The Science of Surge: Detection and Situational Awareness

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Abstract

As part of the broader "science of surge" consensus initiative sponsored by *Academic Emergency Medicine*, this report addresses the issues of detection and situational awareness as they relate to surge in the practice of emergency medicine. The purpose of this report, and the breakout group that contributed to its content, was to provide emergency physicians and other stakeholders in the emergency medicine community a sense of direction as they plan, prepare for, and respond to surge in their practice.

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This breakout group focused on the detection of events necessitating surge capacity and maintenance of situational awareness in the emergency department (ED). The foundation for this discussion revolved around the need for EDs to have situational awareness of potential hazards in the community for realistic response planning, the need for reliable and timely methods of event detection so that surge capacity may be initiated, and the need for systems to track assets (beds, staff, ventilators, and so on) so they may be used effectively. This consensus group evaluated four main questions: 1) What is the role of the ED in developing a community hazard vulnerability analysis and specifically "situational awareness" of the community dangers? (Situational awareness, a term originally used to describe awareness of tactical situations during aerial warfare, has now been applied to other potentially "tactical" situations. For the purposes of this discussion, we define situational awareness as "the degree of accuracy by which one's perception of his current environment mirrors reality."[1]) 2) What ED-based methods of event detection have been scientifically shown to be effective? 3) What should be the focus of research inquiry in the effectiveness of ED data for early detection of surge needs? 4) What types of decision support tools and products (resource requirements) are needed to help EDs identify the need to initiate surge capacity?

In developing a consensus, we welcomed the discussion of many viewpoints expressed by those interested parties who participated in dialogue about detection and situational awareness as it pertained to surge. This report reflects the proceedings of the breakout group charged with discussing current relevant literature and expert opinion regarding what is definitively known about these questions, our current best recommendations, and ways in which future research can help improve detection and situational awareness. The consensus statements were based on simple majority reached by the parties attending this breakout session.

BREAKOUT SESSION RESULTS

1. What Is the Role of the ED in Developing a Community Hazard Vulnerability Analysis?

Consensus statements:

1. *Community hazard vulnerability analysis needs to be based on likely, local hazards.*

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2. *ED personnel should be aware of the hazards in the their community to appropriately prepare for specific disasters*.
3. *Standardized hazard vulnerability tools or formats will allow vulnerability information to be compared within regions to allocate resources appropriately*.

Hospitals are required to perform a community-based hazard vulnerability analysis under standard EC 4.10 of the Joint Commission on Accreditation of Healthcare Organizations. The Joint Commission on Accreditation of Healthcare Organizations defines a hazard vulnerability analysis as "the identification of potential emergencies and the direct and indirect effects these emergencies may have on the hospital's operations and the demand for its services."[2] Elements of this standard state that hospitals also need to develop a list of priorities among the potential emergencies identified in the hazard vulnerability analysis. This information should be accurate, updated regularly, and preferably based on a geographic information system. Determination of potential hazards and current capacity can lead to identification of vulnerabilities and areas for improvement in the health care organization.

Although health care organizations develop and maintain hazard vulnerability analyses, a key point of the group discussion was that providers in the ED are not aware of the contents of the hazard vulnerability analysis and do not always know what they should be prepared to treat. In general, it was believed that community threats are not always well known or communicated to the health care community. Participants provided examples of responding to emergencies involving toxic industrial chemicals that they did not know existed in their communities. This may result from reluctance of local industries to share information for proprietary or other reasons. There was general consensus that the vulnerability analysis needs to be local and that the ED needs to lead or at least be part of the team performing that analysis. Although no specific tools were identified by the group, there may be tools available to help prioritize hazards that exist in the community. These tools need to be located or developed and then utilized to improve detection of possible local threats.

2. What ED-based Methods of Detection Have Been Scientifically Shown to Be Effective?

Consensus statements:

1. *Education and training in disaster medicine and chemical, biologic, radiologic, nuclear, and explosive (CBRNE) incidents is needed to develop astute clinicians who can quickly recognize such events*.
2. *Syndromic surveillance systems may be useful for relatively large, covert events; however, they have not been proven effective for real-time evaluation of CBRNE events*.

The astute clinician trained to recognize CBRNE events is a critical component in early diagnosis and treatment of casualties of such events. While it was believed that astute clinicians are critical, there was a sense that education on these topics has not been sufficient. A recent study of 631 physicians showed that only 16.3% correctly diagnosed plague and only 49.6% correctly diagnosed botulism. Furthermore, only 9.7% correctly managed plague and 14.6% correctly managed smallpox.[3] More clearly defined competencies need to be identified and incorporated into physician training.

Increased threats of bioterrorism and concerns over recent emerging infectious disease outbreaks have also focused attention on the key role of emergency medicine in disease surveillance. Pollock et al. recently stated that "surveillance of disease, injuries and health risks" and, in particular, outbreak detection are ways in which public health and emergency medicine can extend and expand their relationships.[4] Furthermore, EDs, public health organizations, and homeland security offices locally and nationally have all placed recent emphasis on developing and improving disease surveillance systems.[5,6]

Most surveillance systems in the past were population based and focused on morbidity, mortality, health risks, and incidence and prevalence rates of a particular disease. Also, the reporting mechanisms for these systems were usually passive, relying on reports received from physicians, laboratories, or other individuals or institutions.[7] In contrast, syndromic surveillance systems attempt to collect real-time data, including signs, symptoms, or events that often point to a specific disease. Collection of such data could provide a "first alert" to a possible emerging infection, rather than awaiting specific case reporting or diagnosing. Syndromic surveillance can be defined as "data collection from nonrandom sites in an effort to obtain an early warning about new or rapidly evolving health problems, such as health threats from emerging infectious disease."[4] There are multiple syndromic surveillance systems in existence; however, there are limited data to show reduction in morbidity and mortality, with some success reported for influenza and respiratory syncytial virus (RSV) detection.[8,9] It is important to understand that the true value of a surveillance system can only be seen when there exists actual disease to measure impact and actual detection.

In the past decade, many advances have been made in the informatics world allowing such real-time reporting and rapid exchange of vital medical information, thus aiding in the containment of emerging infections. The integration of new informatics systems will also generate challenges for data sharing. Concerns will include standard data and format coding, standard user interfaces, appropriate quality checks, comparable hardware and software, and adherence to security and confidentiality standards.[10] An additional issue is that the development of these new systems has been costly, with their utility yet to be proven. The Department of Health and Human Services is already spending $43.5 billion (FY 2003) for bioterrorism preparedness, with $870 million going to the Centers for Disease Control and Prevention to improve state and local disease surveillance. The Centers for Disease Control and Prevention has contracted with Computer Sciences Corporation for up to $25 million for software support for a national electronic surveillance system.[5,10,11]

The group focused on the use of influenza or RSV monitoring systems as examples of systems that possess possible potential value for early detection. However,

the consensus was that no systems have been scientifically identified as effective for an actual CBRNE event. Systems need to be developed and then must undergo real-time testing to prove valid for early outbreak detection.

3. What Should Be the Focus of Research Inquiry in the Effectiveness of ED Data for Early Detection of Surge Needs?

Consensus statements:

1. *Focus on validity of current systems utilized for real-time detection.*
2. *Research should focus on real-time detection and the effect this detection has on current practice using firm, salient data points.*
3. *Specialists need to be identified to aid in detection and improve communication channels.*

The discussion began by picking up on the discussion of the last question using influenza and RSV as the point of discussion. The group discussed that there are two ways of examining pressing issues: 1) using past experience to project the future (i.e., using previous influenza events) and 2) using a recurring illness such as RSV to show the value of intervention. The question was raised, "Are EDs typically making any changes in their operations when the flu is identified in a community?" There would be value in examining whether changed ED operations (e.g., isolation methods, calling in additional personnel) would affect the morbidity and mortality of influenza in a community.

Furthermore, salient data points need to be identified that generate a response and that identify the threshold for a response. Also, a system should be developed that enables health care providers to confirm that a response is required. Finally, research needs to focus on whether or not providers typically change practice when surge events occur in an ED.

Finally, the group discussed the need to identify specialists in local health care facilities and communities who can aid in the early detection of surge events, such as subspecialists in related medical fields within health care facilities (e.g., infectious disease, pathology). Specialists working outside of major facilities (e.g., veterinarians, epidemiologists, medical examiners, primary care physicians, pharmacists) may provide expertise in early detection, identification, and warning of surge events. Finally, other events, or personnel who track these events, may contribute to early detection, such as absenteeism (school, work, daycare, and so on), over-the-counter medication use, and emergency medical services use.

4. What Types of Decision-support Tools and Products (Resource Requirements) Are Needed to Help EDs Identify the Need to Initiate Surge Capacity?

Consensus statements:

1. *Benchmarks need to be formed to determine when certain surge actions should be performed.*
2. *Policies and standards of care need to be written and implemented at the local and regional level to ensure "best practice" during surge events.*
3. *Other tools and resources need to be sought to aid in early detection and situational awareness available in the community.*

Accurate modeling and realistic training are needed to define the requirements for each anticipated disaster event. Decision support tools and algorithms may then be created to determine the requirements for each type of episode. Anticipated needs can be reconciled with assets available during a real-world event to determine the amount and type of surge capacity needed. Emergency providers must have access to this information and communication with the first responder community to initiate a response to surge.

Finally, discussion centered on systems designed to allow emergency managers, emergency medical services, and emergency providers to track medical assets (such as personnel, bed availability, pharmaceuticals, and medical equipment) in real-time fashion. Such systems may significantly increase situational awareness at the local and regional level and may allow assets to be used in the most efficient manner. For example, the Emergency Preparedness Resource Inventory allows personnel to create supply inventories, map locations of resources, create status reports, and communicate electronically.[12] Discussion focused on experience with commercial applications, such as the EMSystem (http://www.emsystem.com, Milwaukee, WI) used in a number of communities (including Milwaukee and Kansas City), and the Facilities Resource Emergency Data Base, a secure Internet-based application in Maryland (http://www.bcehs.com/fred.htm) that improves communications with the field and health care organizations and allows for data collection regarding resource availability and information dissemination. Integration of data provided by each health care organization could significantly enhance response capability and capacity at the local, regional, state, and federal levels.

FUTURE QUESTIONS

Additional research topics proposed during this breakout session included the following.

1. Development of ED simulation that includes current operation volume, capacity, and so on for use in disaster modeling.
2. Determination of courses of action based on the type of alert or event (explosion, biologic, and so on) instead of "one plan fits all."
3. Development of a system that allows early prediction of the need for surge response (more proactive and not reactive to events).
4. Analysis of graded responses to events (as opposed to an "all or nothing" response) and its effect on operations and costs.
5. Examination of the use of triage acuity levels as a method to identify when a response is required. For example, when an ED is unable to meet service standards for a given acuity level, some response is required.
6. Regarding the question of the "astute physician": What is required to create and maintain the "astute

physician"? What is the clinical background, resource needs, and level of confidence required to create the physician who can act as the best early warning system?

CONCLUSIONS

Emergency departments provide critical medical care during disasters. To properly prepare for such events, ED providers need to be aware of the hazards in their communities and understand the medical consequences of such hazards. Continued physician education on CBRNE topics is also needed to enhance early diagnosis of such events. Syndromic surveillance systems may play a role in early intervention, but research is lacking on the validity of these systems in preventing and/or decreasing morbidity and mortality during a real outbreak.

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