ORIGINAL RESEARCH

Integrated Decision-Making in Response to Weapons of Mass Destruction Incidents: Development and Initial Evaluation of a Course for Healthcare Professionals

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Abbreviations:
ACEP = American College of Emergency Physicians
EMS = emergency medical services
MSEL = Master Scenario Events List
OEP = Office of Emergency Preparedness
USPHS = United States Public Health Service
WMD = weapons of mass destruction

Abstract

Introduction: Standardized, validated training programs for teaching administrative decision-making to healthcare professionals responding to weapons of mass destruction (WMD) incidents have not been available. Therefore, a multidisciplinary team designed, developed, and offered a four-day, functional exercise, competency-based course at a national training center.

Objective: This report provides a description of the development and initial evaluation of the course in changing participants' perceptions of their capabilities to respond to WMD events.

Methods: Course participants were healthcare professionals, including physicians, nurses, emergency medical services administrators, hospital administrators, and public health officials. Each course included three modified tabletop and/or real-time functional exercises. A total of 441 participants attended one of the eight course offerings between March and August 2003. An intervention group only, pre-post design was used to evaluate change in perceived capabilities related to administrative decision-making for WMD incidents. Paired evaluation data were available on 339 participants (81.9%). Self-ratings for each of 21 capability statements were compared before and after the course. A 19-item total scale score for each participant was calculated from the pre-course and post-course evaluations. Paired *t*-tests on pre- and post-course total scores were conducted separately for each course.

Results: There was consistent improvement in self-rated capabilities after course completion for all 21 capability statements. Paired *t*-tests of pre- and post-course total scale scores indicated a significant increase in mean ratings for each course (all $p < 0.001$).

Conclusion: The tabletop/real-time-exercise format was effective in increasing healthcare administrators' self-rated capabilities related to WMD disaster management and response. Integrating the competencies into training interventions designed for a specific target audience and deploying them into an interactive learning environment allowed the competency-based training objectives to be accomplished.

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Introduction

In the aftermath of a disastrous event, hospitals can expect to become central gathering places not only for casualties, but also for concerned family and friends, media personnel, and an anxious public. During this period, the dangers and unknowns brought on by the emergency and the massive influx of people, quickly can strain or overwhelm the leadership skills of community and hospital decision-makers in areas imperative to an efficient response. These critical response areas include: (1) incident command; (2) triage; (3) patient

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flow; (4) communication; (5) proper reporting to other agencies; and (6) security.[1]

One strategic element for long-term improvements in workforce preparedness for health-related emergency response is designing an integrated learning delivery system based on identified competencies. Use of competencies is considered essential in achieving training efficacy, yet there is a lack of published evidence of the effectiveness of such programs.[2–4] Standardized, validated training programs to teach administrative decision-making to healthcare professionals responding to weapons of mass destruction (WMD) incidents have not been available. To meet this goal, a multidisciplinary team designed, developed, and offered a series of competency-based courses entitled "Healthcare Leadership and Administrative Decision-Making in Response to WMD Incidents." This report provides a description of the development and initial evaluation of this competency-based course in changing participants' perceptions of their capabilities to respond to WMD events.

Methods

Course Development

The initial goals of the multidisciplinary development team were to: (1) define the target populations of participating healthcare professionals to produce an effective, community-based response, with an emphasis on hospital-based activities; (2) to identify key learning objectives for these healthcare professionals; and (3) to provide a unique problem/exercise-based experience for participants that maximized learning about decision-making for WMD incidents. Implicit in these early stages of course development were broad-based discussions with stakeholders. These stakeholders included physicians from various specialties, hospital-based nurse managers and administrators, hospital administrators, emergency medical services (EMS) administrators, who would determine prehospital responses and community reorganization, and public health officials, who would provide a vital linkage to the public health workforce during significant WMD incidents.

Decisions about incorporation of various learning elements were derived through a consensus-building model, with iterations obtained using a national feedback model. Two initial practice runs were performed internally amongst the developmental group during the fall of 2002. Two additional iterations were piloted over the next three months, using a national audience of invited participants from professional associations, societies, and organizations. Eight public course offerings occurred between March and August 2003.

Course Description

All practice runs and course offerings took place at a deactivated 100-bed US Army hospital acquired by the United States Public Health Service (USPHS). Training facilities included two floors of the hospital with general wards, intensive care unit, and operating room, an 11-bed emergency department, EMS administrative offices, a hospital conference room that also served as a hospital incident command center, two decontamination units, and several classrooms. The setting simulated a current, prototypical, small community hospital in the US, and provided a realistic environment for the live exercises without disrupting the schedule of an actual hospital.

Employees of the USPHS selected participants from interested applicants. Preference was given to small teams from willing communities that included individuals representing physician, nursing, hospital, EMS, and public health leadership. All expenses for travel and accommodation were provided by the USPHS.

Each course lasted four days and included three modified tabletop and/or real-time, functional exercises. On Day 1, participants were given an orientation to the training center and classroom instruction on incident command systems. They also received their functional group assignments: ED, EMS, nursing unit managers, hospital administrators, or public health.

On the morning of Day 2, participants were assigned to mixed functional groups to participate in Exercise 1, a modified tabletop exercise based on a scenario involving a chemical explosion with resulting plume dissemination that overwhelmed the community's response resources. In the afternoon of Day 2, participants reported to their functional areas (i.e., emergency department, EMS office, hospital administration office/conference room, nursing unit, public health office) and participated in Exercise 2, a real-time, functional exercise during which students were asked to step into the morning's exercise at a point where the influx of patients had subsided. As they fell into the roles they had observed in the modified tabletop exercise of the morning, a second explosion occurred, resulting in a significant, multiple-casualty incident.

On Day 3, participants completed Exercise 3, a ten-hour, real-time, functional exercise based on a scenario involving a covert, biological event. Exercises 2 and 3 were tailored to address performance statement competencies focusing on five main areas: (1) incident recognition; (2) communication; (3) effective decision-making; (4) integration/management of resources; and (5) response/recovery roles.[5,6] On Day 4, participants took part in debriefing sessions, attended additional lectures, and received take home materials.

A Master Scenario Events List (MSEL) was created for all three exercises for the instructors, coordinators, and exercise controllers to use as a guide. Each MSEL contained a time-sensitive script of the precise events/interjections that would drive the exercise, including summaries of media clips broadcast inside the fictitious hospital during the exercise, a detailed list of patient interjections that would present to the hospital emergency department, and facilitated discussion topics.

The course development phase was a continuous process. Although objectives remained unchanged, active contemporaneous feedback from participants about the curriculum, instructor proficiency, and logistics provided critical information for further course refinement. Participants were asked to rate the quality and content of each speaker/presentation and effectiveness of each exercise as each session was completed. The faculty used the evaluations to determine if changes needed to be made in future sessions and to make improvements for the next course.

	ABILITY TO	n	Mean Pre-Course	SD Pre-Course	n	Mean Post-Course	SD Post-Course
1	differentiate between the public health role and medical community's role in emergency response to WMD events	330	2.92	0.91	333	3.91	0.73
2	relate the fundamentals of an incident command system, including HEICS, and its importance to a successful response to a WMD event	338	2.79	1.04	334	4.13	0.66
3	describe the various roles, responsibilities, and alternative resources of the entities that may respond to a WMD or mass casualty incident	338	2.75	0.87	339	3.93	0.64
4	outline effective communications and information-sharing strategies that are useful in managing the healthcare/medical community response to WMD events	339	2.63	0.84	338	3.93	0.68
5	recognize healthcare facility infra-structural issues that could confront managers in the event of a community WMD event	337	2.82	0.84	336	4.08	0.72
6	effectively respond to a scenario that poses multiple attacks and agents	338	2.50	0.88	339	3.88	0.71
7	describe the types of resources available to the local community from state, regional, and federal agencies	337	2.63	0.93	337	3.68	0.76
8	construct process to request resources from State, Regional and Federal agencies	337	2.32	0.09	335	3.53	0.86
9	differentiate between the Federal "crisis" and "consequence" responses	339	2.12	0.94	338	3.56	0.92
10	implement effective stress management strategies for healthcare institutions related to WMD events	338	2.41	0.85	336	3.56	0.79
11	initiate effective communications and information-sharing processes among various response entities during a WMD event	338	2.55	0.83	339	3.89	0.65
12	design effective leadership and administrative strategies to manage situations and related extraordinary complications of WMD events	338	2.47	0.84	338	3.82	0.73
13	adapt facility infra-structure and resources to meet the challenges of the WMD events situation	338	2.51	0.84	339	3.77	0.73
14	construct a plan for decontamination of ambulatory and non-ambulatory patients	262	2.87	1.10	308	3.89	0.85
15	compare and contrast the differences between the "crisis" and the "consequence" phases of the Federal Response Plan	338	2.08	0.90	338	3.49	0.86
16	develop a plan to address the long-term needs that should be anticipated in a large scale, community disaster resulting from a WMD incident	339	2.29	0.89	338	3.68	0.75
17	explain the Federal "consequence" management resources available to the local community	338	1.99	0.83	336	3.32	0.88
18	outline potential issues and barriers that the healthcare community may face as they begin the process of "returning-to-normal" in a WMD event	338	2.38	0.80	338	3.80	0.73
19	generate a plan to effectively manage the deceased and their remains resulting from a WMD event	338	2.20	0.81	338	3.59	0.92
20	integrate the role of the volunteers and pastoral services in the organization plans for WMD response	338	2.45	0.85	338	3.66	0.86
21	revise the facility EOP for response to a WMD event	301	2.39	0.90	305	3.78	0.79

Table 1—Healthcare Leadership and Administrative Decision-Making in Response to WMD Incidents: Pre- and post-course ratings for capability statements (EOP = emergency operations plan; HEICS = hospital emergency incident command system; n = number; SD = standard deviation; WMD = weapons of mass destruction)

	Course participants (n = 414)		Course participants (n = 414)	
	n	(%)	n	(%)
Gender				
Female	176	(42.5)	155	(45.7)
Male	210	(50.7)	179	(52.8)
Not reported	28	(6.8)	5	(1.5)
Age Range (years)*				
20–39	102	(24.6)	92	(27.1)
40–49	137	(33.1)	117	(34.5)
50–59	114	(27.5)	99	(29.2)
60+	14	(3.4)	13	(3.8)
Not reported	47	(11.4)	18	(5.3)
Professional Group*				
Nurse	143	(34.5)	122	(36.0)
Physician	68	(16.4)	49	(14.5)
EMS personnel	62	(15.0)	49	(14.5)
Other	123	(29.7)	102	(30.0)
Not reported	18	(4.3)	17	(5.0)

Table 2—Demographic characteristics of course and evaluation study participants (*Percentages may not sum to 100 due to rounding) (EMS = emergency medical services)

Core course faculty members remained consistent across all eight courses, and the rotating junior faculty members and coordinators were pulled from a pool of trained individuals. Exercise controllers, with extensive experience in the applicable disciplines, as well as exercise control practices, were utilized to manage the real-time, functional exercise. This enabled the instructors to adapt and evolve the exercise with each set of participants. Their work was aided significantly through the use of real-time video and audio monitoring and recording technologies that enabled direction of the exercises (e.g., selection and timing of interjections) from a central control room.

Course Evaluation

The project evaluation methodology was two-fold: (1) to assess the participants' ratings of each session/exercise; and (2) to assess baseline pre-course and post-course perceived capabilities and competencies. For the latter evaluation component, a specific investigation was conducted using an intervention group only, repeated measures (pre-post) design. The study population consisted of all participants attending one of the eight course offerings between March and August 2003. The study received approval from the local university Institutional Review Board for Human Use.

Evaluation packets were distributed to participants on Day 1 and included a student data form, evaluation forms for individual activities and the overall course, and the pre- and post-course perceived capability assessment forms. Participants were asked to identify themselves on the capability forms, but were told that this information would be used only to match responses and demographic information for data entry. Participants completed the pre-course capability assessment and student data sheets on Day 1 and the post-course capability assessment at the end of Day 4.

The individual exercise/activity evaluations and overall course evaluation were developed using a quality improvement framework.[7] The capability/competency evaluation tool was derived from the course objectives and from the competencies identified in the Office of Emergency Preparedness (OEP) and American College of Emergency Physicians (ACEP) Final Report that corresponded to the course objectives.[5] The competency evaluation tool was reviewed by an expert panel of physicians, nurses, and hospital administrators for validity of the competencies that would be expected of healthcare professionals during a WMD event. The tool was revised based on the panel review input, and then, was pilot tested with the participants in the initial pilot session. The participants in this pilot session were asked to indicate which items were unclear. Most of the modifications that were made at this point were related to specific terminology.

The final instrument contained 21 capability statements (Table 1). For each of the capability statements, participants rated their ability to perform that task on a scale of 1

Course	n	Pre-course Mean (SD)	Post-course Mean (SD)	Change in score Mean (SD)	paired *t*-values*
1	29	43.3 (13.7)	72.1 (9.5)	28.7 (14.2)	10.92
2	28	45.8 (13.6)	72.0 (10.5)	26.3 (10.9)	12.73
3	26	49.5 (11.5)	71.8 (10.1)	22.3 (12.9)	8.83
4	28	51.1 (14.5)	74.8 (12.6)	23.7 (12.8)	9.81
5	39	47.7 (10.9)	67.5 (9.6)	19.8 (12.0)	10.33
6	61	47.8 (11.6)	74.2 (10.1)	26.4 (11.6)	17.87
7	49	43.6 (12.2)	71.8 (9.6)	28.1 (12.7)	15.45
8	38	48.5 (10.4)	68.2 (8.6)	19.7 (10.3)	11.78

Table 3—Pre- and post-course 19-item Capability Scale total scores by course (*p <0.0001; SD = standard deviation)

to 5, with 1 indicating "poor" ability, 3 indicating "adequate" ability, and 5 indicating "excellent" ability. Nineteen of the capability statements were evaluated for all eight courses and these statements formed the basis of the summary scores used to compare capability assessments across courses. Two statements (#14: decontamination in ambulatory care, and #21: revision of the emergency operations plan) were additions to the original form and were evaluated only during the final six courses.

Analyses were performed using SAS 8.2 (SAS Institute, Inc., Cary, North Carolina) and SPSS 11.5 (SPSS, Inc., Chicago, Illinois) statistical software packages. Demographic data were evaluated as counts and percentages. Wilcoxon-signed ranks tests were used to compare the change in pre- and post-ratings for each capability statement across all eight courses. Summing the ratings for the 19 items that were evaluated in all courses created a summary capability scale measure for each participant. A total scale score for each participant was calculated from the pre-course and post-course assessments. Paired *t*-tests on pre- and post-course total scores were conducted separately for each course.[8]

Results

A total of 414 participants were involved in the eight courses. Paired evaluation data were available on 339 (81.9%) participants, and these subjects formed the sample for the current report. Table 1 shows the characteristics of the 414 course participants and 339 study participants. Nurses (ED staff, unit mangers, or administrators) formed the largest category of participants in both groups. The participant mix varied between courses for the study sample. For example, in Course 3, the number of nurses and physicians and their percentages of participants within the course were similar [5 (17.9%) vs. 6 (21.4%) respectively], while in Course 8 there were seven times more nurses than physicians [28 (58.6%) vs. 4 (7.8%)].

The mean values for pre-course (baseline) and post-course ratings across subjects for all 21 capability statements are in Table 2. All baseline mean values were <3, indicating self-rated capabilities as less than adequate. Three capability statements related to federal "consequence" management (#9, #15, #17) had over 70% of the participants self-rating as 1 or 2 at baseline. All post-course mean values were >3, indicating self-rated capabilities as more than adequate. Eleven of 21 items had no participants self-rating at 1 (poor) after completing the course. In contrast, the percentage of participants self-rating at 5 (excellent) ranged from to 8.9% for Item #10 (implementing stress management interventions) to 28.3% for Item #5 (recognizing infra-structural issues) on the post-course evaluation. The Wilcoxon signed ranks test results were significant for all 21 items (all p-values <0.0001), with post-course ratings significantly higher than pre-course ratings. For 17 of 21 capability statements, at least 75% of participants demonstrated a one point or greater increase in self-rated capability.

Examining ratings by participants, responses for the 19 items evaluated in all courses were summed to create a total scale score. Overall scale reliability was assessed using Cronbach's alpha and was >0.94 at both pre- and post-course administration times.[9] The mean values for the pre-course and post-course capability ratings for each course are in Table 3. Paired *t*-tests of pre-course and post-course total scale scores for each course considered separately indicated a statistically significant increase in mean ratings (all p <0.001).

Discussion

This course was the first to offer real-time-exercise, competency-based training in WMD incident response that specifically targeted healthcare administrators from various disciplines. The course capabilities/competencies were designed specifically to reflect administrative functions, in particular strategic planning. The need for such training for decision-makers was highlighted in the evaluation of the first TOPOFF exercise.[10]

Central to the development and evaluation of the course were the competencies identified for this target audience. These competencies were derived from the OEP and ACEP Final Report.[5] The authors of that report identified awareness and performance objectives related to training of

healthcare providers for mass-casualty incidents. Their report also delineated levels of proficiency needed based upon occupation and level of training and identified potential barriers to this education. The training modules for this course (including orientation, exercises, and lecture/discussions) were designed to meet specific objectives, and course content was refined continually based upon how well these objectives were being met.

The course objectives were supported by a recent report of a tabletop exercise conducted within a Pennsylvania hospital system.[11] In that study, participants were asked to rate specific goals of participation in the exercise. The top-rated objectives included improving knowledge related to the hospital disaster plan, communication plan, and availability of resources. Physician/nurse participants rated increasing knowledge related to pre-incident planning as most important. These content areas all were components of the capability statements used in this course.

At baseline, the three lowest-rated capability statements were related to federal consequence management. This suggests that federal-level planners may need to increase dissemination of information in this area, in particular, the types of resources available at the federal level. The highest rated capability statement post-course (#2) related to discussion of the incident command structure, not surprising since this content was provided in lecture format and participants subsequently applied the content in several exercises.

The capability statements were rated at baseline and at the completion of the course, but no long-term, follow-up data were collected to evaluate sustainability. Researchers at the University of Washington found that training in WMD content does produce sustainable knowledge gains at four months post-education among first responders, and that such training can produce significant improvements in self-assessed capabilities to respond to WMD incidents.[12] Their study did not examine whether this increase in knowledge and perceived competency would be predictive of actual performance in a WMD incident. Likewise, this evaluation did not address whether the perceived changes in capabilities were translated into actual outcomes at the participants' institutions, i.e., as revisions to the emergency operation plan or facility adaptations to improve response to WMD events. This represents the next step in the evolution of training—translation of knowledge into action.

Another important feature of this course was the real-time exercise format. Training for first responders in urban centers using this format has been ongoing for some time through federal programs funded by the Defense Against Weapons of Mass Destruction Act of 1997.[13] In addition, various reports have been published on tabletop or live-exercises done at the local, regional, and national level.[1,4,10,11,14] The goal of many of the exercises was to assess system-level response capabilities rather than the preparedness of individual responders. Further work is needed to evaluate the effectiveness of training using live or real-time exercises in improving individual-level performance as it relates to mass-casualty incidents.

One of the unique design elements of the course was interaction between a mix of professions, including EMS, emergency department, nursing unit, and administrative personnel. Anecdotal reports suggest that this opportunity to experience the response to mock WMD incidents from the perspectives of outside and inside the hospital provided participants with new insight into the importance of effective collaboration and communication between stakeholders.

The current investigation is subject to several limitations. Course development continued during the implementation phase based on feedback from participants, as well as faculty, related to the individual scenarios and presentations. While there was global continuity in objectives and content areas across the eight courses, because of the interactive nature of the course, the scenarios did not play out identically. In addition, the size of the courses and differences in the mix of professions also may have influenced the process. For the later course offerings, the maximum size of the course was increased to meet the demand for enrollment. The overall evaluation data presented here do not address these qualitative differences between courses. Therefore, the summary data presented in Table 1 should be interpreted as crude assessments of change in perceived capabilities.

Another factor potentially affecting responses is that the hospital in the scenarios was a small community hospital, but many participants were from larger health systems. Some participants, in particular, the nurse managers, were role-playing in a function or functional group different than their usual work role. While this provided fresh insight into various roles for some, other participants said the actual response to a similar WMD event in their own facility would be very different.

A potential source of bias in responses is that participants wanting to either demonstrate improvement or provide desirable responses to faculty may have inflated their post-course ratings. As a counter to that argument, course faculty noted that these healthcare administrators typically were quite forthcoming in their verbal and written feedback on all aspects of the course. Indeed, it was this candid feedback that allowed continued refinement of the course.

Conclusion

In spite of the limitations, the tabletop/real-time exercise format used in this course was effective in increasing healthcare administrators' self-rated capabilities related to WMD disaster management and response. There was consistent improvement in self-rated capabilities after completion of the course. Integrating the competencies into training interventions designed for the specific target audience, and then, translating them into an interactive learning environment allowed the competency-based course objectives to be accomplished. Further work is needed to identify those basic or core competencies appropriate for healthcare personnel with non-administrative requirements in responding to a WMD incident and to substantiate the effectiveness of real-time, functional exercise training in producing sustainable changes in both perceived performance capabilities and in actual performance.

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THE WORLD ASSOCIATION FOR DISASTER AND EMERGENCY MEDICINE

Requests Input and Expressions of Interest in the Development of Regional Chapters

The World Association for Disaster and Emergency Medicine (WADEM) is an international, humanitarian association dedicated to the improvement of disaster and emergency medicine. Its Board of Directors, pursuant to decisions of the Board made at Edinburgh, Scotland, May, 2005, hereby offer the designation of WADEM Chapters to nation-states, nation-state provinces or individual states, regional organizations and recognized healthcare societies of these entities who share the mission and dedication of WADEM.

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