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Global Health

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A MITRE Corporation Initiative



Dr. Lynette Hirschman, PhD
Director of Biomedical Informatics
lynette@mitre.org

Welcome to the Global Health Issue

This issue highlights key global health challenges that impact U.S. strategic interests. While terrorists and rogue nations are specific enemies whose actions can directly threaten our way of life, global health issues often have complex and indirect effects on national security. For example, most people can appreciate the personal risks associated with infectious disease transmission, yet they may not realize that foreign disease outbreaks can disrupt economies and destabilize fragile states, creating unintended consequences for the United States. Similarly, a casual observer may see no connection between our government's health-focused foreign aid programs and our national security interests, yet such programs can strengthen strategic international partnerships and help contain diseases before they reach our soil. For these reasons, global health issues present both national security threats and smart power opportunities.

In this issue, we highlight some of MITRE's efforts to support the government in this space—activities that range from delivering medical training and telemedicine in war-torn countries, to modeling disease spread across borders, to understanding the role of health psychology in shaping the public's emergency preparedness and response. Aside from the obvious direct benefits of improving global public health, these efforts help to build international partnerships and capacity, transfer knowledge, create infrastructure and contribute to U.S. efforts to win "hearts and minds" abroad.

Finally, MITRE's global health efforts also represent a key facet of social radar, a concept introduced in the previous issue of this newsletter. The social radar metaphor represents MITRE's vision for a coordinated system of sensing and analysis tools that will allow the U.S. government to monitor, understand, forecast, and respond to national security issues as they emerge and unfold. The pages that follow describe how MITRE is pursuing social radar in the global health domain, developing computer simulation models and disease tracking capabilities that will allow us to anticipate and respond to future global health challenges. We believe that these and other social radar capabilities hold great promise for U.S. efforts to promote health and security—here and abroad.

Lynette Hirschman

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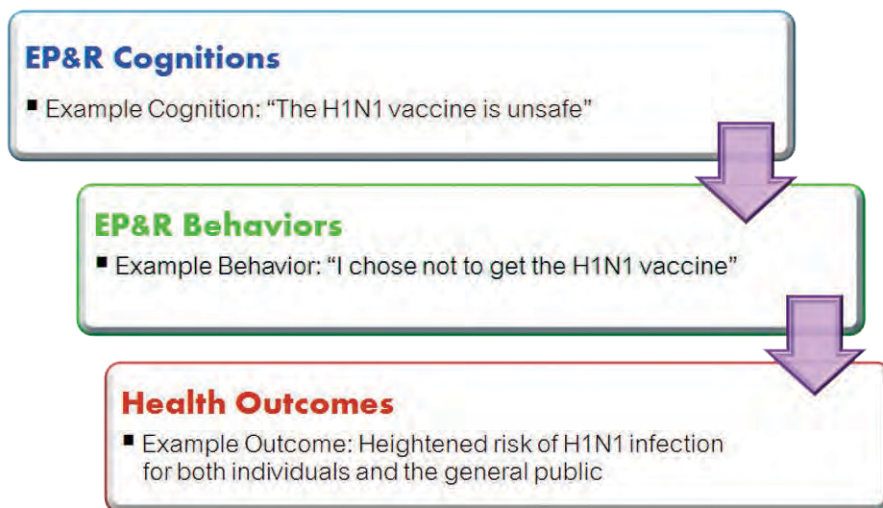


Understanding H1N1: A Psychological Perspective

By Jill Egeth

In recent years, public health experts have anticipated an outbreak of pandemic influenza (PanFlu), an international public health crisis with the potential to end lives, paralyze economic activity, and in some cases even destabilize entire regions of the world. In response to these concerns, both the U.S. government and international organizations have responded with carefully developed emergency preparedness and response (EP&R) plans, including the Centers for Disease Control and Prevention's (CDC) Interim Pre-Pandemic Planning Guidance and the World Health Organization's (WHO) Behavioural Interventions for Reducing the Transmission and Impact of Influenza A(H1N1) Virus. These and other documents provide a foundational structure for effective EP&R, laying out both biomedical (e.g., vaccine and anti-viral distribution plans) and non-pharmaceutical interventions (e.g., social distancing).

With these formal public health plans in place, health officials and leaders face a second, equally daunting challenge: ensuring that the general public understands and willingly participates in them. With that challenge in mind, our MITRE research team has spent the last two years conducting an internally-funded, multidisciplinary research project to: 1) assess Americans' H1N1 flu-related cognitions (including beliefs, attitudes, knowledge, and intentions); 2) determine which cognitions are predictive of people's adherence to EP&R recommendations; and 3) develop a computer simulation model to investigate the potential impact of persuasive communication campaigns on peoples' EP&R behaviors and the spread of H1N1.



Our research team's experience illustrates the challenges of studying a highly dynamic topic like H1N1. In Summer 2009, we collected survey data from a nationally-representative sample of Americans, focusing on cognitions that are closely linked to health-related behaviors, such as H1N1's perceived severity ("How serious a disease is H1N1?") and the respondent's perceived susceptibility ("How likely is it that you will contract H1N1?"). Although the survey yielded rich data, unfolding events led us to the conclusion that public perceptions surrounding H1N1 were highly volatile and would continue to change in subsequent months. Fortunately, we were able to track these changes by leveraging a series of PanFlu surveys initiated by the Harvard School of Public Health (HSPH).

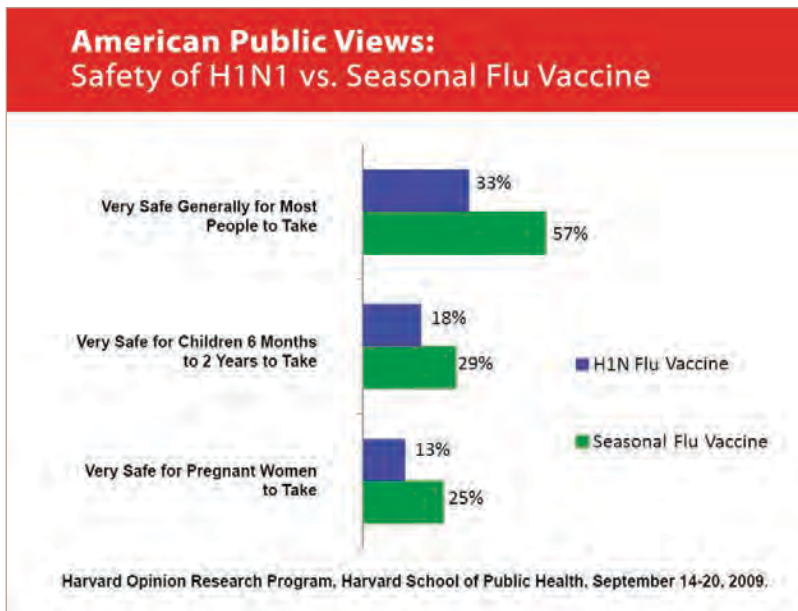
Dr. Jill Egeth

Jill Egeth holds a PhD in health psychology and is Associate Department Head of MITRE's Social, Behavioral, and Linguistic Sciences department. In addition to her work on H1N1 health cognitions, Jill provides systems engineering support and serves as a subject matter expert to the Human Social Culture Behavior (HSCB) Modeling program, a five-year social science research program funded by the Office of the Secretary of Defense.

Social Radar

Emerging technologies in the social, linguistic, and computational sciences open up new possibilities for identifying, tracking, and forecasting societal phenomena across a range of domains. As outlined in our previous issue, the social radar metaphor reflects MITRE's vision for a system of interrelated analytic tools and methods that will provide the U.S. government with decisive information advantage in these domains. Learn more at www.mitre.org/smartpower.

In many cases, these data have underscored how cognitions can shape EP&R outcomes. For example, of the 41% of HSPH participants who reported being unsure as to whether they would seek the H1N1 vaccine, 21% cited fear of contracting H1N1 from the vaccine as a major source of their hesitation. (In reality, it is medically impossible to contract the virus from the vaccine.) Similarly, although 57% of respondents perceived the seasonal flu vaccination to be “very safe,” only 33% held the same perception of the H1N1 vaccine—this despite the fact that both vaccines are produced by the same companies using the same established processes. These and other misperceptions seem to be a significant contributing factor to the sub-optimal H1N1 vaccination rates we have observed to date. Accordingly, better understanding of these maladaptive cognitions will be critical to the development of effective public communication campaigns for PanFlu and other global health threats.



Drawing on these survey findings, our team is developing a hybrid agent-based, discrete event process model for how cognitions can alter disease spread. Our approach allows us to conduct simulations with computer-generated “agents” whom we program to behave in a manner consistent with the findings of PanFlu survey data. For example, in an initial run of the model, we would program 41% of our “people” (agents) to avoid the H1N1 vaccine, 21% of whom would be programmed to have a specific fear of contracting the virus from the vaccine. Once the agents are programmed to reflect the general population’s H1N1 cognitions, we run the model and observe how these cognitions and related behaviors affect the disease’s spread. In subsequent model runs, we can alter the population’s cognitions to simulate the potential impact of a public health campaign, re-running the simulation, and comparing the results with the earlier run in which there was no such campaign.

We believe that these techniques, still currently under development, will one day provide communicators with the ability to model the impact of their communication campaigns in advance of actual message delivery. Communicators will be able to discard potential messages that produce low-impact results and focus their efforts on messages that demonstrate high-impact outcomes in the model. While our current efforts focus on American cognitions in the healthcare domain, our methodology is generalizable and can be applied to the development of a broad range of communication campaigns at local, state, national, and international levels.

Enhancing Global Security through Health Initiatives

By Chris Spirito

Seasoned strategic communications experts recognize that rhetoric alone rarely achieves results and can even backfire. For this reason, the U.S. government strives to complement its messages with tangible assistance to at-risk international populations, including investments in essential services, infrastructure, local economies, and health. This last form of assistance—global health initiatives—is a vital part of the U.S. government’s communication strategy and an emerging focus area for MITRE. These efforts offer clear benefits, including a direct impact on global health and facilitation of relationship building with the international medical community and other stakeholders.



Learn more about the Iraqi Telemedicine Network at:

http://www.mitre.org/news/digest/defense_intelligence/09_08/telemedicine.html

Direct Impact - The U.S. invests significant civilian and military resources toward improving world health, placing particular emphasis on preventing infectious diseases like HIV, TB and malaria. Working toward this goal, MITRE has teamed with physicians from the U.S., Uganda and Kenya through the Harvard School of Public Health; WiRED International; and Partners Healthcare Center for Connected Health to create an HIV/TB Co-Infection Management training seminar. This seminar includes an introduction to HIV/TB co-infection and sessions on screening and diagnosis, treatment, and medications. This type of partnership allows diverse organizations to pool resources and skill sets to directly impact health worldwide.

Relationships with Local Stakeholders – In addition to the direct health impacts, developing relationships with community/tribal leaders and their healthcare providers creates a foundation for pursuing broader U.S.-host nation stabilization goals. In support of this mission in Iraq, MITRE again partnered with WiRED International and Partners Healthcare Center to develop the Iraqi Telemedicine Network (ITN) project. This effort expanded health information and tele-consultation services from five major Iraqi medical centers to 30+ community hospitals, bringing continuing education classes to Iraqi physicians and connecting them to worldwide experts for case consultations. Key to this accomplishment was WiRED’s multi-year investment in building relationships with Iraqi physicians, metropolitan health centers, and smaller communities.

Although it is obvious that these kinds of initiatives can help stabilize countries at risk for preventable disease outbreaks, fewer people recognize that global health initiatives foster trust, information sharing, and collaboration—valuable relational “capital” that can enhance the security of the United States, and the world, for years to come.

Chris Spirito

Chris Spirito (BA, Mathematics, Boston College) is a Principal Engineer in MITRE’s International Operations department. Chris is one of the authors of MITRE’s International Operations Strategic Plan and was recently named a board member of WiRED International, a non-profit focused on improving health in disadvantaged parts of the world. Prior to returning to MITRE in 2006, Chris was the Director of Technology for a nanotechnology research and development consultancy in New York City.

Dr. Jennifer Mathieu

Jennifer Mathieu holds a PhD in Biological and Environmental Engineering. In addition to her disease spread modeling work, Jennifer provides systems engineering support for the Nuclear Waste Materials System Flow Model (MSFM) funded by the Department of Energy; the Human Social Culture Behavior (HSCB) Modeling program funded by the Office of the Secretary of Defense (OSD); and the Cyber Threats' Impact on Mission (CyTIM) testbed project funded by the Air Force, Combat Information Transport System (CITS) Program.

Dr. Grace Hwang

Grace Hwang is a Principal Sensors Scientist at MITRE, where she applies biophysics principles to the development of optical biosensors and to disease spread modeling. Dr. Hwang's work has been funded by the CDC and DARPA, and she currently serves on two National Academies of Science panels focusing on risk assessment for air travel-based disease spread.

Global Disease Spread by Air Travel

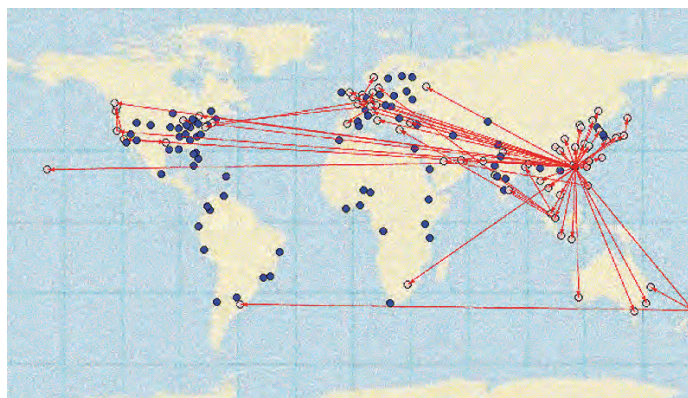
By Jennifer Mathieu and Grace Hwang

Increased air travel enables diseases to spread across geographic and political boundaries with unprecedented speed. For example, the 2002–2003 outbreak of Severe Acute Respiratory Syndrome (SARS) spread from China's Guangdong Province to the United States and 36 other countries in only a few months, and some of the longer SARS "jumps" were directly traced to air travel. We must now plan in terms of global health and response to limit disease spread.

Researchers are increasingly turning to computer simulation to anticipate and mitigate the consequences of rapid disease spread. Early work dates back to 1985, when Leonid Rvachev and Ira Longini presented an equation-based computer model of the 1968-1969 H3N2 influenza pandemic. More recently, as simulation methods have matured and computational power has increased, MITRE and others have built on this foundational work to develop the next generation of applied forecasting tools. Such models depend critically on the availability of detailed data on disease incidence and transmission around the world. Examples of these data include early reports of disease outbreak from biosurveillance systems as well as detailed information on trends and social movements within and between countries—the latter serving as an important element of social radar.

For the last four years MITRE has been drawing on such data sets and models to develop flexible simulations for novel and emerging outbreak scenarios. Currently, we are applying RTI International's disease-spread model to study a range of air travel-based global disease spread scenarios. We are able to simulate the emergence and spread of pandemic influenza by varying the model's parameters, including the outbreak's geographical point of origin and its infectiousness. Using recent population and flight data covering 177 international metropolitan areas, this simulation study provides a baseline exploration of how quickly pandemic influenza might spread to the U.S.

The ultimate aim of such simulations is to equip policymakers and public health officials with the tools they need to prepare for and respond to future outbreaks. For example, MITRE and RTI International recently collaborated in applying initial simulation results to the 2009 Pandemic Influenza Experiment (PIE), an air passenger screening exercise that brought together federal government agency representatives from the U.S., Canada, and Mexico. Conducted as a part of MITRE's larger Collaborative Experimentation Environment (CEE), the experiment focused on testing various screening strategies in a virtual environment created from simula-



Source: Epstein et al. 2007. Controlling pandemic flu: The value of international air travel restrictions. PLoS ONE 5:e401.

tions of air traffic flow, airport health screening, and global disease spread. The PIE focused on how multiple agencies from multiple countries might collaborate during the early stages of a pandemic influenza outbreak to implement and coordinate virus screening for incoming international air passengers.

Looking to the future, disease spread simulations can contribute to a range of emergency preparedness and response (EP&R) goals. PIE illustrates that such models can help governments develop robust and efficient emergency response plans (including contingency plans) for various outbreak locations and scenarios. Moreover, similar models could be used in real time to help decision makers allocate scarce resources and choose among alternative courses of action for containing the disease and minimizing its impact. For example, models might be tailored to provide early warning to unaffected areas or to suggest specific actions that could be realistically implemented—from repositioning vaccine stockpiles to sending antivirals to affected countries overseas. These kinds of forecasting and decision support capabilities will be critical to the development of social radar for the Global Health domain.

Airport Health Screening



U.S. public health entry screening of arriving international travelers at airports during an influenza pandemic.

Spotlight: CAASD

MITRE's Center for Advanced Aviation System Development (CAASD) served as a key data source for the Collaborative Experimentation Environment. Created in 1990 by the Federal Aviation Administration (FAA), the CAASD Federally Funded Research and Development Center (FFRDC) works with the FAA and civil aviation authorities around the world to develop best practices and address key challenges in the areas of safety, security, and efficiency. Learn more at www.mitrecaasd.org.

The Smart Power Initiative

MITRE's Corporate Initiative in Smart Power envisions the coordination and amplification of all instruments of national power through innovative strategies, methodologies, tools and relationships. Our primary objectives are to (1) provide government leaders with methods and tools for social radar and engagement; (2) facilitate planning and coordination of government actions across the Diplomatic, Information, Military, and Economic (DIME) spectrum; and (3) enable the acquisition community in the design of effective, affordable, resilient smart power systems.

About MITRE

As a trusted not-for-profit adviser to the U.S. government, the MITRE Corporation applies expertise in systems engineering, information technology, social-behavioral sciences, human language technology, and enterprise modernization to address our sponsors' critical needs. MITRE manages five Federally Funded Research and Development Centers, including centers for the Departments of Defense and Homeland Security. MITRE also serves a range of other government sponsors and maintains an independent research and development program.



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