive in both elements.”

⁸⁷ Ibid, p. 20

⁸⁸ Ibid, p.22

Inequality in society⁸⁹

“There is inequality in any society. Even in the simplest hunter-gatherer band, some people are bigger, stronger or smarter than others. Further, some people have more power than others: they are more able to determine the behavior of others than vice versa. Some people acquire more wealth than others. Some people are given more status and respect than others...Physical and intellectual capacities, power, wealth, and status may or may not go together ...such inconsistencies among the various areas of inequality are often felt to be problematic. In some societies people try to resolve them by making the areas more consistent. Athletes turn professional to become wealthy; politicians exploit their power and/or move on to attractive business positions in order to do the same; successful business-people enter public office in order to acquire status. This trend obviously increases the overall inequalities in these societies.”

The Individual and the collective in society⁹⁰

“The Swedes and the Saudis [for example] have different concepts of the role of personal relationships in business. *For the Swedes, business is done with a company; for the Saudis, it's done with a person whom one has learned to know and trust* [emphasis mine]. When one does not know another person well enough, it is best that contacts take place in the presence of an intermediary or go-between, someone who knows and is trusted by both parties. At the root of the difference between these cultures is a fundamental issue in human societies: the role of the individual versus the role of the group....the vast majority of people in our world live in societies in which the interest of the group prevails over the interest of the individual. We will call these societies *collectivist* [without any political connotations here]. [This] refers to the *power of the group*. The first group in our lives is always the family...in most collectivist societies, the family ...consists of ...parents, and other children....grandparents, uncles, aunts, servants...or other[s]. ...*they learn to think of themselves as part of the “we” group....[this] is the major source of one’s identity and the only secure protection one has from the hardships of life....one owes lifelong loyalty to one’s in-group, and breaking this loyalty is one of the worst things a person can do* [emphasis mine]. A minority of people in our world live in societies in which the interests of the individual prevail over the interests of the group, societies that we will call *individualist*. In these, most children are born into families consisting of two parents and, possibly, other children....other relatives live elsewhere and are rarely seen. This type is the *nuclear family*. Children from such families, as they grow up, ...think of themselves as “I”. *This “I”, their personal identity, is distinct from other people’s “I”s, and these others are classified not according to their group membership but instead according to individual characteristics* [emphasis mine]. Playmates, for example, are chosen on the basis of personal preferences. The purpose of education is to enable children to stand on their own feet. Children are expected to leave the parental home as soon as this has been achieved....*neither practically or psychologically is the healthy person in this type of society supposed to be dependent on a group.*” [Emphasis mine].

⁸⁹ Ibid, p. 54

⁹⁰ Ibid, p. 90

Learning intercultural communication⁹¹

“The acquisition of intercultural communication abilities passes through three phases: awareness, knowledge, and skills. *Awareness* is where it all starts: the recognition that I carry a particular mental software because of the way I was brought up and that others brought up in a different environment carry a different mental software for good reasons. ...*Knowledge* should follow. If we have to interact with particular other cultures, we have to learn about those cultures. We should learn about their symbols, their heroes and their rituals; while we may never share their values, we may at least get an intellectual grasp of where their values differ from ours....*skills* are based on awareness and knowledge, plus practice. We have to recognize and apply the symbols of the other culture: recognize their heroes, practice their rituals, and experience the satisfaction of getting along in the new environment, being able to resolve first the simpler and later on some of the more complicated problems of life among the others....Intercultural communication can be taught. Some students are more gifted at learning it than others. Persons with unduly inflated egos, a low personal intolerance for uncertainty, ...or known racist or extreme left- or right-wing political sympathies should be considered bad risks for a training program that, at its core, assumes people’s ability to distance themselves from their own cherished beliefs. Such persons are probably unfit for expatriation anyway.”

I will return to Hofstede’s ideas in the following pages.

Maslow’s hierarchy of needs⁹²

This is a theoretical concept that seeks to prioritize the various human needs that drive our thoughts, beliefs and actions through *motivation*. *When we are engaged in work with overseas colleagues with the aim of achieving outcomes involving changes in behavior and the acceptance and imposition of new or adapted norms, then we have to consider issues of motivation as a key driver in all that we and our colleagues do.* Please note that this applies to *our* motivation as well as to the motivation of our overseas colleagues.

I have already raised here a range of cultural issues that put stress on individuals and groups, and therefore drive their responses. Maslow, in the first half of the 20th century, developed his theory of the hierarchy of needs, as can be seen in the figure below. *Maslow suggested that we can’t function effectively on any level, or for any length of time, unless the levels below it have been effectively addressed.* Thus, you would not expect a homeless person to be bothered too much about morality if he has to steal to eat; likewise, a person without a caring family and friends is likely to have problems with self-esteem, or feel that nobody is impressed with him, and he may then feel that it is acceptable to have less respect for others.

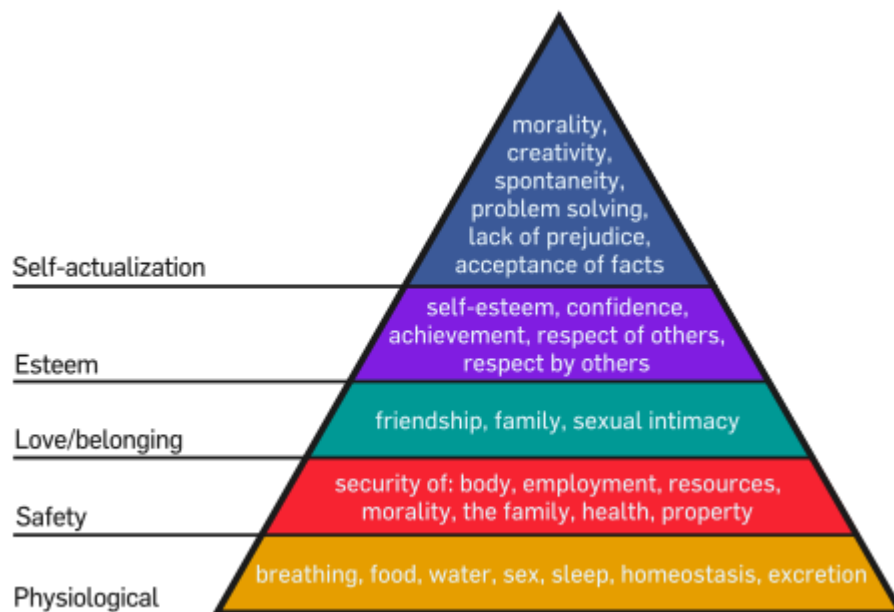
⁹¹ Ibid, p. 419

⁹² See: <http://psychclassics.yorku.ca/Maslow/motivation.html> and <http://web.archive.org/web/20100211014419/http://honolulu.hawaii.edu/intranet/committees/FacDevCom/guidebk/teachtip/maslow.htm>

Maslow said:

“If all the [physiological] needs are unsatisfied, and the [person] is then dominated by the physiological needs, all other needs *may become simply non-existent or be pushed into the background* [emphasis mine]. It is then fair to characterize the whole [person] by saying simply that [s/he] is hungry, for consciousness is almost completely preempted by hunger [for basic needs to be met]. *All capacities are put into the service of hunger-satisfaction, and the organization of these capacities is almost entirely determined by the one purpose of satisfying hunger.* The receptors and effectors, the intelligence, memory, habits, all may now be defined simply as hunger-gratifying tools.

“Capacities that are not useful for this purpose lie dormant, or are pushed into the background. The urge to write poetry, the desire to acquire an automobile, the interest in American history, the desire for a new pair of shoes are, in the extreme case, forgotten or become of secondary importance. For the man who is extremely and dangerously hungry, no other interests exist but food. He dreams food, he remembers food, he thinks about food, he emotes only about food, he perceives only food and he wants only food. The more subtle determinants that ordinarily fuse with the physiological drives in organizing even feeding, drinking or sexual behavior, may now be so completely overwhelmed as to allow us to speak at this time (but only at this time) of pure hunger drive and behavior, with the one unqualified aim of relief.”



Maslow's Hierarchy of Needs

This quote from Maslow's 1943 paper may be directly related to the situation of the person whose country, culture and environment have undergone recent serious changes, or suffered long term economic or other challenges that interfere with his well-being. He may not have even his basic needs met, or they may only be met intermittently, and when this happens, these needs

begin to outweigh his consideration of all else. Externally he may be able to put on a show of acting normally, but internally, all he can think of is regaining a state of balance in which his needs are met – needs of regular and good quality food and drink, for example, at the most basic of levels.

“Another peculiar characteristic of the human organism when it is dominated by a certain need is that *the whole philosophy of the future tends also to change* [my emphasis]. For our chronically and extremely hungry man, Utopia can be defined very simply as a place where there is plenty of food. He tends to think that, if only he is guaranteed food for the rest of his life, he will be perfectly happy and will never want anything more. Life itself tends to be defined in terms of eating. Anything else will be defined as unimportant. Freedom, love, community feeling, respect, philosophy, may all be waved aside as fripperies which are useless since they fail to fill the stomach. Such a man may fairly be said to live by bread alone.”

While Maslow is referring here to basic physiological needs, and he does go on to detail “higher” needs in his paper, we can see here the principle that underpins human reaction to extreme stress. Earlier in the paper I mentioned my friend in the former Soviet state who had to feed herself and a dependent for two years by selling cookies on the way to work. Her need to get the ingredients for those cookies outweighed everything, and was the major driving force of her life for a long period of time. This has major psychological effects on people’s ability to prioritize and to make future plans. *There is no future, or no meaningful future, if you have had your basic security and provision removed from you.* Survival becomes everything.

“It cannot possibly be denied that such things are true but their *generality* can be denied. Emergency conditions are, almost by definition, rare in the normally functioning peaceful society. That this truism can be forgotten is due mainly to two reasons. First, rats have few motivations other than physiological ones, and since so much of the research upon motivation has been made with these animals, it is easy to carry the rat-picture over to the human being. Secondly, it is too often not realized that culture itself is an adaptive tool, one of whose main functions is to make the physiological emergencies come less and less often. In most of the known societies, chronic extreme hunger of the emergency type is rare, rather than common. In any case, this is still true in the United States. The average American citizen is experiencing appetite rather than hunger when he says “I am hungry.” He is apt to experience sheer life-and-death hunger only by accident and then only a few times through his entire life.”

So here we see the concept of the “emergency situation” as being relatively uncommon (by comparison) in the American life. *But when we look at the conditions under which our BMENA friends have to live, we can see quite easily how the securities and benefits of our Western lives do not always exist in their countries.* We hailed the Arab Spring as the arrival of democracy, forgetting that it has taken us hundreds of years to “get it right” in our own countries, and that democracy does not arrive as a culture, fully-formed and ready to go. You cannot just go out and “buy” a democracy package ready-made. Democracy is a mind-set as well as a political theory. The population has to accept democracy into its consciousness and to accept what it means in practice. The population has to learn what the boundaries of democracy are, and to go through a

process of education and experience that instill democracy into heads, hearts and minds. Our politicians, and we ourselves, have naively assumed that once democracy “arrives” in Arab countries, people will just get on with life under this new system and all will be well.

Applying Maslow to scientists and biosecurity

While the levels in Maslow’s diagram are defined in terms of the needs of the human individual on a social level, we can also apply the concept to individuals in a science context.

Physiological needs, the most fundamental of all, can equate, in terms of our biosecurity work, to the acquiring of a place on a course of scientific study, or a professional position. This is the doorway into a science career (birth is the doorway into Maslow’s original diagram).

Safety needs can equate to security in that position, in terms of adequate salary, other rewards and recognition of our efforts and achievements, and physical safety and security. We could also include wider concepts such as political security and financial security.

Love/belonging needs equate to our sense of belonging to a recognized, defined group; in this case we are talking about the professional group – the community of scientists, both local, national, regional and international. If our scientist does not feel he belongs to a community of peers, or he does not wish to belong to a community of peers, then we have a problem.

Esteem needs equate to our acceptance by our colleagues, managers, employers, and so on; it can also apply to our social acceptance that results from our holding this studentship or professional position; it includes all also all of the respect and rewards that we expect or hope to receive as professional and personal recognition of our abilities and prospects for future gain.

Self-actualization means to reach our full potential. *Once we have got all the lower levels sorted out, we can be freed up to do “the fluffy stuff”. Nothing at this level equates to simple survival – it is all to do with non-urgent issues that require thought, planning, objectivity, critical skills and an open mind.* Here, self-actualization as a scientist equates to being able to spend time and effort in being objective rather than always subjective; being able to engage in ethical debate (the kind of difficult issue that tends to get left on the shelf if there are other more pressing problems that need attention), being creative rather than just repetitive in our thoughts and actions, solving long term problems in advance rather than just reacting to today’s crisis, and accepting that we can’t fix everything, and some things will continue to be problematic.

I think it’s quite clear how these levels of need can be applied to the individual working in biosecurity. We may note, of course, that some folks like to look as if they have reached the higher levels, but underneath, there are some shaky foundations (this goes for all of us). Clearly this is just a model, and there are people who can function at the self-actualization level when undergoing serious challenges that would knock most of us off our perches – and many of our BMENA colleagues fall into this category. *However, as supporters of our BMENA colleagues, we need to be aware that people can only function at this level under severe stress for a fixed length of time before stress becomes overwhelming, resulting in personal and professional problems. We need to account for this in our long term planning of educational efforts.*

Perhaps one of the most important factors on the diagram is “self-esteem” in our work. I have mentioned *status* several times here, and it is a vitally important element in all we do in BMENA countries (and in our own if we are honest). *It is arguably one of the key drivers (or even “the” key driver) that motivates our overseas colleagues to join with us.* This has both positive and negative consequences. When colleagues use preferential access to our courses through nepotism or other social favoritism, other people, who may be better placed to use the course materials, will lose out. On the other hand, participants who really use our educational events to gain awareness of the issues, acquire more knowledge about them, and apply this in practice, thus developing skills, *ought* to gain more status in their home community as they will be well-placed to become influential promoters of biosecurity.

When people are engaged in a daily struggle to survive or progress in any way that they wish to, sometimes in terms of personal advancement, furthering their professional skills, in their economic situation or in terms of technological access, or around religious disagreements or political upheaval, or in post-conflict situations, it is very hard for them to prioritize the same things that we prioritize in the West. When we know that our job is safe as long as we perform it well, when we know that our union is looking after our interests in salary disputes, that our mortgage is well on the way to being paid off, that our kids are safe at school, that we have more than sufficient food for ourselves and our families and that the elections really are fair and open (even if we don’t like the results), then we can easily focus our efforts on the details of advanced practice and the “fluffy stuff” of continuing professional development, networking to promote our scientific ideas, pursuing grants on high-level or blue-skies research. *But when our colleagues overseas cannot rely on **any** stability in the same way, or on very little of it, why on earth should they be bothered about all the high level “fluffy stuff”? If survival is the priority, then let’s be honest – the finer points of biosecurity networking and every little detail of good biorisk management are highly unlikely to get a lot of attention.*

Cultural Competency model

I’ve left this to the end of this section because it simply provides a useful framework that I will return to in Section 3. Anyone who is interested can read up on this model as there is quite bit of a literature out there dealing with it. For now, just look at it as a way of guiding engagement and planning.

This is a concept that grew from healthcare in the later part of the 20th century in the United States, in response to the changing needs of the population for effective health interventions. It became apparent to the majority white, educated, English-speaking healthcare establishment that many parts of the American population were not receiving the care they needed, for language, social, religious and other cultural reasons. As a result, a movement to make the majority of healthcare providers more aware of the different needs of minority groups began to emerge. The idea of cultural competency has grown from this. It includes these elements:

- *Awareness* (of one’s reactions to other cultures)
- *Attitude* (do you have a general head-knowledge of the need for cultural understandings or do you actually engage in it in your own life and experiences)
- *Knowledge* (do you really understand the needs of other cultures and do you actually “practice what you preach”?)

-
- *Skills* (do you have the ability to actually communicate effectively with people from other cultures? Can you manage verbal and non-verbal communication effectively in a multi-cultural setting? Have you practiced?!)

I will return to these principles in Section 3, as they are a useful model for us in biorisk management.

SECTION THREE: PRACTICAL PROBLEMS AND RESPONSES

Some examples of problematic behavior

I've just collected here some anecdotes, admittedly some of them are extreme, from my personal experience that may shed some light on how and why members of non-U.S. cultures may occasionally find it difficult to handle U.S. folks in practice. All of the quotes or paraphrases below were actually said, and none of the speakers had any clue as to how they sounded to listeners. The actions described were all carried out as normal, routine and assumed to be acceptable by the folks doing them. Of note, the problems described here were caused by non-scientists. Rather, they were caused by people *associated* with the support of scientific education activities. I think that this is something that we need to look at. (Can I please make the point here that I am not saying that all U.S. communication is problematic – I'm just giving you some strong examples here to make my point. I have many U.S. friends and colleagues who are consummate communicators – it's just that when public communication goes wrong, it goes *really* wrong). In my experience, all the scientists and educators that I have worked with on overseas projects have been excellent or good communicators and have formed good relationships with local participants. However, my impression is that those who "come with us" or who have a public, official voice seem to be in need of the inter-cultural skills training. I leave it to you to decide. These are all examples of the worst sort of unhelpful discourse employed by thoughtless folks who simply never questioned the right of the U.S. to be "top dog" because of power and money.

"You break it, you buy it"

On a recent visit to Iraq, I was talking to a U.S. individual from a military background. His entire perspective was one of threat identification and reduction. By the end of our time together I assumed that I was also probably seen as a threat to him. One day we were passing some bombed out buildings that had not been repaired yet. I wondered aloud who would one day fix them up. He said "*Oh you know, it'd probably be us – you break it, you buy it*". I could not think of a response that was polite and repeatable. What our Iraqi colleagues listening in thought of this, I cannot imagine. But this phrase, so casually thrown out, just said it all. *We broke it* (we had to bomb it in order to achieve our ends); *we will fix it* (because "they" can't or won't); *we have money*, "*they*" *don't*; *we can do what we want here* (because we just can); *if it's our responsibility, then we own it*. The same chap kindly told me also, when I was discussing UK defense and the European Union, that "What are you talking about – I thought it was us that defended you guys". Nice. No doubt he owns us too.

When we see a threat, we go in and we deal with it

I was at a high-level meeting in the UK recently, discussing UK support activities overseas, at which some U.S. government colleagues were present. The senior of the visitors got up and opened

his talk with an explanation of what his government section did. He said, describing the U.S. response to security challenges from other countries, “*When we see a threat, we go in and we deal with it*”. This was said as if it was absolutely normal and with about as much insight as if he had announced he was going out for a take-away meal. Now just think, for a minute, how this would be received if it came from, say, Pakistan, or Jordan? Let’s imagine that senior government staff from one of these countries, when visiting overseas with partners, said this in a meeting. And let’s imagine that their country has the money and capacity to do this in practice. How would it be if a BMENA country saw a perceived threat in the U.S. and just decided it was acceptable to “*see it, go in and deal with it*”? It’s just not a good way to make friends and influence people – in the UK we’re on the U.S. side, but even we don’t like it.

Some of you may have noticed this

Following on from this perspective, I have a good example of how this “we just go in and fix it” approach can cause bad feeling. At a major international meeting in the U.S. a while ago, I was present at a session that had an audience from all over the world, especially from the Middle East and Far East. The session was focusing on biosecurity in industry. A relatively high-level U.S. government individual (one of several) addressed the meeting by emphasizing the power of the U.S. compared to the rest of the world, and peppered his speech with examples of U.S. intervention powers. There was not really any need for this, given the motivated audience who had come to hear the session, yet he made a comment that was presented as being amusing/ironic/illustrative, when he said that U.S. power could achieve anything it wanted, “*as some of you may have noticed recently in Abbottabad*”. There was an audible murmuring of discomfort in the audience, but he just ploughed on. The audience was heavily skewed towards science and had many scientists in it, including many BMENA scientists or science representatives. How did this comment and those that went with it, make them feel? Is it appropriate to broadcast U.S. “might” in such a setting? Is it helpful to make what sounded like a flippant comment about the killing of an individual, even if that individual was widely known as a terrorist? Many people in the Middle East did not see this individual this way – but to use a reference to his death as an illustration of U.S. power and reach seems to me to be crass and insensitive. I didn’t like it even though I support anti-terrorism efforts.

Car bombs as a norm

I was at a meeting in Washington, DC, recently at which a senior and well-respected scientist made the statement, when discussing biosecurity in terms of national values, that “*the reason that car bombs are largely unknown in the U.S. is because in the U.S., car bombs are not a norm*”. When I criticized this statement, and said that I did not know of any country where car bombs are a norm, I was met with some degree of shock in the room. Heads turned in amazement. Further, at the subsequent coffee break, two different people approached me to talk. The first, a senior academic at a northern U.S. university, thanked me for my critique of the comment about car bombs and told me that she had never before thought that people in the villages of Pakistan could be upset by car bombs – it was news to her that car bombs would be considered abnormal in such countries. I also wondered what she thought of our attitudes to car bombs in the UK – we have had plenty - but I was so stunned that I did not think to ask her. The second person told me that I was clearly not trying to make myself popular in the room by my comments.

Better late than never

I was recently at an educational event in a BMENA country and a representative from the U.S. Embassy was coming to give an opening address. We were all ready to start, but he had not arrived. So we filled, and filled, and filled. Eventually, he turned up. Instead of apologizing for his late arrival, which had delayed the start of the sessions, and inconvenienced us all, he breezed in and immediately just assumed control of the room. No eye contact with us or with the participants, he just strolled across to the lectern saying “Ok, here we go.....let’s get started.....is everybody here?....is everything ready?....” and off he went on his speech. We just looked at each other in disbelief. But as the U.S. was paying for the event, we all just went along with it. He focused his speech on the inconveniences to him caused by “the terrorists” who had caused recent changes in his travel plans and emphasized how “We know that none of us let the terrorists get us down or stop us doing our work”. Ok. But this was in front of a local audience, some of whom may have had some sympathy with “the terrorists”, who were after all, members of the host population, in whose country we were guests. Some of these terrorists may have been relatives of those present (which does not excuse their activities, but puts a different slant on how the audience may have heard this speaker). While I can see the need to fight terrorism in all its forms, is it a good idea to refer to the cultural (or actual) kinsmen of your hosts as terrorists, when you are holding an event that is aimed at influencing hearts and minds? Why would you, as a local, change your behavior if you didn’t like the sentiments expressed in the opening speech? Those comments may have ruined the whole event for some participants.

Guns ‘n’ toilets

I had another example of a cultural upset described to me by people who attended similar event at which I was not present. An important U.S. individual was arriving at an educational event in a BMENA country to give a speech, and came with a number of armed soldiers as his security. Upon arrival to the building, the armed soldiers walked straight into the female toilets, without any warning, with weapons, and inspected the toilets for threats. While female participants at the event were in there. I have to say that had I been in the toilet when armed soldiers walked in, I would have had something to say about it. Why is it that the security “needs” of one visiting individual were considered of more importance than the privacy and dignity of local women? This is not security, it is appalling bad manners, discourteousness in the extreme, and a very poor way of getting people “on side”. What did this action say to the local participants about respect and the value placed on them as individuals and professionals?

Hopefully, these examples will focus your mind on how the adverse effects of these may have been avoided. You will note that *most of these anecdotes resulted in people being disrespected, annoyed, insulted, shocked, or all four. We can also see how an accumulation of such experiences could really upset an individual or group, possibly resulting in behavior changes that nobody wants to see.* At the very least, these examples reduced the desire for interaction with the speakers/actors, and if folks don’t want to work with us, we are in a mess.

Philosophical distinctions

We need to think about our motivations in biosecurity education carefully. *It seems to me, and I am happy for someone to put me right if I am wrong, that U.S. (and UK to a large extent) support and interventions in the field of biosecurity and all biorisk management activities, is still modeled*

*closely on the old post-Second World War and post-Cold War paradigm of **diverting** scientists away from something, and towards something else **in case they hurt us***⁹³. After the Second World War, many German rocket scientists were “diverted” to the U.S. After the Cold War, much effort has been put into “diverting” Soviet weapons scientists into other activities. There are many arguments to be had over these historical approaches, and this is not the place to go into them. It seems to me that many U.S. people *think that this is the way to treat all overseas biotechnology scientists*, because it seems so normal for people in the U.S. to consider other countries as a threat to security. This is not just a U.S. issue – when I took a trip to St Petersburg in Russia in 2006, my father was seriously worried because I was going to be with “the Russians” – who in his mind had been an enemy for decades. However, given the examples of problematic discourse and behaviors that I gave on earlier pages, this is a problem, because it this approach is “picked up” by our overseas colleagues, whether we say it openly or not. I think that this needs to be recognized and addressed.

It seems to me that as we are not in a war or a post-war situation (despite the so-called War on Terror), *we should **not** be couching our biosecurity support and interventions in the same terms as we have done in the post-war situations of the twentieth century*. Today we *all* face risks from the abuse of biotechnology, so is it really appropriate to approach today’s problem from yesterday’s perspective? Especially when doing so serves to impede our efforts, thereby defeating the purpose of our work?

This approach assumes that: 1) non-Western scientists are planning, or are likely to plan at some point, to involve themselves in hostile (to the West) scientific activity; and 2) the West is at risk in some way from a “real” threat in the form of people (scientists). Of course, this is very different from diverting scientists after wars from work *that we know for a fact they were involved in*. Today, we seem to be trying to divert folks from work that they *might be involved in at some point in the future*. Hence the security approach rather than the development approach. But how would we feel if we were being viewed this way?

Too much talk is focused on getting “them” to “our” standards. Teaching “them” how to do it. And so on. All against a background that seems to be largely driven by the need for “our” security. Now this seems an inappropriate way to get folks to want to actually take up the norms, knowledge and skills that we are trying to “sell”. *Yes, people will want to engage with us to get new equipment and so on, but we really want our colleagues in other countries to adopt and adapt the norms, knowledge and skills we’re sharing and **run with them***. In order to do this, we need to win, to coin a phrase, *hearts and minds*. *And if we are seen to be constantly driven by the prioritization of our own security and of our own benefits, why should they bother with it all once we have delivered the new biosafety cabinet, held a seminar, ticked a funding box and gone home?*

This is a major issue and needs to be tackled from the top down. One could say that this approach is also being driven by our old friend, *democracy* – no politician who wants to be elected, or stay elected, in the U.S. is now prepared to “let up” on “the threat” from the Middle East. In the anticipation therefore that nothing much is going to change anytime soon, I suggest that we at least try to be aware of this and the effect it can have on our work and on our BMENA colleagues.

⁹³ See, for example, the Russian Transition Initiative, at https://www.llnl.gov/str/JanFeb05/pdfs/01_05.2.pdf

Bio-engagement as a development activity, not a security endeavor

*Following on from this, it is my opinion, based on my experiences, that the education of, and awareness-raising activities among, BMENA scientists and science educators should be considered as a **long term development activity** rather than as a **threat reduction enterprise**.* To consider engagement between the U.S. and counterparts overseas, from any region, from the perspective of defense, is to immediately cast the overseas partner(s) as a potential threat, thereby imposing an unequal and hierarchical nature upon the relationship. Indeed, one may argue that by taking a defense approach, it is not possible to initiate any type of connection that may be considered a *relationship*; rather, the “defender” views his connection with the “potential threat” as no more than a convenient association that seeks, in real terms, to only benefit itself. I would propose that we need to ask ourselves why we are assisting overseas countries at all, questioning the rationales for such interventions.

If we seek to encourage overseas partners to engage with us in improving the capacity and sustainability of their biorisk management endeavors, we must demonstrate to partners *how such activities will benefit them*. In other words, there must be “something in it for them”, and this needs to be something more than funding. This precludes, of course, any approach that seeks to protect the position of one side at the expense of the other. It has been said, for example, that while the United States seeks to support overseas countries in improving their biorisk management capacities (including issues of both biosafety and biosecurity), it is important – from the U.S. perspective – to “maintain a competitive advantage” economically. While this is understandable at some level, one has to question what this and similar responses to overseas support actually implies.

Is it the aim to only support overseas countries up to a certain point? If so, what is that point, and how would that point be recognized or categorized? What happens if Country A, having been supported by U.S. interventions such as assistance in biotechnology education, begins to compete with the U.S. in the biotechnology or biotechnology education sector? Are we to actively look for signs of such competition emerging in Country A and then reduce our assistance to prevent the loss of U.S. competitive advantage? Clearly, this poses some theoretical and practical challenges to U.S. engagement with other countries, not to say ethical ones.

Different standards do not always mean unacceptable standards

It should be borne in mind that by “engaging” with overseas individuals and organizations, Western actors are, to some extent, actually practicing a form of neo-colonialism. It can be argued that by passing on “our” knowledge and skills to “them” that we are in fact pressuring them to take up and comply with values and/or systems that they may not wish to accommodate. This can be disguised in many ways, usually with at least one hidden agenda, including “education” (“we know better than you and will help you to think more like us so you are less of a threat to us”); “development” (“we can help you to *improve* your country because it needs it”); “aid” (“we will give to you out of our generosity because you cannot afford to help yourselves, even though much is lost to corruption inside your country”) and “disaster relief” (“we will help you in an emergency because it makes us look good and gets into places easily”), among others. We can, of course, be engaged in overseas support activities out of altruistic motives, and these may indeed be the underlying motives of individuals engaged in in-country support work. However, my opinion is that nation states rarely engage in activities for altruistic reasons (feel free to disagree). Politicians need to be elected or re-elected, and while balancing popularity against duty, or a moral

imperative, I would suggest that most governments are principally interested in seeking “what’s in this for us?” rather than “let’s see how we can help you out of the goodness of our hearts”.

One only needs to look at differing standards in health and safety law and practice to see that Western values are not always required or welcomed in all countries. A man who has to climb up 40 floors of bamboo scaffolding to carry out his day’s work on a building site, without a helmet or safety net⁹⁴ may actually be glad of the job and the funds it provides. We may think that he has no choice but to work in these dangerous conditions, but he may well have decided that the risks are acceptable to him in order to achieve the outcomes he wants, at least for now – the necessary funds to raise a family. Who are we to assume that he needs us to intervene and remove his workplace by imposing “our” standards of health and safety, if these put him out of a job? Likewise, the woman working in a “sweatshop” producing cheap tee shirts for our supermarkets may consider herself content if she earns enough to feed herself and her children. Who defines what “ethical shopping” is? Ethical to whom? The tee-shirt buyer, the supermarket chain or the machinist who loses her job when the sweatshop closes after adverse publicity on our evening news?

How is this different from teaching biorisk management? Given that one of the principles of biorisk management is risk evaluation and characterization – defining how acceptable a risk is – why are we so slow to accept that our overseas colleagues are already doing the same everyday themselves? We think we are passing on our skills to result in a safer environment, safer labs, safer personnel, and so on. But if a laboratory has been working effectively (in the eyes of the lab workers and management) for years, what gives us the right to arrive and start telling them “how to do it properly”? Are we seriously saying that labs in the non-Western world that are working with dangerous pathogens are regularly allowing their staff to become infected and fall ill and die, or allowing serious exposures which endanger the public? Do we not think that management and workers are not already committed to working in ways that keep them safe? Why would they knowingly put themselves at risk?

Of course, we know from experience that many of our colleagues in BMENA countries (and elsewhere) are well aware of the limitations under which they have to work. *Stories abound of how biosafety rules in any given laboratory or scientific facility actually depend on what “the boss” lays down as the law – which depends, of course, on how up-to-date and well-informed are the skills and understanding of that boss. In such circumstances, a scientist will find him or herself working to different biosafety standards in different facilities.* Many facilities are hampered by a lack of Standard Operating Procedures for even basic activities such as hand-washing protocols. Infrastructure problems mean that waste cannot be effectively disposed of, for example. Lack of maintenance of equipment is an ongoing problem – how often is the autoclave checked, and what evidence signals that it is not sterilizing contents properly? Basic standards such as labeling of bottles and samples are not always implemented, sometimes with terrible consequences; fridges are shared between units with conflicting biosafety needs, and even contain staff lunches! However, in my experience, *most labs are run on the biosafety principles put in place by the boss.* This means that s/he is requiring that staff work to a set of rules – *they may not be as effective as they could be, but they are rules all the same.* The will is already there to engage with us, but we do not sufficiently recognize this. In my view, *the best way to help here is to start with the rules folks are already using, and base teaching around those.* The participants will see the problems as

⁹⁴ See: <http://www.youtube.com/watch?v=kjtsDsgHCFY> You must watch to the very end.....

teaching progresses, and be able to make changes accordingly. In this way, *folks have ownership of their “new” rules because they are simply the old rules, adapted – and better still – adapted by themselves, not us.*

Biosafety and biorisk management before biosecurity

On top of the awareness of our BMENA colleagues of the limitations under which they work, there is also the issue of being open and honest with funding agencies and visiting colleagues from the U.S. (or elsewhere) who are trying to assist development. *We need BMENA colleagues to be honest in their interactions with us. It is difficult, of course, to tell a guest who is bringing gifts (in effect) that the gift is no good without something else to go with it. Worse, it is almost impossible to tell a gift-bearer that while his gift is welcomed, it is actually not the thing that is really needed right now.*

On a recent trip to a former Soviet state, where I was delivering teaching materials focusing on biosecurity, the audience of students, professors and professional scientists were clearly keen to engage with the topic. However, when I asked some pointed questions in discussion after the session, I found that one or two of the audience (professors and facility directors) asked me, carefully, for some help with basic biorisk management skills. Once this was aired openly, more chipped in and said that they also needed the same things. Nobody wanted to offend me, or to seem ungrateful, but in the public session it was not possible to be open about the priorities actually facing them in “the real world”.

The science educators and the facility directors saw that biosecurity is important, but what chance is there of implementing it effectively when basic biosafety practices are not standardized or in place? To admit such a need is not a weakness, but a necessity. I felt awkward when this was aired, not because I looked down on the audience’s expressed needs, but for myself because we had simply not been well enough informed to recognize this basic level of need. We were there at considerable expense to deliver fairly high-level materials. This was being done to meet some of the needs of our own country’s foreign policy strategy, as well as wanting to help colleagues overseas, but we were missing some of the point.

This brings us back to Maslow’s hierarchy of needs in a way, and to the point I made earlier about difficulties getting in the way of the implantation of recognized needs and norms. *Colleagues need to be able to implement effective biosafety before they can implement effective biosecurity.* In my view, biosecurity encompassed biosafety – both are based around the need for containment:

- *Biosafety addresses the containment of pathogens, toxins and other dangerous materials;*
- *Biosecurity addresses the containment of pathogens, toxins and other dangerous materials AND the containment of information, knowledge, data, equipment and intellectual property.*

Thus, biosafety needs to be in place first. It’s no good trying to put the cart before the horse. But in my experience many colleagues are embarrassed to ask for this. I know that massive biosafety work has been done already by the U.S. in the BMENA region, but it has not reached everybody, and many still fall through the cracks.

On top of this, status is huge in BMENA cultures, and affects all interactions with us. For example, some professors won't teach juniors, but do not know all the relevant knowledge in detail themselves so they have to *appear* to know it. This is stressful on them and impedes uptake of our support. Much of our teaching simply reinforces the lack of infrastructure and knowledge that many of them experience and this can make them feel worse. *They have to smile and say "brilliant", knowing that they will never be able to achieve what we're saying due to lack of money, leadership or opportunities.* Politics get in at every level and other priorities take over biosecurity or any other issue we are trying to address or support. As supporters of overseas colleagues, we need to provide very basic training and require professors to attend so that they can pass it on to others – in this way we can say we are training the trainers when we are actually saving face and training them.

A simple way forward to address both the need for basic information and the status issue, that I want to explore myself, is the production of a series of YouTube videos on all aspects of biosafety, biosecurity and biorisk management. These could range from five minutes on how to don personal protective equipment properly, through hand washing, bench techniques and so on, right up to planning policy and risk assessment. The videos would be in English with a choice of language subtitles. This avoids judging any particular society. If we provided such videos on YouTube, senior scientists as well as junior ones would be able to watch them in the privacy of their own homes, and acquire new knowledge, understanding and the theory of skills, without their colleagues knowing it. This seems to me to be a quick, affordable and easy way to start remedying the problems I've outlined here.

Associated with biosafety needs, we also need to recognize that biosecurity and biosecurity networks are too far off for many just yet – trying to run a safe lab is all that many can manage and that is a huge achievement when it happens. Let's provide the networking opportunities and be the focus of biosecurity networks while they can focus on lab-based stuff first. Then they can look at national and regional networks for biosecurity. I'm not saying that nobody in a BMENA country is ready to engage in a biosecurity network, or that nobody has got biosafety right – *I'm just saying that there are still too many gaps and we should not try to advance our own ideas too quickly.* Unfortunately, when our funding is directed from the top, a long way from the grassroots of reality, this is a hard point to get across. Plus, many overseas colleagues, when quizzed about their abilities, standards and so on *after* training will never feel able to admit the problems they still have. We need to cultivate real communication, such as I have described above where folks disclose important things to me at coffee time – only in such interactions are we likely to hear the real needs expressed. And if we are too senior or distant to attract the personal, quiet chats, we have a problem.

Long term planning

Let's have better planning for long term support when we provide infrastructure overseas – no BSL3 labs to be built unless 5-year maintenance and maintenance training is implemented from day one, with a clear take-over plan for when the five year is completed. When we provide new equipment, training and maintenance has to be inbuilt to the contract with follow-on plans too.

Partnerships with U.S. universities and with equipment suppliers should be the norm – but as equals not as benefactors. I know that many exchange programs have been running for many years, but can we not run more of them? What about instigating whole academic posts in universities purely for work with overseas countries? The post holder could be required to spend so much of each year in the overseas country, co-leading, with local professors, serious research projects tailored to the level of infrastructure in-country and focusing on a topic that will advance that country's growth, health and so on effectively. We also need to prioritize the development of field infrastructure in order to supply all the labs and equipment we provide, with good quality samples. And the overseas partner should have to achieve certain goals as well to qualify for benefits. We need to develop good working relationships with individual and groups in-country over the long term – this is not always possible given upheavals and high staff turn-around, but should still be the aim. Successful personal and institutional relationships will enhance uptake of norms and stimulate new ideas for collaboration.

It's not “their” culture that's the problem, it's ours

We are doing some good work overseas, but we could do better if we got our eyes off our own needs and onto the needs of the people we are trying to help – *defined by them* – not us.

There are a few things that U.S. scientists need to change in what they *do* in their interactions with BMENA scientists, but the biggest change needs to be in how they *understand* where BMENA scientists are coming from in terms of:

- *the challenges of their recent and not-so-recent political upheavals and of their social situation as members of majority or minority groups in their society, as males or females, as juniors or seniors, etc., as all of these are linked to the level of power they have as individuals and the levels at which they can respond and act*
- *the role of their religious ideals in underpinning their actions and beliefs,*
- *the limitations of their economic situation, and the actions that they may not be able to take*
- *the limitations and pressures placed on them by their lack of access to the technology that they would like to have*
- *the ways in which they speak and engage with us when the “aid-game” is going on.*

Some Americans tend, without recognizing it, to be quite loud, as well as being very positive and assertive, from the stage of greeting right through entire conversations and bringing these to a close on their own terms. These qualities have great strengths, but can also be off-putting to non-Westerners. It is over-bearing and can be quite overwhelming sometimes. Please be aware that to folks whose social norms require more modesty and quiet negotiation, this is like being hit with a sledge-hammer. Don't do it if you want to influence people effectively (see my example above of the embassy guy arriving late and just taking over the room on arrival, or the guy who introduced Abbottabad unnecessarily into a speech on industrial biosecurity issues) .

I also have something to say here to BMENA colleagues. Get away from the idea that to be practicing Western-standard science you need to have all-singing all-dancing equipment and be doing all the “big” stuff – if there is no call for it in your country, or the field work systems are not yet in place, don't ask for it. *Focus instead on capacity-building in your country in terms of*

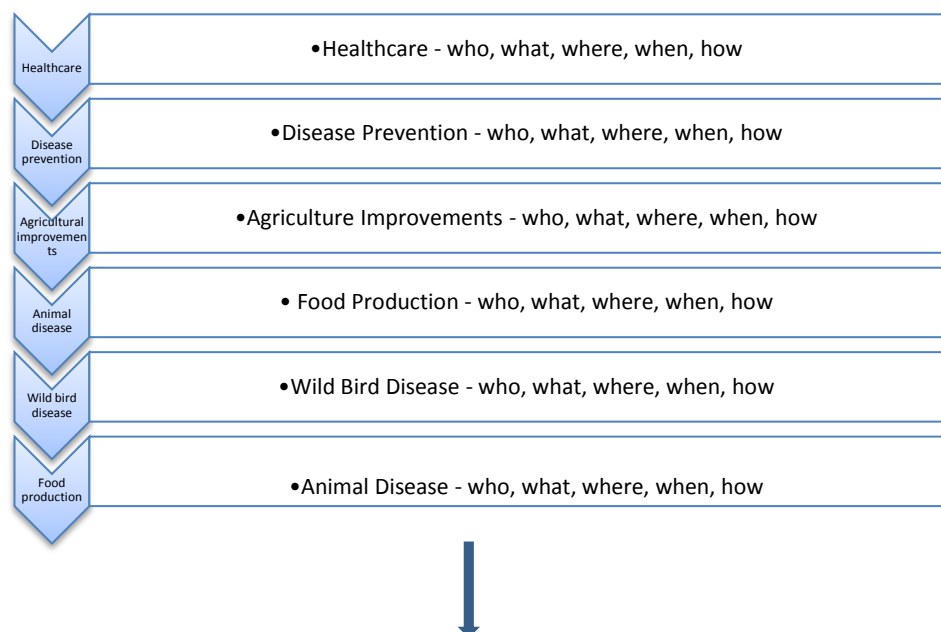
awareness (of actual need), knowledge (of how to develop responses to the needs), understanding (of how you can implement the responses) and skills (the application of your new or enhanced awareness, knowledge and understanding to address the problems in your country through effective scientific activity). Then you can move on to the bigger things.

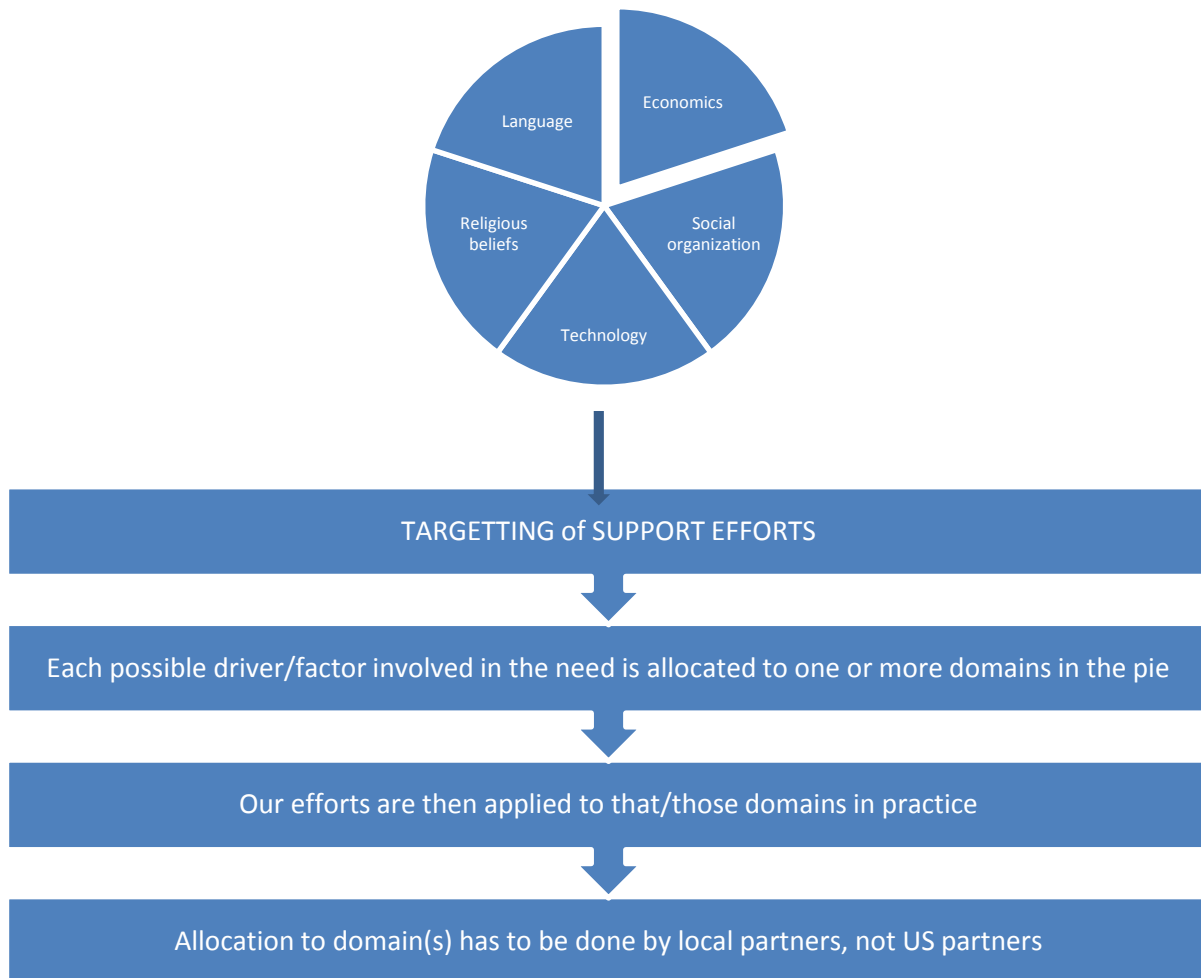
Outcomes, not individuals

I believe that in order to improve interactions between the U.S. and its BMENA partners, we need to look at *outcomes* first, not the individuals employed in doing the work leading up to the hoped-for outcomes. *If we look at the desired outcomes of our interventions, then we can step back and try to understand what the U.S. and the BMENA drivers are likely to be that will result in successful outcomes, partially successful outcomes or even occasional failures.*

Stage One

First, define, in collaboration with BMENA colleagues (the right ones for the job, meaning, the ones who will have the most influence at home in promoting biosecurity, not the ones with the most influence in getting to the table) what the in-country need is. This may, for example, relate to healthcare, agricultural issues, zoonoses, or other issues. *Then, with local partners, formulate what the desired outcomes would be after an intervention or series of interventions. By involving BMENA colleagues in this definition process, we will be able to formulate outcome aims that meet the need and will be culturally manageable “at home”.* This presupposes, of course, that the BMENA colleagues are open to being honest and realistic in terms of *what their country/area/institution actually needs rather than what it wants for purposes of status, income, power or any other personal gain.* So choosing realistic BMENA partners in planning is crucial – and this can only come with time, when solid trust relationships can grow.





Applying a real-need concept to the archaeological theory of culture “pie”

Stage Two

Having defined the desired outcomes of the project or intervention, use the archaeological theory of culture and look at all of the five domains involved. Ask how each domain may enhance or impede the achievement of the desired outcomes. For example, *under “social organization” we need to know the personalities and the people-history of an institution before we go in and provide funds. We need to know the social organization of the institution.* Is there anyone there who could cause a problem on a personal level and act against the desired outcomes? Then, in the third stage (below, using the Cultural Competency Model) work out a way to address this threat in a non-contentious way that does not undermine them. Under “economy”, for example, it is a foregone conclusion that we will be asked for more money – *but work with BMENA colleagues to find ways to better use what’s there already, and don’t let money be the driver of anything.* Once it is clear to colleagues that money is not always going to be forthcoming, priorities will become more practical and realistic.

The easiest way to use the archaeological theory of culture is to take your active needs considerations, for example, *“how can we best address this country’s needs for controlling the*

possibility of zoonotic transfer of disease from wild birds to domestic poultry and possibly to humans?” Then we can mind-map all of the people, institutions, resources, and abstract influences that are involved in this scenario, and allocate them all to one or more segments of the culture theory “pie”.

Stage Three

Once all the possible actors, infrastructure, and resources are allocated (by the in-country locals, not U.S. partners) to one or more domains in the “pie”, then we can see which domains in which to apply our efforts. If a key actor is allocated to the social organization domain, then we need to apply our efforts there; if a key piece of infrastructure is allocated to the economics domain, then we apply our efforts there. If more than one domain is implicated in one actor/infrastructure/timing, or other consideration, then we need to discuss with local partners how best to prioritize our efforts.

This is basically a kind of risk assessment exercise – using the culture framework as a means of identifying and assessing the risk of the desired outcome being thwarted.

Once this assessment has been done, then go to the Cultural Competency Model to plan the practical response to the risk, within the domains you have identified in Stage Two:

- *Awareness* – you have done this with the application of the archaeological model
- *Attitude* – now you know in what cultural domain (social organization, economics, technology, etc) the possible problem lies, and you can take a positive attitude to tackling it – you *understand* where at least *some* of the problem lies and this gives you optimism
- *Knowledge* – work with your BMENA planners to seek the best way to tackle the possible problem
- *Skills* – implement the planned response to the possible problem

Summary

This model closely mirrors Hofstede’s theories. Remember that he said:

“We have to recognize and apply the symbols of the other culture: recognize their heroes, practice their rituals, and experience the satisfaction of getting along in the new environment, being able to resolve first the simpler and later on some of the more complicated problems of life among the others....*Intercultural communication can be taught.*” [Emphasis mine].

This is where the scientists and the educators come in – *they are the ones who will interact with the BMENA colleagues “at the coal face” in the lab and the classroom, and crucially, in the lunch room where so much vital exchange takes place. They are the ones who need to **use the symbols** (words, gestures, pictures or objects that carry a particular meaning that is recognized as such by only those who share the culture), **recognize the heroes** (persons, alive or dead, real or imaginary, who possess characteristics that are highly prized in a culture and thus. serve as models for behavior) and **practice the rituals** (collective activities that are technically superfluous. to reach desired ends, but that, with a culture, are considered socially essential).*

I cannot specify what are the symbols, heroes and rituals in BMENA societies. Only locals can do that. *But I would suggest that it is vital for educational activities and materials to be formulated in conjunction with BMENA colleagues **who do** understand the relevant symbols, heroes and rituals.* This should not be done in a patronizing way, but in a similar way to that which I advocated with regard to the use of religious values and ideals. *We don't need to go trawling for symbols, heroes and rituals, but a local BMENA colleague would immediately recognize certain issues has having some resonance with some local norm, value or tradition that a U.S. colleague would not.*

So if there are certain local or regional customs, concepts and so on that will assist in the uptake of the educational aims, then *use them*. Only a local or someone with relevant experience can do this. I managed to do this with some success in Iraq (you will remember my “Islamic biosecurity”) - with discussing how the Koran provides useful verses in support of public health – not because I am a Muslim, but because I grew up in a Christian fundamentalist home, so I understood how folks with a heavy dose of religious ideals in daily life might think and feel. The class suggested the Koranic verses once they recognized that I respected their views even if I did not belong to the Islamic faith. We met in the middle and it worked.

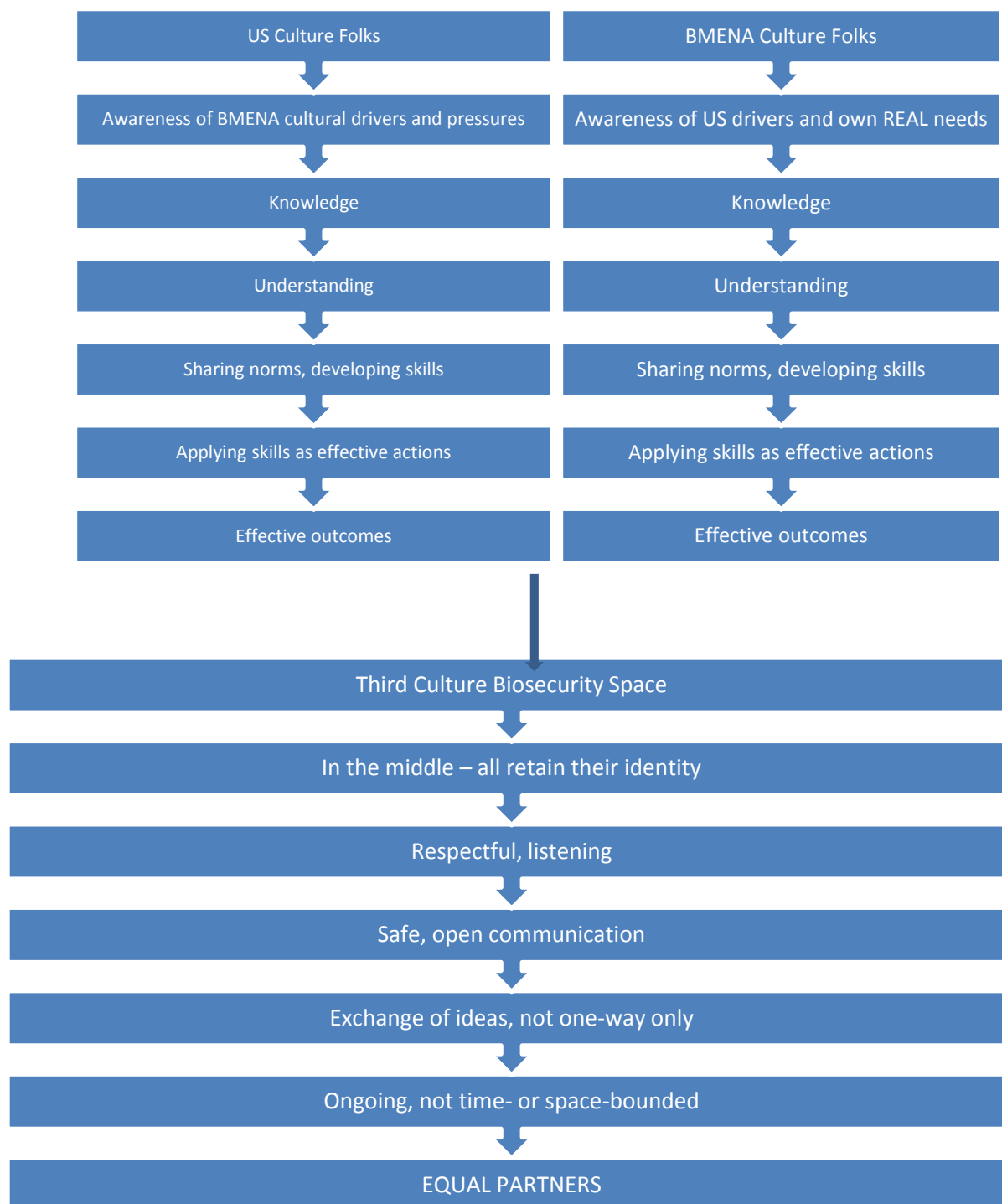
Third Culture Biosecurity

I mentioned quite a bit about Third Cultures in the introduction to this paper. I hope that by now you will be able to visualize this yourself. It seems to me that in order for us to move forward effectively, we need to recognize that we, and our overseas colleagues, *must meet in the middle* somewhere in order to interact effectively. Neither of us needs to abandon our cultural identity, but we do need to recognize and get rid of, or adapt, some of our cultural “baggage” that may be getting in the way of effective communication and action. We also need to *recognize* each other's baggage and take it into account. Overleaf on page 62 is my diagrammatic picture of Third Culture Biosecurity.

In this model, we *both* have to *increase our awareness of ourselves and our own weaknesses, strengths and limitations, and each other's; acquire and increase our knowledge of each other's, and our own, weaknesses, strengths and limitations; work to increase our understanding of these; then develop our skills with each other by sharing our norms, followed by applying skills effectively.* These activities *should* result in effective outcomes.

Crucially, the Third Culture space, as defined here, includes activities that result in *equality between the partners*. We must implement *respect* in our talk, our actions and our approach. This needs to start in our *thoughts*. Once we have both established a respectful space, we can listen *to each other*. This then allows us to engage in *safe, honest and open communication, through which we can share our norms (both ways)*. This space does have to somehow exist “out there” in the sense that it has to be ongoing and not be limited in time or in space. It should not just exist for the partners in just one workshop and then stop once the workshop is over.

It would be helpful for there to be a literal space defined for this concept, perhaps as a web presence. Then all partners in U.S.-BMENA biosecurity endeavors would have a web-space to which they could go to see accounts of the activities that they have engaged in, ongoing discussions on discussion-boards, and other activities that they may not be involved in. In this way, the Third Culture space is visible and ongoing.



A model of Third Culture Biosecurity

Cultural training

I would suggest that all individuals who are to be engaged in either planning, organizing, carrying out, monitoring, or evaluating science support work overseas (in any area of the world outside the

*U.S.) should be **REQUIRED** to undergo cultural awareness training **BEFORE** they start.* This includes policy-makers as well as trainers/tutors and grant-holding organizers. Such a training course should last two-three days, and involve a mix of teaching and of group exercises applied to scenarios such as these:

- A scientist is required to work on a project that involves research that conflicts with his religious values;
- A scientist is told that he can only be appointed to his desired position if he agrees to focus on research that economically benefits certain sections of society, and that he has to avoid work that he knows could benefit those most in need;
- A junior scientist has a better understanding of biorisk management than his seniors in the facility and can see a lot of problems that could be solved easily if simple SOPs were put in place;
- A scientist applies for an six-month exchange post in the U.S.; he has good English; a colleague who is related to his boss, but has weak English, is recommended by the boss instead, and gets the post;
- A scientist has to teach students who come from rich and influential families in the area, who believe that democracy means that rules no longer apply; they threaten the science tutor if they do not receive the marks they want;
- A facility director is asked if he will host a workshop with visiting U.S. scientists focusing on biosecurity implementation; this is to be a national event with colleagues coming from other institutions across the country; the facility director knows he needs to get a grip on biosecurity, but he also knows that his facility has major weaknesses in biosafety; he is worried about his colleagues from around the country seeing the weaknesses of his facility, but he needs the prestige that hosting a U.S.-led event will bring;
- And so on.....

Groups must identify cultural norms that underpin the scientist's responses, and identify possible problems that may arise out of these; then they must devise ways of effectively minimizing the risk of these adverse outcomes in ways that are acceptable to both host and visitors.

Only when folks have been exposed to thinking in some depth about how “the others” think, can they really start to recognize that their version of “normal” is only *one version of it*. To date, I have seen too many examples of U.S. folks just not *getting this*, and most of these examples have come from the folks driving the policy, rather than the folks engaged in meeting and working with overseas colleagues (although I have encountered some trainers who have worked overseas who I personally would not want to let out of the country). However, given the comments made by scientists in the U.S. that I have heard (not on overseas workshops), there is a high level of cultural illiteracy evident among them that really needs to be addressed. They are simply thinking this way because the current U.S. national mind-set is directed to seeing off threats – it’s not a moral failing on their part. They are responding to a cultural perspective, just as our overseas partners are responding to theirs. *Unfortunately, the attitude of policy-makers filters down through all the other levels of folks until it reaches our hosts in overseas countries. This is one of the major sources of problems.* But I believe that even a small amount of training, around the ideas I have presented here, would go some way to improving this situation.

It's the culture, stupid

We need to remember that it's our culture that is largely the problem, not anyone else's. We in the West tend to forget that the majority of the world's populations do not live in "our" culture. It's easy to see that global populations *do* aspire to share in *some* of our cultural baggage – food, fashion, music, entertainment among other domains. However, just because we see overseas folks drinking our Coca Cola and eating our McDonalds burgers, *we should not fall into the trap of assuming that they also want to adopt our values into their social, economic, technology, religious and language norms*. This misunderstanding leads eventually to the ways in which we have been expecting our overseas science partners to take up our scientific norms without recognizing that these do not exist in a vacuum. *We just do not recognize ourselves how **our** norms reflect **our** values and social systems*. We need to understand *their* norms and then support them in adopting effective biosafety, biosecurity and biorisk management norms *into the norms that they already live under*. This is very different from assuming that all non-U.S. scientists are a threat in some way. *It is very different from thinking that we need to "divert" our overseas colleagues from some possible anti-U.S. activity that **might** take place in the future*.

We also need to remember that we have not yet got biosafety and biosecurity completely sorted out yet in our own back yard. Why do we have laboratory accident logs in place if we do not continue to have laboratory biosafety accidents, mishaps, oversights, and negligence incidents? I have been teaching biosecurity now for several years and I have never yet met a scientist or science educator in the UK or the U.S. who thinks that s/he needs to consider biosecurity in his/her work.....all scientists are convinced that their work is harmless and totally beneficial until we point out the possibilities of misuse. Even then, not all are convinced. We only need to look at the H5N1 debate, and see the responses of Fouchier and Kawaoka⁹⁵ to critique their work, to see this in action. *So let's be aware of our own weaknesses and not approach the rest of the world as if we have got it all 100% right*. We may be a lot further down the road to safety and security than some of our overseas colleagues, but this is largely to do with our economic status and the relative security we experience in our political and social systems. *It is not a reflection on the attitudes of folks who just happen to live in more challenging environments*. We laugh now at "old fashioned" ideas such as phrenology – the science of understanding a person by measuring the bumps on his head – but we still seem, at times, to practice a cultural phrenology, in which we think we can judge a person's attitudes towards us just because of his cultural origins.

I offer the ideas in this paper to you and hope that they go some way to introducing you to the concept of different cultures as different patterns of seeing everyday life. That's all it is. But it is important as different views on everyday life result in some unnecessary misunderstandings that it is relatively easy to avoid, if we all get the idea of *mutually-beneficial, shared-benefit outcomes*. I think that the concept of the Third Culture Biosecurity (or Third Culture any other aspect of science) is a useful starting point. We don't expect anyone to jump into the "other" culture, simply to meet us in the middle space between our culture and theirs. Then we each retain our own "selves" and all that means to us, but recognize that our "different" colleagues are also retaining their own selves and all that this means to them. But when we meet in the middle, we can share and exchange ideas, norms and critiques in a safe place.

⁹⁵ See: <http://www.redicecreations.com/article.php?id=23629>

Finally, my own view, personally, is that if an individual anywhere in the world is set in his or her mind to develop a malign use for science, then s/he will do it, regardless of our efforts to educate and inform. Ultimately, I do not see how it will ever be possible to stop ill-intentioned people from making biological or chemical weapons. But what we can do is to share our knowledge, skills and understanding of risk management and the responsible conduct of science, as widely as we possibly can. This will, in turn, promote the safe and secure use and practice of science for most of the people most of the time. And that is probably the best we can achieve. So let's get to it. Together, as equals, not as potential enemies.

Global Partnership WG Projects

	A	B	C	D	E	F	G
1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
2	Canada	Global	World Health Organization (WHO)	Strengthening Global Biological Security at the Health-Security Interface	Canada provided funding to support International Health Regulations (IHR) implementation and strengthen Global Alert and Response activities.	Biological	9/2010 - 6/2012
3	Canada	Global	World Organisation for Animal Health (OIE)	Strengthening Global Biological Security at the Animal Health-Security Interface	Canada provided funding to support, inter alia, emergency preparedness response, disease surveillance networks and OIE's Performance of Veterinary Services evaluation tools.	Biological	10/2010 - 3/2013
4	United Kingdom	Iraq		US DoS Support to the Iraq science fellowship programme	Support to Iraqi scientist fellowship programme	Biological	2011-12
5	United Kingdom	Iraq		US DoS - FETP supplementary training.	In country capacity building in public health, biosafety and security, disease surveillance and outbreak response.	Biological	2012
6	United Kingdom	Middle East / North Africa		Contribution to US DoS - MENA infectious diseases / biosecurity workshop	In country capacity building in public health, biosafety and security, disease surveillance and outbreak response.	Biological	6/1/2012
7	United Kingdom	Middle East / North Africa		Contribution to US DoS Scientists engagement/training - Training courses on modern diagnostic techniques	Follow-on diagnostics training by Jordan University of Science and Technology for scientists from priority countries. Promote improved biosafety and biosecurity and build capacity in disease control, surveillance and training in modern diagnostics.	Biological	2011 -12
8	United Kingdom	Morocco	Morocco	Contribution to US DoS - FETP	In country capacity building in public health, biosafety and security, disease surveillance and outbreak response.	Biological	2012
9	United Kingdom	Middle East / North Africa		Middle East disease surveillance / regional capacity building	Funding contribution to a Middle East disease surveillance project.	Biological	2012 -2013
10	United Kingdom	Middle East / North Africa	OIE	Support to the OIE-PVS tool for the Evaluation of Performance of Veterinary Services (OIE-PVS tool).	Assessment of in country veterinary services.	Biological	2011 -12
11	United Kingdom	Middle East / North Africa	OIE	Rift Valley fever workshop: regional network to address diagnosis and control	Support disease specific workshop.	Biological	2012
12	United Kingdom	Afghanistan		Contribution to US DoS - Afghan-Tajik FETP "One-Health" project.	Enhancement of regional capacities to detect, diagnose, and manage outbreaks of infectious diseases.	Biological	2012

Global Partnership WG Projects

	A	B	C	D	E	F	G
1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
13	United Kingdom	Afghanistan	OIE	Support to the OIE Reference Laboratory twinning program.	Development of lab twinning project. Promotion of improved biosafety and biosecurity and build capacity in modern diagnostics, disease control, and surveillance.	Biological	2011-12
14	United Kingdom	MENA	WHO	Global Alert and Response Programme	Support to development of training materials for the Global Alert and Response Programme.	Biological	2011-12
15	United States DoD	Non-FSU (South Asia, Southeast Asia, Middle East, Africa)		DoD COOPERATIVE THREAT REDUCTION (CTR) PROGRAMS - Cooperative Biological Engagment Program (CBEP): Projects provide bio-engagement support and disease reporting/research in non-FSU territories including various countries in Africa, Southeast Asia, South Asia and the Middle East.	Projects include efforts in South Asia, Afghanistan, Iraq and East Africa to enhance disease surveillance, detection, diagnosis and reporting, biosafety & biosecurity assistance, and cooperative biological research. Expansion occurring in FY12 for efforts in southern Africa and Southeast Asia. Bio-engagement included biosafety and biosecurity upgrades to existing facilities, and building partner nation capacity to detect, diagnose, report, and respond to biological pathogen outbreaks.	Biological	6/2002 - 9/2011
16	United States DoD	Africa		DoD Armed Forces Health Surveillance Center - Global Surveillance for Emerging Infectious Diseases	Surveillance of the following priorities: antimicrobial resistant organisms (ARO), respiratory infections, gastrointestinal infections (GI), sexually transmitted infections (STI), febrile and vector-borne infections (FVBI), malaria and malaria drug resistance, training and capacity building	Biological	2002-2011
17	United States State	Middle East and North Africa		Biological Security Engagement (BEP): Provides technical and financial assistance to improve laboratory biosafety and biosecurity in high-risk areas through securing biological laboratories, best practices trainings, capacity building, and cooperative research and development.	BEP supports developing infectious disease laboratory system capacity, disease diagnostic capabilities, safe and secure sample transportation, technical training for scientists and laboratory biorisk management	Biological	10/2010-9/2011
18	United States USAID	Global	UNDP, WFP	United Nations Central Fund for Influenza Action	This multi-donor trust fund, managed by UNDP, will coordinate UN efforts to prevent, prepare, and respond to a global influenza pandemic.	Biological	9/2007 - 9/2012
19	United States USAID	35 Countries in Asia and Africa	IFRC	Humanitarian Pandemic Preparedness (H2P) Programme	H2P was designed to support the development of influenza pandemic preparedness plans and protocols for communities in the areas of health, food security and livelihoods in those countries most vulnerable to a pandemic influenza outbreak.	Biological	9/2007 - 3/2012

Global Partnership WG Projects

	A	B	C	D	E	F	G
1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
20	United States HHS	Worldwide	Mutiple country specific partners such as WHO, the Bill and Melinda Gates Foundation, US Dept of State, US Dept of Defense, USAID, Bloomberg, and others.	Field Epidemiology Training Program (FETP)	Established in 1980, CDC's FETPs help countries build sustainable capacity for detecting and responding to health threats and develop expertise so disease outbreaks can be detected locally and prevented from spreading. FETPs provide actionable information so public health workers use science and data to detect and monitor disease outbreaks and determine public health policy and programming. As part of their mission to strengthen public health systems globally, FETPs also assist countries to meet their core capacity requirements for surveillance and response under the revised International Health Regulations (IHR, 2005). Currently 24 CDC-supported FETPs worldwide serving over 40 countries. Over 2600 public health leaders have graduated from this 2 year intensive program. (6/2002-9/2011)	Biological	Since 1980
21	United States HHS	Worldwide		Food Defense	The international outreach of FDA and partner agencies is vital to fulfilling the FDA's Strategic Priorities of strengthening the safety and integrity of the global supply chain and ensuring the safety of the food supply from farm to table. Main objectives of international food defense outreach are to raise global awareness of the issue and establish global person/centers of food defense expertise; build relationships with key counterparts in government, the private sector and academia; and identify opportunities for continued collaboration in protecting the global food supply.	Biological	
22	United States HHS	Worldwide		Food Defense	FDA assists foreign governments in investigating large or unusual food borne outbreaks when requested, providing reference laboratory consultations, and assisting in foreign disease surveillance projects. USG labs serve as collaborating centers and reference laboratories for the OIE and FAO, providing reference assistance, diagnostic tools and expertise, development, distribution and harmonization of research protocols, and training and assistance programs.	Biological	

Global Partnership WG Projects

	A	B	C	D	E	F	G
1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
23	United States HHS	Worldwide		Countering Biological Threats: National Implementation of the Biological Weapons Convention and Multinational Outbreak Response and Bioterrorism Investigation Demonstration, in Tbilisi, Georgia, 17-19 May 2011	The workshop aimed to promote interagency (in particular public health-law enforcement but also civilian-military) cooperation, coordination and synchronization for preparing, detecting, and responding to infectious disease outbreaks; to establish regional partnerships to enhance training and disease surveillance and containment initiatives; and to strengthen the core capacities required by the WHO International Health Regulations and existing national measures consistent with the obligations under the BWC and the UNSCR 1540 to deter, prevent, and respond to biological incidents or threats. There were about 100 participants from US, Georgia, Armenia, Azerbaijan, Bulgaria, Romania, Moldova, Turkey, Poland, and Kenya, as well as representatives of inter-governmental organizations (WHO, UNODA, NATO, and ECDC).	Biological	05/17/2011- 05/19/2011
24	United States HHS		WHO and PATH	International capacity to manufacture influenza vaccine in developing countries.	The HHS Biomedical Advanced Research and Development Authority (BARDA) provided four sets of grants totaling \$40.4 million to help WHO strengthen the ability of developing countries to produce influenza vaccines, potentially reducing the global threat of influenza pandemics.	Biological	9/2006 - 9/2011
25	United States HHS	Worldwide		Foreign Regulators Seminar	Seminar offered to foreign regulators in response to a steadily increasing demand for information and training in regulation of biologics. It provides information about the US biologics regulatory processes in an efficient, organized and integrated manner. The program allows experts to explain the regulatory role of FDA biologics, as well as the science, technology, regulations and processes used to do its work. The program offers many advantages to traditional visits such as providing our foreign regulatory counterparts with the opportunity to hear from a broader array of FDA experts, and providing an opportunity for FDA staff and their foreign counterparts to meet and discuss topics of mutual interest.	Biological	

Global Partnership WG Projects

	A	B	C	D	E	F	G
1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
26	United States HHS	Worldwide	WHO Prequalification program		FDA has been involved in discussions with WHO's Diagnostics and Laboratory Technology team (DLT) to define a potential collaboration regarding the WHO Prequalification of Diagnostics Program, within the context of promoting access to good quality, safe, and reliable diagnostics appropriate for use in resource-limited settings, and establishing the necessary infrastructure to ensure that diagnostic testing in these settings is sustainable and contributes to improved health care and patient outcome.	Biological	
27	United States HHS	Worldwide	International Standards		FDA has been significantly engaged in providing expert review for the assessment of new WHO diagnostic-related international standards and reference materials project proposals presented annually at the WHO's Expert Committee on Biological Standardization meeting. The development and use of international biological reference standards support the standardization of materials and approaches used in medical diagnostics and play a vital role in the development of safe and effective products.	Biological	
28	United States HHS	Worldwide	WHO/TDR		A member of the CDRH Office of In-Vitro Diagnostics (OIVD) Staff functions as a consultant to the WHO/Tropical Disease Research Diagnostic Evaluation Panel, which developed guidelines on recommendations for best practice in clinical trials for the evaluation of tropical disease diagnostic assays and have addressed different issues and methods for evaluating the impact of new diagnostics that do not perform as labeled in disease endemic countries. The representative meets with the group annually. The group discusses the impact on individuals as well as on populations	Biological	
29	United Kingdom	Tajikistan, Georgia, Azerbaijan, Ukraine, and Pakistan.	Dual use bioethics for the life sciences. Development of a five country specific lecture series.		Promote culture of integrity, accountability, and responsibility guided by codes of conduct, bioethics norms, and awareness of the BTWC within the scientific community.	Biological Bioethics	2011
30	Canada	Global	International Federation of Biosafety Associations (IFBA)	IFBA Secretariat Activities	Canada provided funding to support secretariat services and other initiatives allowing IFBA to advocate effectively for an increased awareness and culture of biosafety.	Biological Biosafety	4/2009 - 5/2012

Global Partnership WG Projects

	A	B	C	D	E	F	G
1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
31	Canada	Global	European Committee for Standardization (CEN)	CWA 15793 "Laboratory Biorisk Management"	Canada provided funding to support the dissemination of CWA 15793 and the development of an accompanying Guidance Document.	Biological Biosafety	12/2008 -2/2011
32	United Kingdom	Afghanistan		Contribution to US DoS - Support to Afghan biorisk association.	Promotion of regional approach to responsible and safe working practices.	Biological Biosafety	2013
33	United Kingdom		WHO	Support to WHO Biorisk Management Train the Trainer (TtT) Programme.	Development of training (Biosafety and Biosecurity) outreach at national and regional levels.	Biological Biosafety	2011-12
34	United Kingdom		WHO	Support to WHO national training courses on biorisk management and the shipment of infectious substances.	Promote safe and secure working practices. Cooperation with other international initiatives (WHO IHR).	Biological Biosafety	2012-2013
35	United States HHS		WHO	WHO Advisory Committee on Variola Virus Research	Support the activities of the WHO ACVVR which monitors the research with live Variola virus and performs visits at the two authorized repositories of live variola virus (CDC and VECTOR) with the aim of ensuring that the conditions of storage of the virus, and that the research done in the laboratories meet the highest requirements of biosafety and biosecurity, as mandated by the World Health Assembly in resolution WHA60.1.	Biological Biosafety	2008-2011
36	EU	Mediterranean region and South-East Europe	Istituto Superiore di Sanità, Rome (Italy)	IFS/2010/238-194 EpiSouth: a network for the control of health and security threats and other bio-security risks in the Mediterranean Region and South-East Europe	to increase through capacity building the bio security in the Mediterranean region and South-East Europe (10 EU + 17 non EU countries)	Biological Biosecurity	15/10/2010-15/04/2013
37	Republic of Korea	Others (Afghanistan)		Biosafety, Biosecurity and Biological Non-proliferation	In 2009, the ROK financed the installation of biosecurity equipment and sponsored a training program on its use at the Central Veterinary Laboratory. In 2011, the ROK financed the installation of physical protection system at the Animal Vaccine Production Laboratory (AVPL). * in cooperation with the U.S.	Biological Biosecurity	2009-2011
38	Switzerland	Iraq	Request under UNSC Res 1540	Bio-Security Training for Iraqi Specialists (in Switzerland)	Technical support in order to restore Iraqi capacity in the field of biosafety and biosecurity (e.g. fight against animal diseases).	Biological Biosecurity	2011
39	United Kingdom	Iraq		Contribution to US DoS - Assessment of physical security requirements at laboratories.	Laboratory facility upgrade in Northern Iraq.	Biological Biosecurity	2012

Global Partnership WG Projects

	A	B	C	D	E	F	G
1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
40	United States State	Worldwide, Non-FSU		Global Threat Reduction (GTR)- Biological Security Engagement (BEP): Provides technical and financial assistance to improve laboratory biosafety and biosecurity in high-risk areas through securing biological laboratories, best practices trainings, capacity building, and cooperative research and development.	BEP helped address global biosecurity risks from bioterrorism and infectious disease outbreaks through providing technical assistance, training, and workshops in strengthening biosafety and biosecurity capabilities and developing safe, secure, and sustainable lab capacity building with national standards for comprehensive biological security.	Biological Biosecurity	2006-2010
41	United States State	Jordan		Nonproliferation and Disarmament Fund (NDF) - Development of a Biosecurity Training Center	A project to build an international biosafety and biosecurity training center at the Jordan University of Science and Technology in Irbid, Jordan	Biological Biosecurity	9/10-present
42	United States State	WHO		Nonproliferation and Disarmament Fund (NDF) - Pathogen Security Training Materials for the World Health Organization	A project to deliver a series of train-the-trainer biosafety/biosecurity seminars	Biological Biosecurity	11/05-11/11
43	United States State		WHO	Nonproliferation and Disarmament Fund (NDF) - Guidelines for Security of Dangerous Pathogens and Toxins	A project to assist the World Health Organization to establish guidelines for the security of dangerous pathogens.	Biological Biosecurity	5/04-8/07
44	United States HHS	Worldwide	WHO	Distribution of WHO Guidance Document: Responsible life sciences research for global health security	Distribution of the WHO Guidance document, Responsible life sciences research for global health security, aimed to consider the risk associated with accidents, with research that may pose unexpected risks and with the potential deliberate misuse of life sciences research. The purpose of this guidance document is to inform Member States about the risks posed by accidents or the potential deliberate misuse of life sciences research and to propose measures to minimize these risks within the context of promoting and harnessing the power of the life sciences to improve health for all people. This guidance contributes to the implementation of Resolution WHA55.16 and promotes a culture of scientific integrity and excellence, distinguished by openness, honesty, accountability and responsibility.	Biological Biosecurity	
45	Canada	Global	UN Office for Disarmament Affairs	Biological and Toxin Weapons Convention (BTWC) Implementation Support Unit (ISU)	Canada provided funding to support outreach activities of the BTWC ISU, and to facilitate participation in the BTWC process by resource-challenged States Parties.	Biological BTWC	4/2010 - 2/2012

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1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
46	Canada	Global	Verification Research, Training and Information Centre (VERTIC)	National Implementation Measures (NIM) Programme	Canada is providing funding to support VERTIC's NIM Programme, in support of universalization and effective national implementation of the BTWC process.	Biological BTWC	1/2010 - 8/2012
47	EU		UNODA	Council Joint Action 2008/588/CFSP of 10 November 2008 in support of BTWC	The overall objective is: - to support the universalisation of the BTWC, - to enhance the implementation of the BTWC, including the submission of CBM declarations, and - to support the best use of the Inter-Sessional Process 2007-2010 for the preparation of the 2011 Review Conference.	Biological BTWC	24 months
48	EU		WHO	Council Joint Action 2008/307/CFSP of 14 April 2008 in support of the World Health Organisation activities in the area of laboratory bio-safety and bio-security	The overall objective is to support the implementation of the BTWC, in particular those aspects that relate to the safety and security of microbial or other biological agents and toxins in laboratories and other facilities, including during transportation as appropriate, in order to prevent unauthorised access to and removal of such agents and toxins. - Promotion of bio-risk reduction management through regional and national outreach, - Strengthening the security and laboratory management practices against biological risks,	Biological BTWC	24 Months
49	EU		The Graduate Institute of International Studies, Geneva	Council Joint Action 2006/184/CFSP of 27 February 2006 - BTWC	Overall objective: to support the universalisation of the BTWC and, in particular, to promote the accession to the BTWC by States not Party (signatory States as well as non-signatory States) and to support the implementation of the BTWC by the States Parties. - Promotion of the universality of the BTWC; - Support for implementation of the BTWC by the States Parties.	Biological BTWC	18 Months
50	United States State		Interpol	Nonproliferation and Disarmament Fund (NDF) - Establishment of legislation to restrict Biological Weapons activities worldwide	A project to assist the International Criminal Police Organization (INTERPOL) to develop, establish and enact domestic penal measures in foreign countries to criminalize or otherwise restrict biological weapons-related activities.	Biological BTWC	11/05-5/09

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1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
51	United States DoD	Global		DoD COOPERATIVE THREAT REDUCTION (CTR) PROGRAMS - Regional Security Engagement Program. The Regional Security Engagement Program (RSEP) is designed to build partner capacity with regard to Combatting WMD and Combatting Terrorism. RSEP's two main vehicles for engagement are the Seminar on Combating WMD and Terrorism and the Regional Combating WMD Symposium. The two-week seminars, sponsored by the Threat Reduction Engagement Program and by the Combatting Terrorism Fellowship Program, are executed by the Defense Threat Reduction Agency in collaboration with the Regional Centers, (under the Defense Security Cooperation Agency) to address concerns associated with the nexus between proliferation of WMD and terrorism. The one-week symposium is focused on building partner capacity to address concerns associated with the proliferation of WMD and supports the Geographic Combattant Commands' CWMD Program participation by partner nations. Both types of engagement promote the creation of a collaborative network of mutual support and long-term regional inter-ministerial integration and civil-	RSEP began with one Seminar in collaboration with the George C. Marshall Center for EUCOM and AFRICOM countries, and one Symposium in collaboration with the Near East South Asia Center for Strategic Studies (NESA) for CENTCOM in FY12. In FY13, we have conducted two Seminars with the Marshall Center, one Seminar with NESA, and one Symposium with CENTCOM. We are currently planning Symposiums for PACOM, CENTCOM, and AFRICOM and are scheduled to conduct three seminars with the Marshall Center and NESA in FY13.	Combatting WMD and Terrorism	RSEP does not have dedicated funding. We use TREP, CTFP, and the COCOMs contribute CDI.
52	United States DoD	Global		DoD COOPERATIVE THREAT REDUCTION (CTR) PROGRAMS - Threat Reduction Engagement (TREP): Projects facilitate cooperation with the combatant commands, build relationships with international partners, support relationship building for CTR Program development in new geographic areas, and help advance the mission of the CTR Program.	Bilateral defense consultations, multi-lateral regional exchanges, bilateral cooperative planning conferences, security working groups, exchange visits, sponsorship of tabletop exercises and field exercises, workshops, and training that supports and advances CTR mission areas.	Combatting WMD and Terrorism	6/2002 - 9/2011
53	United States State	Libya	OPCW	Nonproliferation and Disarmament Fund (NDF) - Libyan Threat Reduction	A project to eliminate conventional weapons systems in Libya in excess of defense requirements, remove or destroy WMD-related items, weapons, or delivery systems, and to secure weapons stockpiles, WMD-related sites, and secure and improve border crossings.	Combatting WMD and Terrorism	10/11-present
54	United States State	Libya		Nonproliferation and Disarmament Fund (NDF) - WMD Efforts in Libya	A project to assist Libya completely eliminate its WMD infrastructure.	Combatting WMD and Terrorism	9/04-present
55	United States State	Libya		Nonproliferation and Disarmament Fund (NDF) - WMD Disarmament Activities in Libya.	A project to completely eliminate Libya's WMD materials and infrastructure.	Combatting WMD and Terrorism	1/04-7/08

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1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
56	EU		EU Non-Proliferation Consortium	Council Decision 2010/430/CFSP of 26 July 2010 establishing a European network of independent non-proliferation think tanks in support of the implementation of the EU Strategy against Proliferation of Weapons of Mass Destruction	The objective of this network of independent non-proliferation think tanks is to encourage political and security-related dialogue and the long-term discussion of measures to combat the proliferation of weapons of mass destruction (WMD) and their delivery systems within civil societies, and more particularly among experts, researchers and academics. It will constitute a useful stepping stone for non-proliferation action by the Union and the international community. The Union wishes to support this network as follows: – through organising a kick-off meeting and an annual conference with a view to submitting a report and/or recommendations to the representative of the High Representative of the Union for Foreign Affairs and Security Policy (HR), – through creating an Internet platform to facilitate contacts and foster research dialogue among the network of non-proliferation think tanks.	Nonproliferation of WMD	36 Months
57	EU		BAFA	IFS/2008/145-130 Assistance in export control of dual-use goods	The specific objective is to support the development of the legal framework and institutional capacities for the establishment and enforcement of effective export controls on dual-use items, including measures for regional cooperation with a view of contributing to the fight against the proliferation of WMD and related materials, equipment and technologies	Nonproliferation of WMD	19/03/2008 - 31/12/2010
58	EU	North Africa and selected countries in the Middle East	UNICRI	IFS/2009/200-523 Knowledge management system on CBRN trafficking in North Africa and selected countries in the Middle East	The aim of the project would be to develop a durable co-operation legacy in the area of trafficking of CBRN materials (preparation phase to "EU CBRN Centres of Excellence")	Nonproliferation of WMD	16/03/2009 - 15/07/2011
59	EU	South East Europe and for North Africa	UNICRI	IFS/2010/253-484 Knowledge Management System on CBRN risk mitigation - Evolving towards CoE "Mediterranean Basin"	to integrate the existing Knowledge Management Systems, namely for South East Europe and for North Africa, and to prepare the evolution towards a Centre of Excellence in the Mediterranean Basin dealing with CBRN risk mitigation (preparation phase to "EU CBRN Centres of Excellence")	Nonproliferation of WMD	25/11/2010 - 30/04/2012
60	EU		BAFA	IFS/2010/256-885 Assistance in export control of dual-use goods	Continuation of the on-going activities in this field in the already covered countries, with possible extension to other regions/countries.	Nonproliferation of WMD	21/12/2010 - 01/07/2013

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	A	B	C	D	E	F	G
1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
61	EU	Middle East, Gulf region, Mediterranean Basin, Central Asia and Southern Africa, South East Asia, Ukraine / South Caucasus	UNICRI	IFS/2011/263-555 (set-up)IFS/2011/273-506 (actions) CBRN Centres of Excellence – Second phase	Set-up of three to four new Centres in the Middle East and, possibly, Gulf region, Mediterranean Basin, Central Asia and Southern Africa and extension of the projects in South East Asia and in Ukraine / South Caucasus and implementation of thematic projects in all project areas of priority 1	Nonproliferation of WMD	23/08/2011 - 28/02/2013
62	EU		EU	Chemical, biological, radiological and nuclear (CBRN) Centres of Excellence – Third Phase	(1) to extend existing activities (management contracts with JRC and UNICRI) till the end of 2014 with the aim of improving national CBRN policies and defining comprehensive tailored assistance packages, in a coherent and effective combination of national and regional dimensions [€5.5 million], (2) to improve national CBRN policies through the implementation of concrete actions in the areas of export control of dual-use goods, illicit trafficking of CBRN materials, bio-safety and bio-security, scientists' engagement [€9.2 million] including governance.	Nonproliferation of WMD	To be signed in 2012
63	EU		JRC UNICRI Consortia (EU MS)	Chemical, biological, radiological and nuclear (CBRN) Centres of Excellence – Fourth Phase	(1) To extend existing activities (management contracts with JRC and UNICRI) until the end of 2014 with the aim of improving national CBRN policies and defining comprehensive tailored assistance packages, in a coherent and effective combination of national and regional dimensions [€5.5 million], (2) to improve national CBRN policies through the implementation of concrete actions in the areas of export control of dual-use goods, illicit trafficking of CBRN materials, bio-safety and bio-security, scientists' engagement [€9.2 million] including governance.	Nonproliferation of WMD	To be signed in 2012/13
64	United States State	Global		Nonproliferation and Disarmament Fund (NDF) - Support for Proliferation Security Initiative Interdiction Activities	A project to support the interdiction of WMD and WMD-related materials worldwide under the Proliferation Security Initiative.	Nonproliferation of WMD	5/05 - present
65	United States DOE	Middle East and North Africa		Confidence-Building Measures: Middle East Scientific Institute for Security (MESIS)	Promotion of regional capacity-building activities including arms control, nonproliferation, and nuclear security.	Nonproliferation of WMD	10/2003-9/2011
66	EU			Co-operation in export control of dual-use goods	To strengthen the export control systems of partner countries, with a strong link with the Regional Centres of Excellence activities, by aligning them to the standard of the international export control regimes and treaties and therefore meeting the requirements of the UNSCR 1540 (2004).	Nonproliferation of WMD	To be signed in 2012

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1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
67	United States HHS	Worldwide	WHO	International Roundtables	A series of roundtables aimed to determine the scope of other countries' activities, interests, and concerns pertaining to dual use life sciences research; informing other countries and the international community about NSABB draft work products and obtaining feedback; establishing and maintaining communication with other countries and the international science and policy community on dual use research issues; and collaborating with other countries and the international community to establish a larger, more robust dialogue on issues related to dual use life sciences research.	Nonproliferation of WMD	
68	United States HHS	North and South America, Europe, China, and the Middle East/Gulf region	European Molecular Biology Organization, the European Science Foundation, the European Society of Clinical Microbiology and Infectious Diseases, and Institut Pasteur, CAS, InterAcademy Panel (IAP), the International Union of Microbiology Society, the International Union of Biochemistry and Molecular Biology, Kuwait Institute for Scientific Research	International Webcasts and Video-teleconferences	International outreach, region by region aimed to foster international engagement of life sciences researchers, biosafety and biosecurity experts, government policy officials, and ethicists on the issue of dual use life sciences research, including an awareness of strategies for managing dual use research of concern and an appreciation of how these issues are being addressed around the globe; and to examine various approaches to promoting the responsible conduct of research with dual use potential.	Nonproliferation of WMD	

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1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
69	United States HHS	Worldwide		NIH/OSP DUR outreach and NSABB reports	<p>For the past several years, NIH has conducted an extensive program of outreach to foster awareness of the dual use research issue and promote a culture of responsibility in addressing it. This has included presentations and training sessions on the issue of dual use research in the life sciences at major scientific meetings of key constituency groups. Audiences have included life science researchers, senior research administrators and research oversight and compliance officials. In addition, in order to promote enhanced understanding of the dual use issue within the research community, NIH has staffed exhibit booths at meetings and events to disseminate educational material about dual use research, answer questions, and receive feedback from the community. Numerous educational resources have been developed including a video that is available on the NIH Dual Use Research Program Web site as well as on YouTube, a brochure targeted to investigators conducting life sciences research, and a toolkit encompassing a slide set and a module that articulates steps for developing and disseminating a code of conduct for dual use research. NIH also manages the National Science Advisory Board for Biosecurity (NSABB), a Federal advisory committee</p> <p>The NSABB has produced two reports on outreach and education, specifically, and a body of other reports – a proposed framework for DUR oversight, biosecurity concerns related to synthesis of select agents and synthetic biology, ways to enhance personnel reliability and strengthen the culture of responsibility, and considerations for development and dissemination of codes of conduct for DUR –that are widely disseminated. All are available on the NIH web site: http://oba.od.nih.gov/biosecurity/biosecurity.html</p>	Nonproliferation of WMD	
70	United States DoD	Global		DoD COOPERATIVE THREAT REDUCTION (CTR) PROGRAMS - Program Support: Expenses related to administrative and advisory support, and conduct of audits and examinations.	Provide funding for CTR audits and examination requirements, continue support to seven overseas offices within FSU, support CTR overall program expansion, project development costs, and advisory and assistance contracted support.	Other / Joint Project Types	6/2002 - 9/2011
71	United States DoD	Middle East, but global.		Consequence Management Assistance Program (CMAP)	DoD, through the Defense Threat Reduction Agency, initiated CMAP in FY 2012 to assist Combatant Commands (COCOMs) with building consequence management capacity in partner nations. CMAP increases the tactical training and operational capabilities of partner nations to effectively respond to WMD incidents and will support COCOM requirements to aid partner nations in building capacity to prevent the spread of WMD. CMAP has conducted planning and training events in the Middle East.	Other / Joint Project Types	Began in 2012

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1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
72	Italy	Iraq		Internationalisation of Iraqi institutions and scientific facilities and collaboration with Italian scientific and academic centres	Academic publications and technical and scientific equipment provided to selected Iraqi academic and scientific institutions. Project carried out by the Landau Network – Centro Volta (LNCV).	Scientist engagement - Iraq	2005-2008
73	United Kingdom	Iraq		Contribution to US Civilian Research and Defence Foundation (CRDF). Support to the Iraq national reconstruction and judicial reform programme.	Objective: Support to the Iraq national reconstruction and judicial reform programme.	Scientist Engagement - Iraq	2008 -2010. Follow-up activity 2012.
74	United States State	Iraq		The Iraq Scientist Engagement Program (ISEP) engages Iraqi scientists, technicians, and engineers with WMD and weapons-applicable skills to promote Iraqi scientific and technological development.	ISEP sponsors scientific conferences, trainings, and research grant competitions aimed at promoting chemical and biological security best practices and engaging scientists, technicians, and engineers on peaceful, civilian pursuits.	Scientist Engagement - Iraq	6/2010 - 9/2012
75	United States State	Iraq		Global threat Reduction (GTR) - The Iraq Scientist Engagement Program engages Iraqi scientists, technicians, and engineers with WMD and weapons-applicable skills to promote Iraqi scientific and technological development.	The Iraq scientist engagement program provided training, travel grants, research and development grants, and technical expertise to engage and redirect scientists, technicians, and engineers to peaceful, civilian pursuits.	Scientist Engagement - Iraq	2002-2010
76	United States State	Iraq		Nonproliferation and Disarmament Fund (NDF) - Iraqi Scientist Redirection	A project to assist former Iraqi weapons scientists transition to peaceful, commercial research.	Scientist Engagement - Iraq	9/04-11/06
77	United States State	Iraq		Nonproliferation and Disarmament Fund (NDF) - Redirection of Iraqi Weapons Scientists	This is a project to assist former Iraqi WMD scientists perform legitimate, peaceful, commercial research.	Scientist Engagement - Iraq	12/03-11/06
78	Italy	Iraq		Internationalisation of Iraqi institutions and scientific facilities and collaboration with Italian scientific and academic centres	4 international workshops; 4 closed roundtables; 7 intensive seminars and training courses; 59 short-term fellowships and 52 long-term fellowships (2-9 months) for retraining at Italian Universities and scientific institutes (205 months in Italy). Project carried out by the Landau Network – Centro Volta (LNCV).	Scientist engagement - Iraq	2005-2008

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	A	B	C	D	E	F	G
1	GP Member Reporting	Country/Region of Project	International Organization	Project Title/Description	Project Details	Project Type	Funding Dates
79	Italy	Iraq		Training and Reorientation in the field of bio-chem technology for peaceful applications	Three phases: a preliminary phase in Iraq, an intensive phase in Italy and a final phase in Iraq. Two modules: Chemical products in agriculture and environmental pollutants and Prevention, evaluation and management of the environmental pollution: polluted sites and remediation techniques. 24 Fellowships. Project led by the Insubria Center on International Security of the University of Insubria.	Scientist engagement - Iraq	2010
80	United States State	Libya		Global Threat Reduction (GTR) - The Libya Scientist Engagement Program supports the transition of former Libyan WMD scientists to civilian careers through technological partnerships.	The Libya scientist engagement program provided training, travel grants, research and development grants, and technical expertise to engage and redirect scientists, technicians, and engineers to peaceful, civilian pursuits.	Scientist Engagement - Libya	2002-2010
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82							
83							