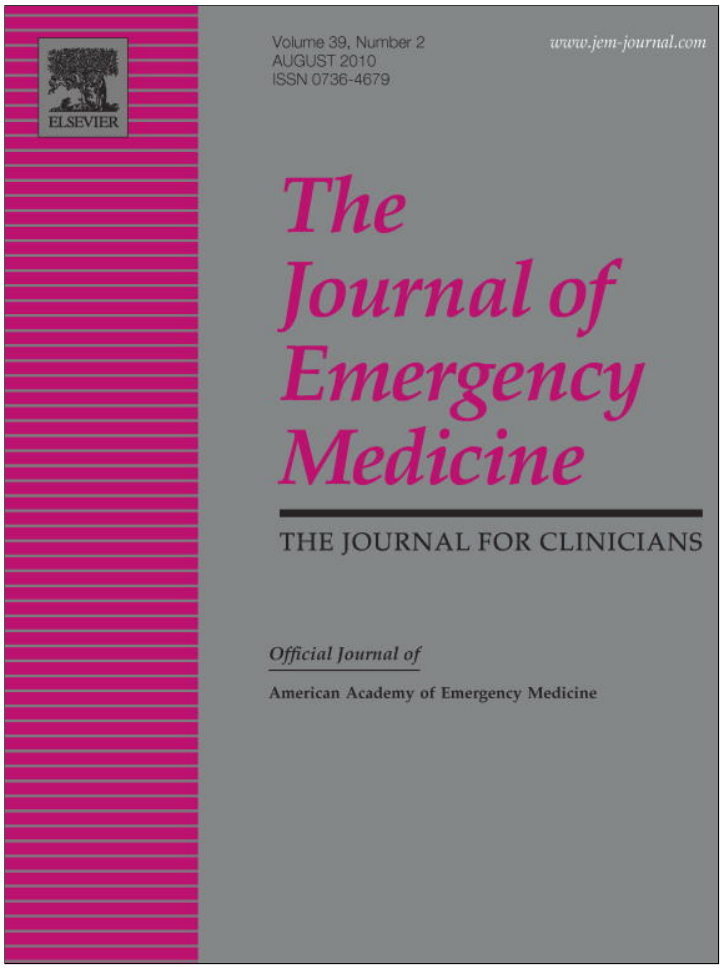

The Journal of Emergency Medicine, Vol. 39, No. 2, pp. 220–226, 2010

0736-4679/$–see front matter

doi:10.1016/j.jemermed.2009.08.064

Education

DISASTER 101: A NOVEL APPROACH TO DISASTER MEDICINE TRAINING FOR HEALTH PROFESSIONALS

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□ **Abstract—Background: Despite efforts to improve preparedness training for health professionals, disaster medicine remains a peripheral component of traditional medical education in the United States (US) and is a rarely studied topic in the medical literature. Objectives: Using a pre-/post-test design, we measured the extent to which 4th-year medical students perceive, rapidly learn, and apply basic concepts of disaster medicine via a novel curriculum. Methods: Via a modified Delphi technique, an expert curriculum panel developed a 90-min didactic training scenario and two 40-min training exercises for medical students: a hazardous material scene and a surprise mass casualty incident (MCI) scenario with 100 life-sized mannequins. Medical students were quizzed before and after the didactic training scenario about their perceptions and their disaster medicine knowledge. Results: Students rated their overall knowledge as 3.76/10 pretest compared to 7.64/10 after the didactic program. Students' post-test scores improved by 54% and students participating in the MCI drill correctly tagged 94% of the victims in approximately 10 min. The average overall rating for the experience was 4.85/5. Conclusions: The results of this educational demonstration project reveal that students will value and can rapidly learn some core elements of disaster medicine via a novel addition to a medical school's curriculum. We believe the principle of a highly effective and well-received medical student course that can be easily added to a university curriculum has been demonstrated. Further research is needed to validate core competencies and performance-based education goals for US health professional trainees.** © 2010 Elsevier Inc.

□ **Keywords—disaster; disaster medicine; emergency preparedness; training; medical students; health professional; disaster medicine training; emergency preparedness training; mass casualty incident (MCI); education; curriculum development; simulation**

INTRODUCTION

Reviews of health care operations during Hurricane Katrina emphasized the lack of basic training in disaster preparation and response by physicians as a contributing factor to the adverse patient outcomes (1–6). Other research underscores the need for resident subspecialty training, in particular, in Emergency Medicine, Anesthesiology, Family Medicine, Pediatrics, and Surgery as critical to the future success of local emergency preparedness plans (7–10).

In 2003, the Centers for Disease Control and Prevention reported that whereas more than 90% of hospitals trained nurses and staff physicians for terrorism-related conditions, less than half trained residents for the same (11). A 2008 survey of Emergency, Family, and Pediatric Residency programs supports the notion that physician trainees are not being properly trained in disaster medicine. Of the respondents in this survey, only 20% of Pediatric and Family Medicine Resident training programs in the United States (US) reported adequate training for responding to terrorist events, whereas < 50% of Emergency Medicine Residency training programs reported ad-

RECEIVED: 14 February 2009; FINAL SUBMISSION RECEIVED: 3 July 2009;
ACCEPTED: 15 August 2009

equate training for events affecting children (10). A 1999 survey of residency programs regarding bioterrorism training capabilities revealed similar findings (12).

Calls for medical students to develop skill-based competencies for emergency preparedness predate the terrorist attacks of September 11, 2001. In June 2001, an American College of Emergency Physicians task force recommended that both residents and medical students achieve proficiency in the medical response to bioterrorism and weapons of mass destruction (13). Unfortunately, in the years after the 9/11 terrorist attacks, emergency preparedness education assessment largely focused on practicing physicians and not trainees (14–17).

In 2003, the Association of American Medical Colleges (AAMC) and the Institute of Medicine published reports encouraging the early introduction of bioterrorism topics in medical school. The AAMC report, "Training Future Physicians about Weapons of Mass Destruction," was the first to detail a vertical integration of bioterrorism curricula into all 4 years of medical education (18). In response to these reports, medical schools increased the attention paid to bioterrorism topics. In 2004, 104 of 125 US medical schools reported that "Biological/Chemical Terrorism" was included in one or more required medical school courses (19).

Yet, US medical schools have been slow to develop stand-alone curricula that capture the academic breadth of disaster medicine. For example, a search of the AAMC Course Details Database using the terms "disaster," or "preparedness," or "casualty," or "bioterrorism," or "triage" revealed only two courses with any of the above terms in their titles (20). And, with the exception of the notable work of some of our public health educators—for example, those at Columbia University—few medical schools have defined and implemented core competencies for all health professionals in Emergency Preparedness such as those recently advocated by the American Medical Association's Expert Working Group (21).

Research suggests that health care worker training programs lack clarity, objectivity, competency-driven goals, scientific rigor, prospective validation, and consistency across medical specialties (21,22). This is particularly true regarding disaster training for medical students. In our review of the literature, we found only two published articles focusing on the feasibility and efficacy of implementing disaster training to medical students (23,24). Both focus solely on preclinical medical education (i.e., the first and second medical school years), only one study implemented performance-based training in the study design, and neither study included a pretest or post-test to gauge efficacy.

To address this research and training gap, we developed a novel 3-h educational demonstration project and evaluated its effectiveness in teaching medical students a few key concepts of disaster medicine, including aspects of incident command, self-preservation, and medical response. The project was conceived by the Division of Emergency Medicine after it was observed in September 2007 that most of the graduating medical students had not participated in a mass casualty drill nor had they received significant emergency preparedness training. Using a pretest/post-test design combined with performance-based training exercises, we measured the extent to which 4th-year medical students perceive, rapidly learn, and apply basic concepts of disaster medicine and emergency preparedness.

METHODS

In an effort to introduce concepts of disaster medicine without the necessity of seeking university approval for a new course or changing an existing curriculum, an application was submitted to the Office of Medical Education to offer a disaster medicine course as part of "Internship 101." Internship 101 is designed to prepare 4th-year medical students for their first days as practicing physician interns. It is composed of dozens of 3-h elective courses that students select based on availability and personal preference. Our application for "Disaster 101" was accepted in October 2007 with a maximum capacity of 50 students and first scheduled during the 2008 Spring semester.

Between January and March 2008, a novel curriculum was developed via a multistage process. First, we partnered with the South Carolina Area Health Education Consortium (SC AHEC), who assisted with grant funding, materials, and training expertise. An expert panel in disaster medicine and curriculum design was convened, consisting of four Emergency Medicine faculty physicians, emergency medical technicians, law enforcement, education, and preparedness training experts from the SC AHEC. The primary goal of the expert panel was to condense dozens of hours of existing didactic material and drills into 3 h. The group met three times before the scheduled class date. The primary questions asked of the expert panel were "What concepts do 4th-year medical students need to know about disaster medicine?" and "What can be effectively taught to medical students in one class period?"

Utilizing lessons learned from the SC AHEC, the expert panel decided: 1) the didactic component should be case-based so students could recognize the relevance of disaster medicine knowledge and clinical skills no matter where they went into practice; 2) course content should be directed toward a general medical trainee so it could develop into an interdisciplinary experience; and 3) one-half of the time allotment should be dedicated to

Table 1. Disaster 101 Competency Domains

Disaster Definition/Incident Command (ICS)
Personal Safety
Disaster Communications/Role of Public Spokesperson/Community Wellness
Personal Protective Equipment (PPE)
Triage
Extrication and Patient Transportation
Mass Decontamination
Recognition and Treatment of Toxic Syndromes

performance-based training. Via a modified Delphi technique, the panel pared down numerous disaster medicine and emergency response competencies and competency domains to eight (Table 1).

Once the competency domains were established, the expert panel developed the didactic and performance-based curriculum objectives, a fictional disaster scenario, a slide set, and a pre-/post-test. Performance components of the hazardous materials (HAZMAT) and mass casualty incident (MCI) exercises had been vetted by the SC AHEC during similar educational exercises with community-based physicians. Competencies and objectives were arranged to accommodate the course's 3-h scheduled time limit (Table 2).

Running concurrent with the curriculum development process was logistical planning. The MCI exercise required meetings and facility tours to establish a safe site for trainees, HAZMAT equipment, and mannequins. University officials, including those from the Office of the President, the Board of Trustees, the Office of the Dean, Medical University Hospital Disaster Preparedness Committee, and Parking, were made aware of our plans to reduce logistical and public relations problems. Public Safety assisted in cordoning off the area, and Public Affairs actively participated to ensure appropriate media coverage of the event.

Table 2. Disaster 101: Final Course Curriculum

90-minute lecture: case scenario
Consent and Pretest
Disaster Definition/Incident Command (ICS)
Personal Safety and Personal Protective Equipment (PPE)
START Triage
Recognition and Treatment of Toxic Syndromes
Post-test
40-minute Hazardous-material Exercise
Personal Safety and Personal Protective Equipment (PPE)
Mass Decontamination
Recognition and Treatment of Toxic Syndromes
40-minute Mass Casualty Incident (MCI) Exercise: 100 Mannequins
Competency Assessment of START Triage

START = Simple Triage and Rapid Treatment.

Figure 1. Students participating in the HAZMAT scene training scenario.

The fictional case and a brief overview of appropriate responses, both at the scene and at the receiving hospital, were presented by content experts in a traditional lecture format. The case involved an overturned truck on a rural, two-lane highway with a possible chemical exposure and multiple victims. After the 90-min lecture component, students went outside to be greeted by five tactical emergency medical services professionals who divided them into two groups: one group dressed in HAZMAT suits and participated in a simulated chemical spill victim decontamination (Figure 1), whereas the other group participated in the MCI drill that required them to rapidly triage 100 life-sized inflatable mannequins tagged with physical parameters indicating respiratory, circulatory, and mental status parameters (Figures 2, 3). After about 40 min, the student groups switched exercises.

Figure 2. Students transporting an inflatable mannequin, tagged with vital signs and clinical information, to a triage station during the MCI training scenario.

Figure 3. MCI triage station for "delayed" patients.

Due to time constraints, "Disaster Communications" and "Extrication and Patient Transportation" were eliminated from the exercise, and "Personal Safety" and "Personal Protective Equipment" (PPE) were combined. In addition, the START (Simple Triage and Rapid Treatment) system was the only triage paradigm discussed and demonstrated.

The pretest/post-test and course evaluations assessed student attitudes, appreciation, and knowledge of the disaster curriculum. The test developed by the expert panel was limited to seven multiple-choice questions that assessed knowledge of basic disaster medicine concepts. The course evaluation was a standard College of Medicine course questionnaire. The percentage of correctly tagged mannequins during the MCI drill was used to assess learning of the practical aspects of the START system.

All students signed a "Consent and Waiver" prior the course. To enhance the learning experience, it was decided that the students would not be informed about the hazardous material or MCI scenarios before the lecture, but that they would be given an opportunity to decline participation if they did not feel comfortable with the exercise. The project was approved by the University Institutional Review Board.

RESULTS

The course was offered in the spring semesters of 2008 and 2009. Thirty-five 4th-year medical students were in the first class offering and 33 participated in the second offering. All students consented to full participation before the course. Students in the 2008 class took the pretest to survey basic knowledge and assess learning of the didactic material immediately before the 90-min case-based lecture, and the post-test immediately after the lectures. The 2009 class could take the pretest via an e-learning tool up to several days before the class, and the post-test was available online for 3 weeks after completion of the course. Thirty (86%) students completed the post-test in 2008 and 31 (94%) completed the post-test in 2009.

In 2008, the average of the students' post-test scores improved by 48%, with 39% correct on the pretest and 58% on the post-test. In 2009, post-test scores improved by 21%, with an average of 47% correct on the pretest and 57% correct on the post-test. In 2008, students participating in the MCI drill correctly tagged 94% of victims in approximately 10 min time. In 2009, students participating in the MCI drill correctly tagged 90% of victims in the same time period. In a post-course evaluation, students were asked to rate their knowledge of disaster medicine both before and after the course. In 2008, before the didactic program, the students rated their overall knowledge as 3.76/10 (below average to average) compared to 7.64/10 (average to above average) after the didactic program. In 2009, the students rated their overall knowledge as 2.52/5 (average) before and 3.76/5 (above average) after the didactic program. In 2008, the average overall rating for the experience was 4.85/5, and 100% of the respondents recommended the class for next year's students. In 2009, the course evaluation did not have an average overall rating. When asked if they would recommend Disaster 101 to next year's students, three students responded neutrally, 14 students agreed, and 16 students strongly agreed that the class should be recommended to next year's students.

DISCUSSION

Terrorist attacks, weapons of mass destruction, the threat of pandemic influenza, and the recent devastating impact of natural disasters have fostered growth in emergency and disaster preparedness training for US health care workers. The Joint Commission now requires all hospitals that provide "emergency services" to perform annual community-wide disaster drills (25,26). In October of 2007, President Bush signed Homeland Security Presidential Directive 21 calling for the dissemination of disaster medicine education and training in public health fields (27). In 2008, Health and Human Services announced they would provide $398 million to states through the Hospital Preparedness Program to help hos-

pitals improve "surge capacity" and train workers for mass casualty events (28).

Although some progress has been made, disaster medicine and emergency preparedness remain peripheral components of traditional medical education in the United States. Of the many common obstacles encountered by educators when attempting to implement or change medical school curricula, the availability of time and the allocation of money are often cited (10).

We believe the principle of a highly effective and well-received medical student course that can be easily added to a university curriculum has been demonstrated here. The three major indicators for success of our course were the pretest vs. post-test grades, course evaluations, and MCI exercise performance. Increases of 48% and 21%, in 2008 and 2009, respectively, were seen in the scores between the pretest and post-test.

The second indicator was the course evaluation. In this evaluation, the students rated the course as a 4.85/5 in 2008. Unfortunately, due to a new computerized evaluation system used in 2009, no overall rating was used by the students to rate the course. However, in both years, students were enthusiastic about recommending the course to the next year's 4th-year medical students, as seen by the 100% of 2008 students recommending the course, and 91% in 2009 saying that they agree or strongly agree that the course should be recommended to next year's students, with no students saying that they disagree with recommending the class to students the following year.

Finally, the results of the MCI exercises indicate that after the didactic portion of the course, students are able to apply the material learned to a training scenario. Recognizing that a full-scale MCI drill or actual mass casualty incident requires more training in the aspects of incident management, advanced triage, and medical response, this brief hands-on experience demonstrated that the students applied the basics of a simple triage system with some precision.

Limitations

The number of students observed in this educational demonstration project was small and, as a result, the study's conclusions are not easily generalized. Measuring competency is inherently difficult, but even more difficult when well-validated standards for disaster medicine are not available. Our pretest/post-test was short to accommodate time constraints and its brevity may have limited our study's ability to measure students' knowledge accurately. We were not able to assess long-term recall of the data largely because we had difficulty contacting students after they graduated. We also recognize that providing the same questions to students before and after the didactics can confound the knowledge of the material with knowledge of the test. Although statistically sophisticated testing would have been preferable, it was not practicable, nor do we feel it necessary to demonstrate the efficacy of our novel curriculum in this unique academic setting.

We recognize that student answers to our question regarding self-knowledge may reflect the student's comfort with the topic as opposed to knowledge, but the self-rated assessments were in agreement with the findings of the pretest/post-test scores. Also, we attempted to measure performance using the percentage of accurate patient triage during the MCI drill. Our evaluation of triage skills was not an accurate measure of the comprehension and retention of the didactic training material, as there was no "pre" evaluation of the students' triage skills. Although this was the most accessible methodology available, it is a relatively simplistic measure that in future studies could be replaced by video reproduction or computer simulation for competency review.

When using the course evaluations to measure value of the course as perceived by the students, comparison against the other "Internship 101" courses would be beneficial. Unfortunately, we did not have access to these evaluations.

CONCLUSION

This project revealed that senior medical students value and can rapidly apply core concepts of disaster response. We believe the principle of a highly effective and well-received medical student course that can be easily added to a university curriculum has been demonstrated. To validate core competencies and performance-based education goals for US health professional trainees, medical schools should consider novel approaches to incorporating disaster medicine into existing curriculum.

Acknowledgment—Kristin Caldwell Cochran, BBA, is acknowledged for her assistance with the administration and planning of the 2008 and 2009 Disaster 101 courses.

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ARTICLE SUMMARY

1. Why is the topic important?

The project outlines a significant research and training gap in disaster medicine, namely, emergency preparedness competencies for health professional trainees. Although some progress has been made, disaster medicine remains a peripheral component of traditional medical education in the United States and is a rarely published research topic in the medical literature.

2. What does this study attempt to show?

Using a pretest/post-test design combined with performance components, we measured the extent to which 4th-year medical students perceive, rapidly learn, and apply basic concepts of disaster medicine and emergency preparedness.

3. What are the key findings?

The results of this educational demonstration project reveal that students will value and can rapidly learn some core elements of disaster medicine and emergency preparedness via a novel addition to a medical school's curriculum.

4. How is patient care impacted?

Patient care is not directly impacted by the results of this study. However, we believe that the principle of a highly effective and well-received medical student course that can be easily added to a university curriculum has been demonstrated. To validate core competencies and performance-based education goals for US health professional trainees, medical schools should consider novel approaches to incorporating disaster medicine into their existing curriculum.