Early Warning for Infectious Disease Outbreaks: A Q&A with Larry Madoff

The IQT Quarterly recently interviewed Larry Madoff, Editor of The Program for Monitoring Emerging Diseases (ProMED-mail). ProMED-mail reports on outbreaks and disease emergence, providing early warning information to a global audience and allowing informed discussions in real time. Madoff discussed ProMED's information dissemination process, the broader community of infectious disease reporting, and the future of outbreak detection and response.

What is ProMED? How did it begin? Who participates?

Founded in 1994, ProMED-mail was intended to harness the Internet in the service of detecting emerging infectious or toxin-mediated diseases, either natural or intentionally caused, that threatened human beings. Its goal is to provide early warning, disseminating information rapidly to a wide audience and allowing informed discussion in real time.

As of 2015, ProMED-mail has 75,000 subscribers in more than 180 countries who receive email reports on outbreaks and disease emergence. Readers can also receive reports via Twitter, Facebook, or an iPhone app. Reports are selected and interpreted by a panel of specialist moderators who provide expert commentary, supply references to previous reports and to the scientific literature, and put the report in perspective for a diverse readership. Reports are simultaneously posted to ProMED's website. ProMED's guiding principles include transparency and a commitment to the unfettered flow of outbreak information, freedom from political constraints, availability to all without cost, commitment to the One Health concept (see below), and service to the global health community.

What kinds of illnesses are reported on ProMED?

ProMED focuses on newly described or unknown diseases, epidemics, and outbreaks, and on the emergence of diseases in new areas or populations. In addition to its focus on human disease, a unique feature of ProMED is its emphasis on the One Health concept, recognizing the importance of diseases that affect plants and animals as well as zoonoses (diseases carried by animals that can also infect humans, such as *Escherichia coli* O157, monkeypox, Nipah virus, SARS, and spongiform encephalopathies). About 60 percent
of emerging diseases are zoonoses.1 Specific examples include ProMED’s extensive coverage of the outbreak of foot-and-mouth disease that devastated livestock in the United Kingdom, as well as the recent outbreaks of avian influenza in Europe, Southeast Asia, and the U.S. For this reason, ProMED’s staff includes 14 veterinary health specialists with diverse expertise to help us sift through the news of diseases among animals. ProMED provides extensive coverage of less sensational but equally important illnesses, such as dengue fever and norovirus infection (Table 1). Because of their ample coverage in other forums, tuberculosis and HIV infection are not covered by ProMED except in unusual circumstances.

How does it work?

Receipt of information. Each day, ProMED receives reports, many from subscribers, containing new data on outbreaks or diseases, some of which are reported firsthand and some of which are reported from other sources. In addition, our staff searches the Internet and traditional media for relevant items and scans a variety of official and unofficial websites (e.g., national, regional, and local health authorities, and international organizations) looking for recent updates. Since 2007, ProMED has collaborated closely with HealthMap, an organization based at Boston Children’s Hospital and Harvard Medical School that automatically scans a large number of news and official websites and continuously searches for infectious disease reports. These reports are provided to ProMED for further analysis and form the basis for some ProMED reports. ProMED’s staff of 57 individuals collaborates virtually across 33 countries.

Review and verification. All incoming information is filtered through the “top moderator” — either the editor, or one of the associate editors — who is on duty on a given day. Some reports are rejected immediately because they contain information that is irrelevant, not credible, outdated, or duplicates information contained in previous reports. Most reports are examined carefully and then sent to a member of ProMED’s specialty moderators for further review. The panel includes experts in viral diseases, bacterial diseases, plant diseases, veterinary diseases and zoonoses, and epidemiology. Sometimes reports are translated and, on occasion, sent to outside experts for their opinions.

Subsequently, the specialty moderator’s main task is to assess the reliability and accuracy of the information. At times, this involves verification of the report from another source, including direct contact with a colleague who might possess firsthand knowledge. In order to help ProMED validate outbreaks of emerging diseases, we established the EpiCore Project (a joint venture between the Skoll Global Threats Fund, HealthMap, ProMED-mail, and TEPHINET) that seeks to maximize the advantage of nontraditional information sources by creating a system for field-based verification of reports from these sources. We are forming a cadre of trained health professionals from around the world that leverages expertise to verify reports received in a geographic proximity through innovative surveillance approaches.

The moderator also edits the piece for content, provides references (both from prior ProMED reports and from the scientific literature), and adds commentary. This commentary is usually brief, with the intention of providing background and perspective. Often multiple reports of the same outbreak or disease entity may be grouped into a single report to enhance clarity and minimize the number of emails our readers receive. Edited reports are returned to the top moderator for final editing, verification, and additional commentary.

Dissemination of information. Finalized reports are simultaneously posted to the ProMED website and distributed to one or more of 19 mailing lists that are based on the interests, language, and region of the subscribers. Approximately one-third of our readers receive the main ProMED-mail list; they receive every report as it is distributed. Other lists are oriented toward animal diseases, such as ProMED-AHEAD (ProMED-Animal Health and Emerging Animal Diseases) or plant diseases. ProMED-EDR (ProMED-Emerging Disease Reports) is designed for readers who want to receive only reports of disease occurrences and do not want to receive discussion, background reports, or announcements. Digest forms of each list are also available. Digest subscribers receive an assemblage of reports approximately once per day. There are also daily and weekly update email lists where subscribers receive a list of post titles and links. These minimize the number of emails but may delay the receipt of a given report.

ProMED is organized into eight regional networks spanning six languages (Arabic, English, French, Portuguese, Russian, and Spanish). This allows information to be tailored by regional concerns, and enhances surveillance in regions where disease
emergence is likely but information resources are less developed.

ProMED’s archived database allows users to search 60,000 reports using text, dates, and geographic locations. For example, a user wishing to find reports of Nipah virus in Malaysia could enter these two search terms and receive a list of accessible links. Archives can also be retrieved by email (although without search capability) for those whose Internet connection does not permit Web browser access.

How does ProMED fit into the wider world of infectious disease reporting?

ProMED-mail is a powerful tool, and its growth is testimony to its value. Clearly, however, no single system can detect and report every outbreak of infectious disease worldwide; the need for multiple networks and surveillance systems is widely acknowledged. Other notable systems include:

- The WHO’s Global Outbreak Alert and Response Network draws on numerous sources, including its own teams of public health workers, reporting on outbreaks of public health significance and posting some of the information gathered on WHO’s website.

- The Global Public Health Intelligence Network, a service of Health Canada, automatically searches the Internet for news stories involving emerging disease threats. However, its use is restricted to a select group of public health officials, and it is not publicly accessible.

- Epi-X, provided by the U.S. Centers for Disease Control and Prevention, is a web-based communications system designed to allow public health professionals (including state and local public health departments) to communicate quickly and securely. It does not seek or allow input from most health practitioners or the general public.

- The Emerging Infections Network is a collaboration between the Infectious Diseases Society of America and public agencies that is designed to allow infectious disease physicians to act as sentinels of disease outbreaks.

Numerous other surveillance systems exist, some directed at specific diseases, regions, populations, or other interest groups. The existence of multiple surveillance systems, official and unofficial, is beneficial from a number of standpoints. The complementary flow of information on the basis of the reporting interests and biases of each network makes it more likely that a given outbreak or emergence of disease will be discovered and reported quickly. Each system serves as an important validation tool for the others. Disease outbreaks that are uncovered by one surveillance system but not by another lead to the recognition of gaps in disease detection. Partial redundancy helps ensure that the overall goal of disease detection is accomplished.

What role will technology play in the future of ProMED and outbreak reporting?

ProMED’s focus has never been on technology, but we continue to enhance and refine our operations through collaborations with technically savvy partners such as HealthMap, Metabiota, and EcoHealth Alliance. We are refining our iPhone app and developing an Android version to better allow smartphone users to view our outbreak data and submit information (including photos and geographic coordinates). While many access our reports from our website and social media, we still believe that email is the “killer app” allowing us to push our reports in near real-time to thousands of users. We want our service to be available even to those in remote areas with limited bandwidth or where data is expensive.

We strongly believe that astute human observers are at the heart of global public health and outbreak detection. Technology should therefore be designed to empower individuals to detect and report on unusual occurrences. Smartphones, now more widely deployed, can be one such tool. The ability of concerned and observant people across a variety of disciples to interact virtually — and ProMED itself is a kind of social network — are key to recognizing outbreaks in their earliest stages. Technology should never be prioritized above building human capacity.

What other technology advances do you think are necessary to improve our ability to detect and respond to disease outbreaks?

The ever-widening availability of the Internet, both wired and wireless, is key to our future successes. Other technology directly in the service of astute individuals will include rapid and sophisticated point-of-care (or at least nearby, for example at the district hospital level) diagnostics. In particular, nucleic acid-based technologies will allow specific identification of pathogens. If rapid hemorrhagic fever virus identification had been in the hands of local health
care workers in Guinea in late 2013, the response to the Ebola outbreak might have begun sooner, and thousands of cases and deaths prevented. Of course, new therapeutics and vaccines — and rapid ways to develop and study these in the course of an outbreak, are also critical.

What concerns you most as we look at the future of disease outbreaks?

Both private individuals and public officials tend to overreact to disease outbreaks and then become complacent once the immediate threat has waned. There is also a tendency to “fight the last war.” For example, there is now a tremendous focus on measures to control Ebola, such as personal protective equipment. But we need to remain broadly vigilant and to develop the human capacity and systems to quickly detect and respond to all types of outbreaks. A robust official public health sector should be complemented by a strong unofficial/NGO sector, including services like ProMED.

Our ability to predict outbreaks is very limited. The next outbreak may be food or waterborne or spread by insects. While we recognize hotspots for disease emergence, they may occur at any time or place. Advances in biotechnology may allow for nefarious development of bioweapons and bioterrorism. The unknown unknowns are my biggest cause of concern.

Lawrence Madoff, M.D., is an infectious disease physician specializing in the epidemiology of emerging pathogens, bacterial pathogenesis, and international health. He is Professor of Medicine at the University of Massachusetts Medical School and Lecturer on Medicine at Harvard Medical School. Madoff serves as Director of Epidemiology and Immunization and Deputy State Epidemiologist for the Massachusetts Department of Public Health. Madoff has directed ProMED, the Program for Monitoring Emerging Diseases, since 2002. A graduate of Yale College and Tufts Medical School, he performed his Internal Medicine Residency at New York Hospital-Cornell Medical Center and his Infectious Disease Fellowship at the Harvard Medical School-Longwood program.

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