



Bioterrorism and Health System Preparedness



The Role of Information Technology and Surveillance Systems in Bioterrorism Readiness

The Agency for Healthcare Research and Quality (AHRQ) is the lead agency charged with supporting research designed to improve the quality of health care, reduce its cost, address patient safety and medical errors, and broaden access to essential services. AHRQ sponsors and conducts research that provides evidence-based information on health care outcomes; quality; and cost, use, and access. The information helps health care decisionmakers—patients and clinicians, health system leaders, and policymakers—make more informed decisions and improve the quality of health care services.

Introduction

While traditional disease surveillance relies on often time-consuming laboratory diagnosis, a new breed of syndromic surveillance systems has the potential to significantly speed up detection of disease outbreaks.

In a time of increasing concern over bioterrorist activity, early response to disease outbreaks is a key public health priority and an emerging field of research. Early knowledge of a disease outbreak can improve response time and health outcomes. Recent public health emergencies such as the severe acute respiratory syndrome (SARS) outbreak and the outbreak of monkeypox in the Midwestern United States in the summer of 2003 highlight the important role that

early detection plays in mobilizing rapid response.

While traditional disease surveillance relies on often time-consuming laboratory diagnosis, a new breed of syndromic surveillance systems has the potential to significantly speed up detection of disease outbreaks. These new, computer-based surveillance systems offer valuable and timely information to hospitals as well as to State, local, and Federal health officials.

This Issue Brief describes syndromic monitoring systems and how they are used to track trends within patient populations and to establish early warning of disease outbreaks, including potential bioterrorist activity. A Web-assisted audio conference sponsored by the Agency for Healthcare Research and Quality (AHRQ) in October 2003 examined the role of information technology and surveillance systems in disease detection and bioterrorism preparedness. Presentations



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Understanding Syndromic Surveillance

Syndromic surveillance is a relatively new term in clinical medicine; it refers to the active monitoring of a patient population for disease outbreaks, said Michael Shannon, M.D., Chief of the Department of Emergency Services at Children's Hospital at Harvard Medical School. Syndromic surveillance systems monitor data that are routinely collected—in emergency rooms, for example. Based on presenting complaints rather than final diagnosis, these computerized systems can provide an early signal of unusual illnesses in a patient population—including symptoms resulting from bioterrorist activity.

Disease detection and diagnosis once relied solely on the astute clinician. Now, with advances in information technology, disease monitoring can be done electronically using “real-time” or instantaneous data analysis. While the astute clinician remains critical to early detection, this technology reduces the burden on clinicians to identify an unusual disease

occurrence. Automated decision-support systems also offer an important tool to clinicians who are likely to be on the frontlines of detecting a disease outbreak or bioterrorist event. These systems enable the clinician to use computer programs to make a faster diagnosis.

The Center also developed the Bioagent Diagnosis Program, which can be used to detect possible bioagent causes for presenting symptoms. An automated decision-support tool, the program allows clinicians to enter information on a patient's chief complaints into a computerized

Pediatric Disaster Preparedness—Areas of Need

- ▲ School preparedness.
- ▲ Surge capacity planning for pediatric casualties.
- ▲ Training of first responders in managing pediatric disaster victims.
- ▲ Development of national pediatric disaster response teams.
- ▲ Assessment tools to identify children with significant mental health issues resulting from a disaster.

Pediatric Disease Surveillance Technologies

The Center for Biopreparedness at Children's Hospital Boston has developed both syndromic and automated decision-support tools for early disease detection. The Center's EDScope prototype is a syndromic surveillance program that monitors children's emergency department visits and chief complaint patterns, signaling when the number or type of visits is outside the range expected. To create EDScope, the Center reviewed 10 years worth of data on 500,000 visits to the Children's Hospital Boston emergency department. EDScope can now predict—within 5 to 10 percent—the number of children who will visit the hospital's emergency department and their chief complaints.

worksheet. The program then presents information on possible bioagent causes for the patient's symptoms.

Syndromic surveillance systems can also be used to improve public health preparedness for children outside the hospital. For example, used in the school setting, syndromic surveillance can identify a sudden change in absentee rates or in illnesses among children visiting the school nurse, both of which may signal a disease outbreak. “Children are not small adults,” says Shannon. “There is a real challenge in being able to manage children in the event of a disaster, and it's going to require much more training and education of first responders.”

Shannon points to five critical areas that need greater attention and



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Michael Shannon, M.D., M.P.H.

resources to prepare for a potential public health emergency involving children (see box at left). In all these areas, information technology has a valuable role to play.

Accelerating the Public Health Investigation Cycle

The Realtime Outbreak and Disease Surveillance Laboratory at the University of Pittsburgh—known as the RODS Lab—uses information technology to improve detection of disease outbreaks, either naturally occurring or resulting from bioterrorism. The Lab’s signature systems are the National Retail Data Monitor (NRDM) and its RODS system. “We’re trying to accelerate the basic public health investigation cycle

with the use of information technology,” said Michael Wagner, M.D., director of the laboratory.

The Lab’s NRDM system analyzes sales of over-the-counter health care products to detect disease outbreaks. With the cooperation of seven national pharmacy and grocery companies, the NRDM gathers, evaluates, and interprets massive amounts of sales data routinely collected by the retail industry on over-the-counter medications. The standard coding system for consumer products—the 12-digit Universal Product Code or UPC printed on every package—enables collection of this data.

The NRDM receives data daily from 15,000 stores on sales of over-the-counter health care products such as cough syrup. This data provides

valuable information on medications that may be purchased early during the course of an illness. Computerized algorithms monitor these data to detect unusual patterns of sales. At present, the NRDM captures 30 percent of the Nation’s sales of over-the-counter health care products. The lab aims to enlist enough additional retail chains to reach 70 percent and also hopes to decrease the data’s time latency to less than 24 hours. Any public health official can obtain a free account that provides access to the NRDM by contacting nrdm-accounts@cbmi.pitt.edu.

The first real-time public health surveillance system for early detection of disease outbreaks, the Lab’s RODS system examines hospital emergency room data from across the country. The RODS model analyzes and integrates clinical data from emergency departments within a geographic region to provide an instantaneous picture of symptoms and an early warning of disease outbreaks. The system monitors in real time information such as chief complaints that are routinely collected

Information Technology to Support Bioterrorism Preparedness

- ▲ **Detection and monitoring systems** support disease and threat surveillance and collect national health status indicators.
- ▲ **Analytical systems** facilitate real-time evaluation of live data feeds and turn data into information to identify disease outbreaks.
- ▲ **Information resources and knowledge management** systems provide reference information, distance learning, and decision support.
- ▲ **Alerting and communications technologies** transmit emergency alerts, facilitate routine professional discussions, and support collaborative activities.
- ▲ **Response systems** help manage vaccine distributions, track side effects, and disseminate public health information.



from patients visiting emergency departments.

Used during the winter 2000 Olympics, RODS currently operates in several States, including Michigan, Ohio, Pennsylvania, and Utah. For more information about RODS, visit www.health.pitt.edu/rods. In 2003, the University of Pittsburgh made the RODS software publicly available to accelerate development of software for disease outbreak surveillance. Source code and information about RODS can be found at the RODS Open Source Project Web site at <http://openrods.sourceforge.net>.

Developing a Standard Language

Currently, many public health surveillance systems generate data for public health labs, the clinical community, and State and local health departments. Many of these systems operate in isolation, however, and fail to capitalize on the potential for electronic data exchange. The current public health investigation cycle—from the first hint of trouble to managing a disease outbreak—is lengthy and frequently involves manual exchange of data across many public health organizations. For example, during the anthrax attacks of fall 2001, investigators communicated thousands of environmental test results exclusively by phone and fax.

Dr. John Loonsk, associate director of the Information Resources Management Office at the Centers for Disease Control and Prevention, explained that surveillance and preparedness systems fall into several categories ranging from detection systems to response systems (see box previous page).

When an outbreak is discovered, systems must be in place to manage the response by tracking vaccine side effects, disseminating public health alerts, and treating cases of the disease. A unifying framework is needed to better monitor data streams from different public health entities to ensure a successful response. “These systems need to work together to share data and use technology approaches that will allow them to exchange data more efficiently,” said Dr. Loonsk.

The CDC’s Public Health Information Network (PHIN) will provide a framework to unify data streams from different organizations to ensure early detection and an efficient response to health emergencies. PHIN is currently under development as an umbrella system that is building on the technologies of existing CDC systems such as the National Electronic Disease Surveillance System, the Health Alert Network, and the Epidemic Information Exchange (see box below).

Major Components of CDC’s PHIN Initiative

The BioSense Initiative supports early detection activities associated with possible bioterrorist threats. This CDC initiative monitors regional health data—combined with clinical data from the Department of Defense and Department of Veterans Affairs—to identify trends related to a possible bioterrorist attack.

The National Electronic Disease Surveillance System (NEDSS) (www.cdc.gov/nedss/) promotes the use of data and information system standards to advance the development of efficient and integrated surveillance systems at the Federal, State, and local levels.

The Epidemic Information Exchange or Epi-X is the CDC’s secure, Web-based communications network that serves as a communication exchange between CDC, State and local health departments, poison control centers, and other public health professionals. The system provides rapid reporting, immediate notification, and coordination of health investigations.

The Health Alert Network (HAN) (www.phppo.cdc.gov/han/) ensures communications capacity at all local and State health departments to broadcast and receive public health alerts. The initiative also ensures local capacity to receive distance learning offerings from CDC.



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PHIN aims to transform the public health community with information systems that enable real-time data flow, computer-assisted analysis, and rapid dissemination of information. PHIN includes five key components that correspond to the information technology in the box on page 3: detection and monitoring, data analysis, information dissemination, alerting, and response.

In the event of a disease outbreak, PHIN will ensure consistent exchange of information between public health organizations through uniform data and vocabulary standards. The Federal government has moved aggressively to standardize data exchange through the Consolidated Health Informatics, an initiative to establish a portfolio of

clinical vocabularies and messaging standards that would ensure compatible health data systems across Federal agencies. Key to this activity is the use of Health Level 7, or HL7, and Logical Observation Identifiers Names and Codes, or LOINC. HL7 is a standards-based protocol for formatting, transmitting, and receiving data in a health care environment. LOINC codes are universal identifiers or names for laboratory and other clinical observations. PHIN is incorporating the codes used in HL7 and LOINC, both of which are independent, non-governmental systems.

PHIN is also a process, explains Loonsk. The initiative requires a commitment from the public health community to use its standards and a

commitment to participate in the development and implementation of electronic specifications. In fact, the PHIN technical requirements—both data and systems specifications—are included in over \$2 billion in cooperative agreement funds awarded in 2002 and 2003 by CDC and the Health Resources and Services Administration. These agreements are designed to upgrade the preparedness of the nation's public health care system to respond to bioterrorism, infectious disease outbreaks, and other public health threats and emergencies.

For More Information

For the most current information on PHIN, including data and technical specifications, please visit www.cdc.gov/phin. The PHIN Web site also provides contact information for technical assistance offered by the CDC to support PHIN.

The complete audioconference on “The Role of Information Technology and Surveillance Systems in Bioterrorism Readiness” is available as a streaming presentation and as a text transcript on the AHRQ Web site (www.ahrq.gov/browse/bioterbr.htm).

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