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Hospital Disaster Preparedness in Los Angeles County

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Abstract

Background: There are no standardized measures of hospital disaster preparedness or hospital “surge capacity.”

Objectives: To characterize disaster preparedness among a cohort of hospitals in Los Angeles County, focusing on practice variation, plan characteristics, and surge capacity.

Methods: This was a descriptive, cross-sectional survey study, followed by on-site verification. Forty-five 9-1-1 receiving hospitals in Los Angeles County, CA, participated. Evaluations of hospital disaster plan structure, vendor agreements, modes of communication, medical and surgical supplies, involvement of law enforcement, mutual aid agreements with other facilities, drills and training, surge capacity (assessed by monthly emergency department diversion status, available beds, ventilators, and isolation rooms), decontamination capability, and pharmaceutical stockpiles were assessed by survey.

Results: Forty-three of 45 hospital plans (96%) were based on the Hospital Emergency Incident Command System, and the majority had protocols for hospital lockdown (100%), canceling elective surgeries (93%), early discharge (98%), day care for children of staff (88%), designating victim overflow areas (96%), and predisaster “preferred” vendor agreements (96%). All had emergency medical services-compatible radios and more than three days’ worth of supplies. Fewer hospitals involved law enforcement (56%) or had mutual aid agreements with other hospitals (20%) or long-term care facilities (7%). Although the vast majority (96%) conducted multiagency drills, only 16% actually involved other agencies in their disaster training. Only 13 of 45 hospitals (29%) had a surge capacity of greater than 20 beds. Less than half (42%) had ten or more isolation rooms, and 27 hospitals (60%) were on diversion greater than 20% of the time. Thirteen hospitals (29%) had immediate access to six or more ventilators. Less than half had warm-water decontamination (42%), while approximately one half (51%) had a chemical antidote stockpile and 42% had an antibiotic stockpile.

Conclusions: Among hospitals in Los Angeles County, disaster preparedness and surge capacity appear to be limited by a failure to fully integrate interagency training and planning and a severely limited surge capacity, although there is a generally high level of availability of equipment and supplies.

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Keywords: hospital disaster preparedness, surge capacity

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A disaster may be defined as a natural or man-made event that results in an imbalance between the supply and demand for resources.¹ The events of September 11, 2001, and the devastation from Hurricanes Katrina and Rita highlight the importance of hospital disaster preparedness and response. Prior disasters have provided perspective on current challenges in disaster management. Confusion over roles and responsibilities, poor communication, lack of planning, suboptimal training, and a lack of hospital integration into community disaster planning are some previously identified major problem areas.²

Optimal disaster planning begins with a comprehensive risk assessment and vulnerability analysis to identify the most likely threats to a particular hospital and

community. Thus, earthquakes are a relevant threat to Californians, hurricanes threaten the southeastern coastal areas of the United States, and tornadoes threaten the Midwest. One must consider terrorist attacks on airport facilities, military bases, storage depots, and nuclear power plants in the surrounding area. Because hospitals do not function in isolation during a disaster, it is essential for emergency medical services (EMS) and hospital disaster plans to be integrated into the community disaster plan. Preestablished relationships between hospitals and other community response entities such as fire safety, law enforcement, public health, and local government administration increase the likelihood of an integrated and effective response during a large-scale emergency. Regions participating in the Metropolitan Medical Response System (a federal program that requires linkages among first responders, medical treatment resources, public health, emergency management, volunteer organizations, and the private sector) have demonstrated enhanced hospital preparedness and pharmaceutical management plans.^{3,4}

There are numerous common misconceptions regarding disasters held by lay people, hospital administrators, and physicians. Many assume that all disaster victims arrive by ambulance after being triaged and stabilized by EMS personnel. In fact, large numbers of casualties with minor conditions often arrive unannounced,⁵ and most victims arrive on foot or by personal vehicles and present to the nearest hospital within 90 minutes of the incident.⁶ Although hospitals depend on fire personnel to perform patient decontamination from exposures to chemical agents under usual circumstances, fire personnel are often unable to perform this task during a disaster. Due to limited training and experience, exposures to biological, radiological, and nuclear agents pose further difficulties for both hospital and fire personnel. Failure of emergency department (ED) personnel to decontaminate patients may place the hospital staff and facility at risk for secondary contamination.

Having a written disaster plan does not equal preparedness. Unfortunately, the mere existence of a disaster plan may create a false sense of security for hospital personnel and community leaders. The Joint Commission on Accreditation of Healthcare Organizations mandates that all accredited hospitals in the United States have a written disaster plan and that the Hospital Emergency Incident Command System is understood and implemented.⁷ Yet, very few hospitals have emphasized the importance of having a realistic plan, one that can be followed in a real disaster, and very few hospital planners have actually experienced a disaster. There is scant literature on the effectiveness of mass casualty incident training for staff using such drills.^{8,9} Unannounced drills and exercises may be more effective, because the EDs do not have the luxury of prepositioning extra personnel and supplies, which often occurs in the setting of an announced drill.¹⁰

Many of the logistical problems faced in disasters are not caused by shortages of medical resources but rather from failures to coordinate their distribution.¹¹ In fact, large numbers of unsolicited and unannounced personnel arrive at the scene or ED to offer assistance, and such "convergent volunteerism" may compound the disaster.¹²

Many assume that physicians and nurses should be at the disaster scene to immediately treat casualties. Yet, medical personnel perform best at tasks familiar to them and in familiar environments; thus, physicians and nurses should staff areas of the hospitals where they work most efficiently. Unless specially trained in the field of search and rescue, EMS, or disaster response, physicians and nurses are ill equipped to function effectively at a disaster scene.¹³

The published literature demonstrates that U.S. hospitals are inadequately prepared for a disaster. In a questionnaire-based study published in 2001, fewer than 20% of respondent hospitals had response plans for biological or chemical weapons incidents, and only 12% had one or more self-contained breathing apparatuses.¹⁴ In 2002, 54 of 62 ED directors (87%) in Philadelphia, PA, reported that there existed severe deficiencies in physician training and education, antidote stocking, written policies, interagency agreements, and decontamination facilities.¹⁵ Similarly, another recent survey revealed that 72% of hospital administrators interviewed in Federal Emergency Management Agency Region III reported that they felt unprepared to manage a biological, chemical, or nuclear event, and less than half reported that they were able to perform a hospital-wide security lockdown.¹⁶ Hospitals designated as Level 1 trauma centers fared no better according to a 1996 survey, which revealed that only 30% had complete hazardous materials response plans and only 58% had performed a drill in the preceding year.¹⁷

Los Angeles County is vulnerable to both natural and man-made disasters. The region is in proximity to 200 earthquake faults, including the San Andreas fault.¹⁸ Hospitals play a critical role in the medical response to earthquakes; yet, after even a moderate earthquake, hospitals are vulnerable to structural and nonstructural damage. After the Northridge earthquake on January 17, 1994, which had a moment magnitude of 6.7, eight of 91 hospitals (9%) required evacuation.¹⁹ Earthquakes are considered the major natural threat to Los Angeles County.

Wildfires also occur with regular frequency. In October 2003, fires swept across southern California from Ventura County to the Mexican border, damaging approximately 745,000 acres and destroying more than 3,000 homes. Twenty-three people were killed and 174 injured, and the estimated damage exceeded \$2 billion, the largest property loss from wildfires in the state's history.²⁰

Los Angeles County has a socially and economically heterogeneous population and has experienced civil unrest, including the two largest riots in U.S. history, the Watts and Rodney King riots. Los Angeles County is also a potential terrorist target, because it is home to what many consider symbols of America and materialism: Disneyland, Universal Studios, national television networks, and one of the busiest international airports in the world.

While several surveys assessing hospital disaster preparedness have been published, none had a second phase in which questionnaire items were verified or clarified during an on-site survey.^{8,21-25} Reporting bias, which is an inherent limitation of questionnaire-based studies, may be diminished by on-site verification. Thus,

the objective of our study was to characterize disaster preparedness among a cohort of hospitals in Los Angeles County, CA, focusing on practice variation, plan characteristics, and surge capacity, using a telephone-based survey tool and an on-site survey to verify and clarify initial responses.

METHODS

Study Design and Population

We utilized a telephone survey followed by an on-site survey. A convenience sample of the first 45 designated 9-1-1 receiving hospitals in Los Angeles County agreeing to participate was enrolled. Because all data were deidentified and reported in aggregate, our study was verified as exempt by our institutional review board.

Survey Content and Administration

We developed a questionnaire (Appendix 1, available as a Data Supplement at <http://www.aemj.org/cgi/content/full/j.aem.2006.05.007/DC1>) that includes 117 items focusing on areas previously identified as standards or evidence of preparedness in the published literature.^{1-5,8,9,14,21,26-31} During the period between July 2002 and June 2004, the survey was administered by telephone, followed by on-site verification (Appendix 2, available as a Data Supplement at <http://www.aemj.org/cgi/content/full/j.aem.2006.05.007/DC2>) or revision of the information obtained.

Participating Hospitals and Interviewees. At the time of hospital recruitment, there were 81 designated 9-1-1 receiving hospitals in Los Angeles County. A letter of invitation to participate in the survey was sent to each hospital's designated "disaster coordinator," defined as the staff member responsible for coordinating disaster preparedness at that hospital, which was a role variably filled by an ED nurse, the hospital safety officer, or the radiation safety officer. Before the survey, we estimated that 40–45 hospitals would constitute a practicable sample of respondents to interview and institutions to inspect on site. A convenience sample of the first 45 institutions agreeing to participate was thus enrolled in our study. A single physician (AHK) administered the questionnaire (Appendix 1) to the disaster coordinator by telephone, during which time an in-person hospital site survey for a later date was scheduled.

Due to the breadth of the survey, we anticipated that the disaster coordinator would be unable to answer one or more of the questions during the telephone interview. When this occurred, he or she was encouraged to have other resources and personnel available during the on-site survey to help complete the questionnaire. During the on-site survey, the interviewer (AHK) met with personnel from various hospital departments, including the ED and pharmacy, radiology, and respiratory therapy departments, and also toured the morgue, decontamination facility, and designated area for the incident command post. The coordinated efforts of multiple hospital departments and personnel are necessary for hospital disaster preparedness; thus, we believed an accurate evaluation of a hospital's preparedness would

require a hospital-wide on-site assessment to complete all questionnaire items.

Survey Items. Questionnaire items included a description of the structure of the hospital disaster plan, modes of intrahospital and interhospital communication, decontamination capability and training, characteristics of drills, pharmaceutical stockpiles, and each facility's surge capacity (assessed by monthly ED diversion status and number of available beds, ventilators, and negative pressure isolation rooms). Because a survey performed in 1994 demonstrated that hospitals were better prepared when the medical directors of the ED participated in community planning,³² we also assessed whether each hospital participated in the local disaster planning committee. Additional survey items examined mutual aid agreements with other hospitals and with long-term care facilities, predisaster "preferred" agreements with medical vendors, protocols for canceling elective surgeries and early inpatient discharge, the ability to provide day care for dependents of hospital staff, syndromic surveillance systems, ongoing training with local EMS and fire agencies, communication with the public health department, a volunteer credentialing system, a system for hospital lockdown, and a protocol for mass fatality incidents.

Data Analysis

Data obtained from the telephone survey and the on-site visit were recorded on data collection forms. All data were stored in an Access database (Access 2003; Microsoft Corp., Redmond, WA). The database was translated into SAS (SAS Institute, Inc., Cary, NC) format using DBMS/Copy (DataFlux Corp., Cary, NC). The statistical analysis was performed using SAS version 8.1.

Descriptive statistics were tabulated for categorical survey items. Because of the nonrandom sampling of hospitals, we did not calculate 95% confidence intervals around observed proportions, and we have taken a descriptive, qualitative approach to interpretation, rather than a formal hypothesis-testing approach. Accordingly, our results should be viewed as hypothesis generating and exploratory in nature.

RESULTS

Of the 45 hospitals surveyed, 14 (31%) were trauma centers, 40 (89%) were community hospitals, and 5 (11%) were public hospitals (Table 1). Twenty-nine (64%) had specific certification for the care of children in the ED, and although ambulances do not transport pediatric patients to the remaining 16 hospitals, they are legally mandated to perform a medical screening examination on walk-in pediatric patients.

The hospitals' disaster plans consistently were Hospital Emergency Incident Command System based; included protocols for hospital lockdown, canceling elective surgeries, and early inpatient discharge; provided day care for children of hospital staff; designated overflow areas for victims; and included prior agreements with vendors. Disaster plans were less likely to explicitly involve law enforcement, and relatively few institutions had mutual aid

Table 1
Characteristics of Hospital Disaster Plans

Hospital Disaster Plan Characteristic	Hospital Categories					
	Community vs. Public		Trauma Center Category			All Hospitals (N = 45), n (%)
	Community Hospital (n = 40), n (%)	Public Hospital (n = 5), n (%)	Level 1 Trauma Center (n = 6), n (%)	Level 2 Trauma Center (n = 8), n (%)	Nontrauma Center (n = 31), n (%)	
Hospital characteristics						
Level 1 trauma center	2 (5)	4 (80)				6 (13)
Level 2 trauma center	7 (18)	1 (20)				8 (18)
Nontrauma center	31 (78)	0 (0)				31 (69)
Community hospital			2 (33)	7 (88)	31 (100)	40 (89)
Public hospital			4 (67)	1 (14)	0 (0)	5 (11)
PCCC	5 (13)	4 (80)	6 (100)	3 (43)	0 (0)	9 (20)
EDAP	19 (48)	1 (20)	6 (100)	8 (100)	6 (19)	20 (44)
Neither PCCC nor EDAP	16 (40)	0 (0)	0 (0)	0 (0)	16 (52)	16 (36)
Components of disaster plan						
Hospital Emergency Incident Command System–based system	38 (95)	5 (100)	6 (100)	6 (75)	31 (100)	43 (96)
Protocol for hospital lockdown	40 (100)	5 (100)	6 (100)	8 (100)	31 (100)	45 (100)
Involvement of police in plan	22 (55)	3 (60)	4 (67)	5 (71)	16 (52)	25 (56)
Volunteer credentialing policy	29 (73)	5 (100)	6 (100)	8 (100)	20 (65)	34 (76)
Policy to cancel elective surgery	37 (93)	5 (100)	6 (100)	8 (100)	28 (90)	42 (93)
Policy for early discharge of patients	39 (98)	5 (100)	6 (100)	8 (100)	30 (97)	44 (98)
Protocol to provide day care for children of hospital staff	34 (84)	5 (100)	6 (100)	8 (100)	25 (81)	39 (88)
Designated overflow area for victims in plan	38 (95)	5 (100)	6 (100)	8 (100)	29 (94)	43 (96)
Mutual aid or “preferred” agreements						
With hospitals	9 (23)	0 (0)	0 (0)	0 (0)	9 (29)	9 (20)
With long-term care facilities	3 (8)	0 (0)	0 (0)	0 (0)	3 (10)	3 (7)
With vendors	38 (95)	5 (100)	6 (100)	8 (100)	29 (94)	43 (96)
Space surge characteristics						
Licensed bed capacity >200	25 (63)	5 (100)	6 (100)	6 (75)	18 (56)	30 (67)
Isolation rooms <10	26 (65)	0 (0)	0 (0)	4 (50)	22 (71)	26 (58)
Capability to create extra isolation	20 (50)	4 (80)	4 (67)	4 (50)	16 (50)	24 (53)
Ambulance diversion >20%	22 (55)	5 (100)	4 (67)	6 (75)	17 (55)	27 (60)
Impacted by nursing shortage	38 (95)	5 (100)	6 (100)	8 (100)	29 (94)	43 (96)
Surge capacity >20 beds	10 (25)	3 (60)	3 (50)	3 (38)	7 (23)	13 (29)
Equipment, supplies, and pharmaceuticals						
EMS-compatible radios	40 (100)	5 (100)	6 (100)	8 (100)	31 (100)	45 (100)
Walkie-talkies	40 (100)	5 (100)	6 (100)	8 (100)	31 (100)	45 (100)
Availability of ham radios	25 (63)	2 (40)	2 (33)	2 (25)	23 (74)	27 (60)
Level C personal protective equipment	34 (85)	5 (100)	6 (100)	8 (100)	25 (81)	39 (87)
Warm-water decontamination shower	17 (43)	2 (40)	2 (33)	3 (38)	14 (44)	19 (42)
Availability of Geiger counters	38 (95)	5 (100)	6 (100)	6 (75)	31 (100)	43 (96)
≥3 Days of hospital supplies	40 (100)	5 (100)	6 (100)	8 (100)	31 (100)	45 (100)
Chemical antidote stockpile	18 (45)	5 (100)	5 (83)	2 (25)	16 (52)	23 (51)
Antibiotic stockpile	16 (40)	3 (60)	5 (83)	3 (38)	11 (35)	19 (42)
Immediate availability >5 ventilators	10 (25)	3 (60)	3 (50)	2 (25)	8 (26)	13 (29)
Current number of ventilators >20	31 (78)	4 (80)	6 (100)	7 (88)	22 (71)	35 (78)
Surveillance system in place	39 (98)	5 (100)	6 (100)	8 (100)	30 (97)	44 (98)
Training and drills						
Biannual decontamination training	18 (45)	1 (20)	1 (17)	3 (38)	15 (48)	19 (42)
Disaster training with other agencies	7 (18)	0 (0)	0 (0)	0 (0)	7 (23)	7 (16)
Drills involving multiple agencies	38 (95)	5 (100)	6 (100)	8 (100)	29 (94)	43 (96)

PCCC = pediatric critical care center that provides an emergency department capable of managing complex pediatric emergencies, a pediatric intensive care unit, physicians with pediatric subspecialties and/or experience in pediatric care, pediatric critical care consultation for community hospitals, and outreach educational programs for the EMS community; EDAP = emergency department approved for pediatrics.

agreements either with other hospitals or with long-term care facilities (Table 1).

Although two thirds of the hospitals had a licensed bed capacity greater than 200, more than half had fewer than ten designated isolation rooms. More than half were on ambulance diversion more than 20% of the time, and less than one third claimed to have a surge capacity greater than 20 beds. Almost all hospitals noted a substantial effect of the current nursing shortage on surge capacity. Perhaps most striking, of the 14 trauma centers, which are generally the largest of the facilities, only six (43%) claimed to have a surge capacity greater than 20 beds.

There was generally high availability of equipment and supplies, but less than half of the responding hospitals had warm-water decontamination showers and an antibiotic stockpile. Chemical antidote stockpiles were available in 23 hospitals (51%). However, less than one third of hospitals had immediate access to six or more ventilators, suggesting a significantly limited ability to respond to a biological or chemical event resulting in multiple victims with respiratory failure.

The vast majority of hospitals participated in drills that involved multiple agencies. Yet, only seven (16%) actually conducted disaster training with other agencies. Surprisingly, none of the public hospitals or trauma centers conducted such interagency training.

Although the relatively small number of public hospitals and, separately, trauma centers studied make it difficult to reliably compare results between hospital categories, it is noteworthy that public hospitals did not appear to be superior to community hospitals in involving law enforcement in disaster planning or in having mutual aid agreements with other hospitals or long-term care facilities. Further, all five public hospitals and more than two thirds of the trauma centers (five of which are also public hospitals) are on ambulance diversion more than 20% of the time, signifying a significant shortage in surge capacity. Last, while a greater percentage of public hospitals had access to six or more ventilators, such access was not universally present at public hospitals or in trauma centers.

DISCUSSION

While prior disaster experience has illustrated the importance of interagency and interinstitutional cooperation in mounting an effective disaster response, our survey identified variability in the extent to which hospitals in Los Angeles County had involved law enforcement in disaster planning or developed mutual aid agreements with hospitals and long-term care facilities. Although the vast majority of institutions participate in drills that involve multiple agencies, only a very small fraction actually train with these agencies in preparation for a real disaster. Survey responses regarding indirect measures of surge capacity, such as the percentage of time on ambulance diversion, the stated ability to provide greater than 20 beds, and the perception of an impact from the nursing shortage, suggest a significant limitation of surge capacity across hospitals.

We conducted on-site clarification of survey responses, a process that distinguishes our study from prior surveys

and potentially diminishes the reporting bias inherent in questionnaire-based studies. Overall, while there were few direct contradictions between information provided during the telephone survey and the site visit, there were many telephone survey items that were unanswered until the on-site portion of the study was performed. Information regarding institutional disaster preparedness involves multiple hospital departments, such as the ED, pharmacy, radiology, laboratory, operating rooms, and outpatient clinics. Thus, it is difficult for a single hospital disaster coordinator to provide accurate answers to a comprehensive questionnaire without the involvement of other hospital personnel. Among our cohort of telephone survey participants, no hospital denied permission for on-site verification.

Although terrorism preparedness was a high priority in hospitals immediately after September 11, 2001, and the subsequent dissemination of anthrax, preparedness appears to have become less of a priority with time. A recent survey evaluating the impact of additional funds on hospital disaster preparedness reported a lack of improvement between 1996 to 2000 in the capacity for hospitals to decontaminate patients and in the stockpiling of nerve agent and cyanide antidotes.³³ Others have noted that federal and state government funds have yet to reach the hospitals.⁹ Thus, although the U.S. government has developed a domestic preparedness program to aid local emergency response agencies, there is clearly a gap between federal efforts and the current state of preparedness at individual hospitals.

LIMITATIONS

Our study has a number of limitations. The sample size of 45 hospitals is relatively limited and, because the first 45 hospitals were selected to participate, self-selection bias is likely. The 45 participating hospitals may have differed systematically from the 36 nonparticipating hospitals, although we would suspect that participating hospitals were better prepared than the nonparticipating hospitals. The survey was conducted in Los Angeles County with its unique hazards, which limits the generalizability of the results. Additionally, the study was conducted over 24 months, during which time there has been significant emphasis on domestic preparedness. Many of the surveyed hospitals were in the process of receiving federal monies to purchase decontamination trailers, supplies, and personal protective equipment during the survey. Over the past four years, the majority of the hospitals in Los Angeles County have acquired decontamination trailers, personal protective equipment, and medical and surgical stockpiles. Thus, it is possible that our results would differ accordingly if the study were performed again.

CONCLUSIONS

Among a convenience cohort of hospitals in Los Angeles County, CA, disaster preparedness appears to be limited by a failure to fully integrate interagency training and planning, a failure to develop mutual aid agreements, and a severely limited surge capacity. In contrast, there is generally a high level of availability of equipment and

supplies, although greater efforts should be made to ensure widespread availability of ventilators, chemical antidotes, and antibiotics.

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References

- Noji E. Disaster epidemiology. *Emerg Med Clin North Am.* 1996; 14:289–300.
- Waeckerle J. Disaster planning and response. *N Engl J Med.* 1991; 324:815–21.
- Higgins W, Wainright C, Lu N, Carrico R. Assessing hospital preparedness using an instrument based on the Mass Casualty Disaster Plan checklist: results of a statewide survey. *Am J Infect Control.* 2004; 32:327–32.
- Braun BI, Darcy L, Divi C, Robertson J, Fishbeck J. Hospital bioterrorism preparedness linkages with the community: improvements over time. *Am J Infect Control.* 2004; 32:317–26.
- Auf der Heide E. Disaster planning, Part II: disaster problems, issues, and challenges identified in the research literature. *Emerg Med Clin North Am.* 1996; 14:453–80.
- Auf der Heide E. The importance of evidence-based disaster planning. *Ann Emerg Med.* 2006; 47:34–46.
- Auf der Heide E. Designing a disaster plan: important questions. *Plant Technol Safety Manage Ser.* 1994; 3: 7–18.
- Hsu EB, Jenckes MW, Catlett CL, et al. Effectiveness of hospital staff mass-casualty incident training methods: a systematic literature review. *Prehosp Disaster Med.* 2004; 19:191–9.
- Murphy JK. After 9/11: priority focus areas for bioterrorism preparedness in hospitals. *J Healthc Manag.* 2004; 49:227–35.
- Jasper E, Sweeney B, Williams E, Gates E. Value of an unannounced drill in preparing hospitals for a terrorism attack or other mass casualty event [abstract]. *Acad Emerg Med.* 2004; 11:562.
- Quarantelli EL. *Delivery of Emergency Medical Care in Disasters: Assumptions and Realities.* New York, NY: Irvington Publishers, 1983.
- Cone DC, Weir SD, Bogucki S. Convergent volunteerism. *Ann Emerg Med.* 2003; 41:457–62.
- Bissell RA, Becker BM, Burkle FJ Jr. Health care personnel in disaster response: reversible roles or territorial imperatives? *Emerg Med Clin North Am.* 1996; 14:267–88.
- Wetter D, Daniell W, Treser CD. Hospital preparedness for victims of chemical or biological terrorism. *Am J Public Health.* 2001; 91:710–6.
- Greenberg MO, Jurgens SM, Gracely EJ. Emergency department preparedness for the evaluation and treatment of victims of biological or chemical terrorist attack. *J Emerg Med.* 2002; 22:273–8.
- Treat KN, Williams JM, Furbee PM, Manley WG, Russell FK, Stamper CD Jr. Hospital preparedness for weapons of mass destruction incidents: an initial assessment. *Ann Emerg Med.* 2001; 38:562–5.
- Ghilarducci DP, Pirrallo RG, Hegmann KT. Hazardous materials readiness in the United States level 1 trauma centers. *J Occup Environ Med.* 2000; 42: 683–92.
- Schultz CH, Koenig KL, Noji EK. A medical disaster response to reduce immediate mortality after an earthquake. *N Engl J Med.* 1996; 334:438–44.
- Schultz CH, Koenig KL, Lewis RJ. Implications of hospital evacuation after the Northridge, California earthquake. *N Engl J Med.* 2003; 348:1349–55.
- Parker L, Kenworthy T, McMahon P. Areas ‘disaster waiting to happen.’ *USA Today.* Nov. 3, 2003:4A.
- House H, Graber MA, Scheckel SS. Is your emergency department ready for a terrorist attack? *Emerg Med.* 2003; Oct:46–53.
- Gough AR, Markus K. Hazardous materials protection in the ED practice: laws and logistics. *J Emerg Nurs.* 1989; 15:477–80.
- Agency for Healthcare Research and Quality. AHRQ unveils hospital bioterrorism preparedness tool. Available at: <http://www.ahrq.gov/news/press/pr2002/bioterrpr.htm>. Accessed Nov 3, 2003.
- Cone DC, Davidson SJ. Hazardous materials preparedness in the emergency department. *Prehosp Emerg Care.* 1997; 1:85–90.
- Niska RW, Burt CW. Bioterrorism and mass casualty preparedness in hospitals: United States, 2003. *Adv Data.* 2005; 364:1–14.
- Khan AS, Levitt AM, in collaboration with the CDC Strategic Planning Workshop. Biological and chemical terrorism: strategic plan for preparedness and response. Recommendations of the CDC strategic planning workgroup. *MMWR Recommend Rep.* 2000; 49:1–14.
- Klein JS, Weigelt JA. Disaster management: lessons learned. *Contemp Problems Trauma Surg.* 1991; 71: 257–66.
- Simon R, Teperman S. The World Trade Center attack. Lessons for disaster management. *Crit Care.* 2001; 5:318–20.
- Levitin HW, Sieglson HJ. Hazardous materials. Disaster medical planning and response. *Emerg Med Clin North Am.* 1996; 14:327–48.
- Schultz CH, Mothershead JL, Field M. Bioterrorism preparedness. I: The emergency department and hospital. *Emerg Med Clin North Am.* 2002; 20: 437–55.
- Ridge T. The critical role of hospitals involved in national bioterrorism preparedness. *J Healthc Prot Manage.* 2002; 18:39–48.
- Landesman LY, Markowitz SB, Rosenberg SN. Hospital preparedness for chemical accidents: the effect of environmental legislation on healthcare services. *Prehosp Disaster Med.* 1994; 9:154–9.
- Keim ME, Pesik N, Twum-Danso NA. Lack of hospital preparedness for chemical terrorism in a major US city: 1996–2000. *Prehosp Disaster Med.* 2003; 18: 193–9.