

Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Assessing hospital preparedness using an instrument based on the Mass Casualty Disaster Plan Checklist: Results of a statewide survey

Wayne Higgins, PhD,^a Charles Wainright III, PhD,^a Ning Lu, PhD, MPH,^a and Ruth Carrico, PhD, RN, CIC^b
Bowling Green and Louisville, Kentucky

Background: Hospitals would play a critical role in a weapon of mass destruction (WMD) event. The purpose of this study is to assess preparedness for mass casualty events in short-term and long-term hospitals in Kentucky.

Methods: All short-term and long-term hospitals in Kentucky were surveyed using an instrument based on the Mass Casualty Disaster Plan Checklist and a brief supplemental bioterrorism preparedness questionnaire based on a checklist developed for the Agency for Healthcare Research and Quality.

Results: Responses were received from 116 of the 118 (98%) hospitals surveyed. Hospitals reported surge capacity equal to 27% of licensed beds, and virtually all respondents were engaged in planning for weapons of mass destruction events. However, advanced planning and preparation were less common. Large regional differences were observed, especially in the area of pharmaceutical planning. Preparedness planning in general and pharmaceutical management planning in particular were more advanced in counties participating in the Metropolitan Medical Response System Program (MMRS).

Conclusions: Hospital mass casualty preparedness efforts were in an early stage of development at the time of this survey, and some critical capabilities, such as isolation, decontamination, and syndromic surveillance were clearly underdeveloped. Preparedness planning was more advanced among hospitals located in MMRS counties. (*Am J Infect Control* 2004;32:327-32.)

In response to the terrorist attacks of September 11, 2001 (9/11) and the release of anthrax through the mail in the following weeks, the federal government provided \$135 million to the states in fiscal year 2003 through the Bioterrorism Hospital Preparedness Program.¹ States were required to assess hospital preparedness and develop regional response plans to receive the bulk of these funds.² In Kentucky, the total allocation was approximately \$1.8 million, and the Kentucky Department for Public Health contracted with the Kentucky Hospital Association (KHA) to conduct the assessment.³ The KHA established a bioterrorism task force comprising hospital executives, infection control practitioners, emergency planners, and KHA staff to survey hospitals in the state. This task

force approved the survey methodology and provided oversight for the study.

After considering several checklist type instruments, the task force selected the Mass Casualty Disaster Plan Checklist: A Template for Healthcare Facilities, developed by the Association of Professionals in Infection Control and Epidemiology (APIC) and the Center for the Study of Bioterrorism and Emerging Infections,⁴ as the basis for the survey instrument. This paper reports findings from the KHA survey.

The danger of terrorism involving weapons of mass destruction (WMD) was recognized well before 9/11. The federal government increased support for preparedness in response to Presidential Decision Directive 39, issued in 1995, and the Defense Against Weapons of Mass Destruction Act of 1996, which included funds to improve planning, training, and equipment for local emergency response agencies.^{5,6} The federal government also funded the Metropolitan Medical Response System (MMRS), which supports planning, training, and equipment purchases to improve hospital and health system preparedness⁶ and implemented a number of programs to strengthen the public health system.

The critical role of hospitals in any WMD event is widely recognized. Macintyre et al cited prompt recognition of the incident, staff and facility protection,

From the Department of Public Health, Western Kentucky University, Bowling Green,^a and the University of Louisville Hospital, Louisville.^b

Reprint requests: Wayne Higgins, PhD, Prof., Department of Public Health, Western Kentucky University, 1 Big Red Way, Bowling Green, KY 42101-3576; E-mail: wayne.higgins@wku.edu.

0196-6553/\$30.00

Copyright © 2004 by the Association for Professionals in Infection Control and Epidemiology, Inc.

doi:10.1016/j.ajic.2004.03.006

patient decontamination and triage, medical therapy, and coordination with external emergency response and public health agencies as key elements of health care facility response plans.⁷ The American Hospital Association (AHA) offered broad recommendations for hospital and community-wide preparedness.⁸ More detailed recommendations for dealing with bioterrorism were developed jointly by the APIC Bioterrorism Task Force and the Centers for Disease Control and Prevention (CDC) Hospital Infections Program Bioterrorism Working Group,⁹ and, effective on January 1, 2001, the Joint Commission for the Accreditation of Healthcare Organizations (JCAHO) required hospitals to have emergency management plans based on a hazard vulnerability analysis. However, the limited research evidence available prior to 9/11 suggested that hospitals were ill prepared to respond to casualties resulting from exposure to hazardous materials or radiation.¹⁰⁻¹⁵ This study assesses the preparedness of Kentucky hospitals to respond to bioterrorism and other mass casualty events.

METHODS

The Mass Casualty Disaster Plan Checklist was modified in 2 ways to convert it into a survey instrument. First, some items on the checklist asked for a single answer to questions that contained 2 or more parts. These items were separated, unless the multiple parts were so closely related that a single response was appropriate. Second, some items of specific interest to the KHA task force were added (eg, respondents were asked how much their facility had spent on preparedness since 9/11). The final instrument was 14 pages long, with 252 items.

In July 2002, the questionnaire along with a cover letter was mailed to chief executive officers (CEOs) of all 118 short-term and long-term hospitals in Kentucky. The CEOs were asked to oversee completion of the survey. In practice, most CEOs assigned completion of the survey to staff members responsible for emergency planning and/or infection control, and input was typically obtained from several staff members. The survey was also available on the KHA Web site, and a few respondents completed it electronically.

In August 2002, the Agency for Healthcare Research and Quality (AHRQ) released a needs survey for hospitals to use as a checklist for assessing their capacity to handle victims of bioterrorist attacks and the adequacy of their emergency plans.¹⁶ Because the AHRQ instrument focused on bioterrorism, the area of greatest concern to state officials, the KHA task force mailed a brief supplemental survey (3 pages, 20 questions) using items selected from the AHRQ instrument in September 2002.

Repeated calls were made by KHA staff to hospitals that did not respond to the surveys. Clarification and corrections were also made via telephone. In total, the survey process extended from July 2002 to February 2003.

RESULTS

One hundred sixteen hospitals and hospital systems (98%) responded to at least 1 survey. One hundred eight (92%) responded to both surveys; 3 responded to the first survey only, and 5 responded to the supplemental survey only. Responding hospitals accounted for all but 325 of Kentucky's 18,403 licensed hospital beds (98%). Hospital responses were aggregated for the state as a whole and for each of 14 multicounty emergency management areas (EMAs). Twelve of the EMAs had 100% response rates, and the lowest EMA response rate was 86%.

Surge capacity

States were directed by the CDC to prepare regional response plans based on the assumption that resources to treat 500 casualties should be available. No guidance was provided regarding how many of the 500 casualties might require inpatient care. Statewide, hospitals reported the ability to surge 4881 beds or 27% of all licensed beds in the state. One hundred thirty-two surge beds (3%) were reported by long-term hospitals. Based on the assumption that 25% of casualties would require inpatient treatment, all 14 EMAs met the 500 casualty planning standard. However, when it was assumed that half of the casualties would require hospital admission, 6 rural EMAs did not have adequate surge beds. Respondents reported a total of 594 isolation beds and 937 adult, 193 pediatric, and 214 neonate ventilators. Only hospitals in the Louisville area reported operating at full bed capacity more than 25% of the time.

Emergency planning

Virtually all hospitals (99%) had disaster plans and disaster planning committees (95%). More than 9 out of 10 reported collaborative relationships with emergency medical services (96%), emergency management agencies (94%), law enforcement agencies (95%), fire departments (95%), and health departments (92%). Almost all respondents (96%) reported that disaster plans were widely distributed and readily available throughout the facility. Eighty-three percent reported that the board and medical staff had reviewed the plan, and 73% reported that disaster plans addressed weapons of mass destruction incidents (defined as biologic, nuclear, incendiary, chemical, explosive and/or radiologic on the survey instrument). Almost all

Table 1. Composite scores* by emergency management area and median scores for Kentucky

EMA	General response	External traffic flow	Media	Reception of casualties	Communication and resource cut off	Pharmaceutical plan	N
1	0.80	0.81	0.94	0.93	0.94	0.21	4
2	0.80	0.88	0.78	0.93	0.88	0.33	9
3	0.75	0.88	0.78	0.93	0.50	0.17	5
4	0.45	0.63	0.78	0.96	0.50	0.50	9
5	0.63	0.56	0.50	0.79	0.38	0.00	6
6	0.84	0.63	0.83	0.86	0.80	0.67	16
7	0.63	0.50	0.44	0.57	0.88	0.00	7
8	0.60	0.63	0.78	0.89	0.50	0.33	5
9	0.90	0.88	1.00	0.96	0.88	0.17	9
10	0.74	0.75	0.61	0.88	0.88	0.17	4
11	0.73	0.75	0.61	0.98	0.31	0.33	7
12	0.75	0.75	0.44	0.82	0.50	0.33	8
13	0.65	0.75	0.88	0.86	0.50	0.42	16
14	0.69	0.63	0.72	0.71	0.75	0.33	6
KY Med	0.75	0.75	0.78	0.89	0.75	0.33	111

EMA, Emergency management area; Med, median; N, number of hospitals in each EMA.

*Median scores calculated from index scores ranging from 0 to 1 for each EMA, with 0 being least prepared and 1 best prepared. Higher scores indicate that hospitals in the EMA are better prepared to respond.

(96%) reported conducting annual disaster exercises and conducting a formal critique of the exercise, which is shared with all key participants (90%).

More detailed questions concerning planning and preparation activities revealed mixed results. The vast majority of respondents reported that emergency plans addressed basic activities, such as designating an incident commander (90%), assigning responsibility for recalling off-duty staff (91%), and specifying the location of the hospital disaster control command center (90%). However, fewer reported plans that addressed more detailed activities, such as specifying which areas to close if staffing shortages occur (26%), specifying how volunteers were to be incorporated and managed (35%), and describing how to manage vehicles and personnel that converge on the facility (12%). Seventy-eight percent reported having the ability to lock down the facility, but only 56% had tested the lock down procedures.

Composite measures

Six sections of the primary survey had sufficiently high internal consistency and intercorrelation among items (Cronbach's $\alpha > 0.7$) to serve as composite measures of the variables of interest. For these sections (general response capability, ability to handle and control external traffic flow, preparation to deal with the news media, preparation to receive casualties and victims, preparation to deal with being out of communication or cut off from resources, and preparation to manage pharmaceuticals), a single index score, ranging from 0 to 1.0, was calculated for each EMA. Lower scores suggest that hospitals are less prepared to

respond in a particular area. Table 1 displays median scores for each EMA and the median score for the state as a whole. For each composite measure, there was considerable variation across EMAs, although, as a group, hospitals reported a reasonable level of preparedness planning in all areas except pharmaceutical management. Hospitals were generally well prepared to receive casualties and conduct activities such as triage and treat, admit, or transfer multiple casualties on short notice, but pharmaceutical planning, which could be of vital importance in a bioterrorism event, was less advanced.

Only 43% of respondents reported that the pharmaceutical allocation plan provided for prophylaxis of caregiving staff, and even fewer reported planning for prophylaxis of first responders (34%) and caregiver's family members (20%). Thirty-two percent of respondents reported participating in a community or regional pharmaceutical stockpile. Thirty-eight percent reported emergency plans that addressed stockpiling antibiotics and supplies, and only 25% maintained a separate cache of antibiotics to treat staff in the event of a bioterrorist incident. Higher levels of pharmaceutical planning were observed in EMAs 6 and 13, which include Kentucky's 2 MMRS regions.

WMD preparedness

Most respondents reported that their medical staff members have access to information for treating victims of biologic (82%), chemical (77%), nuclear (67%), radiologic (69%), and major burn (73%) exposures. Sixty-three percent reported having radiation detection instruments, but only half reported having

Table 2. Surveillance capabilities of hospitals

	% Yes
Does the facility currently have a baseline established for numbers of patients seen in the facility emergency department, outpatient clinics, or via direct admission, stratified according to clinical symptoms?	49
Is there currently a process to evaluate and track 100% of all microbiologic results and stratify according to organism?	73
Does a process exist to notify infection control 24 hours a day/7 days a week?	85
Has your facility developed a process and procedure for reporting unusual cases or other relevant information to local, state, and/or federal authorities?	89
Does your hospital have an information system that provides information on biologic agents and the management of infectious patients?	47
Does your hospital have an electronic database system in place that tracks patients' presenting problem or chief complaint?	56
If yes, does your hospital surveillance system track the following?	
Emergency department visits	55
Hospital admissions	62
Influenza-like illness	28
Increased antibiotic prescription rate	20

a dedicated decontamination facility, a critical capability in many WMD scenarios. Far fewer (19%) reported that their emergency preparedness plan identified a need for additional isolation beds. The availability of high-level personal protective equipment (PPE) was also limited. Only 6% of respondents reported having an adequate amount of Level A PPE, and only 22% reported an adequate amount of Level B PPE. When asked to identify their most important needs if external funds become available, respondents cited education and training (49%), decontamination equipment (36%), communication equipment (20%), and PPE (20%).

Surveillance capability is essential for detecting a covert bioterrorism event when the first indication of an attack may be patients presenting with influenza-like illness at hospital emergency departments, primary care physician practices, and clinics.^{17,18} Table 2 displays surveillance related responses from both surveys. More than half (56%) of respondents had electronic database systems that track patient's presenting problems. Of these, only 28% tracked influenza-like illness, and only 1 in 5 tracked increased antibiotic prescription rates.

Regional planning and response to 9/11

Questions added to the primary survey by the KHA task force asked about hospital participation in regional bioterrorism response planning and changes initiated after 9/11. Half of all respondents reported participating in regional response plans. Among participants, about one quarter (24%) reported regional response plans addressing quarantine, and 39% reported plans addressing patient isolation.

Respondents reported updating disaster plans (81%), implementing additional training (66%), and purchasing new equipment (38%) since 9/11. Overall, respondents reported spending almost \$1.7 million to increase preparedness in response to the terrorist attacks. When asked to identify their 3 highest priority needs if external funds became available, respondents listed almost \$18.5 million in needed investments, primarily for training and equipment.

Impact of the metropolitan medical response system program

The Metropolitan Medical Response System (MMRS) of the US Department of Health and Human Services, which became operational in 1997, provides funds to major US cities to help them develop plans for responding to the health and medical consequences of a terrorist attack with chemical, biologic, or radiologic agents.⁷ In fiscal year 2000, Louisville-Jefferson County and Lexington-Fayette County received MMRS contracts. To evaluate the impact of the MMRS program, responses from hospitals in Jefferson and Fayette Counties were compared with responses from hospitals in all other counties.

The Louisville and Lexington areas contain most of the state's large, tertiary care hospitals and both of its academic medical centers; thus, it was not surprising that hospitals in these areas reported more beds, larger pharmaceutical inventories, and more equipment, such as ventilators. They also reported greater laboratory capability to rule out potential bioterrorism agents. However, hospitals in Fayette and Jefferson Counties evidenced superior readiness in other areas that may be attributable to the MMRS program.

Table 3 displays preparedness activities that were significantly more common among hospitals located in Fayette and Jefferson counties. Pharmaceutical planning was considerably more advanced in the MMRS counties. Hospitals in these counties were more likely to have dedicated decontamination facilities and to have conducted a disaster exercise using the decontamination facility. Agreements with other health care facilities to accept patients were more likely to be in place, and, as expected, regional planning was more advanced in the MMRS counties.

Table 3. Comparison of hospital preparedness between MMRS and non-MMRS

Items	MMRS N = 24 Yes (%)	Non-MMRS N = 94 Yes (%)
Have developed job action sheets or role cards for all personnel involved in disaster response*	66.7	37.5
Have dedicated decontamination facility*	93.3	62.5
Have conducted disaster exercise using decontamination facility within the past 6 months*	85.7	53.8
Have determined an alternate location for the hospital disaster control command center*	80.0	50.0
Disaster plan includes a procedure for moving contaminated vehicles, which come into the property to an isolated location*	33.3	10.3
Media area has been located so as not to be in close proximity to the emergency department, command center, and waiting areas for relatives, family, and friends*	100.0	70.5
Arrangements have been made with other health care facilities for the relocation of patients should the facility be unable to support patient care*	100.0	69.2
Pharmaceutical plan makes provision for prophylaxis of:		
Caregiving staff [†]	93.3	39.5
First responders [†]	80.0	28.9
Their immediate family [†]	60.0	14.5
Pharmaceutical plan identifies pharmaceutical warehouses within the local area [†]	93.3	39.5
Pharmaceutical plan outlines how pharmaceuticals can be procured, transported, and delivered to the facility within a secure environment [†]	80.0	40.3
Disaster plan addresses stockpiling antibiotics and supplies [†]	80.0	35.8
Hospital participates in community or regional pharmaceutical stockpile [†]	73.3	26.3
A regional disaster plan is being developed [‡]	85.7	44.2
Hospital has MOA with the following to accept patients who can be discharged early during a disaster:		
Nursing facilities	8.3	38.3
Rehabilitation facilities	33.3	8.5
Psychiatric facilities	29.2	5.3
Laboratory staff is certified for packaging and shipping infectious substances [‡]	78.6	32.9

MMRS, Metropolitan Medical Response System.

* $P < .05$; [†] $P < .001$; [‡] $P < .01$. P values are based χ^2 test statistics.

Mean scores on the 6 composite measures were compared for hospitals in Fayette and Jefferson counties and facilities in all other counties. Hospitals in the MMRS counties scored significantly higher on

the measures for pharmaceutical management ($P < .001$) and preparation for being out of communication or cut off from resources ($P < .001$).

DISCUSSION

The Mass Casualty Disaster Plan Checklist formed the basis for a useful instrument to assess hospital preparedness for WMD events. Results from the KHA surveys were used to develop regional hospital preparedness plans in Kentucky.

Large regional differences in hospital preparedness were observed across EMAs, with areas containing MMRS counties generally reporting more advanced levels of preparedness. Overall, the results suggest that much work remains to be done. Hospital WMD preparedness planning and coordination on a community or regional basis were in early stages of development at the time of this survey, and some critical hospital response capabilities, such as isolation, decontamination, and syndromic surveillance were clearly underdeveloped. These results are generally consistent with those of a national survey of 2021 short-term, non-federal, general hospitals in metropolitan statistical areas conducted by the US General Accounting Office (GAO) between May and September 2002. The GAO found that most hospitals reported participating in basic planning and coordination activities for bioterrorism response, but many lacked the medical equipment to handle the number of patients that would likely result from a bioterrorist incident.²

The MMRS program appears to be producing positive results as evidenced by the comparison of MMRS and non-MMRS counties in Kentucky. Most encouragingly, hospitals in MMRS counties reported more advanced pharmaceutical planning and preparedness, an area of critical importance in a bioterrorism event. However, the need for greater support for preparedness efforts in non-MMRS counties was evident in the large variations across EMAs and low scores on the composite measure of pharmaceutical planning.

There are several limitations to this study. First, the results cannot be generalized nationally because only hospitals in Kentucky participated. Second, the 2 surveys extended over 7 months at a time when hospitals were busily engaged in preparedness activities. Thus, it seems likely that early respondents continued to improve during the study period, and these improvements are not reflected in the results. However, much of the delay was caused by the need to clarify responses to questions in the supplemental survey, and the GAO survey also extended over a prolonged time period (4 months).² In addition, repeated calls from KHA staff resulted in a remarkably

high response rate, although this process extended the duration of the survey.

Third, Kentucky hospitals have continued to improve preparedness and response capabilities since this survey was completed. It is likely that hospitals are better prepared today in a number of areas, both because of increased investment and training related to bioterrorism readiness and in response to concerns raised by the outbreak of Severe Acute Respiratory Syndrome (SARS). Almost \$1.8 million in federal funds have been provided to hospitals in the Commonwealth, and some hospitals purchased decontamination equipment and PPE with these funds. However, Kentucky hospitals had already spent almost \$1.7 million of their own revenues to improve preparedness, and respondents identified more than \$18 million in high priority needs. Thus, in Kentucky as elsewhere, the burden of preparing for catastrophic terrorism is largely an unfunded mandate for hospitals.

Finally, the finding that the MMRS program has had a favorable impact on hospital preparedness should be viewed as suggestive. The Institute of Medicine has recommended a comprehensive evaluation process for this program and noted several limitations of checklist-type questionnaires for evaluating complex programs, such as the MMRS.⁷

Overall, the surveys described above provided a valuable input to regional and state-level preparedness planning. Comments from hospital CEOs suggest that responding to the survey based on the Mass Casualty Disaster Plan Checklist provided a useful educational experience for them and their staff, as well as helping improve emergency plans. As preparedness efforts continue, these or similar instruments could be administered periodically to assess the progress of hospital preparedness planning.

References

1. Statement of the American Hospital Association before the National Committee on Vital and Health Statistics Panel on National Preparedness and a National Health Information Infrastructure. February 26, 2002. Available from: <http://www.ncvhs.hhs.gov/020226pl.htm>. Accessed January 2004.
2. US General Accounting Office. Report to Congressional Committees: Hospital preparedness: most urban hospitals have emergency plans but lack certain capacities for bioterrorism response. US General Accounting Office, August 2003. Kentucky Epidemiol Notes Rep 2002;37:3.
3. Mass Casualty Disaster Plan Checklist: a template for healthcare facilities. Available from: <http://www.apic.org/bioterrorchecklist.doc>. Accessed January 2004.
4. Tucker JB. National health and medical services respond to incidents of chemical and biological terrorism. JAMA 1997;278:362-8.
5. US Congress. National Defense Authorization Act for Fiscal Year 1997. P.L. 105-201, Title XIV, Defense against weapons of mass destruction, subtitle a, domestic preparedness section.
6. Manning FJ, Goldfrank L, editors. Preparing for terrorism: tools for evaluating the metropolitan medical response system program. Washington, DC: National Academy Press; 2002.
7. Macintyre AG, Christopher GW, Eitzen E, Gum R, Weir S, De Atley C, et al. Weapons of mass destruction events with contaminated casualties. JAMA 2000;283:242-9.
8. American Hospital Association. Hospital Preparedness for mass casualties final report. Available from: <http://www.hospitalconnect.com/ahapolicyforum/resources/disaster.html>. Accessed January 2004.
9. English EF, Cundiff MY, Malone JD, Pfeiffer JA, Bell M, Steele L, et al. Bioterrorism readiness plan: a template for healthcare facilities. Centers for Disease Control and Prevention Atlanta. 1999. Available from: <http://www.cdc.gov/incidod/hip/Biol/13apr99APIC-CDCBioterrorism.PDF>. Accessed January 2004.
10. Thanabalasingham T, Beckett MW, Murray V. Hospital response to a chemical incident: report on casualties of an ethyldichlorosilane spill. BMJ 1991;302:101-2.
11. Burgess JL. Hospital evacuations due to hazardous materials incidents. Am J Emerg Med 1999;17:50-2.
12. Edgell M, James MR. Contaminated casualties: are we prepared to receive them? J Accid Emerg Med 1994;11:172-4.
13. Burgess JL, Blackmon GM, Brodtkin CA, Robertson WO. Hospital preparedness for hazardous materials incidents and treatment of contaminated patients. West J Med 1997;167:386-91.
14. Cone DC, Davidson SJ. Hazardous materials preparedness in the emergency department. Prehosp Emerg Care 1997;1:85-90.
15. Wetter DC, Daniell WE, Treser CD. Hospital preparedness for victims of chemical or biological terrorism. Am J Public Health 2001;91:578-92.
16. AHRQ unveils hospital bioterrorism preparedness tool. Press release, August 23, 2002. Agency for Healthcare Research and Quality, Rockville, MD. Available from: <http://www.ahrq.gov/news/press/pr2002/bioterrpr.htm>. Accessed January 2004.
17. Waeckerle JF. Domestic preparedness for events involving weapons of mass destruction. JAMA 2000;283:252-4.
18. Lazarus R, Kleinman K, Dashevsky I, Adams C, Kludt P, De Marie A, et al. Use of automated ambulatory-care encounter records for detection of acute illness clusters, including potential bioterrorism events. Emerg Infect Dis 2002;8:753-60.