OPERATIONS RESEARCH (ONLINE FORUM COMMENTARY)
Vol. 57, No. 4, July–August 2009, online commentary
ISSN 0030-364X | EISSN 1526-5463 | 09

INFORMS

Commentary on "Homeland Security: From Mathematical Models to Policy Implementation" by Lawrence M. Wein

Eva K. Lee
Director, Center for Operations Research in Medicine and Health Care
School of Industrial and Systems Engineering
Georgia Institute of Technology
Atlanta, GA 30332

I applaud Dr. Wein for writing such an insightful article of his own experience over a broad spectrum of homeland security research. Larrys work has unquestionably and positively influenced US government policy on homeland security measures and strategies. He and his co-authors study on confronting an anthrax attack and dispensing of medical counter measures ignited a chain of useful reactions to public health policies and initiatives on rapid and strategic bio-response. Time-constrained casualty mitigation in an anthrax attack demands rapid protection that goes well beyond existing health systems capabilities. Much of my work with CDC since 2003 focuses on enhancing those capabilities. This includes rapidly determining and setting up optimal locations for dispensing sites, efficient clinic layout design, optimal staffing, intra-facility disease propagation and mitigation strategies, and subsequent clean-up and long-term economic impact.

Mass dispensing via point-of-dispensing (POD) sites (walk-throughs and drive-throughs) are critical. Even early stage analysis (2002) indicated that US hospitals cannot cost-effectively take on the burden of mass dispensing. This is partly due to limited surge capability and partly because they will be overwhelmed with both the genuinely ill and the 'worried well.'

The three postal service exercises demonstrated impressive results. Since 2008, it has been suggested that the postal service be the first layer of prophylaxis treatment upon confirmation of attack. Under the City Readiness Initiative, many cities have been working diligently to develop executable mass dispensing and POD plans. Today, many standards have been put in place, although many hurdles remain. Because anthrax requires a 60-day antibiotic regimen to be effective – including follow-up vaccinations – POD strategies remain critical for bio-response infrastructure success.

POD is viewed either as a comprehensive means for mass dispensing or as the second layer of response (following initial postal delivery). Many emergency planners remain concerned about the security requirement of postal delivery. There are undeniably serious doubts that local jurisdictions have sufficient security personnel (from local law enforcement teams, or from private security firms) to protect postal workers both at home and on the job. From my own work with the CDC Strategic National Stockpile and with local emergency planners, there is also serious concern regarding postal worker availability. Incentives have been offered to provide them with MedKit or advanced prophylactic treatment to protect them and their family members. Compounding concern are recent cutback announcements and closure of postal services in some cities.

The food poison analysis by Larry and co-authors has perhaps garnered the most controversy. Fortunately, this controversy has usefully raised national awareness around insufficient food safety measures and the vulnerabilities this country faces. While I am not personally aware of proactive countermeasures being researched or developed, this subject has been raised in some of the high-level governmental meetings on homeland security and medical preparedness that I have attended.

There are many challenges. Our food and water sources are open and relatively unguarded. To protect the sources, serious investments of manpower and technology from multiple levels of private/local/state/federal agencies are needed. This in turn poses a daunting task for FDA. Setting forth new regulations and inspection processes to ensure adherence to guidelines will be a challenge. Food safety is certainly high on FDAs priority list; however, it is difficult to evaluate how much effort should be placed on detecting and controlling deliberate food tampering. There is much to learn from successful 'product recall' strategies and implementations.

Pandemic flu planning and analysis has been a top priority in public health since the avian flu and the SARS incidents in Asia in 2002. There has been active and continuing study in personal hygiene and protection since then. Face-masks were widely used during the SARS outbreak. To date, little data are available about the effectiveness of non-pharmaceutical interventions, such as hand hygiene and facemasks, for preventing influenza virus transmission.

In a randomized clinical trial in Hong Kong (2008), three arms (control, surgical face masks, and hand hygiene) were tested. It was found that laboratory-based or clinical secondary attack ratios did not significantly differ across the intervention arms. A recent CDC-sponsored randomized trial (published in 2009) further reported that hand hygiene without or with facemasks seemed to reduce influenza transmission. However, the differences in transmission compared with the control group were not statistically significant.

As swine flu continues to spread, much of the public concern in the United States now relates to the efficacy and dosage of vaccines. At this writing, the first wave of H1N1 flu vaccine is slated for public usage in Fall 2009. There are certainly hurdles in producing effective vaccine, due to the intrinsic difficult steps in the biological and synthesis process. Some recent breakthroughs have shed new light on speeding up the design process. For example, in a recent study predicting immunity effectiveness of vaccine, my colleagues and I found that treatment outcome response can be detected within a week through certain discriminatory gene signatures.

Rapidly identifying gene signatures could facilitate the rapid evaluation and design of new and emerging vaccines, identify individuals who are unlikely to be protected by a vaccine, and answer fundamental questions that can lead to better vaccinations and prevention of disease. A clinical trial has just begun for the swine flu vaccine, and we are expecting to evaluate the treatment effectiveness and outcome response as early as November 2009.

The biometric study for US visitors is an excellent example to showcase how an OR modeling study can affect policy change readily and rapidly. 10-finger printing technology has been used in various federal procedures already, Larrys study and his effort in educating the policymakers directly expedited the introduction of such existing technology (procedure) to an important screening environment.

With the ever changing dynamic of infectious diseases (and means of biological attack), the need for public prophylaxis is real. The dispensing strategies that public health emergency departments have tested and trained for since 2004 are critical to public health and medical preparedness. This is evident by a confirmed Hepatitis A incident in a grocery store in Erie county in New York state in 2008. The case triggered subsequent prophylactic treatment of 10,000 individuals. The Georgia Tech team was present in the drive-through second booster shot event.

Surveillance and early detection remain a daunting task in much of the counter-terrorism research. Surveillance to natural disease outbreaks is a traditional responsibility of public health. Since the Spanish American War (with malaria), US national security agencies have been involved

in the surveillance process. In the 21st century, there exist environmental detectors that are designed to detect aerosolized biomaterials. However, severe limitations exist, including the sites, coverage, and limited DNA materials that they can detect. Clinical and syndromic surveillance may take a longer time to identify a patient case, but are often more definitive, and thus they can trigger rapid decision processes that are necessary to protect the regional population.

For radiological exposure, detection remains a huge challenge, in part because of the various isotopes of radiation materials and the different penetration powers. Some radiation contamination requires bioassay to confirm. Others can be detected by sophisticated monitoring devices. The death of Russian agent Alexander Litvinenko as a result of polonium poisoning in 2006 underscores the vast complexity of radiation detection and treatment. Terrorists will not be carrying large concentrated amounts of radioactive material that will trigger detectors readily. Rather, they will use unusual isotopes and tiny amounts scattered over various locations. A detection program that is capable of identifying all radiological threats is virtually impossible.

Another open hurdle is the design of effective medical countermeasures. Although there are standard antibiotics being planned for dispensing in response to anthrax, many medical experts worry about the drug-resistant mutated anthrax virus. This holds true for many infectious diseases. For radiological protection, animal models are still being tested as technological companies race the clock to come up with appropriate medical countermeasures that can satisfy FDA requirements.

Beyond sharing with us the technical findings and policy-changing process, it is refreshing that Larry outlined important issues to consider: problem choice, contextual learning, self-funding, high-profile outlets, and educating policymakers. Many of us can appreciate the importance of close collaboration across different disciplines. The learning process can be long as we desire to make a substantial impact in the field. In my own experience, self-funding not only can help speed up the research process, it is also necessary in some cases. For example, my 2003 initiative with CDC on biological and infectious disease work did not carry a price-tag. This was important and practical as CDC had budgeted much of their funding resources directly to equip local and state public health departments with technological advances. Today, we do have funding for various investigations and in-the-field measurements and evaluations.