Prepare for a major disaster: the laboratory and beyond

By Thomas Williams, MD

The world has changed. The Oklahoma City bombing, the World Trade Center attacks, and the proliferation of terrorist organizations intent upon inflicting massive innocent loss of life have heightened the level of emergency preparedness we must achieve. A practical perspective is that while terrorist threats have driven enhanced emergency planning worldwide, the payoffs of preparedness for most of us will more likely accrue for a natural, nonterroristic disaster caused by incidents of nature or accidents of man.

If the worst happens, we must respond as a team to best preserve lives and livelihoods: first responders; local, county and state governmental agencies; public health and humanitarian entities; and healthcare facilities and laboratories. This article highlights generic relationships within this team and promotes preparedness for selected nonanalytic challenges a laboratory may experience during a major emergency.

The purpose of the Clinical and Laboratory Standards Institute (CLSI, formerly NCCLS) Report X4-R, Planning for Challenges to Clinical Laboratory Operations During a Disaster, is to fill a perceived gap in readily available information geared specifically to logistical, nonanalytic challenges to laboratory operations during a major emergency. The focus of this article is the challenges faced by hospital-associated laboratories, and it draws upon X4-R to help laboratory leadership appraise the preparedness level in their community, facility, and laboratory. It should be noted that preparedness plans for hospital-associated and independent laboratories are different.

The emergency universe

Clinical laboratories invariably exist within communities — most within hospitals. Routine laboratory operations are in many ways dependent upon the normalcy of the community and hospital environments. In a large-scale disaster, both intentional and accidental disruptions of infrastructure and function could interrupt operations of the unprepared laboratory. Intentional disruptions include community and hospital emergency responses intended to 1) secure healthcare facilities and other community assets; 2) separate and protect citizens from the location and effects of a disaster; 3) focus and, ultimately, expand response resources; and 4) initiate an integrated command and communication structure. All of these responses may directly or indirectly affect the laboratory.

During an incident, the integration and control of the community response, including healthcare, will centralize at the emergency operations center (EOC) affiliated with the local emergency management agency (EMA). The community’s disaster plan [part of a local emergency operations plan (LEOP)] details community operations during disasters of various types, including acts of terrorism. Individuals will implement pre-existing memoranda of understanding or MOUs to accomplish, for example: 1) facilitating expanded care for mass casualties; 2) sharing medical personnel and supplies among hospitals; 3) operating emergency communications systems; 4) designating one or more hospitals to receive and care for patients affected by a particular type of incident or agent, as well as selecting locations and stations to receive incoming assets including volunteer medical-support personnel.

The bottom line? The operational universe will change dramatically during an emergency. The community will cope with the disaster, the hospital will cope with both the disaster and the community response to the disaster, and the laboratory will cope with the disaster, its hospital’s response, and its community’s response. It is, therefore, useful for laboratory leadership to understand what the community and hospital emergency response relationships are — as well as to understand local plans and to know the organizers and stakeholders involved in plans affecting the laboratory.

Laboratory disaster planning: five selected challenges

Many challenges can potentially affect laboratory leadership and staff during a major disaster. This is a complex topic, but this article will briefly discuss five challenges: 1) general communication, 2) mass fatalities, 3) electrical power failure, 4) transportation, and 5) personnel. For those interested in learning more, CLSI document X4-R and listed websites offer additional information. Laboratory leadership may also want to become involved in facility and even community disaster planning. Thoughtful review of a facility’s plan and a community’s LEOP may provide insights and surprises. LEOPs reside in the public domain and are usually available online on a local (usually county) government website. It is not uncommon for LEOPs to contain assumptions or gaps regarding entities’ roles in responding to a disaster. Dialogue with emergency planners about an LEOP’s inaccuracies can lead to more effective preparedness plans, as well as to ongoing multidisciplinary relationships which will enhance the quality of emergency response plans.

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Challenge 1: communications

The laboratory’s product is information, the transfer of which is wholly or partly dependent upon an electronic communications infrastructure. Laboratories also rely upon real-time communications systems to tactically direct staff about varied duties on a minute-by-minute basis.

Perhaps the seminal technical challenge in a major community incident is the failure of telephone, cell phone, paging, and fax systems — at least those systems supported by public landlines. Failure may result from physical damage or, more commonly, simply from system overload. Remember that fax, cell phone, and paging systems rely in part upon public landline circuits (exceptions below) and early failure of these systems in an incident should be expected.

Figure 1. OMMRS Radios Installation Configuration

It is useful to conduct a communications assessment to detail what roles various types of communications play in the tactical (directing laboratory staff functions) and operational (result reporting, ordering, and billing) arenas. This would include within-facility or system phone and fax capability, as well as e-mail and Web-based links. Check with the facility/system communications specialist.

A facility may have emergency communications support. Backup radio systems usually require nonroutine procedures, such as completion of message forms for relay by trained operators to designated sites. Figure 1 shows the emergency radios installed in healthcare facilities and supporting entities throughout the Omaha/Council Bluffs, IA, metro area.

While operational communications assessment is beyond the scope of this article, it is not complex. Laboratory leadership should determine what sites are used to send and receive operational data (orders, results, reference laboratory, billing, consultation), and what technical means are used to send the data. The key question for risk assessment is: Does this communication pathway, at some point, rely upon the ordinary public telephone system? CLSI X4-R details basic considerations and possible options.

Challenge 2: mass fatalities

Disasters usually result in unusual numbers of injured and deceased persons. Because hospital morgue operations invariably fall under the purview of the laboratory, both its laboratory and pathology leadership and staff may find themselves charged with the management of unusual numbers of remains.

Any incident that results in more deaths than a community can usually manage is properly termed a mass-fatalities incident. In the absence of a community mass-fatalities plan, authorities may ask local morgues to store remains in numbers which exceed area refrigeration capabilities. This would be a serious adversity for the unprepared facility.

But even worse, other healthcare facilities would face such challenges as informing, counseling, and maintaining the privacy and security of distraught family members (on average, eight to 10 per deceased); securing and tracking personal effects and possibly evidence (with chain of custody); interacting with law enforcement, public health, and other authorities; and releasing public information. They may even receive requests to assist with autopsy exams and identification.

For all these reasons, the single best resource a hospital-based clinical laboratory and pathologist can have is a good local (community) mass-fatalities plan. Unfortunately, many — if not most — communities do not have one. A community plan is usually found within or will reside within or be referenced within an LEOP. Three common attributes of a satisfactory plan include (1) statement of the number of deaths which cause activation of the plan; (2) centralization of all incident-related morgue operations at a single secure site; and (3) a broadly inclusive (interagency, interdisciplinary) scope. A good sample community plan can be found on the National Association of Medical Examiners website (www.thename.org). The National Mass Fatalities Center (www.massfatalities.com) provides on-site or off-site training to assist communities in developing their own plans.

Challenge 3: electrical power failure

The emergency power distribution within healthcare facilities may be surprisingly limited, in ways not revealed by routine, periodic emergency generator tests. Even though the loss of public facility power is a rare event, laboratory leadership should carry out an emergency power audit at any opportunity. It is simple to do. (“Walk around, look, test.”) Sample questions include:

- Are emergency power outlets all really “hot”?
- Is there adequate emergency lighting in all critical operational, restroom, patient-care, and morgue areas?
- Are mechanical/pneumatic transport systems supported?
- Is all refrigeration (i.e., morgue body coolers) supplied?
- Are facility environmental-control systems sufficiently supported to control room temperature in highly instrumented areas during seasonal extremes?

Laboratory leadership should contact facility engineering and administration about significant findings beyond the laboratory’s purview. Flashlights, extension cords, portable fans, and air conditioners — even ice — may be identified as essential emergency equipment.

Challenge 4: transportation

Depending upon the nature of the incident and systems’
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Depending upon the security and mass-care challenges confronting hospitals, hospital security in cooperation with law enforcement may impose “lockdown” with restricted access through police perimeters and designated, limited facility ingress/egress sites and entrances. Courier services may experience disrupted transport and deflections. Governmental and community services will likely be overwhelmed and unavailable to assist.

If laboratory personnel consider undertaking transportation, the following are suggestions to implement before departure. First, they should determine safe and passable routes via communications through their facility’s systems with their community’s EOC. They should ensure that their identification (badges) will permit them to pass security perimeters. They should discuss their plans with facility and laboratory leadership and take working communications with them, if possible — remember, a cell phone may not count for much. Depending upon the community and facility emergency plans, suitable communications may include public service, general mobile radio service, or amateur radio service equipment — the latter two require licensed operators. Transportation personnel need to report their routes and plans. It is best, however, to leave transportation to trained and communications-equipped personnel.

Challenge 5: personnel

The personnel (and personal) challenges imposed by the intensely emotional, disruptive, prolonged, and potentially dangerous qualities of a major community disaster are potentially the most complex and important of all. Diane Myers, RN, MSN, NCP, disaster consultant, and Len Zunin, MD, a psychiatric consultant, have outlined four sequential phases of emotional response to disaster in their book, The Four-Step Guide to Healing Conversations Following Disasters. They are:

- an initial “heroic” phase characterized by fear, confusion, and adrenaline rush, but with unity;
- a “honeymoon” phase, wherein personal needs are denied, chaos is tolerated, community strength emerges, and expectations are unrealistic;
- a “disillusionment” phase when complex realities resulting from self denial, sleep deprivation, emergence of interpersonal and organizational conflict, bureaucracy, and realization of the magnitude of loss and challenge overwhelm the disaster worker; and
- a “reconstruction” phase that begins incident recovery, potentially accompanied by post-traumatic stress disorder (PTSD) or depression. [See the National Center for Post Traumatic Stress Disorder website (www.ncptsd.org).]

During an incident, experts have advocated “self care,” including orientation to the incident, setting boundaries (predetermined shift length, limited exposure to traumatic stimuli), using a “buddy” system, and employing personally efficient stress-management techniques. Laboratory leadership should also seek psychological and mental-health professionals and chaplains to provide support. They should also make certain individuals sustain routine physical/living/nutritional needs.

Table 1. Further planning information

<table>
<thead>
<tr>
<th>Disaster-preparedness resources</th>
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<tr>
<td>1. The Omaha Metropolitan Medical Response System. <a href="http://www.ommc.edu/bioterrorism/emmediate.htm">www.ommc.edu/bioterrorism/emmediate.htm</a></td>
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<tr>
<td>2. CLIS, Planning for Challenges to Clinical Laboratory Operations During a Disaster: A Report. (N+R) Thomas L. Hearn, PhD (Chairholder); J. Rex Astles, PhD, FACC; Lawrence R. Kaplan, PhD, FACC; Anthony R. Sambol, MASM(NRM), SV(ASCP), CBSP; Thomas L. Williams, MD, FACC, FASCP, FCAP. By permission. <a href="http://www.nmii.org">www.nmii.org</a></td>
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<td>3. The International Mass Fatalities Center. Peter Teahan, President. By permission. <a href="http://www.massfatalities.com">www.massfatalities.com</a></td>
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<td>4. The National Association of Medical Examiners. <a href="http://www.thename.org">www.thename.org</a></td>
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<tr>
<td>5. Disaster Mortuary Operations Response Team. <a href="http://www.dmort.org">www.dmort.org</a></td>
</tr>
<tr>
<td>7. Hospital Emergency Incident Command System (HEICS). Information used with permission of the State of California Emergency Medical Services Authority. <a href="http://www.emsa.ca.gov">www.emsa.ca.gov</a></td>
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<td>13. Health Resources and Services Administration Bioterrorism Hospital Preparedness Program. <a href="http://www.hrsa.gov/bioterrorism.htm">www.hrsa.gov/bioterrorism.htm</a></td>
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<tr>
<td>22. Biologic Disease/Agent Listing. <a href="http://www.bt.cdc.gov/Agent/Agentlist.asp">www.bt.cdc.gov/Agent/Agentlist.asp</a></td>
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Critical Incident Stress Management (CISM) is a product of the International Critical Incident Stress Foundation and provides a structured approach to helping people prepare for, deal with, and recover from stressful events. CISM has been widely adopted by law enforcement, the fire/rescue community, and, increasingly, emergency departments. CISM-trained personnel may work in the emergency department if the laboratory resides in a hospital, and may be able to assist, if needed.

The education and preparedness of laboratory personnel about disasters will maximize personal and institutional capacity to respond to such incidents. The Hospital Emergency Incident Command System (HEICS) is being progressively adopted by healthcare organizations as a means to organize and immediately activate a scalable emergency response, which is also integrated with the incident command system of emergency responders. HEICS is a product of the San Mateo County (CA) Emergency Medical Services Agency. The HEICS manual and organizational chart is available via www.emsa.ca.gov/dms2/heics_main.asp.

The logistical challenges confronting laboratory operations during a major disaster are unique and complex and have received limited exploration in laboratory literature. An activist role in education, training, and internal risk assessment is advised.

Abridged checklist

The following checklist was selected as pertinent to the five challenges discussed in this article. They are cited from CLSI document X4-R and are intended as guidelines for preparedness enhancement, not as mandatory accomplishments.

- Laboratory and facility representatives are familiar with the healthcare-related community’s response plans and have knowledge about the contents of relevant documents, such as LEOP and other annexes and MOUs that exist between healthcare and relief agencies in the community.
- Laboratory and facility representatives have installed and, if appropriate, arranged staffing of wireless backup communications to assure contact with other healthcare facilities and emergency operations personnel in the event of failure of routine telephone systems.
- Laboratory and facility representatives know whether their community’s mass fatalities plan incorporates key markers of a complete plan.
- An area has been designated as a secondary (expanded) morgue site.
- A full emergency power audit (including facility lighting, power plugs, environmental temperature regulations) has been conducted with full facility emergency power support during one (or more) seasonal temperature extreme(s).
- Laboratory personnel/leadership are involved in facility disaster planning.

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Kansas contains almost 2.7 million people who are served by approximately 45,825 health professionals. Prior to the training described here, only 1% of this core group was trained in terrorism response. Receipt of a Health Resources and Services Administration (HRSA) Bioterrorism Training and Curriculum Development Program grant helped establish a two-year goal to train 10% (4,580) of the core group of Kansas multidisciplinary health professionals to address the consequences of a biological, nuclear, chemical, agroterrorist, or related incident. One training program, Can It Happen in Kansas? Response to Terrorism and Emerging Infections, is described and the responses of the clinical laboratory professionals are evaluated.

Although the frequency of bioterror organisms and possible chemical-warfare substances encountered in the lab is extremely rare, lab personnel must be familiar with the basic characteristics of these agents. As first-line responders in local defense programs, it would not be out of the ordinary for the lab to be first to encounter a biological agent. For example, in April 2003, a Michigan laboratory reported tiny, faintly staining, Gram-negative coccobacilli, later identified as Brucella species. Complicating the role of the laboratory, protection must be provided for laboratory personnel who analyze suspicious materials, samples, and specimens. Even with established bioterrorism procedures and protocols, 12 lab employees were exposed to Francisella tularensis at a Martha’s Vineyard Hospital.

To date, there have been no published studies documenting the knowledge, confidence, and competency of lab workers concerning disaster preparedness. Several surveys on knowledge and perceptions of competency of health professionals in fields other than laboratory science have been conducted and published. These surveys document low levels of knowledge and perceived competency and high levels of interest in additional training.

To help determine the impact of Can It Happen in Kansas?, which covered basic concepts of terrorism preparedness, lab professionals were surveyed on their confidence levels and perceptions of readiness of their workplace. A focus group was conducted to gain further information about the views and experiences of this training.

Methods

Kansas Area Health Education Centers (AHECs) and the University of Kansas Medical Center’s (KUMC’s) Continuing Education Department served as the delivery system for the training. Six eight-hour sessions were offered December 3-15, 2003, in the cities of Overland Park, Pittsburg, Topeka, Wichita, Garden City, and Hays, KS. A team-teaching methodology, with experts presenting lectures, covered numerous terrorism topics including:

- a clinical perspective on biologic warfare, terrorism, and emerging infections;
- the role of the clinical laboratory in the response to bioterrorism;
- the medical management of chemical casualties;
- basic preparedness for radiological disasters;
- the role of emergency response in a terrorist incident;
- bioterrorism preparedness in Kansas; and
- implications of bioterrorism on Kansas’ agriculture and health infrastructures.

Quantitative. A preliminary test (pretest) was administered to determine a participant’s baseline knowledge or preparedness for the educational experience, and a post-test was given after the period of instruction to determine what participants learned. To further evaluate the longer-term effect of this training, the tests were administered again on a volunteer basis following three- and 10-month post-training periods, and the results were analyzed. Participants’ approval was obtained through the Institutional Review Board at the University of Kansas School of Medicine in Wichita.

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The pretest/post-test included a Likert scale to gauge attitudes or reactions to the training. Each degree of agreement was given a numerical value from one to five (1=very poor, 2=poor, 3=average, 4=good, and 5=excellent). Thus, a total numerical value could be calculated from all the responses. Another scale, with the following values — unmet, 25% met, 50% met, 75% met, and 100% met — was designed to assess changes in participants’ confidence on additional preparedness-related topics.

Qualitative. Three laboratory technologists took part in a focus group representing a Veterans Administration Hospital, the County Health Department, and an urban hospital. All three were engaged in safety and emergency-preparedness activities in their respective laboratories.

Results
Quantitative. Table 1 details the demographics of the laboratory professionals participating in the training initiative. Table 2 shows a clear increase in trainees’ scores between pre- and post-tests. Of note is that the competency — “ability to meet patient needs” — of respondents was the same — 3.0 or average — at pretest as at three-months post-test. This may be attributed to the fact that clinical laboratory professionals rarely see patients in person, thus presenting challenges for them to assess. This competency did rise slightly at the 10-month post-test. The other competencies followed a distinct pattern with an increase from pretest to post-test, a decrease from post-test to three-month post-test, and an increase from three-month post-test to 10-month post-test.

Table 3 shows that the lab scientists’ pretest scores demonstrate that a majority felt that the emergency-preparedness requirements of their workplace had been met. At post-test, the percentage of needs met in identifying Category A pathogens dropped to 25%. CDC Category A agents, those most likely to cause mass casualties if intentionally disseminated, include some of the classic warfare agents, such as Bacillus anthracis and Francisella tularensis. At 10-month post-test, four of 11 or 36%, believed this need had not been met — yet, an equal percentage believed it had been 75% met.

Discussion and conclusions
Preparedness should be based on clearly defined performance standards, training to meet or exceed those standards, and self-evaluations through multidisciplinary exercises and other means. Adequate response is crucial to the survival and well-being of a community. Our best indicator for adequate response was that following Can It Happen in Kansas?, trainees reported mostly higher scores from pretest to post-test, and from pretest to the three- and 10-month post-tests.
Table 4. Summary of representative focus group remarks.

“We’re getting everything done we need to get done, but we are really stretched. So, an unexpected event would really crush us.”

“I had very little knowledge. When I think of terrorism, I think of biologicals. They increased my awareness of radiologicals or even chemical weapons.”

“The chain of command does not seem to be real clear — at least to all of us in microbiology at the hospital. Certain officials are supposed to be notified, but what do we do in the laboratory?”

“I guess one thing that drew me to the presentation was the agricultural aspect of the whole thing.”

“Living in the Midwest, I think we kind of tend to be — I hate to say ‘naïve’ — but we just think, ‘No, it is not going to happen here,’ but it could.”

decreased slightly from the post-test to the three- and 10-month post-tests.

This study was limited by its relatively small sample size and by the fact that participation was limited to Kansas. Additionally, the three- and 10-month survey methodology may suffer from potential selection bias as only those who agreed on the post-test to provide their contact information were invited to participate in a follow-up survey. Despite these limitations, the strength of this study lies in the fact that it is the only evaluation of its kind and, thus, an important first step in helping us better understand preparedness needs.

Although we have highlighted dependence on the capability of the medical laboratory to respond to a terrorist attack, the preparedness of this workforce remains largely unknown. The Can It Happen in Kansas? Response to Terrorism and Emerging Infections curriculum and evaluation strategies met many of the lab scientists’ terrorism-response training needs. The curriculum and evaluation described may offer models for other states considering such terrorism-preparedness curricula and evaluation methodologies to target clinical laboratory and other health professionals. They may serve as useful tools for healthcare workers nationwide, with the potential to ensure that the workplace is effectively prepared to respond to intentional and unintentional disasters.

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References