Institute on Science for Global Policy (ISGP)

Emerging and Persistent Infectious Diseases: *Focus on Pandemic Preparedness*

Conference convened by the ISGP April 11—12, **2014**
in partnership with Ursinus College in Collegeville, Pennsylvania

ISGP Academic Partnership (IAP) with Ursinus College

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Emerging and Persistent Infectious Diseases: ***Focus on Pandemic Preparedness***

Conference convened by the ISGP in partnership with
Ursinus College, in Collegeville, Pennsylvania, U.S.
April 11–12, 2014

An ongoing series of dialogues and critical debates
examining the role of science and technology
in advancing effective domestic and international policy decisions

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Introduction

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Preface

The contents of this book were taken from material presented at a conference convened by the Institute on Science for Global Policy (ISGP) on April 11–12, 2014, in partnership with Ursinus College, in Collegeville, Pennsylvania. This specific ISGP conference, *Emerging and Persistent Infectious Diseases (EPID): Focus on Pandemic Preparedness,* was the first of a new series of ISGP Academic Partnerships (IAP) conferences based on collaborations with distinguished academic institutions. These IAP conferences reflect a common commitment to significantly improve the communication of credible scientific and technological (S&T) understanding to both policy makers and to the public *writ large.*

The process used to organize ISGP conferences begins with the recognition that EPID has become a focal point on the international stage for numerous critical issues affecting public health spanning the diverse cultural, ethical, and economic characteristic that define all societies. Societal decisions concerning how to appropriately incorporate the often transformational scientific advances associated with EPID into public and private sector policies rely on debates that highlight the credible options developed worldwide. Given the global impact of EPID, such debates deserve attention from both domestic and international policy makers from a wide range of disciplines. ISGP conferences offer a rarely encountered environment in which such critical debates can occur among internationally distinguished scientists, influential policy makers, and societal stakeholders.

Based on extensive interviews conducted by the ISGP staff with an international group of subject-matter experts, the ISGP invited three highly distinguished individuals with expertise in EPID to prepare the three-page, policy position papers (designed for the nonspecialist) to be debated at the Ursinus College IAP conference. These three policy position papers, together with the not-for-attribution summaries of the debates of each paper, are presented in this book. The areas of consensus and actionable next steps that were developed by all IAP conference participants in

the caucuses that followed the debates are also presented. The debate summaries and caucus results, derived from the contributions of IAP conference participants, were prepared by the ISGP staff in collaboration with the students enrolled in the conference-inspired *Pathogens, Pandemics, and Preparedness (PP&P)* course taught by Ursinus College faculty.

ISGP Academic Partnerships (IAP)

Recent history suggests that many societies would benefit from improving how scientifically credible information is used to inform policy decisions on a wide range of pressing issues (e.g., infectious diseases, climate change, environmental sustainability, energy sources). Those engaged in the IAP programs recognize that communication between those with S&T expertise and those policy makers responsible for ensuring safe, secure, and prosperous societies must be effective and timely. Venues that promote the concise and accurate presentations of viable S&T options to policy makers, while encouraging critical assessments, are essential in identifying effective policy decisions that can be publicly supported and therefore, implemented. No less important is the organization of venues in which the public can both witness and participate in such debates concerning the advantages and potential risks of these S&T options. IAP events provide opportunities for both college- and university-level students and the public to debate those important societal issues of our time that depend on an accurate understanding of credible S&T options.

Such public events are derived from the invitation-only debates and caucuses pioneered by the ISGP in which candid exchanges of ideas and criticism among international S&T professionals, policy makers in government and the private sector, and societal leaders are the norm. These critical debates and caucuses are the centerpieces for the pedagogical approach underlying IAP programs, and therefore are emulated in the structure of the IAP that are convened at participating colleges and universities. The participating students organize and lead each IAP conference at their respective institutions with audiences comprised of their fellow students, faculty, and members of the public.

The academic preparation of the students begins with classroom studies under the supervision of faculty. In addition to the classroom studies, participating students are offered the opportunity to (i) assist the ISGP staff in interviewing S&T experts worldwide, (ii) read the extensive background material and reports available to the ISGP (including advance copies of the policy position papers used in formal ISGP conferences), (iii) participate in the formal debates of the policy position papers alongside leading experts in the field, (iv) moderate the caucus groups to ensure

Areas of Consensus and Actionable Next Steps are democratically reached and consolidated, and (v) help to craft conference publications.

The overall educational experience can be viewed as a "practical S&T-policy laboratory" designed to (i) prepare the students for active roles in informing and guiding policy makers at the local, regional, national, and global levels and (ii) expose the public to informed debates provided by distinguished S&T experts and led by students who have participated in the IAP. Taken together, both experiences are important steps toward ensuring that appropriate respect for rational thinking is given to the future formulation and implementation of public and private sector polices.

Current realities

As the second decade of the 21st century opens, most societies are facing difficult decisions concerning how to appropriately use, or reject, the dramatic new opportunities offered by modern scientific advances and the technologies that emanate from them. Advanced scientific research programs, as well as commercially viable technologies, are now developed globally. As a consequence, many societal issues related to S&T necessarily involve domestic and international policy decisions, both in the public and private sectors.

The daunting challenges to simultaneously recognize immediate technological opportunities while identifying those emerging S&T achievements that foreshadow transformational advantages and risks within specific societies are now fundamental governmental responsibilities. These responsibilities are especially complex because policy makers must consider the demands of different segments of society, which often have conflicting goals. For example, decisions must balance critical commercial interests that promote economic prosperity with the cultural sensitivities that often determine if, and how, S&T can be successfully integrated into any society.

Since many of our most significant geopolitical policy and security issues are directly connected with the remarkably rapid and profound S&T accomplishments of our time, it is increasingly important that the S&T and policy communities (public and private) communicate effectively. With a seemingly unlimited number of urgent S&T challenges, both more- and less-affluent societies need their most accomplished members to focus on effective, real-world solutions relevant to their specific circumstances.

Recent history suggests that most societies would benefit from improving the effectiveness of how scientifically credible information is used to formulate and implement governmental policies. There is a critical need to have the relevant S&T information concisely presented to policy communities in an environment that

promotes open questions and debates led by those nonexperts directly engaged in decisions. The IAP model of debate aims to simultaneously convey to the public this same degree of understanding, confidence, and acknowledgment of risk necessary to obtain the broad societal support needed to effectively implement any decision.

ISGP conference structure

At each ISGP conference, internationally recognized, subject-matter experts are invited to prepare concise (three pages) policy position papers. For the April 11–12, 2014, IAP conference at Ursinus College, these papers described the authors' diverse views and perspectives on the current realities, scientifically credible opportunities and associated risks, and policy issues concerning Pandemic Preparedness. Students from the *Pathogens, Pandemics, and Preparedness (PP&P)* class taught at Ursinus College were invited to assist in the editing of the policy position papers prior to their public dissemination several weeks before the conference convened. Conference participants were from Ursinus College and the communities it serves including faculty and students from colleges and universities across the country, local high schools, government and public health representatives, private-sector and industry leaders, and epidemiologists and leading researchers in related fields.

The conference agenda was comprised of three 90-minute sessions, each of which was devoted to a debate of a given policy position paper. In each session, the author was given 5 minutes to summarize his views while the remaining 85 minutes were opened to all participants, including other policy paper authors, for questions, comments, and debate. The debates focused on clarifying the understanding among the nonspecialists and identifying areas of consensus and actionable policy decisions supported by scientifically credible information.

While the Chatham House Rule (no attribution of remarks to any participant outside the conference setting) is routinely used in many ISGP conferences to encourage frank discussions and critical debates, all IAP conference are conducted without any restrictions on attribution. This procedure recognizes the importance of engaging the public and press in debates that facilitate professional and respectful communication while accurately articulating well founded scientific and policy options.

The not-for-attribution summaries of each debate, prepared by the ISGP staff in collaboration with Ursinus College students in the *PP&P* class, are based on the collective notes and recordings from each debate and are presented here immediately following each policy position paper. These summaries represent the best effort by staff and students to accurately capture the comments and questions made by the participants, including the other authors, as well as those responses made by the

author of the paper. The views expressed in these summaries do not necessarily represent the views of a specific author, as evidenced by his respective policy position paper. Rather, the summaries are, and should be read as an overview of the areas of agreement and disagreement that emerged from all those participating in the debates.

Following the three debates, small caucus groups co-moderated by ISGP staff and Ursinus College students and representing a cross section of all participants, worked to identify areas of consensus and the actionable next steps to be considered within governments and civil societies in general. Subsequently, a plenary caucus was convened for all participants. While the debates focused on specific issues and recommendations raised in each policy position paper, the caucuses focused on overarching views and conclusions that could have policy relevance both domestically and internationally.

A summary of the overall areas of consensus and actionable next steps emerging from these caucuses is presented here immediately following this introduction under the title of **Conference conclusions.**

Concluding remarks

IAP conferences are designed to provide environments that facilitate publicly accessible debates of the credible S&T options available to successfully address many of the most significant challenges facing 21st century societies. IAP debates test the views of subject-matter experts through critical questions and comments from citizens and nonspecialists committed to finding effective, real-world solutions. Obviously, IAP conferences build on the authoritative reports and expertise expressed by many domestic and international organizations already actively devoted to this task. As a not-for-profit organization, the ISGP has no opinions nor does it lobby for any issue except rational thinking. Members of the ISGP staff do not express any independent views on these topics. Rather, IAP programs focus on fostering environments that can significantly improve the communication of ideas and recommendations, many of which are in reports developed by other organizations and institutes, to the policy communities responsible for serving their constituents in the public.

While IAP conferences begin with concise descriptions of scientifically credible options provided by those experienced in the S&T subject, they rely heavily on the willingness of nonspecialists and citizens to critically question these S&T concepts and proposals. With the introduction of the IAP conference model, now students and the general public can voice their opinions and learn how decisions that undoubtedly will impact their lives are made. Overall, IAP conferences seek to provide a new type of venue in which S&T expertise not only informs the citizen, but also in which

realistic policy options can be identified for serious consideration by governments and societal leaders. Most importantly, IAP programs are designed to help ensure that S&T understanding is integrated into those real-world policy decisions needed to foster safer and more prosperous 21st century societies.

Conference conclusions

Area of Consensus 1

The goal of improving communication should not be to simply increase knowledge, but also to expand public engagement. Effective, reliable, and culturally cognizant communicators need to be identified to disseminate up-to-date public health information using multiple community and media sources (e.g., social media, schools, faith-based groups, etc.). This information must be tailored to cultural, educational, language, and economic interests of the recipients.

Actionable Next Steps

- Establish ongoing panels of subject-matter experts, journalists, and government officials to educate and disseminate information to the public regarding appropriate science and public health information.
- Focus communication methodologies on improving public awareness of disease symptoms and transmission through effective advertising based on scientifically credible research and physician experience.
- Organize, train, and incentivize members of the community, including scientists and physicians, to provide a trusted network for communicating public health information and literacy through regionally and culturally tailored outreach programs.
- Prepare a library of consistent messages compatible with a variety of communication outlets (e.g., Twitter, Facebook, press releases, news media, and text messages) for the rapid dissemination of infectious disease information that reinforces public acceptance. While in emergencies, this information can be disseminated by means of existing alert infrastructures (e.g., Amber Alert and National Weather Service systems), local governments and mobile phone companies must help to expand communication options.
- Organizations with global reach (e.g., the U.S. Centers for Disease Control and Prevention and the World Health Organization) must more proactively use social media to engage the public in disseminating accurate and relevant health information. Messaging using the arresting imagery and text such as employed in the U.S. public health campaigns targeting tobacco would more effectively capture the public attention.

Area of Consensus 2

The most difficult obstacle to pandemic preparedness is clearly communicating to a general community. Unfortunately, in recent decades the public understanding of science itself has significantly diminished; even its respect for the rational thinking that underlies the scientific method has faded.

Actionable Next Steps

- Educational systems need to adjust their curricula to provide the public with understanding of health sciences topics and disease prevention tactics, the relevance of the information, and the magnitude of the personal risk to each individual. Educational systems must teach students at all levels to critically analyze information, to personally connect the relevance of that information to their daily lives, and to make decisions influenced by their understanding, despite lack of familiarity with these topics.
- Replace K-12 standardized testing with a more relevant metric that assesses critical thinking and reading comprehension. Ensure that "applied topics" courses (e.g., nutrition, disease prevention, health) are offered in K-12 schools. Promote cooperative learning and civic engagement to develop a range of possible solutions in the classroom rather than one distinct answer. School districts and administrators must take the lead in encouraging teachers to adopt this education strategy.
- Ensure that teachers of these specialized concepts are qualified to do so through continuous training, education, and certification. Ensure that knowledgeable individuals are integrated into the reconstruction and crafting of curriculum standards.
- Encourage media and communications majors to enroll in science and health literacy courses during undergraduate training (i.e., encourage journalists to attain a certain level of proficiency in science). Professional communicators should continue their education while in the field through various outlets (e.g., webinars, seminars, specialized conferences, training courses).

Area of Consensus 3

It is essential to national security that the prevention of disease pandemics be addressed by multifaceted, global approaches that include both pharmaceutical and nonpharmaceutical interventions.

Actionable Next Steps

- Emphasize in policy decisions the benefits of international research and development through government-private sector partnerships that facilitate the creation of pharmaceutical interventions, especially with respect to developing universal influenza vaccines and antivirals and the increased distribution of these interventions.
- Ensure that health care providers adhere to structured prescription guidelines for antivirals and provide patients with guidelines for proper antiviral use.
- Train professionals, such as health care providers, first responders, educators, and business leaders, to recognize potential disease outbreaks and respond according to a universal code of structured protocol.
- Develop a set of widely distributed (e.g., health care workers, first responders, general public) evidence-based guidelines (e.g., U.S. Department of Transportation Emergency Response Guidebook) regarding personal protective equipment that should be used in infectious-disease circumstances.
- Support the development of global infrastructure for vaccine manufacture in resource-poor countries to establish a self-sustaining system of vaccine production. With increased worldwide vaccine manufacturing and distribution, enact international agreements to meet the challenges of rapidly emerging pandemics.

Area of Consensus 4

Available data concerning disease surveillance (e.g., international hotspots) is not yet fully benefiting local and regional communities with respect to pandemic preparedness. Optimizing the impact of global disease-surveillance data for decisions within local and regional communities must be given the highest priority, especially when evaluating risk management issues.

Actionable Next Steps

- Improve the global networking system and culturally sensitive database focused on identifying the incidence of zoonotic animal diseases. Such a system needs to have an effective communication infrastructure among animal husbandry, veterinary medicine, and human medicine.
- Develop educational materials and programs that increase awareness of the potential consequences of pandemic outbreaks beyond health (e.g., economic), recognizable symptoms, and the appropriate actions to be

taken (e.g., consult a physician). A culturally competent communication network (e.g., mobile services) supported by local and regional communities committed to dissemination of accurate physician-reported information on emerging disease hotspots is needed.

- Establish a communication system between local health facilities and public health officials that distributes data in compliance with HIPAA laws and flags relevant pathogen information (e.g., symptomology, diagnostic tests, and transmission mechanisms). Computer algorithms can be used to assist in the preliminary analysis of data in these databases.
- Incentivize graduate and medical students worldwide to actively participate in infectious-disease surveillance programs and facilitate the use of this system internationally, especially for students moving between countries.
- Increase trust between affluent and less-affluent nations through mutually beneficial scientific and public health collaborations that integrate surveillance into the health support systems that benefit the host countries (e.g., local hospital programs, social services, health care facilities, and emergency services).
- Develop and implement evidence-based, standardized diagnostic tests for pathogen detection enabling timely dissemination of surveillance data, especially in areas lacking communications infrastructure, including training and equipping qualified personnel in hotspots.

ISGP conference program

Friday, April 11

09:30 – 10:30	**Registration**
09:45 – 11:00	*Brunch*
11:15 – 11:30	***Welcoming Remarks*** **Dr. George Atkinson,** Institute on Science for Global Policy (ISGP), Founder and Executive Director And **Dr. Bobby Fong,** Ursinus College President

Presentations and Debates

11:30 – 13:00	**Dr. Stephen Morse, Columbia University Mailman School of Public Health, United States** *The First Steps in Pandemic Preparedness*
13:00 – 13:30	*Break*
13:30 – 15:00	**Dr. George W. Korch, Jr., Office of the Assistant Secretary for Preparedness and Response (ASPR), Department of Health and Human Services (HHS), United States** *Planning for the Next Pandemic*
15:00 – 15:30	*Break*
15:30 – 17:00	**Dr. Kasisomayajula "Vish" Viswanath, Harvard School of Public Health (HSPH), Dana-Farber Cancer Institute (DFCI), Health Communication Core, Dana-Farber/ Harvard Cancer Center, DFCI-HSPH Center for Translational Health Communication Science, United States** *Communicating Risk in the Age of Information Plenty: Implications for Policy and Practice of Emerging and Persistent Infectious Diseases*
17:00 – 18:00	*Reception*

Saturday, April 12

08:30 – 09:00	*Breakfast*
Caucuses	
09:00 – 11:30	**Focused group sessions**
11:30 – 13:30	*Lunch*
14:00 – 16:00	**Plenary caucus session** Dr. George Atkinson, *moderator*
16:00 – 16:30	**Closing Remarks** Dr. George Atkinson

The First Steps in Pandemic Preparedness**

Stephen S. Morse, Ph.D.
Professor of Epidemiology, Columbia University
Mailman School of Public Health, New York, U.S.

Summary

Pandemics are epidemics that are able to spread to all or most of the world. Examples include the Human Immunodeficiency Virus (HIV/AIDS) and influenza pandemics, including four in the 20th century and, in 2009, H1N1. Emerging infections (infections that newly enter the human population or rapidly spread from a geographically limited area) have been responsible for past pandemics, and others have pandemic potential. Well-known examples of emerging infections include Severe Acute Respiratory Syndrome (SARS) and its recently discovered relative Middle East Respiratory Syndrome (MERS), the avian ("bird") influenzas (H5N1, H7N9), and Nipah virus. Most are zoonotic (originating from other animal species), often through unintended consequences of human activities.

No pandemic or emerging infection has ever been predicted. Therefore, early warning surveillance is essential to inform a timely response. But, despite gradual improvements over the last few decades, capabilities remain uneven. While the scientific issues are complex, we have the scientific framework to begin attacking this problem, and recent technological and scientific advances in diagnostics and communications make this an opportune time. Recommendations include: (i) the need to develop capability both to identify (and rule out) common infectious diseases, as well as the unexpected or unusual; (ii)implementing the revised International Health Regulations (IHR); (iii) coordinating reporting systems and enhancing data sharing; (iv) encouraging interagency cooperation; (v) maintaining well-trained medical personnel; (vi) strengthening research to refine microbial risk assessment and triggers for action; and (vii) continuing to educate policy makers on the importance of early-warning surveillance. Communications and information dissemination at all levels also remain critical issues.

Current realities

Each new infection has been recognized only after causing a number of cases of human disease. Since the middle of the last century, we have witnessed the emergence of a number of "new" infections and pandemics. HIV/AIDS was unknown until

the late 1970s, and has now become one of our greatest health concerns worldwide. Emerging infections include SARS in 2003 and, since 2013, its relative MERS, Nipah, and others.

There is an urgent need to develop the capability to predict accurately which "new" infections could become a pandemic or serious global health threat, but this methodology does not yet exist. Therefore, we must rely on early-warning surveillance to identify the next pandemic (whether of an already-known infection, such as influenza, or the "next HIV"). But, despite improvements made over the last few decades, early-warning capabilities are not systematic; they are inconsistent in geographic distribution, with many gaps in coverage, and in what and how they report.

Scientific opportunities and challenges

Scientifically, we have unparalleled **opportunities** to develop effective early warning systems: a basic, if embryonic, scientific framework on which to build exists, and new capabilities that were unthinkable only a decade ago are emerging in communications, informatics, and diagnostic technology. When ProMED-mail (originally an email listserv for reporting and discussing emerging infectious diseases) was initiated in 1994, there was no World Wide Web, and many colleagues in remote areas could get email access only via satellite uplinks. Today, email is widespread and mobile phone service covers most of the world. These advances make it far easier to report outbreaks, to develop networks for surveillance and data sharing, and to rapidly organize collaborative research. In the response to the 2003 SARS outbreak, both epidemiologic data and basic research were shared rapidly through electronic networks, greatly accelerating the development of diagnostic tests and allowing effective public health response based on rapid case identification. The widening availability of mobile phone networks now extends this reach even further, making disease event reporting possible even in locales without health care or public health infrastructure. Similarly, advances in molecular technology have revolutionized diagnostic and identification capabilities (e.g., portable rapid molecular diagnostic tests, methods for genome sequencing of pathogens, and the computational power to compare these genomes and follow their geographic movement and evolution).

The World Health Organization's (WHO) revised International Health Regulations, known as IHR (2005), although officially adopted only a few years ago, encourages each country to strengthen and utilize its infectious disease surveillance and warning capabilities more broadly. Avian flu H5N1 has compelled the main international agencies in human and animal health (WHO, The World Organization for Animal Health [OIE], and The Food and Agriculture Organization of the

United Nations [FAO]) to work more closely together. In 2009, the U.S. Agency for International Development (USAID) initiated an "Emerging Pandemic Threats" program (which includes an early warning component, PREDICT) — an excellent example of what can be done to begin developing global capacity in early warning and response.

Among the **challenges**, the need to develop and implement sustainable early warning and response capacity continues, and emerging infections remain a moving target. Environmental and ecological changes worldwide, together with globalization, will increase both the opportunities for new infections to emerge and spread and the complexity of the interactions. It is therefore essential to develop a deeper understanding of the drivers of emergence, and of how to prevent diseases from taking advantage of trade routes. Although the technology exists to identify many new and previously unknown microbes in other species, some of which have potential to become serious emerging infections, our ability to predict which infections are important remains limited. Therefore, as already mentioned, we need to develop sound scientific approaches for risk assessment and prediction. Not least, to be effective, an early warning system must be integrated into a functioning system of preparedness and response, with regular exercises and clear communication plans.

Policy issues

Implementation of expanded early warning and response, and sustained political will, remain the greatest challenges. I suggest the following as specific steps toward developing a more effective system:

- Human capital is essential. Recruit and retain skilled personnel (especially epidemiologists, for outbreak investigation, and laboratory scientists), and educate clinicians to recognize and report unusual outbreaks. The general public can also be educated to recognize and report these events (there are some "crowd-sourcing" efforts recently begun, such as "Flu Near You"). Lead: Public health community, scientific community, governments (at all levels), relevant international organizations such as WHO
- Mind the gap! Ensure global coverage and coordination of reporting systems worldwide, and enhance data sharing. A good starting point is to fully implement IHR (2005) in all countries. For the future, there would be many benefits to an effective Electronic Medical Records system (with suitable protections for individual privacy, of course) having global coverage, universally compatible data standards, and an alerting capacity for large or unusual outbreaks. Lead: National health authorities (with active engagement at state and local levels), and internationally WHO (with

assistance of development agencies and other donors)

- Strengthen laboratory capacity for identification of both known and unknown infectious agents. As many emerging infections are zoonotic, there should be sharing of data and, when appropriate, samples between human and animal health resources (the "One Health" framework). Promising starts have been made here (e.g., USAID "Emerging Pandemic Threats" program, WHO/FAO/OIE joint "tripartite" efforts), and should be extended. Lead: WHO with OIE (livestock, wildlife), FAO (livestock, food animals), and local Ministries (U.S. equivalent is state health department or Centers for Disease Control and Prevention [CDC]); scientific community (technological development)
- Research to develop a framework for prediction and risk assessment should be strongly supported by appropriate technical and funding agencies. Lead: Scientific community (with participation of governments and funders)
- Early warning must be part of an integrated system that includes response, mitigation, and countermeasures (vaccines and therapeutics). Some governments have also developed multi-sectorial "Task Forces" or standing committees to ensure broader participation and coordinate actions across all potentially involved government agencies and sectors. Lead: National and state (or equivalent) governments, with donor support
- Communications have always been the weakest link, and must be improved. Research and testing the most effective strategies for public and media information is essential, and must be standardized and practiced before an event occurs. Lead: Governments (Ministry of Health and other partners as discussed in the previous bullet), public health community (message development and testing); senior political leaders (for public and media contact)
- To encourage political will, continue educating policy makers on the importance of early warning surveillance. Lead: All

***** A policy position paper prepared for presentation at the conference on Emerging and Persistent Infectious Diseases (EPID): Focus on Pandemic Preparedness, April 11–12, 2014, Ursinus College, Collegeville, Pennsylvania***

Debate Summary

The following summary is based on recordings and notes by Ursinus College students and ISGP staff during the debate of the policy position paper prepared by Dr. Stephen S. Morse (see above). Dr. Morse initiated the debate with a 5-minute statement of his views and then actively engaged the conference participants, including students of Ursinus College's Pandemic Preparedness course and other authors, throughout the remainder of the 90-minute period. This Debate Summary represents the best effort by ISGP staff, including contributions by Ursinus students, to accurately capture comments offered and questions posed by all participants, as well as responses from Dr. Morse. The views composing this summary do not necessarily represent the views of Dr. Morse, as evidenced by his policy position paper. Rather, it is, and should be read as, an overview of the areas of agreement and disagreement that emerged from all those participating in this critical debate.

Debate conclusions

- While global disease surveillance data have yet to reach full potential as a benefit to local and regional communities, disease surveillance is improving as new methodologies and technologies emerge and are implemented. The key missing elements relate to establishing (i) the political will and stability required to significantly improve pandemic surveillance and (ii) a framework for activities for dealing with identified pandemics.
- More effective communication of disease information and action plans at all levels is critical to ensuring not only the rapid and accurate detection of emerging pandemics, but the efficient implementation of countermeasures and the transfer of clear and useful instructions to the general public.
- While significant challenges exist to the full and transparent implementation of a global disease surveillance network (e.g., limited resources, intra-governmental power struggles, and trade and tourism implications), economic, social, and cultural factors must be taken into consideration when developing the overall prevention plans. Detecting emerging and persistent infectious disease outbreaks also requires consideration of the biological components of disease control.

- Successful implementation of a global disease surveillance network requires (i) a well-educated group of individuals who are willing to assist with the

collection of these data, (ii) the integration of such data into the priorities of local communities, (iii) a globally effective technological infrastructure capable of worldwide monitoring, (iv) a cooperative legal and political framework that includes systematic methods of encouraging compliance in all countries.

Current realities

While it was acknowledged that predicting outbreaks of infectious diseases thus far has been unsuccessful, further research and improved evaluation of the processes used to detect potential pandemics could result in accurate outbreak predictions. One of the obstacles to accurately predicting outbreaks is a lack of understanding of how an outbreak develops. While some viruses require a genetic change to enable jumping from one host species to another, the scientific community still struggles to predict when and how these genetic changes occur. Outbreaks also arise from pathogens that do not require genetic changes to infect new hosts. It was acknowledged that the increasing ability to obtain the complete genomes of viruses and understand the degrees of variation within that genome will greatly aid outbreak prediction in the future.

A major cause of emerging pathogens is environmental and ecological changes that result from human activity. Should research into pathogen emergence be framed as an interdisciplinary study between environmental factors and economic factors? It was generally agreed that factors in determining outbreaks are inter-related on many levels (e.g., food needs, energy needs, and globalization), especially in terms of extractive industries and land use. Thus integrating research and monitoring efforts would greatly improve predictive abilities.

The topic of education of both the public and policy makers was broached several times and from different perspectives. There exists a lack of knowledge in the general public regarding the public health community and its efforts to halt pandemics, primarily because of the inability of scientists to communicate with the public. Scientists tend to be reticent to publicly discuss their research findings until all data have been examined, and to avoid definitive answers, which is what the public desires.

This line of discussion triggered a debate on the exchange of information between practitioners, scientists, government agencies, and the general public. Since clinicians and health care workers are likely to be on the front lines of any emerging epidemic, it is vital that they provide information to government agencies tasked with monitoring outbreaks. The reverse holds true as well: Government agencies also bear the responsibility of informing health care workers about the potential

or real threat of an outbreak. Clear, concise, and understandable information also needs to be relayed to the general public. This cycle of cooperative communication and transparency would improve the ability to rapidly identify potential outbreaks in the community and hasten response times of the appropriate authorities.

A current set of tools available to facilitate better and faster communication are social media and other digital sources of information. The collapse of printed media over the past decade and the rise in popularity of online information sources such as Twitter and blogs, have necessarily changed the way the scientific community communicates with the public. While it was acknowledged that this kind of information-sharing is crucial for outbreak prediction by providing real-time monitoring of events, the veracity of some of these sources was questioned. The list of credible sources seems short, with the U.S. CDC and WHO listed among those that could be trusted to provide accurate information. While these sources are trusted by officials and practitioners, their Web sites may not be widely used by the public.

Rapid exchange of information is critical for the early detection of an epidemic and for coordinating an effective and timely response. It was noted that there are substantially robust tools in the media universe (e.g., Twitter and Instagram, which track trending topics) that have yet to be exploited by health practitioners. These tools may aid in facilitating transmission of information in a much faster and more efficient manner than what is currently in place.

Local political infrastructure and preparedness plans were considered areas where an effective early warning and response system will be critical. While many jurisdictions have adequate preparedness plans for outbreaks, local efforts need to work in concert. Mass transportation centers (e.g., airports, train stations) were identified as high-traffic areas where people enter and leave a local community, necessitating coordination of local, state, and national information to provide early warning of potential outbreaks. The current reality is that preparedness remains siloed in local, state, and national departments with little cross-departmental coordination.

Discussion also touched on the importance of clear, informative communication to policy makers regarding the significance of pandemic preparedness plans and research in preventing pathogen outbreak. It was suggested that such communications are critical to ensuring that pandemic preparedness remains a funding priority. However, this may present a challenge, as policy makers favor definitive answers and concrete assessments while scientists prefer to express data as a percentage of risk. Improving the dialogue between the scientists and policy makers could ameliorate this difference.

Scientific opportunities and challenges

During the past few decades, global travel has grown exponentially, allowing for much quicker and easier communication and transportation among countries around the world. Consequently, one opportunity that has large potential to assist in preparing for a pandemic is the spread of technology from affluent nations to less-affluent nations. In addition to an array of technologies (e.g., vaccines, medications, health monitoring systems) that have created a disparity in health safety between the affluent and less-affluent countries, reporting systems now can be shared easily as well. While global coverage and coordination of these systems must be ensured, some less-affluent countries lack trained technicians who know how to effectively use the provided technology. Although the ultimate goal may be that each country is able to sustain itself without assistance from others, it was evident in this discussion that technology could not simply be supplied without appropriate guidance and instruction. Individuals from less-affluent countries need to be trained using a standardized approach to predicting disease, which includes familiarization with sharing data, taking samples, and other methodologies. This approach would require not only different starting points for different countries, but also attention to already existent cultural differences.

Although the current ability to predict pandemics is still quite poor, there was optimism regarding potential improvements. Accurate weather prediction took approximately 50 years to achieve and it proves to be an incredibly useful tool today. While progress is being made in the science needed for effective early identification of outbreaks, resources need to be continuously invested into early surveillance of pandemics to improve predictive capabilities.

The issue of communication, whether among jurisdictions, departments, policy makers, or the public, was the subject of much debate. It was generally agreed that the field of social science could be instrumental in determining the best strategies for maximizing communication effectiveness. Additionally, big advertising agencies and corporations often test their messages in focus groups prior to release and such an approach would be useful for public health researchers to adopt to ensure that their messages are tailored correctly for the specific needs of the program. It was acknowledged that this would provide new and additional opportunities to incorporate social scientists and their research into outbreak prediction strategies.

Because of increased expansion of technologies and access to research, there is a threat that wider, and possibly unsavory, audiences can now access potentially sensitive research. Dual-use research that is made public potentially can supply information to people who wish to threaten or harm public health, such as bioterrorists. It was noted that even though the public release of dual-use

research is considered risky, such ill-intentioned people already have access to a lot of technology. Additionally, those who wish to do harm always will find ways to do so. Therefore, further restrictions on the publication of dual-use research likely would not prevent nefarious uses of these technologies and the benefits obtained from dual-use research outweigh the potential risks.

Policy recommendations

Trust was a common theme throughout the debate. The development of public trust in the results of a pandemic prediction network will be integral to its success. While uncertainty exists regarding the most effective methods for instilling trust, improving the accuracy of prediction methods and models will allow the public to develop trust in the models.

Preparedness drills were mentioned as an effective way for emergency response teams, public health officials, government, and health care practitioners to test preparedness plans and strategies. While performing pandemic drills may have a numbing effect on the general public, it was generally agreed that practicing for pandemic situations is important for emergency response teams and hospitals.

A recommendation was made to increase interpersonal connections among individuals in local, state and federal departments charged with public health to bolster communication lines between state governments and the federal government. Interhospital communication could be improved by increased political and financial support for networks by which hospitals could easily share data. There was broad support for using focus groups and other social science techniques to ensure that messages for the public are effectively crafted.

One general concern for hotspot surveillance was that the areas containing pandemic hotspots are not always politically stable and consequently operating within these countries may be difficult or dangerous. It was suggested that it might help if policy makers portray participation in this surveillance program as mutually beneficial. Making the collected information readily accessible to the public also may increase trust in the program. Recommendations of sanctions to isolate uncooperative countries and calls for the military to take the lead on pandemic efforts were met with opposition as some individuals felt that positive reinforcement for noncompliant nations would yield better results. While the CDC has already partnered with some U.S. military institutions for global surveillance, it was agreed that a heavy military presence could have a negative impact in many countries.

Improving education for policy makers and the public is critical for effective pandemic preparedness. Specific courses were suggested as a way to better educate policy makers on the specifics of pandemic prediction and preparedness. The types

of education identified as necessary for the public included a better understanding of the basics of hygiene and what to do in a pandemic, rather than an understanding of the science surrounding these issues. While standardized pandemic-related education for government officials and clinicians globally would be effective, a one-size-fits-all solution may lack the cultural sensitivity necessary to work with, and within, different countries.

While advocating moral responsibility on the parts of individuals and industries that cause ecological changes that exacerbate pandemic hotspot potential, the group acknowledged that crafting policy to encourage attitudinal change is challenging.

Planning for the Next Pandemic**

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Summary

Despite decades of experience with the impact of influenza virus on human health, the world still has not developed robust infrastructures to handle seasonal disease, let alone a more problematic newly emerged pandemic strain of the virus. Annual costs to the United States alone in illness and economic loss are probably two orders of magnitude greater than what is currently invested by the country to offset this burden. Significant advances have been made in the ability to produce vaccines as a result of U.S. government investment, but challenges persist against a variety of needs, such as uncovering the basic transmission dynamics of the virus and building international resiliency to respond to an increasing number of newly emerging and dangerous viral strains.

Current realities

Influenza remains a dominant source of morbidity (degradation of health) and mortality worldwide. The emergence of avian H5N1 influenza in humans in 1997 was a warning against past complacency by the medical community regarding the impact to health security from influenza virus. Current realities demonstrate multiple new threats to human health and animal health, including the recent H7N9 outbreak in China with a 30% mortality rate in those infected. Gene sequence analyses have shown that the H7N9 viruses derive from birds, but are slowly showing signs of adaptation to mammals. These changes can enhance the ability of the avian virus to bind to important cellular receptors in the mammalian respiratory tract. This increased binding ability can enhance the ability of the virus to infect cells in the human host, and to grow at the lower body temperatures of mammals relative to birds.

The opportunity for increased emergence of novel avian influenza virus combinations in domestic flocks of chickens, and then in humans, is partially, but not exclusively, due to the increased prosperity and annual income of people in Asia, and especially in China. Based on U.S. Department of Agriculture (USDA)

data, between 2000 and 2011, China's poultry industry expanded by almost 3.3% per year — compared with a little less than 3% elsewhere. Although it is anticipated that this rate will likely slow, chicken output in China is expected to nearly double by next year from its 2000 base. An increased probability of new viruses evolving in ever-expanding avian host populations, along with a steady increase in the global size of the human population, points to a major impact from novel influenza strains on human health as inevitable.

Annual influenza epidemics greatly impact human health, producing an annual average of more than 600,000 years of life lost. This generally results in direct medical cost of $10 billion and a total economic burden of $87 billion worldwide. The U.S. government has invested approximately $6 billion over the past 10 years on influenza, but this is only a fraction of the overall impact that influenza has even in a single year in the U.S.

Vaccines are the most powerful public health and medical countermeasures we have to prevent or reduce the impact of influenza, yet U.S. and international immunization rates for this disease can be described as less than ideal. This stems from a variety of causes, from public perceptions about the safety of vaccines, to personal perception of risk of contracting a severe case of influenza, to debate about the clinical effectiveness of the vaccine itself. Annually, the effectiveness is measured by the Centers for Disease Control and Prevention (CDC) in sentinel clinical sites across the country, and observed effectiveness of the vaccine varies in preventing individual infections depending on virus strain, age of the individual, and vaccine match to the circulating virus (in 2014, the estimate is 62%).

The commercial market has produced influenza vaccines for years, but as time went by, most major pharmaceutical companies eliminated or moved their vaccine production from the U.S., due to lack of significant revenues relative to "blockbuster" drugs. For a while, the U.S. had very limited or no production capability for these vaccines. But with the creation of the Biomedical Advanced Research and Development Authority (BARDA), there was a clear sign from the U.S. government that this trend needed to be reversed. Since 2006, there has been great progress in increasing domestic production capacity, product diversity, and pandemic preparedness with the establishment of BARDA within the Office of the Assistant Secretary for Preparedness and Response (ASPR), Department of Health and Human Services (HHS). But more needs to be done both domestically and internationally. On the domestic front, a variety of new influenza vaccines have been licensed by the Food and Drug Administration (FDA), including a number of first-in-class developments, such as a new cell-based (not egg-based) vaccine, the first recombinant vaccine, and the first H5N1 vaccine that incorporates a new

adjuvant (a substance that enhances the vaccine's effectiveness). In addition, an FDA-approved point-of-care diagnostic test for influenza can distinguish influenza from other respiratory pathogens, and a new, less-expensive and more user-friendly portable ventilator will expand the capability to handle larger populations of severely symptomatic patients. BARDA has also supported the advanced development of several new antiviral drugs to treat pandemic influenza, especially for severely ill, hospitalized patients, pediatric, and elderly populations. On the international front, the U.S. government has invested a great deal of funding and technical training to expand influenza vaccine manufacturing capabilities in developing countries.

The H1N1 pandemic in the spring of 2009 was the first real test of our ability to rapidly identify a new influenza strain and quickly mount a campaign to produce a vaccine for the disease we expected in the subsequent winter season. New decision systems were used to speed production and distribution of vaccine. More emphasis was placed on science preparedness, on evaluation of what went wrong and needed fixing, and on evidence-based rationale for decisions. All of this effort has led to an enhanced state of preparedness in 2014, with improved types of planning for future events.

Scientific opportunities and challenges

Even with the advances that have been made in the ability to rapidly produce vaccines through public-private investments over the past 10 years, we are far from secure in our ability to significantly reduce morbidity and mortality from influenza.

We need improvements in key components of influenza control such as more rapid ability to move from information about a novel pandemic strain to having vaccine ready for people to use ahead of a developing pandemic. We need to improve access to vaccines, and messaging about the importance of vaccines to prevent disease, especially in the most vulnerable populations. We need to increase manufacturing capability on a global scale for these vaccines and for antiviral therapies (drugs) to reduce disease once infected and to reduce transmission of the virus. We have yet to fully understand the fundamentals of virus transmission from person to person and the actual effectiveness of various respiratory protective devices, such as N95 masks.

Fundamental research is needed concerning (i) transmission dynamics within human populations, (ii) human-animal interface and zoonotic transmission of viruses to establish themselves with greater potential for severe and sustained human disease, (iii) improved effectiveness of vaccines in preventing disease and transmission, (iv) a solution for a universal vaccine against all strains of influenza, (v) new approaches to immunotherapeutics, antivirals and immune modulators to

limit clinical severity and reduce transmissibility, and (vi) establishment of a national mechanism to rapidly gain scientific information to inform decision making during the real-time progression of a pandemic.

The emergence of new avian strains that evoke severe disease in a significant percentage of individuals who acquire infection appears to be increasing, and for some of these new strains, only a few genetic changes are needed for sustained human-to-human transmission. There is thus a major need to accelerate research into a "universal" vaccine that can cover multiple serotypes, or that can provide long-lasting immunity and cross-protection in ways not yet offered by current vaccines.

Science preparedness refers to our ability to rapidly respond to emerging conditions. Further investment and planning is needed to take advantage of the time-limited opportunity to understand how conditions change and how new approaches can be used to moderate the course of a pandemic. Examples include a regulatory and resource framework to swiftly establish clinical trials for treatment of severely ill patients with new antiviral or immunotherapeutic drugs during an event.

Finally, we need to stop being blasé in the health care sector about our inadequate immunization of health care workers. For an industry that is supposed to focus on protecting and treating patients, we provide poor examples to the rest of society, with immunization rates for many in this arena hovering in general in the low 20% to 30% rates nationally and internationally.

Policy issues

- Increase emphasis on international pandemic influenza vaccine manufacturing infrastructure in developing countries to reach a World Health Organization (WHO) manufacturing surge capacity goal of 500 million influenza vaccine doses by the end of 2015. Expansion of manufacturing capacity and self-reliance for developing countries would be a major improvement in providing vaccines more rapidly and reliably to the large proportion of cases elsewhere in the world. Lead: WHO and developed countries
- Increase investments in "universal" influenza vaccines (covering a range of serotypes and/or all serotypes of influenza A) that would more effectively provide immune persistence and would tremendously reduce the annual costs for vaccine production and administration, expand herd immunity, and reduce risks from newly emerging serotypes of flu. Lead: Governments
- Expand the diversity and effectiveness of antivirals, including immunotherapeutic-based drugs, to reduce the inherent risk of antiviral resistance in circulating serotypes of flu. Lead: Governments

- Enhance understanding of basic transmission dynamics of influenza virus, the fundamental concepts of which (e.g. infectivity of serotypes, relative contribution of direct vs. indirect transmission from respiratory droplets, etc.) remain unclear. Lead: National Institutes of Health (NIH) and research funding agencies
- Develop next-generation respiratory protection devices that are reusable and easier to fit and can be manufactured in the large quantities that would be needed to support a major event Lead: Industry and regulatory agencies
- Improve our currently inadequate capability to detect emerging pandemic influenza viruses in point-of-care settings. Technology platforms that provide this capacity are becoming available, but there is still slow adoption in routine clinical/laboratory practice. Lead: Industry and regulatory agencies

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*** A policy position paper prepared for presentation at the conference on Emerging and Persistent Infectious Diseases (EPID): Focus on Pandemic Preparedness, April 11–12, 2014, Ursinus College, Collegeville, Pennsylvania.***

Debate Summary

The following summary is based on recordings and notes by Ursinus College students and ISGP staff during the debate of the policy position paper prepared by Dr. George Korch. Dr. Korch opened the debate with a 5-minute statement of his views and then actively engaged the conference participants, including other authors and students of Ursinus College's Pathogens, Pandemics, and Preparedness class, throughout the remainder of the 90-minute period. This Debate Summary represents the best effort by ISGP staff, including contributions by Ursinus students, to accurately capture the comments, challenges, and questions posed by all participants, as well as responses from Dr. Korch. The views composing this summary do not necessarily represent the views of Dr. Korch, as evidenced by his policy position paper. Rather, it is, and should be read as, an overview of the areas of agreement and disagreement that emerged from all those participating in this critical debate.

Debate conclusions

- Increased emphasis on improving the international infrastructure used to manufacture influenza vaccines in developing countries is essential if the WHO goal for surge capacity of 500 million doses is to be reached by 2015. Expansion of manufacturing capacity and self-reliance for developing countries would be a major improvement in providing vaccines more rapidly and reliably to the large proportion of cases worldwide.
- While alternative and supplemental interventions exist for endemic (confined to a particular area) and pandemic (spread globally) influenza (e.g., medications, educational programs, collective community mitigation strategies), vaccines still represent the most effective means of halting and preventing flu transmission and as such should be considered a major part of any preparedness plan.
- It is vital that new, improved, or more effective vaccines and medical countermeasures reach the market in a safe but timely manner both in the U.S. and worldwide. Efforts exist globally to develop new vaccine technologies and to improve existing ones.
- Key lessons learned from previous influenza outbreaks can be used to improve the efficacy of medical countermeasures, the systems for vaccine distribution, and the practicality of community mitigation strategies.
- To effectively address pandemics, educational programs for first responders and health care practitioners need to be are informative, standardized, and

effective. Furthermore, communication with the general public concerning pandemic preparedness must be culturally sensitive and tailored to the specific audience.

Current realities

While it was widely agreed that vaccines represent the best public health tool available to combat influenza, questions regarding current vaccination rates, access to vaccines, and the vaccine development and implementation process were raised.

The rate of influenza vaccination is influenced by subjective and social perceptions of the risk associated with seasonal flu. The typical seasonal influenza mortality rate is, on average, less than 1% (about 20,000 to 30,000 deaths per year). However, the mortality rate of H5N1 is between 40% and 50%. If the seasonal influenza mortality rate increased drastically, the subsequent risk-benefit calculation would likely prompt an increase in the vaccination rate.

An increase in vaccination rates, however, creates challenges related to timely regulatory approvals of targeted vaccines and the distribution of approved vaccines. As the main regulatory authority in the U.S., the FDA faces scrutiny regarding moving either too quickly or too slowly in the drug-approval process. However, lessons were learned from the 2009 flu outbreak and currently fast-tracked approval of vaccines and medical countermeasures are allowed in an outbreak setting. In terms of vaccine distribution, again the 2009 outbreak has served as an illustration of which distribution avenues are effective in ensuring adequate vaccine coverage. It was deemed critical to involve private industry in vaccine distribution in the U.S., including large pharmaceutical conglomerates. There is a concerted effort globally to make vaccine manufacturing technologies available to other countries to increase the capacity of less-affluent countries to provide vaccines for their own populations.

Although vaccines represent the best intervention for influenza, especially in an epidemic setting, new forms of treatment are being developed (e.g., neuraminidase inhibitors, Peramivil, immunomodulatory therapy). While these treatments mitigate symptoms of the flu, relying on any one of these drugs or methods as the single solution to evade or mitigate a pandemic is a mistake. An effective multifaceted approach with a widespread range of medical solutions is the most effective strategy to improve defenses against diseases in general and against pandemics specifically. Although this multifaceted approach requires significant investment in novel products, it appears to be the most promising.

Scientific opportunities and challenges

In terms of research and development, it was generally agreed that priority needs to

be placed on developing tests for early identification, which involves understanding the epidemiological characteristics of the disease at an early stage. Earlier awareness of outbreaks is the most critical aspect of pandemic preparedness because it allows for more effective political decision-making.

Although there is significant and promising research of new vaccines and medications to counter the flu, the correct usage and effective distribution of these promising vaccines and medications remains unclear. For example, the U.S. government spent $1.3 billion to stockpile Tamiflu, a drug that was found later to be ineffective against pandemic flu. This example highlights the fine line between rapid regulatory approval and fully investigating the product efficacy and safety. New products are assessed with a cost-benefit analysis, but as the Tamiflu example illustrates, the perceived risk at the onset of a potential pandemic can produce suboptimal decisions.

For vaccination to be an effective public health tool, a certain rate of coverage is required to achieve herd immunity, in which the whole population is protected because enough individuals have been vaccinated. However, inadequate understanding of the basic biological and epidemiological characteristics of influenza among the general public contributes to lower vaccination rates. Government agencies have undertaken education campaigns to fill this knowledge gap, including through the U.S. CDC Web site. While the information on these Web sites is accurate and easily understood, access to the Internet is not universally available. Consequently additional educational forums are needed to ensure that the general population has all the information necessary to make an informed decision regarding flu vaccination.

Policy issues

There are a number of strategies, of which vaccination is one, for combating pandemic flu. It was recognized that in the face of a pandemic, closing schools and businesses is an effective community mitigation strategy to prevent the spread of disease. Statistical case studies done on the 1918 epidemic show that social-distancing practices are effective at lowering both the morbidity and the mortality of influenza. However, these practices have resultant economic costs (e.g., lost income) and many people are simply unwilling to pay those costs to minimize risk of infection. The immense economic costs on an individual or family, often from foregone income, thwart any successful implementation of distancing practices. Strategies need to involve parents, schools, and other community centers to foster a sense of social responsibility in participating in distancing programs. When

combined with this sense of responsibility, distancing mechanisms for reducing disease transmission can be effective.

Although vaccines remain an effective intervention against the flu, vaccines may be cost prohibitive for some. Current systems in the U.S. to assist financially struggling individuals and families can be challenging to navigate. Excessive paperwork and long waits to enroll in the free vaccine programs reduce the likelihood that individuals will participate, impairing herd immunity to pathogenic spread. In the case of more pressing emergency circumstances, however, it was pointed out that these programs become more easily accessible to those in need, especially to those with high risk of infection. However, for individuals and families at or near the poverty level, even near-free vaccines ($5 to $10) may be a sufficient financial burden to disincentivize these individuals from being vaccinated. Free or reduced-price programs to provide the vaccine are needed in combination with effective communication regarding (i) the existence of these programs and (ii) the importance of being vaccinated. There was general agreement that these responsibilities must fall on the government, at either the federal or state level, not on the pharmaceutical industry. While the current system needs to be improved, during an emergency, vaccines likely would reach populations that are unable to pay for them.

To maintain herd immunity, not only do individuals of lower economic status need to be vaccinated but a large percentage (varying by disease) of all individuals need to be vaccinated. Herd immunity factors into the policy question of mandatory vaccinations. Some considered that designating an action as mandatory is countereffective and would cause public animosity against the government, which could result in more individuals opting not to vaccinate themselves or their children. It was generally agreed that mandatory vaccination for certain childhood diseases is still relevant but may not apply to a pandemic or endemic flu situations.

The timeliness of the distribution of vaccines is essential to effectively halt the spread of pathogenic diseases. Prior experiences during pandemic outbreaks, which utilized centralized distribution through the CDC, have shown that this method can be effective. However, internationally, vaccine production is a private enterprise, and the efficiency of this privatized system is responsible for successful distribution on a seasonal basis. Arguments were made for the effectiveness of either the centralized or the privatized system depending on the specific aspects of an outbreak. The debate over the most efficient system of vaccine distribution will likely be settled with empirical data, which may be collected during future incidences of pandemic outbreak.

It was generally agreed that vaccines represent a powerful tool to prevent or halt the spread of influenza pandemics. There remain significant scientific and

policy challenges for the future of new flu vaccines and medical countermeasures but systems currently exist to help ensure that new technologies will be adopted and implemented safely and effectively.

Communicating Risk in the Age of Information Plenty: Implications for Policy and Practice of Emerging and Persistent Infectious Diseases**

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Summary

Policy makers and public health practitioners are wrestling with how to communicate and mitigate risks of infectious diseases through various mechanisms at the national level (e.g., country governments), as well as the transnational level (e.g., the World Health Organization [WHO]). Twentieth century-designed communication planning, however, is confronting a 21st century reality — a revolution in communication and information technologies with significant consequences for Emerging and Persistent Infectious Diseases (EPID). The consequences of this revolution include: generation of a large amount of information and its transmission at speeds that allow little control over how it is interpreted by different groups; difficulty among institutions and social groups in assessing and communicating risk accurately; and widening communication inequalities among individuals, groups, and nations. To address current challenges in communicating about disease risks, a new transnational information and communication "architecture" with the following four core elements, is needed: development and maintenance of capacity to assess, interpret, and communicate risks as expeditiously as possible; continuous surveillance of the information environment to monitor how EPID risk communication is occurring, to facilitate quick and prompt action; promotion of policies and practices that mitigate the inequalities in risk communications; and continued research to develop evidence-based risk communication policies and strategies.

Current realities

The ways in which infectious-disease risk information fares once it enters the public

arena require critical scrutiny. This process may be examined under three broad areas: the generation (origin) of information, the public arena, and the reception and effects of risk communications.

Generation of risk information It is now widely recognized that communication is a critical part of any risk management strategy and in contemporary societies, determining how and what to communicate to the public is a complex process, involving several public and private sector organizations and the media. To make decisions regarding both the timing and content of risk communication, coordination and communication among different agencies is necessary. However, decisions usually are made in a complex environment where authority may be spread over different agencies and the political, social, and cultural context of the audience varies widely. Basic issues include who decides to take the lead on communication, what policies and procedures are in place, and when and how to release the information. More critical and complicated decisions involve how the information is framed and communicated to diverse audiences whose social, cultural, and economic backgrounds may vary considerably. It is also critical to consider the communication infrastructure of a given country, both in terms of trained professional communicators and the penetration of different media to reach different publics.

The public arena The degree of control exercised by the authorities over risk communication messages is immediately challenged once it enters the public arena. As a result, the information environment on EPID is arguably more complex than it has ever been, raising questions about how and what to communicate about risk. Three broad groups, with varying degrees of specialization, expertise, and resources, influence how the information is further diffused to the public: journalists, the entertainment media, and interest groups.

Journalists are important gatekeepers between the authorities and the public. On a positive note, since reporters use communications from authorities (e.g., press releases and press conferences) to generate many story ideas, sometimes these messages are included almost verbatim in the news stories. Conversely, journalists are under deadline pressure, prefer clear story lines, and work under limitations of space and time. In addition, few journalists have a formal background in science or medicine, which could have positive or negative consequences for the accurate communication of risk information.

A developing body of work documents the clear and often powerful effects of entertainment media on risk-related behaviors such as tobacco use, obesity, risky

sex, and violence. Entertainment media also create strong images in public through movies such as *Contagion* or *Outbreak*. Little, however, is known about the role of popular culture and entertainment media in communication and interpretation of the risks of EPID and their mitigation.

The revolution in Information and Communication Technologies (ICTs) is upending the way people and institutions generate information, communicate, and interact with each other. The Internet has successfully led to the steady erosion of the oligopoly of conventional media over the generation and dissemination of information. "User-generated" content allows risk information to be interpreted by anyone, which is actually done by millions of bloggers and micro-bloggers through social media. Bloggers and stakeholders have broad-ranging credibility, expertise, and ideologies (or even kookiness). They offer multiple interpretations of "facts" about infectious diseases and ways to "mitigate" them, potentially sowing seeds of confusion. The role of social media and active participation of citizens is one of the most significant transformations and is likely to have the most profound effect on communication and interpretation of risk in the 21st century.

Reception and effects of risk communication How audiences encounter information on risk influences their knowledge, attitudes, and behaviors with regard to EPID and efforts to mitigate EPID. Audiences may encounter risk information (e.g., on avian flu) in two ways. The most common encounter may be characterized as "incidental exposure" — information obtained through routine use of media for news or entertainment (e.g., television, newspapers or magazines, Internet, and radio). In addition, social networks including social media are an important source of exposure and interpretation. Audiences also encounter risk information when actively seeking information either for themselves or for others, especially when facing a threat of any kind.

A variety of personality, individual, cultural, and social factors influence exposure, seeking, and subsequent risk communication effects. At the individual level, a person's perceptions, including personal susceptibility, severity of the threat, and perceptions of the safety of mitigating actions, such as vaccines, influence whether he/she takes action. Trust in authorities is also a critical determinant of whether people follow and act on information. The role of social factors such as social class, race, and ethnicity, is of enormous importance in influencing exposure, understanding, and acting on risk information — a phenomenon characterized as communication inequalities. It is now well established that social class (usually measured as schooling), and race and ethnicity, play a significant role in what kind of channels people access and use, as well as the degree to which they can process

that information and act on it. In general, people who are relatively poor are less likely to use channels such as the Internet and print media, and have difficulty in processing the information and limited capacity to act on it. Numeracy (the ability to interpret quantitative information) is also strongly associated with class. Communication inequalities are a worldwide phenomenon, with profound implications for communication of risk about EPID.

Scientific opportunities and challenges

Related to the 21st century information environment, five scientific challenges and opportunities are especially critical: (1) information on EPID is complex, competing with other topics; this raises questions about how to attract and maintain the attention of the audience; (2) how are communications about risks of EPID tracked and how can misinterpretations be countered? No known models of information surveillance systems exist at this point; (3) it is widely accepted that those who are among the poor, and in lower- and middle-income nations, are at great risk of EPID and its consequences compared with those who are well off and in wealthier nations. Thus, the specific effects of culture and class on EPID risk information need to be explored; (4) we need more scientific evidence on what role different media, genres, and formats play in communicating about the risks of EPID and with what consequences; (5) lastly, ICTs, particularly mobile media, and social media, offer an enormous potential to reach people who have been bypassed by earlier communication revolutions. Mobile technologies and related software, such as text messaging, in combination with social media, can be exploited to bridge inequalities and disparities.

Policy issues

Recommendations for science, policy, and practice in the context of EPID include:

- **Develop an international risk information and communication architecture.** With the development of ICTs, there are many opportunities to tap the software of the cyber-infrastructure to track, analyze, and disseminate risk information about EPID. Public-private partnerships, in which the private sector develops the technologies and the public sector fields and tests them, need to be created. Optimally, an organization such as WHO will take the lead in association with other agencies such as the International Telecommunication Union (ITU) and the private sector.
- **Invest in human capital to expeditiously assess, interpret, and communicate EPID risks.** Given the pace of movement and the rapidity with which infectious diseases and information are spread, it is critical that

countries have capacity in the form of risk communicators (e.g., Public Information Officers) within their health agencies. While multilateral organizations, such as the World Bank or WHO, can provide the technical assistance and lead training efforts, much of the action is likely to occur within the governments of the countries themselves.

- **Invest in the science, dissemination, and implementation of evidence-based risk communication strategies.** Building scientific capacity for basic research in risk communication science is in the purview of a variety of sectors. Research institutions and universities will lead with support from the private sector and government.
- **Promote access to ICT to mitigate inequalities in risk communication.** Given the enormous inequalities in communication, even the most thoughtful risk communication strategy is unlikely to result in effective mitigation. National governments must recognize the value of access to ICT, and offer subsidies where necessary to promote access.

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Debate Summary

The following summary is based on recordings and notes by Ursinus College students and ISGP staff during the debate of the policy position paper prepared by Dr. Kasisomayajula "Vish" Viswanath. Dr. Viswanath opened the debate with a 5-minute statement of his views and then actively engaged the conference participants, including students of Ursinus College's Pandemic Preparedness course and other authors, throughout the remainder of the 90-minute period. This Debate Summary represents the best effort by ISGP staff, including contributions by Ursinus students, to accurately capture the comments offered and questions posed by all participants, as well as responses from Dr. Viswanath. The views composing this summary do not necessarily represent the views of Dr. Viswanath, as evidenced by his policy position paper. Rather, it is, and should be read as, an overview of the areas of agreement and disagreement that emerged from all those participating in this critical debate.

Debate conclusions

- Barriers to the effective dissemination of infectious-disease information include inequalities in public education and telecommunications infrastructure, as well as a lack of trust between the general public and the organizations providing the information. With the myriad sources of information now available, it is essential that effective methods be found that correctly identify the scientifically credible information and plans of action needed to combat disease pandemics.
- Because effective communication of disease information is helpful only if its recipients are able to formulate meaningful and appropriate responses, it is critical that communications be tailored to recipients' needs and interests, thereby enabling them to more accurately perceive risks and respond effectively.
- Education of the global public is a primary concern for organizations releasing infectious-disease information. While social media outlets and popular culture currently may confuse and thereby impair the public's ability to effectively analyze reality, these information outlets also can be utilized to communicate scientifically accurate, relevant information to a wider demographic.
- Because journalists often serve as a bridge between scientists and the public, their ability to properly communicate necessary scientific information is critical. Since the media industry is undergoing reorganization its structure,

outlets, and popularity, journalists often do not fully understand, and therefore accurately convey, useful disease outbreak information.

Current realities

Although communication of the risk of pandemics and other health concerns has improved, effective communication among scientists, policy makers, health practitioners, and the general public remains suboptimal. Scientists often deliver complicated messages filled with language that the public has difficulty in understanding. Further, this information can be distorted and misinterpreted when presented by the media. Journalists may have good intentions when reporting important public health information, but changes in the field of journalism have influenced the quality of reporting. How much scientific background do journalists need to effectively communicate scientific issues? Some argued that journalists don't need an in-depth science background as long as they can accurately interpret the general information. Discussion ensued, with no conclusion, regarding the level of scientific knowledge journalists need to have to communicate important scientific issues such as health concerns to the public.

Policy makers also may not have the appropriate science education to communicate public health information accurately. Concern was raised that policy makers are too heavily influenced by the quantity of information they receive rather than by the quality, leading to the dissemination of less-than-credible information. However, it was argued that career politicians and their advisers are often qualified to understand scientific information and it was suggested that scientists seek out those politicians and/or staff members who are interested in and educated about science.

Private agencies also have a role in communicating information to the public and it was suggested these entities need to be responsible for playing a role in risk communication. In some countries the best campaigns are led by private agencies and the private sector plays a critical role in communication. It was suggested that private sector companies often are misunderstood because they must balance disseminating information with preventing panic. There also appears to be some resistance from the public toward efforts to gather data. For example, Montgomery County implemented a program that was designed to identify health trends by analyzing 911 calls. However, the public responded negatively to the interrogation questions and thus the program was terminated.

Educational inequalities exist, particularly in pandemic hotspots, and this inequality prevents the people most in need of the information from understanding the health risks that are being communicated to them. Unfortunately, education is still lacking in these impoverished and underserved areas, leaving these geographic

areas at higher risk for the spread of infectious diseases during times of epidemics or pandemics.

There was significant debate regarding effective communication to individuals who are inclined not to get vaccinated or vaccinate their children. While the percentage of the population that needs to be vaccinated to achieve herd immunity is 95%, that target has not been met. There are clusters of people who choose not to get vaccinated, leaving the whole group more vulnerable. There was discussion, but no conclusion, regarding the question of whether it is effective to make the effort to convince these cluster groups to get vaccinated. For example, a recent study showed that when presented with science-based evidence supporting vaccinations, those people who rejected vaccinations became more entrenched in their anti-vaccination stance.

Used effectively, social media can be influential in communicating health risks to the public. Social media is extremely popular, is used by some groups of people as a means of engaging in conversation to learn more about a topic, and has become an efficient platform to rapidly communicate emergency information. However, the empirical data do not suggest that social media is being effectively used to disseminate information about disease risk. For example, studies suggest that social media did not inform people regarding the H1N1 pandemic or a water-main rupture in Boston that required millions to boil their water. However, there have been several instances of social media communicating other significant events (e.g., the Boston Marathon bombing). Consequently, social media can be used in communicating information quickly, but its effectiveness in communicating health risks needs to be improved.

Scientific opportunities and challenges

It was generally agreed that publicly communicating accurate information in a timely manner regarding infectious disease and pandemic outbreaks is crucial, and that new, simplified ways to disseminate large amounts of public information are needed, especially in countries with less-developed communication infrastructures. However, a simpler dissemination infrastructure does not guarantee that the public will understand the information being released. People have the ability to understand vast quantities of complicated information — if that information is of direct interest to them (e.g., sports talk shows). It was generally agreed that effective communication involves not only the information, but also an ability to connect on a personal level with the recipients, which assists people in understanding the relevance and the severity of risks to themselves and the people around them.

Popular media outlets such as movies, television, and talk shows often

communicate information better than facts and figures presented by traditional health information sources. A major challenge in information dissemination is to use the most appropriate communications outlet for the target constituency.

It was suggested that health information also can be disseminated by major companies that have pharmacy components (e.g., supermarkets). However, there was a potential for the public to mistrust private sector involvement in the dissemination of information because of suspicions of ulterior motives.

Public information regarding disease control must be properly framed. While emotional or gruesome messages can help draw the public's attention to an issue, people also must learn how to appropriately react when a frightening message is presented to them. Communications with resistant groups must be framed in such a way as to provide them with accurate information without making them more resistant. Using focus groups and research to develop the most impactful and effective messages could be helpful; major companies do not release advertisements or information without extensive research on the effectiveness of their messages. It was generally agreed that public health departments, scientists, and institutions involved in outbreak communication should test messages prior to an outbreak to ensure maximal retention and efficacy.

Journalism is another key component in improving the dissemination of scientifically accurate disease-risk information. One study found that only 7% of health care reporters in the U.S. have a science background. It was proposed that certification in science could be one way to ensure that science reporters have a background in science. However, there would likely be significant resistance to this approach amongst journalists and it was questioned whether journalists needed to be science majors to be effective communicators of scientific issues. There was a call for research into the quality of science-related articles written by journalists with no science training.

Because a primary medical focus in a certain locale is on one particular ailment that is "going around," doctors may overlook important symptoms of a less prevalent disease or virus. To improve diagnoses by doctors, it is important to better inform patients and parents regarding imminent symptoms, as well as how to communicate those symptoms effectively to physicians.

Policy issues

New, more effective communication infrastructures must be rapidly installed in pandemic hotspots, as well as in areas that are not in such "danger zones." Regarding effective communication strategies, there was general agreement that scientists are not efficient in communicating science to the general public at this time. While

scientists know how to communicate facts well through probabilities and numbers, their methods fail to engage the public, rendering their communication efforts ineffective. It was widely agreed that formal communications training for scientists would start to bridge this gap in communication.

The most important aspect of public communication is engagement because if the public is not engaged and cannot relate to the topic at hand, information will not spread effectively. One possible solution was training individuals in effective communication approaches. These individuals could then work with public health officials to help create communication infrastructures. Organizations such as the Centers for Disease Control and Prevention (CDC) or the WHO can take the lead on this course of action.

While social media has increased the spread of information, the scientific credibility of that information was questioned. Ways to use social media to effectively disseminate scientifically credible information need to be researched and/or developed. Maintaining cultural sensitivity in different areas throughout the world also would improve effective communication.

Because journalists communicating on scientific and health-related topics do not necessarily have scientific backgrounds, it was suggested that sending health journalists to an annual conference to review prevalent topics and effective communication strategies could improve the quality of their reports.

Simulations among hospital officials, physicians, media, and the general public have been shown to be effective methods of communication. Simulations help show weaknesses in a preparedness system along with associated strengths. The key to the success of these simulations is the involvement of multiple sectors. Solely staging a simulation with physicians or public health officials without interaction by the public is less effective. It was suggested to continue these simulation exercises to analyze the current efficacy of communication strategies while identifying areas of improvement.

It was generally agreed that the use of private businesses to promote various health campaigns has been effective. Reaching out to grocery stores or large drug store chains that stage health clinics (e.g., CVS) can be efficient in endorsing various health campaigns. A suggestion of heavily taxing extremely profitable businesses was mentioned. However, it was agreed that using taxation to maintain services in less-affluent areas is highly unlikely and that public-private partnerships should be encouraged.

Acknowledgment

Numerous individuals and organizations have made important contributions to the Institute on Science for Global Policy (ISGP) program on Emerging and Persistent Infectious Diseases (EPID). Some of these contributions directly supported the efforts needed to organize the ISGP conference, *Focus on Pandemic Preparedness,* convened in partnership with Ursinus College on its campus in Collegeville, Pennsylvania, April 11–12, 2014. Other contributions aided the ISGP in preparing the material presented in this book, including the three invited policy position papers and the summaries, presented without attribution, of the views presented in the discussions, critical debates, and caucuses that ensued at Ursinus College.

The willingness of those in the scientific and policy communities to be interviewed in the preparation for the conference is appreciated, as are the efforts of the three subject-matter experts invited to present their views concerning pandemic preparedness in their policy position papers. The willingness of these authors to engage all conference participants in the vigorous debates and caucuses that compose all ISGP conferences was especially noteworthy. The biographies of these three authors are provided here.

The success of every ISGP conference critically depends on the active engagement of all participants in the often-intense debates and caucuses. The exchange of strongly held views, innovative proposals, and critiques generated from questions and debates fosters an unusual, even unique, environment focused on clarifying understanding for the nonspecialist. Since these debates and caucuses address specific questions related to formulating and implementing effective public and private-sector policies, ISGP and Ursinus College are greatly indebted to all those who participated in the conference.

The efforts made by the faculty, students, and administration of Ursinus College in collaboration with the ISGP to organize and convene the first conference within the ISGP Academic Partnership (IAP) program were uniformly recognized as outstanding and are appreciated. The results of their efforts served the interests not only of the academic community, but of the communities engaged with Ursinus College. The brief biographies of the faculty and students from Ursinus College involved are presented here.

The members of the ISGP Board of Directors also deserve recognition for their time and efforts in helping to create a vital, increasingly relevant not-for-profit

organization that is addressing many of the most important societal questions of our time. The ISGP remains a not-for-profit organization that does not lobby on any issue except rational thinking. The brief biographical backgrounds for the ISGP Board members are presented here.

The energetic, highly professional work of the ISGP staff merits special acknowledgment and appreciation. The staff's outstanding interviewing, organizing, and writing skills remain essential to not only organizing the conference itself, but also to recording the often-diverse views and perspectives expressed in the critical debates, capturing the areas of consensus and actionable next steps from the caucuses, and persevering through the extensive editing process needed to assure the accuracy of the material published here. Biographical information on all the ISGP staff involved is presented here.

ISGP programs are financially supported by government agencies and departments and through gifts from private-sector entities and philanthropic individuals. Specifically, the IAP conference on *EPID: Focus on Pandemic Preparedness* received funding for its general activities from a grant by the Howard Hughes Medical Institute to Ursinus College. The ISGP also benefited greatly from generous gifts provided by the U.S. Department of Health and Human Services, Assistant Secretary for Preparedness and Response, the MARS Corp., and Edward and Jill Bessey.

Dr. George H. Atkinson
Founder and Executive Director
Institute on Science for Global Policy
July 11, 2014

ISGP books from ISGP conferences listed below are available to the public and can be downloaded from the ISGP Web site: www.scienceforglobalpolicy.org. Hardcopies of these books are available by contacting info@scienceforglobalpolicy.org.

ISGP conferences on, or related to, Emerging and Persistent Infectious Diseases (EPID):

- *EPID: Focus on Pandemic Preparedness,* convened April 11–12, 2014, in Collegeville, Pennsylvania, U.S., in partnership with Ursinus College.
- *EPID: Focus on Antimicrobial Resistance,* convened March 19–22, 2013, in Houston, Texas, U.S., in partnership with the Baylor College of Medicine.
- *21st Century Borders/Synthetic Biology: Focus on Responsibility and Governance*, convened December 4–7, 2012, in Tucson, Arizona, U.S., in partnership with the University of Arizona.
- *EPID: Focus on Societal and Economic Context*, convened July 8–11, 2012, in Fairfax, Virginia, U.S., in partnership with George Mason University.
- *EPID: Focus on Mitigation*, convened October 23–26, 2011, in Edinburgh, Scotland, U.K., in partnership with the University of Edinburgh.
- *EPID: Focus on Prevention*, convened June 5–8, 2011, in San Diego, California, U.S.
- *EPID: Focus on Surveillance*, convened October 17–20, 2010, in Warrenton, Virginia, U.S.
- *EPID: Global Perspectives*, convened December 6–9, 2009, in Tucson, Arizona, U.S., in partnership with the University of Arizona.

ISGP conferences on Food Safety, Security, and Defense (FSSD):

- *FSSD: Focus on Food and the Environment*, will be convened October 5–8, 2014, in Ithaca, New York, in partnership with Cornell University.
- *FSSD: Focus on Food and Water,* convened October 14–18, 2013, in Lincoln, Nebraska, U.S., in partnership with the University of Nebraska–Lincoln.
- *FSSD: Focus on Innovations and Technologies,* convened April 14–17, 2013, in Verona, Italy.
- *FSSD: Global Perspectives,* convened October 24, 2012, in Arlington, Virginia, U.S., in partnership with George Mason University.

ISGP conferences on Science and Governance (SG):

- *The Genomic Revolution,* convened September 6, 2014, in cooperation with the Parliamentary Office on Science and Technology of the British Parliament within the House of Lords. London, United Kingdom.

Biographical information of Scientific Presenters

Dr. George W. Korch, Jr., Ph.D.

Dr. George W. Korch, Jr., is the Senior Science Advisor to the Assistant Secretary for Preparedness and Response, Health and Human Services, and is a Visiting Professor in the Department of Molecular Microbiology and Immunology, The Johns Hopkins Bloomberg School of Public Health. Dr. Korch retired from the U.S. Army Medical Department in 2008, where he had served in a number of leadership roles, including the Commander of the U.S. Army Medical Research Institute of Infectious Diseases and the Director of the Department of Defense Medical Chemical and Biological Defense Research Program. He also served as one of the first Directors of the National Biodefense Analysis and Countermeasure Center, Department of Homeland Security. His areas of expertise are viral and rickettsial zoonotic diseases, and medical countermeasure development (vaccines, therapies, and diagnostics) for biodefense needs. He serves or has served on such committees as the Institute of Medicine's Forum on Microbial Threats, the State of Maryland's Life Sciences Advisory Board, and with the Standards Development for the American Type Cell Culture.

Dr. Stephen S. Morse, Ph.D.

Dr. Stephen S. Morse is Director of the Infectious Disease Epidemiology Certificate program and Professor at Colombia University Medical Center of Epidemiology. His interests focus on epidemiology and risk assessment of infectious diseases (particularly emerging infections, including influenza), and improving disease early warning systems. He was previously appointed as the Program Manager for Biodefense at the Defense Advanced Research Projects Agency (DARPA), Department of Defense, where he co-directed the Pathogen Countermeasures program and subsequently directed the Advanced Diagnostics Program. Before his time at Colombia, he was Assistant Professor of Virology at The Rockefeller University in New York, and remains an adjunct faculty member. His book, "Emerging Viruses" (Oxford University Press), was selected by *American Scientist* for its list of 100 Top Science Books of the 20th Century. Dr. Morse was Chair and principal organizer of the 1989 NIAID/NIH (National Institutes of Health) Conference on Emerging Viruses, served as a member of the Institute of Medicine/National Academy of Sciences' Committee on Emerging Microbial Threats to Health (and chaired its Task Force on Viruses), and was a contributor to its report, *Emerging Infections* (1992). He served on the Steering Committee of the Institute of Medicine's

Forum on Microbial Threats, the National Academy of Sciences' committees on biowarfare threats, and as an adviser to numerous government and international organizations. He was the Founding Chair of ProMED (the nonprofit international Program to Monitor Emerging Diseases) and was an originator of ProMED-mail, an international network inaugurated by ProMED in 1994 for outbreak reporting and disease monitoring using the Internet.

Dr. Kasisomayajula "Vish" Viswanath, Ph.D.

Dr. Kasisomayajula"Vish" Viswanath is a Professor of Health Communication in the Department of Social and Behavioral Sciences at the Harvard School of Public Health (HSPH) and in the McGraw-Patterson Center for Population Sciences at the Dana-Farber Cancer Institute (DFCI). He is also the Faculty Director of the Health Communication Core of the Dana-Farber/Harvard Cancer Center (DF/HCC). Dr. Viswanath is also the leader of the Cancer Risk and Disparities (CaRD) Program of the DF/HCC. He is the Founding Director of DF/HCC's Enhancing Communications for Health Outcomes (ECHO) Laboratory. He chairs the Steering Committee for the Health Communication Concentration (HCC) at HSPH and teaches health communication courses within this concentration. Dr. Viswanath's work focuses on translational communication science to influence public health policy and practice. His primary research is in documenting the relationship between communication inequalities, poverty and health disparities, and knowledge translation to address health disparities. Dr. Viswanath received several awards including: Outstanding Health Communication Scholar Award (2010) and the Mayhew Derryberry Award for his contribution to health education research and theory (2009). He was elected Fellow of the International Communication Association (2011), the Society for Behavioral Medicine (2008), and the Midwest Association for Public Opinion Research (2006). He was the Chair of the Board of Scientific Counselors for the National Center for Health Marketing at the Centers for Disease Control and Prevention (CDC), Atlanta, from 2007-2010. He has served as a member of two Institute of Medicine (IOM) Committees and of the National Vaccine Advisory Committee (NVAC) of the U.S. Department of Health & Human Services and Chair of its Working Group on Vaccine Acceptance.

Biographical information of Ursinus College faculty and staff

Dr. Robert Dawley, Ph.D.

Dr. Robert Dawley is Professor of Biology at Ursinus College and Co-Director of the Center for Science and the Common Good, which is supported by a grant from the Howard Hughes Medical Institute. Dr. Dawley also has served as Co-Chair of the Biology Department and as Coordinator of its cross-campus Common Intellectual Experience course. His journal publications include *Evolution* and *the Proceedings of the National Academy of Sciences*. Dr. Dawley received his Ph.D. from the University of Connecticut and his undergraduate work was at Wayne State University.

Dr. Akshaye Dhawan, Ph.D.

Dr. Akshaye Dhawan is an Assistant Professor at Ursinus College. He received his Ph.D. in Computer Science from Georgia State University in 2009. He received his M.S. in Computer Science from Georgia State and his Bachelor of Engineering in Computer Science and Engineering from Visvesvaraya Technological University, India. His research work has focused on distributed algorithms for Wireless Sensor Networks and Social Networks.

Dr. Anthony Lobo, Ph.D.

Dr. Anthony Lobo is an Associate Professor of Biology at Ursinus College. His research involves studying the physiology, biochemistry, and molecular biology of archaea, and he teaches courses in microbiology, cell and molecular biology, and immunology. Dr. Lobo formerly was a postdoctoral research scientist at the University of Wisconsin-Madison. He received his Ph.D. from Cornell University in Microbiology and his Bachelor's degree in Microbiology from Pennsylvania State University.

Charlene Wysocki

Charlene Wysocki, Director of Research and Sponsored Programs at Ursinus College, works with faculty and staff to provide information and assistance in the grant-funding process. Along with researching funding opportunities, she is responsible for monitoring all grant activity as well as ensuring compliance with college and federal regulations for all sponsored programs. Ms. Wysocki also facilitates programming

aspects of the college's institutional grants from the Teagle and Mellon Foundations and the Howard Hughes Medical Institute (HHMI).

Biographical information of Ursinus College student participants

Samantha Cermignano, B.S.

Samantha Cermignano is a Senior Fellow of the Institute on Science for Global Policy. In 2014, upon completion of her Biology major (concentration in Pre-Health), she graduated Cum Laude with a Bachelor of Science from Ursinus College. As an undergraduate, Ms. Cermignano was a member of Beta Beta Beta National Biological Honor Society, the treasurer of the Whitians Women's Honor Society, a peer mentor for the Brownback-Anders Pre-Health Society, and held a position at the University of Pennsylvania as a visiting undergraduate researcher in hematology. She has previously been published in the journal *Blood*.

Jamie Faselt

Jamie Faselt is an undergraduate at Ursinus College pursuing a Bachelor of Science in Biology with minors in Environmental Studies and Applied Ethics. She has twice participated in Summer Research Fellowships where she has studied agro-ecology. In summer 2014, she was involved in the Howard Hughes Medical Institute-funded FUTURE program, where she mentored a younger student in field and lab research. Ms. Faselt is a Fellow for the Center for Science and the Common Good, a Resident Advisor, and a Bonner Leader, a scholarship program requiring a strong commitment to community service.

Megan Giroux, B.S., B.A.

Megan Giroux received her B.S. in Psychology and B.A. in Dance from Ursinus College. She interned with the ISGP in 2013 and participated in two of its conferences, in Lincoln, Nebraska, and Collegeville, Pennsylvania. She will be attending Simon Fraser University in fall 2014 as a Ph.D. candidate in the Experimental Psychology and Law program.

Jennifer Grugan

Jennifer Grugan is a junior Biology major at Ursinus College. She is a member of the Center for Science and the Common Good at Ursinus. In summer 2014, she was an intern at Einstein Medical Center, participating in research and weekly academic Emergency Medicine conferences.

Zeba Hussaini, B.S.

Zeba Hussaini received a Bachelor of Science degree in both Biology and Applied Ethics, graduating Magna Cum Laude from Ursinus College. She was an intern for ISGP in the summer of 2013 and attended the Food Safety, Security, and Defense conference at University of Nebraska-Lincoln. She was a fellow for the Center for Science and the Common Good, an Ambassador, and conducted biology research. She will be attending Jefferson Medical College starting August 2014.

Rebecca Keenan

Rebecca Keenan is a member of the Ursinus College Class of 2016. She is majoring in Biology and minoring in French. Ms. Keenan is a Fellow of the Ursinus College Center for Science and the Common Good and is interning for the ISGP Academic Partnership program. She also is a Teaching Assistant for Biology labs and a Peer Assisted Study Session Instructor for Organic Chemistry.

Robert Kelly, B.S.

Robert Kelly is a 2014 Ursinus College graduate with a Bachelor of Science in Biology. During his time at Ursinus College, Mr. Kelly became a member of the Ursinus Green Fellows program where he undertook the role of Assistant Director of the organic farm. He also was President of the Ursinus Fencing Association. Currently, Mr. Kelly is in the process of moving to California from King of Prussia, Pennsylvania, to pursue a career in ecology.

Alexander Lowe

Alex Lowe is a junior at Ursinus College, working to attain dual degrees in Biology and Philosophy, with a particular interest in Biomedical Ethics. Outside of the classroom, he holds leadership positions on campus as a Resident Advisor to first-year students, as well as Secretary of Ursinus College Environmental Action and Vice President of the Ursinus Triathlon Club.

Travis Maider, B.S.

Travis Maider is a 2014 graduate from Ursinus College with a degree in Chemistry. Originally from Massachusetts, Mr. Maider will be in Senegal with the Peace Corps until December 2016.

Kenton Marquigny

Kenton Marquigny is a junior majoring in Neuroscience at Ursinus College with an interest in advanced prosthetics. Mr. Marquigny is a Fellow of the Center for Science and the Common Good, as well as a Student Consultant with the Ursinus

Teaching and Learning Initiative. He also has worked with a philanthropic adviser group and as an elementary school tutor.

Kevin Monahan

Kevin Monahan is a senior at Ursinus College majoring in Biology and minoring in Spanish. Apart from his studies, Mr. Monahan plays quarterback on the football team and is involved in various honor societies and jobs on campus.

Aubrey Paris

Aubrey Paris is a Chemistry and Biology double-major, French minor, and Fellow of the Center for Science and the Common Good at Ursinus College (Class of 2015). She is a 2014 AMGEN Scholar at the University of California, Berkeley, and her research involves the catalytic chemistry of alternative energy strategies. She is a co-founder of Globalized Ethics for Medical Science (GEMS), a not-for-profit and publicly accessible infectious-disease reporting database. Ms. Paris is a Fellow of the Institute on Science for Global Policy and has worked for the advancement of the biotechnology industry at BioNJ in Trenton, New Jersey.

Elana Roadcloud

Elana Roadcloud is an intern for the ISGP Academic Partnership program and is majoring in Biology at Ursinus College. Ms. Roadcloud works in a cell biology lab doing undergraduate research on dopaminergic neurons in *C. elegans* and is currently a Fellow of the Center for Science in the Common Good at Ursinus.

Daniel Selechnik

Daniel Selechnik is a former ISGP Academic Partnership intern. He is currently pursuing a Bachelor of Science in Biology from Ursinus College, where he works as a Supplemental Instructor for introductory Biology courses.

Kayla Waits, B.S.

Kayla Waits received her degree in Biology from Ursinus College. She played on the Ursinus College women's varsity soccer team and conducted research as a Neurobiology Research Assistant, studying the effects of prenatal ethanol exposure on the corticothalamic system. During the summer of 2013, Ms. Waits served as a Howard Hughes Medical Institute Research Assistant and FUTURE Mentor. She recently accepted a position at the University of Pennsylvania as a Neuropathology Researcher specializing in neurodegenerative diseases that include, but are not limited to, Alzheimer's disease, Parkinson's disease, and frontotemporal dementia.

Kathryn Yoo

Kathryn Yoo is majoring in Biology and minoring in Anthropology, while following the pre-medical track at Ursinus College. Ms. Yoo is a member of the Ursinus College Women's Volleyball team, a Fellow of the Center for Science and the Common Good, the philanthropy chair for Sigma Sigma Sigma National Sorority, a member of Beta Beta Beta National Biology Honors Society, and a Fighting for Ophelia mentor.

Biographical information of ISGP Board of Directors

Dr. George Atkinson, Chairman

Dr. George Atkinson founded the Institute on Science for Global Policy (ISGP) and is an Emeritus Professor of Chemistry, Biochemistry, and Optical Science at the University of Arizona. He is former head of the Department of Chemistry at the University of Arizona, the founder of a laser sensor company serving the semiconductor industry, and Science and Technology Adviser (STAS) to U.S. Secretaries of State Colin Powell and Condoleezza Rice. He launched the ISGP in 2008 as a new type of international forum in which credible experts provide governmental and societal leaders with the objective understanding of the science and technology that can be reasonably anticipated to help shape the increasingly global societies of the 21st century. Dr. Atkinson has received National Science Foundation and National Institutes of Health graduate fellowships, a National Academy of Sciences Post Doctoral Fellowship, a Senior Fulbright Award, the SERC Award (U.K.), the Senior Alexander von Humboldt Award (Germany), a Lady Davis Professorship (Israel), the first American Institute of Physics' Scientist Diplomat Award, a Titular Director of the International Union of Pure and Applied Chemistry, the Distinguished Service Award (Indiana University), an Honorary Doctorate (Eckerd College), the Distinguished Achievement Award (University of California, Irvine), and was selected by students as the Outstanding Teacher at the University of Arizona. He received his B.S. (high honors, Phi Beta Kappa) from Eckerd College and his Ph.D. in physical chemistry from Indiana University.

Dr. Janet Bingham, Member

Dr. Janet Bingham is President and CEO of the George Mason University (GMU) Foundation and GMU's Vice President for Advancement. GMU is the largest university in Virginia. Previously, she was President and CEO of the Huntsman Cancer Foundation (HCF) in Salt Lake City, Utah. The foundation is a charitable organization that provides financial support to the Huntsman Cancer Institute, the only cancer specialty research center and hospital in the Intermountain West. Dr. Bingham also managed Huntsman Cancer Biotechnology Inc. In addition, she served as Executive Vice President and Chief Operating Officer with the Huntsman Foundation, the private charitable foundation established by Jon M. Huntsman Sr. to support education, cancer interests, programs for abused women and children,

and programs for the homeless. Before joining the Huntsman philanthropic organizations, Dr. Bingham was the Vice President for External Relations and Advancement at the University of Arizona. Prior to her seven years in that capacity, she served as Assistant Vice President for Health Sciences at the University of Arizona Health Sciences Center. Dr. Bingham was recognized as one of the Ten Most Powerful Women in Arizona.

Dr. Henry Koffler, Member

Dr. Henry Koffler is President Emeritus of the University of Arizona. He served as President of the university from 1982-1991. From 1982 he also held professorships in the Departments of Biochemistry, Molecular and Cellular Biology, and Microbiology and Immunology, positions from which he retired in 1997 as Professor Emeritus of Biochemistry. His personal research during these years concentrated on the physiology and molecular biology of microorganisms. He was Vice President for Academic Affairs, University of Minnesota, and Chancellor, University of Massachusetts/Amherst, before coming to the UA. He taught at Purdue University, where he was a Hovde Distinguished Professor, and the School of Medicine at Western Reserve University (now Case Western Reserve University). Dr. Koffler served as a founding Governor and founding Vice-Chairman of the American Academy of Microbiology, and as a member of the governing boards of Fermi National Accelerator Laboratory, the Argonne National Laboratory, and the Superconducting Super Collider Laboratory. He was also a board member of the Association of American Colleges and Universities, a member and Chairman of the Council of Presidents and a member of the executive committee of the National Association of Land Grant Colleges and Universities. He was also Founder, President and board member of the Arizona Senior Academy, the driving force in the development of the Academy Village, an innovative living and learning community. Among the honors that Dr. Koffler has received are a Guggenheim Fellowship and the Eli Lilly Award in Bacteriology and Immunology.

Mr. Jim Kolbe, Member

Mr. Kolbe is a Senior Transatlantic Fellow of The German Marshall Fund of the United States. He served as a congressman in the United States House of Representatives for Arizona's 5th and 8th congressional districts from 1985 to 2007. Before joining the U.S. Congress, he served in the Arizona State Senate. He is a member of the ISGP Board of Directors and is a Senior Advisor at McLarty Associates, a strategic consulting firm. While in Congress, he served for 20 years on the Appropriations Committee of the House of Representatives, was chairman of the Treasury, Post Office and Related Agencies subcommittee for four years, and for

his final six years in Congress, he chaired the Foreign Operations, Export Financing, and Related Agencies subcommittee. He graduated from Northwestern University with a B.A. in Political Science and then from Stanford University with an M.B.A. and a concentration in economics.

Dr. Charles Parmenter, Member

Dr. Charles Parmenter is a Distinguished Professor Emeritus of Chemistry at Indiana University. He also served as Professor and Assistant and Associate Professor at Indiana University in a career there that spanned nearly half a century (1964-2010). He earned his bachelor's degree from the University of Pennsylvania and served as a Lieutenant in the U.S. Air Force from 1955-57. He worked at DuPont after serving in the military, received his Ph.D. from the University of Rochester, and was a Postdoctoral Fellow at Harvard University. He has been elected a Member of the National Academy of Sciences and the American Academy of Arts and Sciences, and a Fellow of the American Physical Society and the American Association for the Advancement of Science. He was a Guggenheim Fellow, a Fulbright Senior Scholar, and received the Senior Alexander von Humboldt Award in 1984. He has received the Earle K. Plyler Prize, was a Spiers Medalist and Lecturer at the Faraday Society, and served as Chair of the Division of Physical Chemistry of the American Chemical Society, Co-Chair of the First Gordon Conference on Molecular Energy Transfer, Co-Organizer of the Telluride Workshop on Large Amplitude Motion and Molecular Dynamics, and Councilor of Division of Chemical Physics, American Physical Society.

Mr. Thomas Pickering, Member

Mr. Thomas Pickering is Vice Chairman of Hills & Co., international consultants, and Strategic Adviser to NGP Energy Capital Management. He co-chaired a State-Department-sponsored panel investigating the September 2012 attack on the U.S. diplomatic mission in Benghazi. He served as U.S. ambassador to the United Nations in New York, the Russian Federation, India, Israel, El Salvador, Nigeria, and the Hashemite Kingdom of Jordan. Mr. Pickering also served on assignments in Zanzibar and Dar es Salaam, Tanzania. He was U.S. Under Secretary of State for Political Affairs, president of the Eurasia Foundation, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs, and Boeing Senior Vice President for International Relations. He also co-chaired an international task force on Afghanistan, organized by the Century Foundation. He received the Distinguished Presidential Award in 1983 and again in 1986 and was awarded the Department of State's highest award, the Distinguished Service Award in 1996. He holds the personal rank of Career Ambassador, the highest in the U.S. Foreign

Service. He graduated from Bowdoin College and received a master's degree from the Fletcher School of Law and Diplomacy at Tufts University.

Dr. Eugene Sander, Member

Dr. Eugene G. Sander served as the 20th president of the University of Arizona, stepping down in 2012. He formerly was vice provost and dean of the university's College of Agriculture and Life Sciences, overseeing 11 academic departments and two schools, with research stations and offices throughout Arizona. He also served as Executive Vice President and Provost, Vice President for University Outreach and Director of the Agricultural Experiment Station and Acting Director of Cooperative Extension Service. Prior to his move to Arizona, Sander served as the Deputy Chancellor for biotechnology development, Director of the Institute of Biosciences and Technology, and head of the Department of Biochemistry and Biophysics for the Texas A&M University system. He was Chairman of the Department of Biochemistry at West Virginia University Medical Center and Associate Chairman of the Department of Biochemistry and Molecular Biology at the College of Medicine, University of Florida. As an officer in the United States Air Force, he was the assistant chief of the biospecialties section at the Aerospace Medical Research Laboratory. He graduated with a bachelor's degree from the University of Minnesota, received his master's degree and Ph.D. from Cornell University and completed postdoctoral study at Brandeis University. As a biochemist, Sander worked in the field of mechanisms by which enzymes catalyze reactions.

Biographical information of ISGP staff

Dr. George Atkinson, Ph.D.

Dr. George Atkinson is the Founder and Executive Director of the Institute on Science for Global Policy (ISGP) and is an Emeritus Professor of Chemistry, Biochemistry, and Optical Science at the University of Arizona. His professional career has involved academic teaching, research, and administration, roles as a corporate founder and executive, and public service at the federal level. He is former Head of the Department of Chemistry at the University of Arizona, the founder of a laser sensor company serving the semiconductor industry, and Science and Technology Adviser (STAS) to U.S. Secretaries of State Colin Powell and Condoleezza Rice. In 2014, Dr. Atkinson became the president of Sigma Xi, The Scientific Research Society. Based on principles derived from his personal experiences, he launched the ISGP in 2008 as a new type of international forum in which credible experts provide governmental and societal leaders with the objective understanding of the science and technology that can be reasonably anticipated to help shape the increasingly global societies of the 21st century.

Jennifer Boice, M.B.A.

Jennifer Boice is the Program Coordinator of the ISGP. Ms. Boice worked for 25 years in the newspaper industry, primarily at the Tucson Citizen and briefly at USA Today. She was the Editor of the Tucson Citizen when it was closed in 2009. Additional appointments at the Tucson Citizen included Business News Editor, Editor of the Online Department, and Senior Editor. She also was a business columnist. Ms. Boice received an M.B.A. from the University of Arizona and graduated from Pomona College in California with a degree in economics.

Dr. Alexis Boyd, Ph.D.

Dr. Alexis Boyd is a Senior Fellow with ISGP. Alexis recently completed her Ph.D. at the Institute of Biomedical Sciences, Department of Microbiology and Immunology at the George Washington University. Her research was focused on the immune response to helminth parasites. Previously, Dr. Boyd was an Infectious Disease Training Fellow at the Centers for Disease Control and Prevention in the Division of Parasitology. She received her M.Sc. in Public Health Microbiology from the George Washington University and majored in Biotechnology at Rutgers University.

Marie Buckingham, B.S.

Marie Buckingham is a Fellow with the ISGP. She received her B.S. in Public Affairs with a concentration in Environmental Management and Economics from Indiana University Bloomington. Previously, she worked at King & Spalding LLP as a project assistant under the Environmental Practice Group in Washington, D.C., and also as a Sustainability Consultant to Microsoft Global in Copenhagen. She is currently applying to M.P.A. in Environmental Science and Policy programs.

Samantha Cermignano, B.S.

Samantha Cermignano is a Senior Fellow of the Institute on Science for Global Policy. She recently received her Bachelor of Science in Biology with a concentration in Pre-Health from Ursinus College. She previously held positions at the University of Pennsylvania as a visiting undergraduate researcher in hematology, at Critical Point Test Prep and Let's Get Ready as an SAT/ACT preparatory coach, and at Ursinus College as a Resident Advisor and office assistant. Ms. Cermignano has been published in the journal *Blood*.

Christina Medvescek, B.A.

Christina Medvescek is Assistant Program Administrator at ISGP. A longtime journalist, editor and former director of public health education publications at the Muscular Dystrophy Association, Ms. Medvescek also is a certified mediator for the U.S. Postal Service and Equal Employment Opportunity Commission, a member of the Leadership Council of the Center for Community Dialogue (Tucson), and a volunteer community mediator for 31 years. A former instructor of cooperative problem-solving skills for children and families, she is currently earning a masters degree in negotiation, conflict resolution and peacemaking.

David Miller, M.B.A.

David Miller is a Scientific/Program Consultant with the ISGP. Previously, he was Director, Medical Advocacy, Policy, and Patient Programs at GlaxoSmithKline, where he led the company's U.S. efforts relating to science policy. In this role, he advised senior management on policy issues, and was the primary liaison between the company and the national trade associations, Pharmaceutical Research and Manufacturers of America (PhRMA) and Biotechnology Industry Organization (BIO). He also held management positions in business development and quality assurance operations. Mr. Miller received his B.S. in Chemistry and his M.B.A. from the University of North Carolina at Chapel Hill.

Dr. Raymond Schmidt, Ph.D.

Raymond Schmidt is a Senior Fellow with the ISGP. In addition, he is a physical chemist/chemical engineer with a strong interest in organizational effectiveness and community health care outcomes. While teaching at the university level, his research focused on using laser light scattering to study liquids, polymer flow, and biological transport phenomena. Upon moving to the upstream petroleum industry, he concentrated on research and development (R&D) and leading multidisciplinary teams from numerous companies to investigate future enhanced oil recovery ideas and to pilot/commercialize innovative recovery methods in domestic and foreign locations. Dr. Schmidt received his Ph.D. in chemistry from Emory University.