Development of an "All-Hazards" Hospital Disaster Preparedness Training Course Utilizing Multi-Modality Teaching

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Abbreviations:
EOC = emergency operations center
HDLS = Hospital Disaster Life Support
HICS = Hospital Incident Command System
MCI = mass-casualty incident
PPE = personal protective equipment

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Abstract

Objectives: The objectives of the study were to develop and evaluate an "all-hazards" hospital disaster preparedness training course that utilizes a combination of classroom lectures, skills sessions, tabletop sessions, and disaster exercises to teach the principles of hospital disaster preparedness to hospital-based employees.

Methods: Participants attended a two-day, 16-hour course, entitled Hospital Disaster Life Support (HDLS). The course was designed to address seven core competencies of disaster training for healthcare workers. Specific disaster situations addressed during HDLS included: (1) biological; (2) conventional; (3) radiological; and (4) chemical mass-casualty incidents. The primary goal of HDLS was not only to teach patient care for a disaster, but more importantly, to teach hospital personnel how to manage the disaster itself. Knowledge gained from the HDLS course was assessed by pre- and post-test evaluations. Additionally, participants completed a course evaluation survey at the conclusion of HDLS to assess their attitudes about the course.

Results: Participants included 11 physicians, 40 nurses, 23 administrators/directors, and 10 other personnel (n = 84). The average score on the pre-test was 69.1 ±12.8 for all positions, and the post-test score was 89.5 ±6.7, an improvement of 20.4 points (p <0.0001, 17.2–23.5).Participants felt HDLS was educational (4.2/5), relevant (4.3/5) and organized (4.3/5).

Conclusions: Identifying an effective means of teaching hospital disaster preparedness to hospital-based employees is an important task. However, the optimal strategy for implementing such education still is under debate. The HDLS course was designed to utilize multiple teaching modalities to train hospital-based employees on the principles of disaster preparedness. Participants of HDLS showed an increase in knowledge gained and reported high satisfaction from their experiences at HDLS. These results suggest that HDLS is an effective way to train hospital-based employees in the area of disaster preparedness.

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Introduction

A disaster is one of the most difficult events healthcare personnel can face. They must be able to provide needed medical care while performing emergency plan tasks, communicating with incident command, managing supplies and resources, and facilitating patient flow. These tasks differ greatly from what normally is expected of hospital personnel on a daily basis. Unfortunately, most hospital personnel are unprepared to cope with a disaster.[1–6] This has been seen far too often, as many disaster situations are characterized by inadequate medical care, poor communication, chaotic management, and meager patient flow.[7–10]

It has been shown that hospital personnel that practice for disaster situations are more likely to perform well during these events.[11–13] However, training for hospital-based employees in this area is largely insufficient or unavailable. In addition, the effectiveness of training modalities such as class-

room lectures, skills sessions, field exercises, or tabletop sessions have not been studied sufficiently, and there are no definitive recommendations on how to train healthcare workers for disaster preparedness.[3] Utilizing any one of these educational modalities in isolation has had some strengths, but each modality also has its accompanying weaknesses.[14,15] In response to these issues, Hospital Disaster Life Support (HDLS) was developed as a multi-modality approach to educate and train hospital-based employees in the area of disaster preparedness.

The HDLS course was designed by hospital personnel at a large urban hospital located in Washington, DC. The course was designed around seven core competencies for all healthcare workers in the area of disaster preparedness as developed by Hsu *et al*.[16] The HDLS course uses a combination of classroom lectures, skills sessions, tabletop sessions, and disaster exercises to teach the principles of hospital disaster preparedness to hospital-based employees. By utilizing a multi-modality approach to train healthcare workers, the weaknesses or limitations of any one training method are minimized. An overview of this course and its overall effectiveness as determined by pre- and post-test evaluations and a course evaluation survey are presented in this study.

Methods

Study Design and Population

Prior to the start date of HDLS, participants completed a Web-based pre-test to assess their previous knowledge of hospital disaster preparedness. The pre-test consisted of 23 items relating to the seven core competencies taught during the course. At the conclusion of HDLS, participants were administered another 23 item post-test to assess their knowledge gained from the course. The average scores of the pre- and post-test for participants were compared using the Student's *t*-test to determine if any knowledge was gained from the course. In addition, participants were given a course evaluation survey at the conclusion of HDLS to document their attitudes about the course. The evaluation consisted of numerical scale-based questions with a value of 1 being least favorable and 5 being most favorable. Data for this study were collected from 10 courses conducted over 15 months. Participants for this study include 11 physicians, 40 nurses, 23 administrators/directors, and 10 other personnel (n = 84). Individuals classified as "other personnel" in this study included: (1) protective services; (2) emergency medical technicians; and (3) non-clinical support. In order to be included in the study, participants had to attend both days of the HDLS course, complete both the pre- and post-test evaluations, and a course evaluation survey. This study was approved for Institutional Review Board exemption by the Washington Hospital Center Institutional Review Board.

Overview of the Course

The HDLS course was taught at the District of Columbia (DC) General Hospital, closed at the time of this course, and more recently at Washington Hospital Center, a large urban hospital also located in Washington, DC. The course consisted of two 8-hour days of training that included classroom lectures, disaster exercises, skills sessions, and a tabletop session. Competencies for this course are based on the seven core competencies for healthcare workers in the area of disaster training established by Hsu *et al* (Table 1). The course was organized into eight units: (1) hospital incident command structure; (2) protecting the staff and the facility; (3) biological mass-casualty incident (MCI) and hospital response; (4) conventional MCI and hospital response; (5) radiological MCI and hospital response; (6) chemical MCI and hospital response; (7) pediatric aspects of a MCI; and (8) system restoration and recovery. The specific lessons for each unit, if applicable, the type of training modality utilized, and the core competencies covered are listed in Table 2.

Day 1

The first day began with two lectures describing the Hospital Incident Command System (HICS), which was based on the [US] National Incident Management System (NIMS) and the National Response Plan (NRP). Participants were instructed on how an incident management system is organized and how to fill the various roles and responsibilities of the Section Chiefs and supervisors within HICS. Additionally, participants were instructed in hospital security and how to protect the staff and facility during a disaster.

The course continued with a lecture on bioterrorism, followed by a tabletop exercise. The participants were taught principles of syndrome surveillance, triage, treatment, and transport of victims of a biological attack. The 90-minute biological tabletop session simulated an outbreak of pneumonic plague in the National Capital Region. During this exercise, participants responded to 70 predetermined questions on management of the event from the aspect of a physician, nurse, hospital administrator, and protective services.

The course continued with four 30-minute lectures on conventional MCIs. Participants were instructed on how to establish a command center, establish lines of communication, prepare triage and treatment areas, and formulate a response plan. The lectures continued with instruction on the medical consequences of conventional attacks, such as explosions or gunshot wounds.

The first day concluded with a two-hour conventional MCI exercise. The exercise simulated a bomb explosion on a DC Metro bus. For this exercise, approximately 20 actors were used as victims. Each victim was given an identification card that described their respective medical conditions, and they were moulaged by professional make-up artists to simulate burns and major injuries. Patient triage and registration was performed in real time, whereas patient treatment was performed in compressed time. While patient care was important, instructors were more concerned with teaching participants how to communicate efficiently within the command structure, manage supplies and resources, facilitate patient flow, and treat specific injuries.

During the exercise, participants were assigned into one of two groups and each was assigned a role specific to HICS. One group worked within the emergency department and triage area, and the other worked within the Emergency

Core Competencies (CC)
1. Recognize a potential critical event and implement initial action
2. Apply the principles of critical event management
3. Demonstrate critical event safety principles
4. Understand the institutional emergency operations plan
5. Demonstrate critical event communications
6. Understand the incident command system and your role in it
7. Demonstrate the knowledge and skills needed to fulfill your role during a critical event

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Table 1—Seven core competencies for healthcare workers in the area of disaster training

Course Overview	CC	Format
Unit 1: Hospital Incident Command Structure	4,6	45 min. lecture
Unit 2: Protecting the Staff and the Facility	3	45 min. lecture
Unit 3: Biological MCI and Hospital Response		
Hospital Approach to Bioterrorism	1,4	30 min. lecture
Biological MCI Tabletop	1–4,6,7	90 min. tabletop
Unit 4: Conventional MCI and Hospital Response		
Hospital Response Issues Related to a Conventional MCI	1,4	30 min. lecture
Clinical Aspects of a Conventional MCI	2	30 min. lecture
Principles of Conventional Disaster Triage	2	30 min. lecture
Initial Steps for Disaster Response	1	30 min. lecture
Conventional MCI Exercise	1–7	120 min. exercise
Unit 5: Radiological MCI and Hospital Response		
Demystifying the Management of a Radiological MCI	2	30 min. lecture
Radiological Skills Session	3,7	90 min. session
Unit 6: Chemical MCI and Hospital Response		
Biochemical Exposures: Chemical Agent Overview	2	45 min. lecture
Hazmat Skills Session	3,7	90 min. session
Chemical MCI Exercise	1–7	150 min. exercise
Unit 7: Pediatric Aspects of a MCI	2	30 min. lecture
Unit 8: System Restoration and Recovery	4	45 min. lecture

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Table 2—Hospital Disaster Life Support (HDLS) course overview and how each unit of the course complies with the core competencies (CC) (MCI = mass-casualty incident, min = minutes)

Operations Center (EOC). Each participant was given a vest that was color-coded and labeled to identify his/her role, and participants were asked to perform skills they had acquired during the course and were related to their job action sheet (JAS). Throughout the exercise, participants used two-way radios and landlines to communicate with other participants and the (EOC). Faculty was staffed in each area to facilitate the drill and monitor the exercise.

Day 2

The second day began with a lecture on a radiological MCI, followed by two radiological skill stations. The lecture covered radiation exposure and contamination, acute radiation syndrome, personal protective equipment (PPE), and decontamination. During the skill session, participants were shown the proper use of all equipment (i.e., dosimeters, Geiger counters) and were required to detect a radioactive pellet hidden in a mannequin. In addition, course participants were taken through a series of radiological scenarios using principles learned in their previous lectures and skills session.

The course continued with a lecture on a chemical MCI, followed by a HAZMAT skills session that consisted of three stations: (1) decontamination; (2) treatment; (3) and patient flow. Participants were taught how to don PPE, and which type of PPE is needed for different chemical exposures. Participants then set up a portable decontamination facility (three tent system) and were instructed on how to effectively scrub and decontaminate ambulatory and non-ambulatory victims.

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Position	Scores		
	Pre-test (mean ±SD)	*Post-test (mean ±SD)*	*p-value*
Physician	67.4 ±14.2	91.1 ±5.5	<0.0001 (14.2–33.3)
Nurse	68.8 ±12.9	88.2 ±6.9	<0.0001 (14.8–24.0)
Administrator/Director	71.2 ±12.2	91.0 ±6.4	<0.0001 (14.1–25.6)
Other	67.4 ±13.3	89.5 ±7.7	<0.0002 (11.9–32.3)
Total	69.1 ±12.8	89.5 ±6.7	<0.0001 (17.2–23.5)

Table 3—Results of the pre-test and post-test scores for participants attending hospital disaster life support (HDLS)

Question	Response (mean ±SD)
Relevant material	4.31 ±0.8
Well organized	4.33 ±0.8
Learned something	4.23 ±0.8
Fulfilled educational needs	4.20 ±0.9
Simulated hospital environment conducive for learning	3.90 ±1.0
Confident in using newly learned knowledge	4.24 ±0.8

Table 4—Results of the course evaluation survey (1 = Least Favorable to 5 = Most Favorable)

At the conclusion of the HAZMAT skills session, course participants participated in a chemical MCI exercise. The exercise simulated the release of a nerve agent in the National Capital Region. The exercise ran similar to the conventional MCI exercise discussed earlier. At the conclusion of the chemical MCI, two more lectures were given on pediatric aspects of a MCI and on system restoration and recovery.

Results

Eighty-four participants were included in the study. Participants' pre- and post-test scores are in Table 3. The average pre-test score for all participants was 69.1 ±12.8. All positions had similar pre-test scores with no position scoring statistically higher or lower than any other position. All positions showed a statistically significant improvement between their mean pre-test and post-test scores. The mean post-test score for all positions was 89.5 ±6.7, an improvement of 20.4 (p <0.0001, 17.2–23.5) points compared to the mean value of the pre-test score.

The HDLS course participants reported that the course material was relevant to their respective positions (4.31 ±0.8) (Table 4). Also, they felt they had learned something from HDLS (4.23 ±0.8), and that the course fulfilled their educational needs (4.20 ±0.9). Furthermore, participants felt confident in using their newly learned knowledge in their respective positions (4.24 ±0.8). The lowest score on the course evaluation survey was in regards to the simulated hospital environment and its conduciveness for learning (3.90 ±1.0). This low score is most likely because the original training facility for HDLS at DC General Hospital was in need of some minor renovations that participants felt should be addressed to help make the facility more conducive for learning. Due to participant feedback, the location of the HDLS course has been moved to a newer facility.

Discussion

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) has mandated that all accredited hospitals have disaster training, implementation of the HICS, and a written disaster plan.[17] Hospital disaster training and preparedness no longer is a luxury, but has become a necessity in standard hospital operations. However, as recent as 2006, the US Institute of Medicine reported that training for healthcare workers in the area of disaster preparedness was deficient.[18]

The HDLS course was designed to address this deficiency in hospital preparedness and to meet the challenges of educating healthcare workers to respond to a variety of disaster situations. Its design was based on established core competencies for disaster training, enabling hospitals to clearly outline the expectations and responsibilities of the hospital personnel it trains. Using a mixed modality approach, participants were able to learn necessary disaster skills and put those skills into immediate practice.

The HDLS course was shown to contain relevant material to disaster training and participants felt the course was well-organized. The post-test score averaged 20.4 points better than the mean pre-test score. Additionally, participants felt confident in using their newly learned knowledge

and that the course fulfilled their educational needs. All of these results suggest that HDLS is an effective way to train hospital-based employees in the area of disaster preparedness.

While similar courses to HDLS are offered around the country, few are specifically targeted to hospital-based employees. The federal government realized the lack of these types of courses for hospital-based employees and funded the development of the Noble Training Center in 1999. The Noble Training Center is the only training hospital devoted entirely to educating hospital personnel in disaster preparedness.[19] While this is a step in the right direction, this is an isolated site for training and not readily available to the majority of healthcare workers across the country. The HDLS course provides a model training course that could be implemented in hospitals nationwide, enabling increased access to training and increased hospital preparedness.

Limitations

Further studies would benefit with the addition of a practical examination to better gauge how much participants have learned from the course. In addition, it would be interesting to identify how much knowledge participants retain from this course. Further research in this area would provide better information as to when participants should re-take the course or attend a refresher course. Lastly, assessing employer satisfaction and attitudes towards HDLS is crucial if this type of training is to be implemented on a larger scale.

Conclusions

Identifying an effective means of teaching hospital disaster preparedness to hospital-based employees is an important task. The HDLS course was designed to utilize multiple teaching modalities to train hospital-based employees in this important area. Course participants showed an increase in knowledge and reported high satisfaction from their participation in HDLS. These results suggest that HDLS is an effective way to train hospital-based employees in the area of disaster preparedness.

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