

Articles

Hospital Preparedness for Hazardous Materials Incidents and Treatment of Contaminated Patients

JEFFEREY L. BURGESS, MD, MS, MPH; GRIFFITH M. BLACKMON, MD, MPH; C. ANDREW BRODKIN, MD, MPH;
and WILLIAM O. ROBERTSON, MD, *Seattle, Washington*

Hospital-based facilities providing emergency care in the state of Washington were surveyed to determine their level of preparedness for hazardous materials incidents including the treatment of contaminated patients. Responses to a faxed questionnaire were received from 95 (94%) of the 101 emergency care facilities in Washington State. Only 42 (44%) of the facilities reported the ability to receive any chemically exposed patient. Of the 95 responding emergency care facilities, 39 (41%) had no designated decontamination facilities; 67 (70%) had protocols for handling chemical contamination and possible evacuation from hazardous materials spills, and 52 (55%) had protocols for handling medical facility contamination and possible evacuation from treating chemically contaminated patients. Twelve (13%) facilities had evacuated their emergency department or other part of the hospital for contamination incidents in the past 5 years. Despite the frequent occurrence of hazardous materials incidents, most emergency care facilities in Washington State are not fully prepared to handle contaminated patients and chemical spills. This may have important implications for the care of persons with exposure to hazardous materials and for implementing Joint Commission on Accreditation of Healthcare Organizations standards and federal Occupational Safety and Health Administration regulations.

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Hazardous materials incidents occur frequently on a regional basis. In the state of Washington from 1992 through 1994, there were 1,444 hazardous materials incidents reported to the state Department of Health, including 333 incidents involving human exposures with 1,268 exposure victims.¹ A hazardous material may be defined as a substance capable of creating harm to people, property, and the environment,² and hazardous materials incidents include airborne releases of gas and vapor, spills of solid and liquid material, and explosions and fires resulting in chemical release to the environment. Victims of exposure to hazardous materials are often transported by ambulance to a single designated medical facility for treatment. In many incidents, however, and especially following large-scale exposures, patients are transported to a number of different facilities. Patients also arrive unannounced at medical facilities, without previous decontamination, after substantial

hazardous materials exposure. Emergency care facilities may thus encounter a wide variety of hazardous materials exposures with little warning and only limited information about the extent of exposure.

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requires accredited institutions to have "emergency procedures that describe the specific precautions, procedures, and protective equipment used during hazardous materials and waste spills or exposures." The JCAHO standards also include "a management plan [that] addresses emergency preparedness," including "evacuating the facility when the environment cannot support adequate patient care and treatment" and "facilities for radioactive or chemical isolation and decontamination."³ For emergency response and hazardous waste operations, the Occupational Safety and Health Administration requires a site-specific safety and health plan, including an emer-

From the Occupational and Environmental Medicine Program, Department of Medicine, University of Washington School of Medicine (Drs Burgess, Blackmon, and Brodtkin), and the Washington Poison Center (Drs Burgess and Robertson), Seattle.

Reprint requests to Jeffrey L. Burgess, MD, MS, MPH, Occupational and Environmental Medicine Program, Harborview Medical Center, 325 Ninth Ave, Box 359739, Seattle, WA 98104.

1. Does your hospital have the ability to receive patients who have been exposed to hazardous chemical materials?					
a) any exposed patients		Yes ___		No ___	
b) only patients decontaminated before arrival		Yes ___		No ___	
c) patients exposed to radioactive materials		Yes ___		No ___	
d) other (please describe)					
2. What facilities for decontamination do you have available?					
a) area with separate ventilation and water containment		Yes ___		No ___	
b) area with separate ventilation only		Yes ___		No ___	
c) portable (outside) decontamination unit		Yes ___		No ___	
d) none		Yes ___		No ___	
e) other (please describe)					
3. How many times have you used your chemical decontamination facilities within the past 12 months?	N/A ___	0 ___	1-5 ___	6-10 ___	>10 ___
4. Have you evacuated your emergency department or other parts of the hospital due to a hazardous materials exposure during the past five (5) years?					
		Yes ___		No ___	
5. Do you have a protocol for handling hazardous chemical contamination and possible evacuation of your emergency department or other areas of the hospital?					
a) for hazardous materials spills		Yes ___		No ___	
b) for contaminated patients		Yes ___		No ___	
6. Do you have a written protocol for treatment of patients exposed to hazardous materials?					
		Yes ___		No ___	

Figure 1.—This hospital survey questionnaire was sent to 101 Washington State emergency care facilities.

gency response plan that includes identifying the nearest medical assistance. The emergency response plan also requires pre-emergency planning for emergency medical treatment and first aid.⁴ Unfortunately, actual emergency response plans frequently designate hospitals for provisional emergency medical treatment without assessing the hospitals' ability to provide care to chemically contaminated patients.

Two recent hazardous materials incidents in Washington State that resulted in emergency department closure focused our attention on hospital preparedness for managing chemical contamination. In the first incident, a patient contaminated from an explosion at a clandestine methamphetamine laboratory presented at a local hospital without previous decontamination. Shortly after his arrival, headache, nausea, vomiting, and mucous membrane irritation developed in several of the hospital staff. The emergency department was closed for seven to eight hours while the situation was assessed and the facility was decontaminated.^{5(p7)} In the second incident, another emergency department was temporarily closed when similar adverse symptoms developed among hospital staff treating a patient with occupational chemical exposure. The facility was reopened after evaluation by an outside hazardous materials team. To assess overall preparedness for such chemical exposure incidents, we conducted a survey of all 101 hospital-based emergency care facilities in Washington State.

Methods

Facilities providing emergency care in Washington State were identified through the Washington Poison Center, the Washington State Medical Association, and the

American Hospital Association.⁶ Of the 120 hospitals and affiliated health care institutions in the state, 101 emergency care facilities were identified. A one-page questionnaire was sent by facsimile machine to all 101 emergency care facilities in June 1996. For facilities not responding within a month, a second questionnaire was sent by facsimile. All facilities not responding to the second questionnaire were contacted by phone to obtain a specific contact person, and a third questionnaire was sent. Incomplete or ambiguous answers were clarified through a telephone interview by one of us (J.L.B.).

The survey questionnaire (Figure 1) consisted of identifying information and a limited set of questions designed to ascertain each institution's self-assessed capability, including physical facilities and existing policies, to care for persons contaminated with hazardous materials. Based on JCAHO standards and our experience with chemical exposures in Washington State, adequate preparation for hazardous materials incidents was considered to include the following:

- Facilities for radioactive or chemical isolation and decontamination;
- A plan for evacuating the facility for sources of contamination, including spills or contaminated patients, or both; and
- A written protocol for the treatment of patients exposed to hazardous materials.

Information on hospital size, as determined by bed count, was collected from *The American Hospital Association Guide to the Health Care Field*.⁶ Washington State population data by county were collected from the current world almanac.^{7(p444)} Statistics on

TABLE 1.—Self-Assessed Hospital (n = 95) Ability to Receive Exposed Patients

Hospital Ability to Receive Patients	Hospitals, No. (%)
Any exposed patients	42 (44)
Only patients decontaminated before arrival	47 (49)
Patients exposed to radioactive materials*	28 (29)
Not able to receive exposed patients	6 (6)

*Not mutually exclusive with other categories.

the number of hazardous materials incidents, number of incidents involving human exposure, and the total number of chemical exposure victims for each county in Washington State were collected from the Washington State Department of Health.¹ Analyses were performed using SPSS software (SPSS for Windows 6.1, SPSS Inc, Chicago, Illinois) to determine the association of hospital size (by bed count) with elements of hospital preparedness and to determine the correlation of county population with the number of hazardous materials events, hazardous materials victim events, and hazardous materials exposure victims by county. Odds ratios (OR) were calculated using standard 2×2 contingency tables, with 95% confidence intervals (CI).

Results

Questionnaires were sent by facsimile machine to all 101 designated emergency care facilities in the state of Washington. A total of 95 (94%) were returned. The person completing the questionnaire varied by facility: 67 (71%) respondents were registered nurses with administrative positions, including director of nursing services, emergency department director, clinical services manager, or risk manager; 9 (9%) were physician emergency department directors or assistant directors; and 14 (15%) were safety, engineering, operations, or other personnel without an MD or RN degree. The remaining five (5%) respondents were nonadministrative staff nurses or physicians.

The number of inpatient beds associated with the designated emergency facilities ranged from 0 to 686, with a median of 74 beds. Of the 95 emergency facilities, 92 were physically located in hospitals. Three emergency care facilities had no inpatient beds but transferred patients requiring admission to nearby inpatient treatment facilities. The self-assessed ability of Washington State emergency care facilities to receive patients with exposure to hazardous materials is presented in Table 1. The self-assessed availability of designated decontamination facilities is presented in Table 2. Of the 56 emergency care centers with decontamination facilities, 45 (80%) had not used their facilities for decontamination during the previous 12 months, and 11 (20%) had used their facilities less than five times. No facility had been used more than five times during the previous 12 months.

TABLE 2.—Self-Assessed Hospital (n = 95) Decontamination Facilities

Facility	Hospitals, No. (%)
Separate ventilation and water containment	22 (23)
Separate ventilation only	13 (14)
Portable (outside) decontamination*	23 (24)
Other†	8 (8)
None‡	39 (41)

*Not mutually exclusive with other categories.

†Other decontamination facilities included a special gurney and floor cloths (meeting naval requirements), designated rooms with shower without separate ventilation or water containment, and an outside shower.

‡An outside hose was not counted as a designated decontamination facility unless a continuous source of warm water was available.

For hazardous materials spills, 67 (70%) emergency care facilities had a protocol for handling hazardous chemical contamination and evacuation of their department or other areas of the hospital. For the treatment of contaminated patients, 52 (55%) emergency care facilities had a protocol for handling hazardous chemical contamination and evacuation of their department or other areas of the hospital. In all, 49 (52%) emergency care facilities had a written protocol for treating patients exposed to hazardous materials. Of the emergency care facilities, 12 (13%) had evacuated their emergency department or other parts of the hospital because of a hazardous materials exposure at least once during the previous five years. Overall, 71 (75%) emergency care facilities did not meet all of our criteria for hazardous materials incident preparation, including designated decontamination facilities; a plan for evacuating the facility when the source of contamination was from spills, contaminated patients, or both; and a written protocol for treating patients with exposure to hazardous materials.

Larger facilities (>72 inpatient beds, n = 48) were more likely than smaller facilities (≤72 inpatient beds, n = 47) to have designated decontamination facilities (OR, 2.3; 95% CI, 1.0 to 5.3). Larger facilities were also more likely to have protocols for handling chemical contamination and evacuation following hazardous materials spills (OR, 3.7; 95% CI, 1.4 to 9.6), for handling chemical contamination and evacuation following the treatment of contaminated patients (OR, 2.7; 95% CI, 1.2 to 6.2), and for treating patients exposed to hazardous materials (OR, 2.5; 95% CI, 1.1 to 5.6).

The occurrence of hazardous materials incidents in Washington State from 1992 to 1994 is reported in Table 3. The county population for the 39 counties in the state ranged from 2,305 to 1,587,505 (median, 45,865 inhabitants). Hazardous materials incidents occurred most frequently in counties with large populations; county population was highly correlated with the 1992 to 1994 counts of total number of hazardous materials incidents by county (R², 0.93), total number of victim incidents by county (R², 0.98), and total number of exposure victims by county (R², 0.92).

TABLE 3.—Washington State Hazardous Materials Incidents By County (n = 39)*

Incidents	Range	Median
Total hazardous materials incidents	0-348	11
Incidents involving human exposure	0-91	2
Total exposure victims	0-371	7

*From Washington State Department of Health data, 1992-1994.¹

Discussion

The results of this survey suggest that a significant percentage of Washington State emergency care facilities, by their own assessment, are not well prepared to provide care for patients with exposure to hazardous materials. Preparation should ideally include both the development of protocols for hazardous materials incidents and implementation through emergency preparedness drills, as required under JCAHO standards. Although the JCAHO standards concentrate on hazardous materials spills within hospitals, the two incidents described in this report demonstrate that secondary contamination occurring during the treatment of contaminated patients can also result in the need for evacuating emergency care facilities. For adequate preparedness, hospitals should have designated decontamination facilities, protocols for the treatment of contaminated patients, and protocols for handling chemical contamination and possible evacuation of their emergency department and other hospital areas when exposure to hazardous materials occurs.

Although we were not able to identify a previous survey of hospital preparedness for hazardous materials incidents, several authors have commented on disaster preparedness and the treatment of patients with chemical exposure.⁸⁻¹² A common theme of these articles is that hospital disaster preparedness was often inadequate. Given the strong correlation between county population and total number of hazardous materials incidents, victim incidents, and exposure victims by county, emergency care facilities in more populated counties should have a greater chance of encountering patients with chemical exposure. Although specific facilities such as trauma centers are often designated to receive hazardous materials exposure victims, contaminated patients may show up at any facility.

The limitations of this study include those typical of questionnaire survey studies. It was not easy to verify the accuracy of the information provided, although the respondents were generally key administrative personnel. Both underreporting and overreporting were possible. For example, institutions may have had protocols for handling hazardous materials exposures of which the respondents were unaware. Prudent medical practice and JCAHO standards, however, require not only the existence of emergency plans but also the implementation and periodic drilling of these protocols. If applica-

ble emergency protocols were available, the lack of awareness of such protocols by key administrators would strongly suggest ineffective implementation. Studies using on-site inspection and surveys in other states would verify and further define the generalizability of our findings.

The equipment and training required for radioactive or chemical isolation and decontamination are not specified in the JCAHO standards. Although separate ventilation and water collection systems provide the greatest margin of safety and chemical control, the provision of these facilities may not be necessary or cost-effective for many institutions. In contrast to primary hazardous materials spills, the extent of chemical contamination present on the skin and clothing of exposed persons will often be within the water treatment capability of municipal water systems. As part of the planning process, hospitals should check with their local municipal systems to determine the need for separate water containment systems. Portable outside decontamination facilities are, by definition, separate from the hospital ventilation system. These may be the most cost-effective means of providing adequate patient care and satisfying existing standards, given the infrequent need of most emergency care facilities to do decontamination. Other options may include using the hospital morgue, which often has separate water containment and ventilation systems, as a designated decontamination facility.

Conclusion

Despite the frequent occurrence of hazardous materials incidents, most emergency care facilities in Washington State are not fully prepared to handle patients contaminated with hazardous chemicals. Although some general guidelines exist,^{13,14} it would be useful for government and professional organizations to make available template protocols for the management of hazardous materials incidents to improve hospital preparedness. The provision of simple and relatively inexpensive portable outside decontamination units, with access to hot and cold running water, should also be encouraged. From a regulatory perspective, safety and health plans for hazardous materials incident sites should take into consideration the extent of hospital preparedness, with a designated and prepared emergency care facility available for the treatment of exposed persons.

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