

Pilot study of a longitudinal integrated disaster and military medicine education program for undergraduate medical students

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Abstract

Disaster medicine education in medical curricula is scarce and frequently nonexistent. It is reasonable to initiate educational approaches for physicians in this field at the medical school level. An understanding of disaster medicine and the health care system during massive casualty incidents has been recommended as an integral part of the medical curriculum in the United States and Germany.

The goal of the reformed curriculum was to develop a longitudinal integrated disaster and military medicine education program extending from the first year to the sixth year based on previously separated clinical and military medicine topics. Emergency medicine physicians, military emergency medical technicians, and Tactical Combat Casualty Care instructors formed an interprofessional faculty group and designed a learning curriculum.

A total of 230 medical students participated in the revised disaster preparedness curriculum. Satisfaction survey response rates were high (201/230, 87.4%). Most of the free-text comments on the program were highly appreciative. The students considered the number of teaching hours for the whole program to be adequate. The students showed significant improvements in knowledge and judgment regarding disaster medicine after the program.

We found that medical students were highly interested, were appreciative of, and actively participated in this longitudinal integrated disaster and military medicine education program, but gaps existed between the students' scores and the educators' expectations. The educators believed that the students needed more disaster preparedness knowledge and skills.

Abbreviations: CBRNs = chemical, biological, radiological, and nuclear incidents, EMT = emergency medical technician, MCIs = mass casualty incidents, MCQs = multiple-choice questions, MND = Ministry of National Defense, TCCC = Tactical Combat Casualty Care.

Keywords: disaster medicine, mass casualty incident, medical education, military medicine

1. Introduction

Modern health systems must respond to a wide variety of catastrophic scenarios covering the breadth of disaster medicine, including emerging infectious disease outbreaks, terror attacks,

and natural disasters.^[1] Effective preparation for, response to, and recovery from disasters require a well-planned, integrated effort involving experienced professionals who can apply specialized knowledge and skills in critical low-resource situations.^[2] An understanding of disaster medicine and the

Editor: Johannes Mayr.

C-YC and S-HT contributed equally to this work.

Funding: This study was supported by a grant from the Tri-Service General Hospital of the National Defense Medical Center and National Defense Medical Center and Ministry of National Defense, Taipei, Taiwan (MAB-108-018), and the Ministry of Science and Technology (MOST 108-2314-B-016-047-MY3).

The authors have no conflicts of interest to disclose.

Supplemental Digital Content is available for this article.

All data generated or analyzed during this study are included in this published article [and its supplementary information files]

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How to cite this article: Tsai YD, Tsai SH, Chen SJ, Chen YC, Wang JC, Hsu CC, Chen YH, Yang TC, Li CW, Cheng CY. Pilot study of a longitudinal integrated disaster and military medicine education program for undergraduate medical students. *Medicine* 2020;99:20(e20230).

Received: 29 January 2020 / Received in final form: 7 April 2020 / Accepted: 8 April 2020

<http://dx.doi.org/10.1097/MD.00000000000020230>

health care system during mass casualty incidents (MCIs) is vital to a successful disaster response and has been recommended as an integral part of the medical curriculum by the Association of American Medical Colleges.^[3] In Germany, federal laws have been enacted requiring medical students to be familiar with disaster medicine principles.^[4] However, while physicians of all specialties may respond in emergencies, disaster medicine training is minimal or nonexistent in most medical school curricula in the United States.^[2,5] The military always has needs related to MCIs and chemical, biological, radiological, and nuclear incidents. A military background makes trainees better educated and prepared for disaster situations than their civilian fellow trainees and students.^[6,7] Both medical experts and students recommend disaster medicine education for undergraduate medical students, but the applicability and feasibility of implanting this training remain to be determined.^[8,9] In a survey conducted in medical schools in the United States, only 17.2% of medical students believed that they were receiving adequate education and training regarding natural disasters.^[10] It is reasonable to initiate educational approaches for physicians in this field at the medical school level, particularly in a military medical school. An approach combining civilian disaster medicine and military deployment medicine can be beneficial both for clinical strategies and in undergraduate teaching.^[11] A longitudinal curriculum provides continuity in the learning environment, integrates educational themes across clinical specialties and focuses on the development of appropriate competencies.^[12,13] Though several topics relevant to emergency response, preparedness, and disasters have been addressed

independently in previous curricula, we thought that integrating those essential elements into a longitudinal integrated disaster and military medicine program could have a positive influence on the preparation of military medical students.

Therefore, we aimed to develop a revised longitudinal disaster and military medical education program and evaluate it in a sample of undergraduate medical students attending a military medical school.

2. Methods

2.1. Framework of the curriculum

The goal of the reformed curriculum was to develop a longitudinal integrated disaster and military medicine education program extending from the 1st year to the 6th year based on previously separated clinical and military medicine topics. To further strengthen and integrate disaster medicine into the current curriculum, we reorganized the relevant courses and trainings as shown in Table 1. The implementation of the longitudinal disaster and military medicine curricula started with the 3-month recruit training and continued through the health care service in the military, emergency medical technician (EMT), Tactical Combat Casualty Care (TCCC), and MCI drills from the 1st to the 4th years. The clinical course in the clerkship thereafter highlighted preventive medicine, traumatology, and aerospace and undersea/hyperbaric medicine. The teaching hours, case numbers, and methods for several specific topics in the clinical course are presented in Supplementary Table 1, <http://links.lww.com/MD/E230>.

Table 1

Modules used in the longitudinal integrated disaster and military medicine education program.

	Modules	Educational goal and core content
Preadmission 1st yr (5 wks)	Recruit training, physical training Health Care Service Training Emergency Medical Technician Training MCI drills, as patients Clerkship for deployment	Lectures on MCIs and triage, the National Incident Management System, cardiopulmonary resuscitation, heat stroke, mental health, preventive medicine, CBRNs, health care equipment and logistics Licensure for EMT-1 Coordinated with the 3rd yr students to role-play as patients in MCI drills Health care units in the Air force, Army, and Navy with daily practice in the military clinic, logistics, maintenance, emergent conditions, disaster prevention, and military-civilian coordination
2nd yr (3 wk)	Military training, as required for the MND	Preventive medicine, CBRNs, gender issues, military psychology, self-harm and suicide prevention, posttraumatic stress disorder
3 rd yr (2 wk)	Deployment medicine TCCC	Wilderness medicine, extreme environments, aero-evacuation, personal protective equipment, blast and burn injuries, decontamination and use of personal protective equipment Introduction to TCCC, Care under Fire, Tactical Field Care, Tactical Evacuation Care, case scenarios MCI drills for multiple scenarios
4th yr	Drills for MCIs, as rescuers Professional and Technical Examinations for Medical Doctors, Part I*	
5th yr	Preventive medicine Short-term clerkship for aerospace medicine and undersea/hyperbaric medicine	Physical checkup for military personnel and occupational hazards (extreme noise conditions) Undersea and hyperbaric medicine in the naval hospital Aerospace medicine in the Aviation Physiology Laboratory
6th yr	Critical care, hyperbaric oxygen therapy and trauma, the incident command system and the National Incident Management System, legal and ethical considerations in disaster response and hospital preparedness in Clerkship Professional and Technical Examinations for Medical Doctors	

CBRNs = chemical, biological, radiological, nuclear threats, EMT = emergency medical technician, HSTC = Health Service Training Center, MCIs = mass casualty incidents, MND = Ministry of National Defense, TCCC = Tactical Combat Casualty Care.

* Indicating the part I medical licensing examination in Taiwan that covers most of the basic medical science.

Interprofessional learning has been recognized as a necessary component of disaster medicine.^[14] Emergency medicine physicians, an internist, an intensivist, surgeons, and military EMT and TCCC instructors formed an interprofessional faculty group and designed a learning curriculum. Coordination between civilians and military personnel is crucial to optimize a disaster response. Civilian and military cooperation needs to be synchronized and adjusted to avoid preventable medical and nonmedical consequences.^[15] Therefore, several drills and exercises were performed by the civilian instructors in the National Fire Agency Training Center in Nantou, Taiwan.

2.2. Teaching format

The program consisted of the acquisition of skills used in emergency and trauma scenarios, linked with specific interdisciplinary modules on disaster responses. Lectures, small- and large-group discussions, hands-on training, and field exercises focusing on the MCI were applied. Oral presentations involving experience sharing were performed in groups at the end of the 3rd year, since the program was thereafter focused on clinical training.

2.3. Evaluations and tests of knowledge

Medical students were encouraged to fill out a survey after their completion of the 3rd year modules. The survey questions focused on assessing students' experiences and opinions of the training, including the disaster exercises. The students provided ratings on a 5-point Likert scale (5 = strongly agree, 1 = strongly disagree). The questions are listed in Table 2.

For the tests of knowledge, at the beginning and at the end of the training, the students were required to respond to 10 multiple-choice questions (MCQs) consisting of basic knowledge and a scenario. After completion of the whole training program, they were again required to answer another 10 MCQs.

2.4. Ethics approval and consent to participate

This study was conducted in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). The study protocol was part of the routine surveys of all curricula. Therefore, the need for consent from the participants was deemed

unnecessary according to the regulations issued by the Ministry of Health and Welfare, Taiwan (1010265075C, <https://dep.mohw.gov.tw/DOMA/dl-16078-31bb0e95-2407-4323-9bbf-a62b7f8dcee3.html>).

2.5. Statistical analysis

Continuous data are expressed as the means \pm standard deviations and were analyzed using a two-tailed Student's *t*-test. The data were analyzed with Statistical Package for the Social Sciences statistical software, version 22.0 (SPSS Inc., Chicago, IL, USA).

3. Results

3.1. Evaluations

A total of 230 medical students participated in the revised disaster preparedness curriculum. The satisfaction survey response rates were high (201/230, 87.4%).

For the disaster drills and exercises performed in the National Fire Agency Training Center, the students were satisfied with the training site and orientation (4.6/5); the experience sharing by the special rescue squad (4.7/5); the drill and disaster relief skills and rescue skills training (4.5/5); their experience in the military camp for the recruited soldiers (3.3/5); the military health services and the logistics for health care instruction (4.5/5); and the evacuation in special circumstances training (4.5/5, Fig. 1). The students' ratings regarding their overall satisfaction with the course, the course literature, and their subjective knowledge gain are shown in Figure 2. Before the program, the students' self-perceived familiarity with the skills and concepts of disaster medicine was 4.0/5. The students considered that the course was helpful for developing skills and knowledge related to disaster medicine (4.4/5), and they were satisfied with the training site (4.4/5), the instructors (4.6/5), and the teaching methods (4.5/5). Overall, the students were satisfied with the whole curriculum (4.5/5). Most of the free-text comments about the program expressed a high level of appreciation. Nearly half of the students considered the number of teaching hours for the whole program to be adequate (47%); 16% of the students considered the program too short, and 37% of them considered it too long.

All students completed the pretest and posttest (230/230, 100%). The results of the pretest and posttest for disaster medicine are shown in Figure 3. In general, the students showed significant improvements in knowledge and judgment after the course (55.7 ± 15.2 to 69.0 ± 12.6 , $P < 0.05$), even though these results were not satisfactory to the clinicians and instructors.

4. Discussion

Disaster medicine and disaster medical response is a complex and evolving field. Appropriate MCI protocols, adequate surge capacities, and patient flow regulation can minimize the impact of an MCI on the health care system.^[16] Therefore, longitudinal integrated curricula focusing on disaster and military medicine is beneficial for medical students.

In this study, we found that the medical students were highly interested in and appreciated the disaster medicine program and actively participated in the hands-on training, as previously described.^[11,17,18] Previous studies also indicated that medical students would like to increase their knowledge in this area and would welcome the introduction of specific courses into the

Table 2

Questions assessing participants' subjective evaluation of and satisfaction with the program.

Were you satisfied with the orientation about the training?
Were you satisfied with the experience sharing by the special rescue squad?
Were you satisfied with the experience in the military camp for the recruit soldiers?
Were you satisfied with the training on health care service logistics during disasters?
Were you satisfied with the training on evacuation in special circumstances during a disaster?
Were you familiar with the skills and concepts of disaster medicine before?
Did you consider the course helpful for developing skills and knowledge of concepts in disaster medicine?
Were you satisfied with the training sites?
Were you satisfied with the content?
Were you satisfied with the instructors?
Were you satisfied with the teaching methods?
Did you consider the time adequate for the curriculum?
Overall, are you satisfied with the whole curriculum?

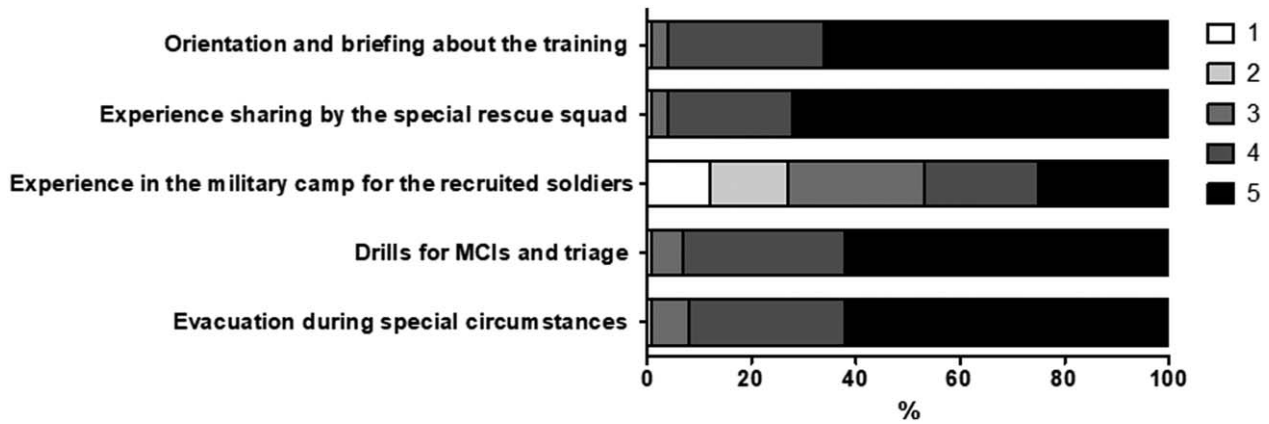


Figure 1. Summarized results of the voluntary evaluation in the 3rd year of the program asking about the students' satisfaction with the disaster drills and exercises performed at the National Fire Agency Training Center (n=201). MCI=mass casualty incident.

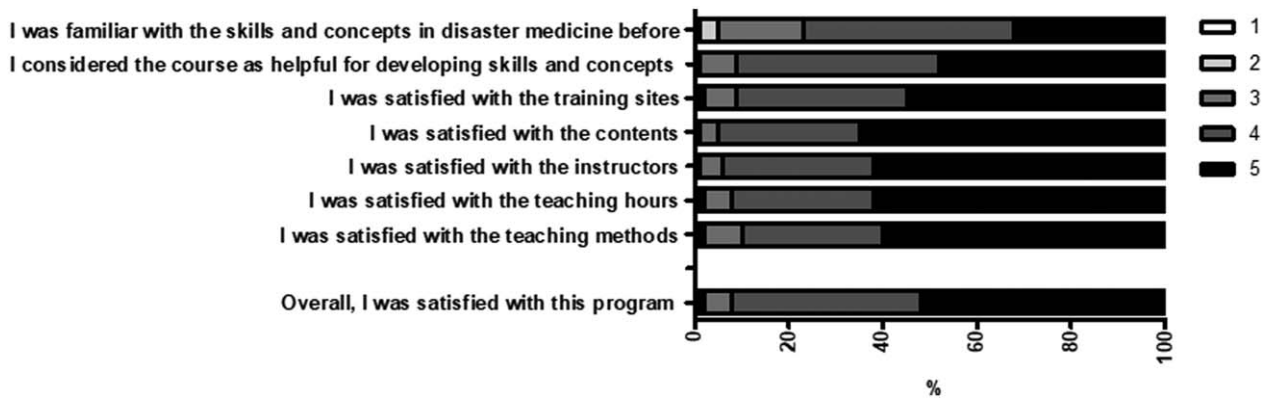


Figure 2. Summarized results of the voluntary evaluation after the 3rd year of the program asking about the students' satisfaction with the course and including a self-evaluation regarding the longitudinal integrated disaster and military medicine program (n=201).

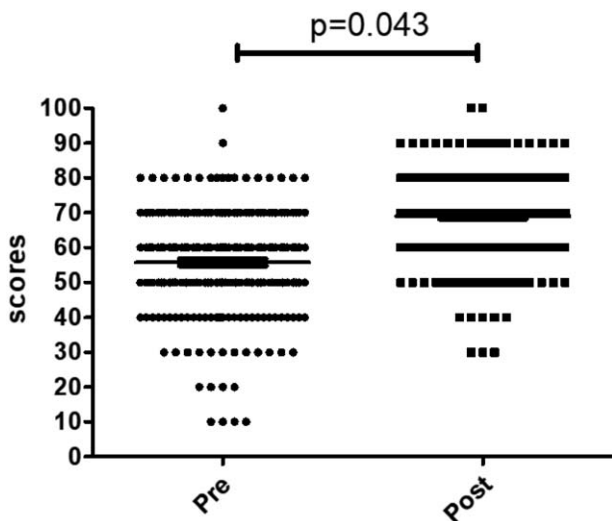


Figure 3. Summarized results of the multiple-choice tests that were performed before (Pre) and after (Post) the longitudinal integrated disaster and military medicine program (n=230).

standard medical curriculum.^[19] Students generally believe in the importance of teaching disaster medicine in the regular curriculum and are generally highly motivated to learn disaster medicine.^[20,21] A previous study also indicated that medical students could have misconceptions regarding disasters.^[8] Consistent with previous studies, despite a high willingness to participate in disaster management, the students might have not been well educated regarding such situations.^[20,21,22] We also noted that the posttest scores, though elevated after the program, were not satisfactory or considered adequate by the clinicians and instructors.^[8] Standardized competency-based educational and training programs that will ensure training in practices and policies that meet both the standards of care and the broader expectations for professionalization in disaster preparedness and surge capacity are needed.^[23] Future research should focus on the utilization of simulation techniques to enhance disaster training and retention of that training at the undergraduate medical student level.

An increasing number of civilian physicians have become involved in disaster preparedness, such as medical directors in the EMT system and those providing medical oversight after several catastrophic disasters.^[24] Most civilian models of disaster medical responses follow the military model.^[25] Teaching disaster medicine is also often confined to military physicians.^[26]

A basic military training background prompts medical students to be more committed, educated, and prepared for disaster situations than their civilian counterparts.^[7] Committed and organized military support minimized the impact on a military hospital during a burn MCI.^[16] Here, we demonstrated another mandatory program that specifically highlighted the incorporation of disaster medicine into current military medicine courses. A search of the medical literature revealed that there are still few mandatory disaster medicine curricula or training courses provided to undergraduate medical students. Disaster training has been mandatory at Thomas Jefferson University for nearly 2 decades. This mandatory disaster preparedness training course requires all 1st-year medical students to attend lectures, undergo practical skills simulation training, and participate in the hospital's interdisciplinary disaster exercise and is successfully integrated into the medical education program without compromising the existing university curriculum.^[27] A previous disaster nursing education program also included a simulation exercise and small-group work; international nursing knowledge; disaster nursing; communication ability promotion; humanity, responsibility, and flexibility; and infection prevention and control.^[28] Disaster response simulation can be utilized as an innovative experiential learning technique. Interprofessional collaboration and positive learning experiences have been fostered between military trainees and health care students in nursing and paramedic sciences.^[29] Nonetheless, low-effort, low-time-commitment, and task-specific drills (disaster huddles) have been shown to effectively improve administrative disaster preparedness in disaster medicine education.^[30]

A longitudinal integrated curriculum provides learner-centeredness with continuity of the learning environment, integrates important educational themes across clinical specialties that focus on the developmentally appropriate attainment and assessment of core clinical competencies, and promotes the connection between science and clinical medicine.^[12,13] Learners are more motivated to learn and develop professionalism in such longitudinal models.^[13] In the setting of nurse education, the majority of nurses gained their knowledge and skills from disaster drills.^[6] Future education research should focus on developing interdisciplinary education to help disseminate disaster medicine topics across all 6 years of medical school.

Incorporating disaster medicine into an already rigorous medical school curriculum is challenging. Here, we provide a model that longitudinally integrates disaster medicine into the current medical school curriculum. The integration of interdisciplinary teams may help medical schools implement disaster medicine training.^[27] Ensuring professional competence and license to practice by combining training methodologies, including individual theory-based education, immersive simulations and team training, is recommended.^[31,32] Despite a 2003 joint recommendation by the Association of American Medical Colleges and the Centers for Disease Control and Prevention, a previous survey revealed that training in disaster medicine and preparedness is minimal or nonexistent in the curricula of many medical schools. Most medical students have never attended courses on disaster medicine during their medical school program.^[19] Movement toward standardized curricula and certification programs can alleviate the lack of knowledge and training as well as better prepare those who respond to those impacted by disasters.^[33] A set of clear, concise, and precise training standards that can be used to ensure workforce

competency in such situations has been developed.^[2] Further studies regarding the evaluation of the gaps between the expectations of the students and those of the educators should be conducted.^[8]

5. Limitations

There were several limitations in this retrospective study. The study was performed at a military medical school, and generalizability to civilian medical schools could be limited. For example, the time typically used for summer vacation was used for the military medicine training course. The disaster medicine modules that were developed could be a blueprint for other medical schools.

6. Conclusion

We found that although medical students were highly interested and appreciative and actively participated in the longitudinal integrated disaster and military medicine program, gaps existed between the knowledge scores and the expectations of the educators. The educators considered that the students still need more disaster preparedness knowledge and skills.

Author contributions

Y-DT, S-HT, Y-HC, T-CY, C-WL, and C-YC provided the concept and designed the program. S-JC, Y-CC, C-CH, and J-CW provided materials and analyzed the data for the study. All authors read and approved the final manuscript.

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