Bioterrorism Preparedness

Public Health Mandate

The Mandatory Health Programs and Service Guidelines (1997) indicates that emergency structures should be in place to deal with infectious disease outbreaks. Staff are to have the technical and professional skills in risk assessment and communication, as well as emergency planning.

Background

Bioterrorism is "the use of a microorganism with the deliberate intent of causing infection in order to achieve certain goals" and is a threat to public health (Health Canada, 2001). Public health officials, as well as clinicians and emergency response personnel, are required to effectively detect, manage, and communicate in the event of bioterrorism. In response to the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003, Naylor et al. (2003) identified a systemic lack of coordinated processes for outbreak management and emergency response in Canada. In addition, the Canadian Coalition for Public Health in the 21st Century has recommended that an information and communications system for public health in Canada be established to deal with infectious and chronic disease, as well as to counter terrorism (Canadian Coalition for Public Health in the 21st Century, 2003).

Issue

There is a need to understand how and if information technology (IT) and decision-support systems (DSS) can be effective in detection, management, and communication during a bioterrorist event.

Finding the Answers

A systematic review was conducted to assess the evidence from peer reviewed evaluations of IT and DSSs for detection, diagnosis, management and communication. In addition, electronic surveillance systems were also evaluated.

The review included 217 IT/DSSs, which could potentially be used by clinicians or public health professionals in the event of bioterrorism. A variety of systems deemed to be valuable during a bioterrorist attack were evaluated. These included 55 detection systems, 23 diagnostic systems, 18 management and prevention systems, 90 surveillance systems and 22 communication systems. Seven integrated systems incorporated more than one system, but were not evaluated. Most of the systems were not specifically designed for use in the event of a bioterrorism attack. This
review drew on evaluations of systems geared to the management of naturally occurring disease rather than for their potential use in bioterrorism. Three sources were used to draw evidence: peer-reviewed papers, government reports and web-based information. Although the U.S. military has designed and evaluated systems aimed at bioterrorism, their results have been classified and are not included in this review.

What is the Evidence?

Detection Systems: Detection systems are used to collect and identify potential biothreat agents. There were few publicly available reports that compared detection systems to a gold standard and their sensitivity (likelihood to get positive result in presence of a biothreat) and specificity (likelihood to get negative result in absence of biothreat) was poor. Detection systems for less than 10 of the most threatening agents are characterized by high false positive rates. Most systems can test only one biothreat agent in a test cycle, test a limited number of samples and cannot test for the most threatening agents (e.g. smallpox). Conclusions cannot be drawn due to the lack of evaluation of these systems.

Diagnostic Systems: Diagnostic systems are used to enhance the likelihood that clinicians consider the possibility of illness from a bioterrorism attack. There is not sufficient evidence to determine if DSSs can help to diagnose illness from a bioterrorist attack. None of the 23 systems evaluated have been formally evaluated in response to a bioterrorism attack. Three general diagnostic DSSs performed better than physicians-in-training, but not as well as experienced clinicians; DSSs also performed better with straightforward rather than complex cases. Although telemedicine systems have been useful to support diagnosis in areas with limited access to specialists, they are unlikely areas for bioterrorist threats. One radiological system was found to be useful to diagnose community-acquired pneumonia, however it is not clear that such a system would be helpful in a bioterrorist event, since it could not be distinguished from other pulmonary diseases. One diagnostic system specific to infectious disease and containing biothreat agents was able to list possible diagnoses for 95% of actual or hypothetical cases. However, limitations were that clinicians may not choose to use such systems if patients present without signs of infection; also clinicians are required to manually enter data which may be a barrier for use; and use of these systems increases inter-user variability.

Management and Prevention Systems: Management and prevention systems are systems which automatically abstract information from electronic medical records to provide specific recommendations based on clinical practice guidelines, such as the use of a particular antibiotic. Evaluations show that such systems can affect clinicians’ antibiotic selection decisions and increase compliance with practice guidelines. These systems have not been designed for bioterrorism-related syndromes and it is unknown if their databases incorporate bioterrorist-related syndromes. Overall, the usefulness of management and prevention DSSs to support
disease related bioterrorism is unknown.

**Surveillance Systems:** Evaluations of surveillance systems indicate that overall, they hold promise for responding to a bioterrorist event, although none of the 90 systems reviewed were used for detecting bioterrorism. In addition, the quality of the evidence is limited since evaluations did not report on representativeness, simplicity, sensitivity, specificity, acceptability, or flexibility of systems. Findings showed that electronic surveillance improved detection over older, manual methods. There is no evidence to suggest which method to collect syndromal data (triage nurses in emergency, clinicians, or administrative data) is most sensitive, timely, acceptable and cost-effective. Surveillance systems which collect data on influenza may be useful for detection of bioterrorist events. However, the time lag in reporting may not be rapid enough. There is little to no evidence to support that surveillance systems for hospital-acquired infections or food borne illnesses investigation have adequate sensitivity, specificity, or timeliness to detect a biothreat. A large data gap is found in systems collecting the earliest surveillance data (school and work absenteeism, telephone calls to nurses, over the counter pharmacy sales, veterinary illness).

**Web-Based Communication Systems:** Systems which link public health officials with clinicians and the public are becoming increasingly available. However, they have not been tested in crisis situations. Pilot evaluations have shown them to securely manage disease reporting needs of local and state officials. No systems effectively linked public health at local, state and national levels. The most evaluated systems were those communicating abnormal findings in electronic medical records between institutions and clinicians. Three communication systems were found to have capacity in supporting the rapid reporting and dissemination of information related to naturally occurring and bioterrorist-related infectious disease, although they required the use of electronic medical records.

**Implications for Practice and Policy**

**Detection Systems:** There is limited data available in order to identify practice and policy implications related to detection systems. Thus, public health staff and clinicians need to lobby for further research to determine the effectiveness of detection systems in the event of biothreats and to develop more effective detection systems. Future research needs to be conducted by independent research groups which compare technologies to each other and against a gold standard. Future development activities need to take into account mechanisms to increase the sensitivity and specificity of detection systems and to improve the overall effectiveness of detection systems. In addition, detection systems need to be: placed in areas which are prone to attack (airports, subways, etc.), must be portable and flexible for use in many settings, and must be able to detect all biothreat agents, and run multiple samples.
Diagnostic Systems: Due to the lack of evidence, DSSs generally require further development and evaluation for application in the event of bioterrorism. Telemedicine systems (such as teledermatology technologies) can improve access to dermatological exposure in the event that bioterrorism impacts geographically remote communities. Thus public health staff should consider using existing telemedicine systems to communicate public health information with clinicians. The limitations of these systems indicate that more DSS development work is required to increase the use and effectiveness of these systems. Developers should look at strategies to link DSSs to hospital information systems to reduce the burden of manual data entry and increase the knowledge bases to include bioterrorism-related information.

Management and Prevention Systems: Hospital IT departments, and IT developers should incorporate comprehensive information about bioterrorism-related syndromes in the development of future management and prevention systems. Clinicians may not choose to use the system in situations which present as common viral syndromes, thereby being ineffective as a bioterrorism management and prevention system. Therefore, clinician training should be enhanced related to bioterrorist-related syndromes.

Surveillance Systems: Public health staff and clinicians should advocate for the use of electronic surveillance systems over manual methods of surveillance. Public health staff and clinicians should continue to track new research on the most effective methods to collect syndromal data. There may be value in the development of surveillance systems to detect influenza, since they could potentially be repurposed through existing IT infrastructures to support surveillance in biothreats. Health care professionals should advocate for the development of surveillance systems to collect early surveillance data.

Communications Systems: The development of web-based communication systems to manage local and provincial disease reporting should be advocated and further research conducted to evaluate their effectiveness. The implementation of electronic medical records should be encouraged in order to capitalize on the potential for timely recognition of bioterrorism events using web-based communication systems. The future development of any web-based communication system needs to ensure that it is compliant with Canada’s Personal Information Protection and Electronic Documentation Act (PIPEDA) (Privacy Commissioner, 2004) and has robust security to ensure patient confidentiality.

In the event of a bioterrorist attack, IT and DSSs have the potential to support public health professionals and clinicians in detection, diagnosis, management, prevention, surveillance and communication. Because the systems which were evaluated in this systematic review were not geared...
specifically to bioterrorist attacks, and evidence is limited, practice and policy implications are difficult to recommend.

**Implications for Research**
The review provides a number of useful recommendations for future development and research of systems related to bioterrorism. The review also supports the need to use methodologies other than systematic reviews (such as surveys), to gain further insights into effective strategies to deal with bioterrorism.

**Sources of Information**


**Summarized by**
Ruta Valaitis, Clinical Consultant, City of Hamilton, Public Health and Social Services Department, PHRED Program and Associate Professor, School of Nursing, McMaster University, Hamilton, Ontario

**Contact Information**
Effective Public Health Practice Project
Public Health Research, Education and Development Program
City of Hamilton, Public Health and Community Services
ephpp@hamilton.ca
www.hamilton.ca/phcs/ephpp