ORIGINAL RESEARCH

When the Going Gets Tough, the Tough Get Going: Improving the Disaster Preparedness of Health Care Providers: A Single Center's 4-Year Experience

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ABSTRACT

Objective: Operation based exercises represent simulation activities, which are of great importance for emergency preparedness, as they simulate real experiences in a guided manner. Whereas their primary purpose is to address the organizational emergency preparedness, little is known about the personal benefits of involved participants and whether these positive changes endure over time.

Methods: Immediate and medium term assessment of the effectiveness on individual preparedness and benefits of participants, based on self-perception, after participating in a set of 4 interdisciplinary field exercises organized as part of the MSc in Global Health-Disaster Medicine of the Medical School of the National and Kapodistrian University of Athens, Greece. The field exercises were carried out yearly, from 2016 to 2019. Data were collected via questionnaires pre- and post-exercise (1 week and 10 months after participation). The sample size was 228 trainees, with a response rate of 88%.

Results: The majority (95%) stated that Mass Casualty Incident (MCI) exercises are appropriate for disaster management training in terms of comprehending theory, and for team-building training. In the case of a real MCI, 22% of the participants declared themselves to be ready to respond prior to MCI exercises. Upon completion, the overall perception of readiness among the participants increased to 77%. Trainee feedback indicated enhancement of both technical and non-technical skills (87%), which were persistent over time, and revealed a high level of satisfaction with the training.

Conclusion: This study shows a positive immediate and medium-term impact of operation-based exercises on technical, non-technical skills, and self-perception of participants.

Key Words: disaster preparedness, simulation exercise, non-technical skills, disaster training

As a matter of course, in most countries, those who respond first to the outbreak of a disaster are specialized governmental organizations such as civil protection, national emergency services, fire brigade, police, coast guard, military forces, and so on. For health care workers in these fields, contrariwise to their civilian colleagues, disaster preparedness begins during their university studies, having periodical training as an integral part of their profession.[1] Nevertheless, since the potential for disaster is growing worldwide, future generations of civilian health workers are likely to respond to such events during duty. Taking cognizance of the prospective around disaster nowadays, both civilians and professionals are potentially involved in disaster response and the public have expressed the need for better preparedness.[2-4]

The provision of high-quality medical care in the challenging and highly dynamic environment of a disaster requires specific knowledge, technical skills and non-clinical competencies from health care personnel.[5,6] The main challenges of medical response in such situations are often, due to poor understanding of the existing medical disaster protocols, lack of experience and inadequate education and training of the involved personnel.[7,8] Training is widely accepted as the key action that can reduce the negative effects of disasters, by creating skilled health care professionals. Nonetheless, although numerous competencies for disaster health care personnel have been developed and endorsed by governmental and professional organizations, universal acceptance and application of these competencies is lacking, resulting in diversities in mass casualty incidents (MCI), disaster preparedness, as well as training curricula.[9,10] Additionally, significant limitations in the design of evaluation methods of disaster preparedness and training have been addressed.[11]

In this context, the medical approach to disaster preparedness has proven to be a problematic issue.[12] Earlier experiences in teaching emergencies and

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disaster preparedness have shown that blended learning approaches increase staff´s knowledge and their satisfaction.[13] Throughout the combination of theoretical and practical teaching, learners experience reality by simulation, make controlled errors, and develop an understanding of the doable and the undoable,[13,14] as demonstrated in fields beyond health care, where outcomes are also dependent on individual and team skills. Operation-based exercises (field exercises) represent a typical example of teaching activity simulation, considered to be an important and integral part of emergency preparedness activities, since they intend to enhance real experiences with guidance in a standardized manner.[15,16] Operation-based exercises typically involve responding to a scenario designed to simulate an emergency situation under more realistic conditions. Such exercises can range from smaller activities such as drills to practicing specific skills or procedures (such as triage, evacuation or communication) to field-based exercises designed to replicate as closely as possible a response to a real emergency. Because the primary purpose of most of such exercises is addressing organizational emergency preparedness (such as testing plans or procedures), little is known on the personal benefits from exercising on the involved staff. Only few quantitative studies included reports of improved knowledge, competencies, improved confidence, and understanding. Again, there is a lack of evidence about whether these positive changes persist over time.[17]

According to Bruner, repetition is the first principle of all learning. Repetition of training especially via experiential learning has positive results regarding the retention and persistence of knowledge.[18-20] This assumption has been confirmed in our case. The overarching purpose of the present study is to assess the role of field exercises in improving individual preparedness of health care professionals. We therefore present and discuss immediate and medium term results on the effectiveness and benefits of exercises to prepare health emergency professionals for responding to emergencies and disasters, based on their self-perception after participating in a set of 4 inter-professional field exercises organized and implemented in the framework of the MSc in Global Health-Disaster Medicine program of the School of Medicine, the National and Kapodistrian University of Athens, Greece, which was carried out yearly, from 2016 to 2019. The course on 'Management of Disaster Victims' is one of the flagship activities of the MSc in Global Health-Disaster Medicine that takes place every year in the third semester of the study. It is organized in collaboration with the local authorities and involves the participation of academics, experienced field workers and civil protection agencies. The scope of the course is to train students, as well as civilian health care professionals and representatives of humanitarian organizations who enroll in the course on how to deal with victims in MCI/disasters in practice.

METHODS

This study focused on the following research questions:

1) What is the educational value for those participating as trainees in field exercises, in terms of technical and non-technical skills, as a preparatory educational tool for disaster management performance, as well as acquisition of core competencies (technical and non-technical)?
2) What kind of impact do emergency exercises have on the immediate and medium term emergency preparedness of individuals?

The study presents quantitative and qualitative data analysis of the feedback (self-assessment) given by all trainees participating in the field exercises in 2016, 2017, 2018, and 2019 (a total of 228 participants). The questionnaires were distributed in 3 phases, before, 1 week and 10 months after their participation in the course (for those of 2016, 2017 and 2018). These questionnaires were identical for the 4 years. The response rate of the survey was 88%.

The questionnaire was self-administered following an explanatory session on its aim with the participants. The questions were finalized after a pilot phase to assess proper phrasing, time required to complete, and coding. The pre- and post-exercise evaluation questionnaire included 14 questions and 15 subquestions, categorized in 3 groups each. The first group focused on demographic data. The second group assessed the level of subjective personal knowledge, experience and preparedness related to disaster response as at the time of the course. The third group assessed the personal perception of effectiveness on individual's performance after MCI scenarios. The majority of questions were formulated so that participants could 'agree' or 'disagree,' while always having the option of 'not sure.' There were some questions in which the level of agreement was evaluated according to a 5-point Likert scale, from 'strongly agree' to 'strongly disagree,' and from 'extremely' to 'not at all.' In the end, there were some open questions. The self-reported evaluation compromises an integral part of assessing the impact of an intervention, as it measures the participants' personal reflections and attitudes to specific elements. As such, the use of the Likert scale is widely used in facilitating the qualitative assessment of health interventions in order to provide valuable information on some of its characteristics in the way these are observed by the participants using an agreement scale. The validity of our qualitative results is observed through assessing the correlations of the different answers given.

The interdisciplinary exercises are launched annually in the third semester of the study program. The study aims to capture the short- and long-term effect(s) of participating in the MCI scenarios. Accordingly, questionnaires were distributed to capture the short and long term effects of the simulation exercise on the participants in the period between 2 consecutive

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exercises which is estimated as 11 months. The period of 1 week was chosen to capture the immediate effect of the training and the period of 10 months, as the longest period before the next simulation exercise of the program to capture the post-intervention effect. This choice was also required in order to avoid the introduction of information bias as the participation to similar exercises during this period was set as an exclusion criterion.

The educational syllabus of MCI scenarios was derived from disaster medicine literature, focusing on (1) Command-Control-Coordination Deployment, (2) Communication, (3) Triage, (4) Basic Trauma Care, (5) Safety-Security Precautions, and (6) Transport Management. The interdisciplinary exercise of MCI in Rhodos Island was executed in cooperation with the fire-brigade, law enforcement personnel, national ambulance service, coastguard, regional port authority, regional hospital, armed forces, regional civil protection service, civil aviation service and experienced field workers (e.g., Greek Red Cross).

Scenarios included mass casualty incidents after (1) a terrorist attack (active shooter- blast scenario) in a passenger ship at Rhodos Port, (2) emergency aircraft landing on regional airport, (3) fire in tourist location, and (4) a hospital preparedness scenario for mass casualty influx incident. Students were allocated in 9 different teams (Triage, Incident Command Centre, Green Team, Yellow Team, Red Team, Logistics, Evacuation Centre, Psychological First Aid, and Media). The duration of the exercise was approximately 1 to 1.5 hours, after which they were gathered together with the facilitators and the external evaluators, for the debriefing process. During this phase, an analysis of the events and discussion regarding the decisions made during the exercise was performed, based on the active reflection of participants.

RESULTS

Study Population

The median age of participants was 39 years old, represented by 56% women and 44% men. The sample consisted of 78% health care professionals (44% medical doctors [41% civilians, 3% military doctors], 22% registered nurses, and 12% other health care professionals), 16% social scientists and 6% other professionals. Although most participants had no previous exposure to a disaster management incident (65%), those who answered positively (25%), were involved in refugee crisis incidents (66%), earthquakes with multiple casualties (20%), and complex road accidents (14%). Many participants (69.6%) claimed that, if they were involved in a disaster, they could provide only limited support since they did not have previous training in disaster management. Only 30.4% of the participants had received training before the MSc.

TABLE 1

Demographic Data of Sample Population and Prior Experience to Disaster Management

Characteristics	Values	Percentage	Frequency
Age	39		
Gender	Men	34%	68
	Women	66%	132
Profession	Physicians	44%	88
	Nurses	22%	44
	Other healthcare providers	12%	24
	Social scientists	16%	32
	Other	6%	12
Years of job experience	0-12 months	7%	14
	1-2 years	36%	72
	6-10 years	21%	42
	>10 years	36%	72
Prior training in emergency medicine via adult learning methodologies	Yes	83%	166
	No	17%	34
Prior exposure to MCI incidents	Yes	35%	70
	No	65%	130

Majority of the participants (83%) stated that they had participated in adult learning methodologies in Emergency Medicine prior to this course, 70% had taken medical simulation courses (BLS, ALS, etc.), real time MCI simulations (10%), problem-centered learning cases (8%), and other kind of exercises (12%). The above exercises had been undertaken in the context of personal initiative (46%), university studies (22%), continuing professional education (23%), and other non-specified activities (9%). With regard to the evaluation of this 'prior exposure,' the majority of the trainees (69%) assessed it as 'moderately' realistic (Table 1).

Educational Outcome

The overwhelming majority (95%) agreed that MCI exercises are appropriate for disaster management training for comprehending the theory of disaster management, as well as for team training. Interdisciplinary training and preparation of all involved stakeholders in the response of a major incident was highly valued (86%) among participants. Regarding the educational method, all participants considered that blending theory and practice represents the most appropriate way of training. In order to achieve better preparedness in disasters, 83% of trainees consider the provision of introductory courses to be an absolute need. Interdisciplinary MCI Simulation led to a better understanding of the theoretical and practical knowledge acquired, according to 91% of the respondents (Figure 1). Extensive briefing and debriefing after each field

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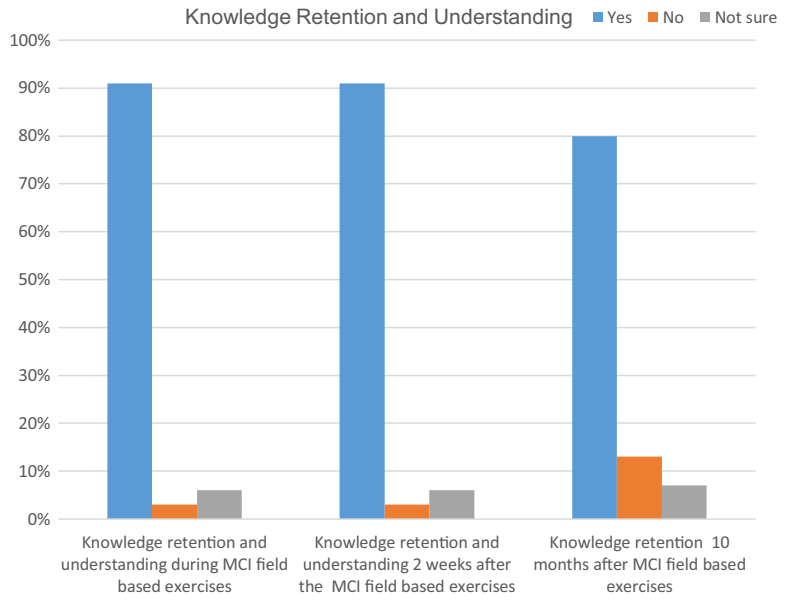
FIGURE 1

Knowledge Retention and Understanding of Disaster Management and Response.



exercise was perceived as a valuable tool for better understanding of key learning points for the vast majority of the respondents (89% and 93% respectively). Based on the outcomes of the survey, participation in interdisciplinary MCI exercises requires special skills and knowledge for most respondents (> 50%) (Table 2). As necessary knowledge for a better mass casualty management, students mentioned the topic of emergency medicine, as well as disaster medicine. Considering the technical-skills domain, BLS, ALS skills, Triage, and Radio procedures were among the appropriate competencies. In the non-technical skills domain, students identified situational awareness, team working, decision making, leadership, and communication as important skills prior to a mass casualty incident (Figure 2). Challenges were faced primarily on non-technical skills; Communication (10%), Situational Awareness (21.25%), Team Working and Conflict resolution (23%), Psychological Issues and fatigue (14%), Coordination (8%), Simulation Issues (17%), and Low Preparation (7%) (Figure 3).

Readiness

In case of a real MCI, 22% of participants declared themselves to be ready to respond prior to the MCI exercises. Upon completion of the course, the overall perception of readiness among participants was raised to 77%. Overall, participants reported feeling more prepared and confident for disaster response when compared to before the training (Table 3). The positive feeling and confidence seems to persist 10 months after the MCI exercises (65%) (Figure 4).

Satisfaction

Overall, a vast majority of participants (80%) reported that the exercises met their expectations and evaluated it as excellent and above average, regarding the organization of the field exercise, and the knowledge and skills acquired. However, prior to the exercises, participants believed that advanced medical knowledge such as ALS and ATLS was necessary (70%). After participating in the course, first aid and triage were the only type of medical knowledge mentioned.

Eighty-one percent (81%) of trainees were willing to participate in future disaster management courses in order to maintain acquired knowledge and skills while 67% expressed their interest in becoming trainers (Table 4).

Technical Skills

Trainees reported improvement of technical skills such as identification of critically injured patients (35%) and triage (37%).

Non-Technical Skills

Trainee feedback indicated enhancement of non-technical skills (87%) such as decision-making, communication, conflict

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TABLE 2

Educational Effectiveness

Characteristics	Values	Percentage	Frequency
Need for blended training model	Yes	100%	200
	No		
	Not sure		
Effectiveness of prior case based learning (table top exercises)	Absolutely agree	30%	60
	Agree	53%	106
	Neither agree – not disagree	13%	26
	Disagree	4%	8
	Absolutely disagree		
Knowledge retention and understanding during MCI field based exercises	Yes	91%	182
	No	3%	6
	Not sure	6%	12
Knowledge retention and understanding 2 weeks after the MCI field based exercises	Yes	91%	182
	No	3%	6
	Not sure	6%	12
Knowledge retention 10 months after MCI field based exercises	Yes	79%	160
	No	13%	26
	Not sure	7%	14
Effectiveness of briefing for performance during the exercises	Yes	89%	178
	No	11%	22
	Not sure	0%	0
Effectiveness of debriefing for knowledge retention and understanding key learning points	Yes	93%	186
	No	7%	14
	Not sure	0%	0
Special knowledge for participating	Yes	55%	110
	No	40%	80
	Not sure	5%	10
Special technical skills for participating	Yes	52%	104
	No	45%	90
	Not sure	3%	6
Special nontechnical skills for participating	Yes	53%	106
	No	42%	84
	Not sure	5%	10
Role assignments and job experiences	Yes	22%	44
	No	63%	126
	Not sure	15%	30
Challenges during the MCI field based exercise	Communication	10%	20
	Situational Awareness	21%	42
	Team Working and conflict resolution	23%	46
	Psychological Issues and fatigue	14%	28
	Coordination	8%	16
	Simulation issues	17%	34
	Low Preparation	7%	14

resolution, teamwork, and coordination among stakeholders. Non-technical skills were assessed as more valuable, when compared with technical skills and special knowledge by the trainees (75%) (Figure 5). Although, before the exercises, trainees sustained that medical knowledge and skills are more important than administrative and non-technical skills, after participating in the course, a change in their mindset had been addressed, proving non-clinical competencies to be more important (66%). Furthermore, regarding the non-technical skills after the exercises, the participants indicated the ones mentioned before the course, and added leadership and collaboration, which had not mentioned previously. Finally, the percentage of the participants that didn't know or didn't express an opinion before the course, was reduced to 0%, indicating that participating in the course contributed to improved understanding (Table 5).

DISCUSSION

The most common challenges encountered and reasons for failure during disaster response are detected in missing or inaccurate information, time pressure, adverse circumstances, communication, teamwork, and coordination among professionals coming from different backgrounds and agencies.[17] At the

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FIGURE 2

Essential Competencies in Field Exercise.

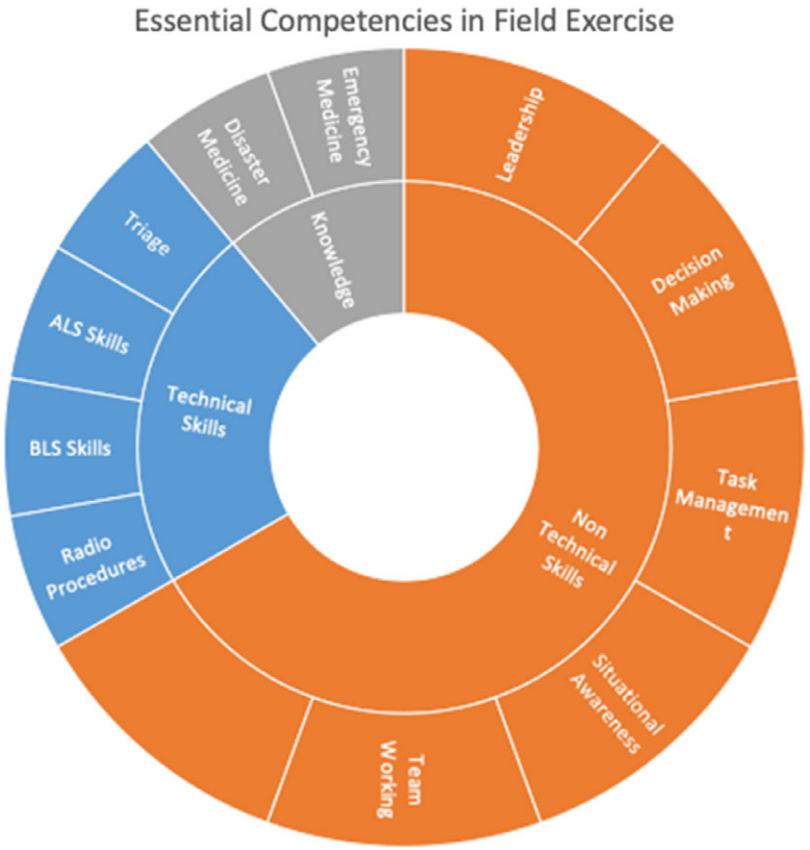
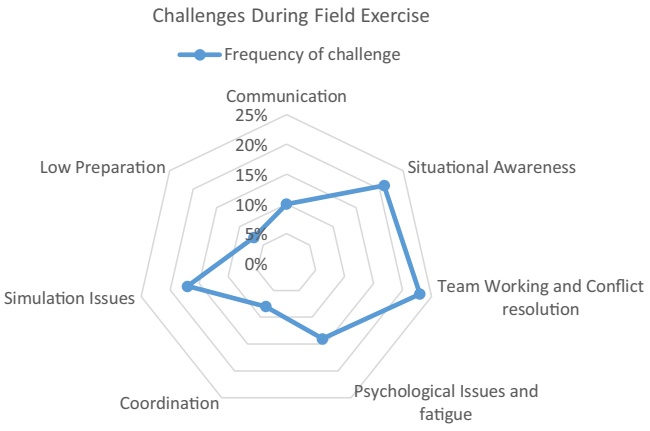


FIGURE 3

Challenges During a Field Exercise.



hand of the complex environment of a disaster, it must be ensured that professionals involved in disaster management are prepared to face the complexities of such events, and to make critical decisions in rapidly changing settings. In order to achieve this, they must acquire specific knowledge and technical skills as well as develop nonclinical competencies, which is difficult in daily practice.[13,23] Nowadays, there is an increasing interest regarding the need for disaster preparedness among civilian health care professionals[3,13,20,21] although a review of post-event reports indicated inadequate training that results in repeated failing patterns. This calls for a new universally-accepted approach in disaster management training.[24]

There are several teaching methods, from traditional learning, through lectures, to full-scale, real-time interdisciplinary exercises. A mixture of both theory and practice is nowadays suggested to be one of the best educational models in disaster management.[13] There have been several studies recognizing adult learning methodologies as a valuable tool for interactive

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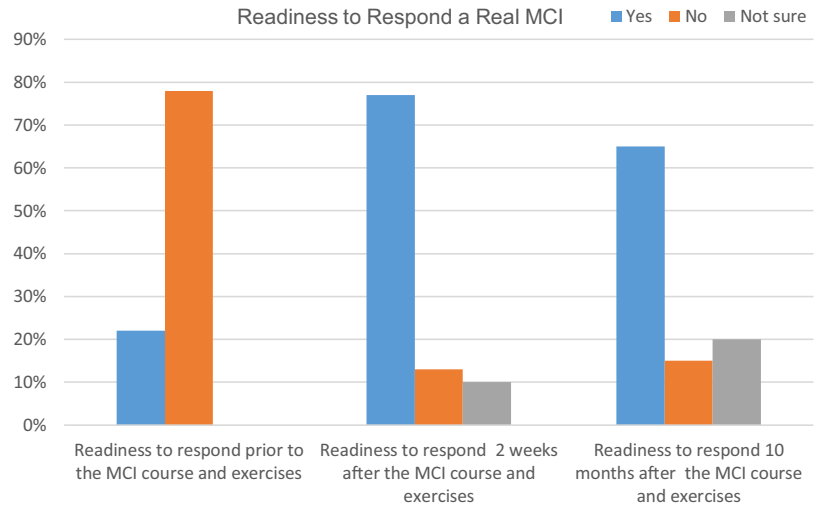
TABLE 3

Perception of Readiness to Respond to Mass Casualty Incidents

Readiness	Values	Percentage	Frequency
Readiness to respond prior to the MCI course and exercises	Yes	22%	44
	No	78%	156
	Not sure	0%	0
Readiness to respond 2 weeks after the MCI course and exercises	Yes	77%	154
	No	13%	26
	Not sure	10%	20
Readiness to respond 10 months after the MCI course and exercises	Yes	65%	130
	No	15%	30
	Not sure	20%	40

FIGURE 4

Readiness to Respond a Real MCI.



training of health care professionals for disaster response.[23,25,26] Training among adult learners should incorporate andragogic principles according to literature. Adult learners are assumed to be self-directed with great accumulated experience, interested in integration of training with everyday life via problem centered approaches.[27]

Learning by doing, meta-schematizing real life experiences into an educational process facilitates inter-sectoral and inter-disciplinary collaboration, and enables a problem analysis and task prioritization while leading to decision making and action undertaking. Kolb's Experiential Learning Theory (1984) defines experiential learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience."[21] There is evidence that experiential learning including simulations and role-playing games along with field exercises and drills can be highly engaging for students and can lead to better long-term memory. Experiential learning has the ability to lead to deeper understanding and develops the individual's soft skills such as problem-solving, critical thinking, improved communication skill, and knowledge management. In particular, it enables learners to better manage highly complex situations that cross disciplinary boundaries and subject domains where the boundaries of knowledge are difficult to manage.

MCI exercises can be used as a research tool to study human decision-making behavior under crisis, representing a teaching instrument to familiarize the participants with disaster management issues such as teamwork, communication and coordination among all the stakeholders, and prepare for disaster management by revealing possible omissions and weaknesses in the existing operational plans.[28-31] Its

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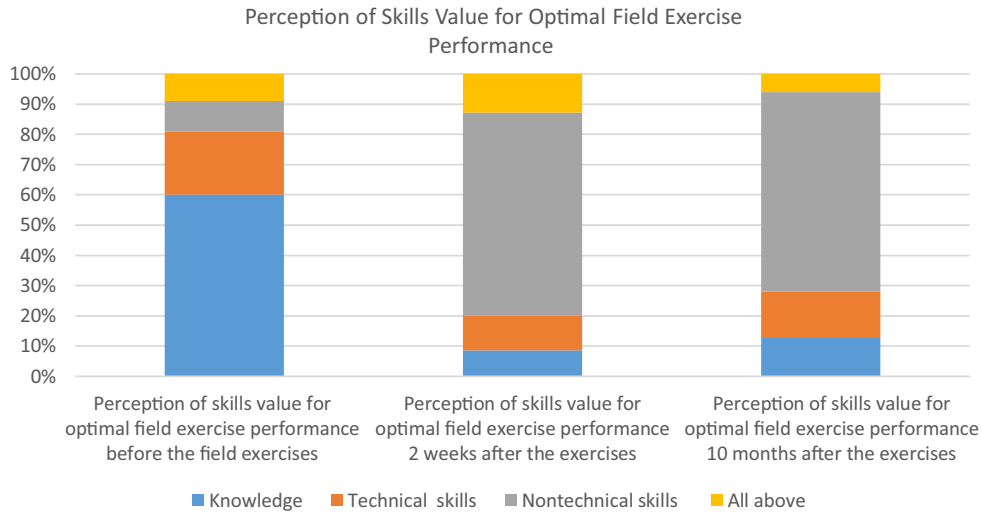
TABLE 4

Individual Satisfaction and Willingness to Future Participation

Satisfaction	Values	Percentage	Frequency
Organization	Excellent	50%	100
	Above average	30%	60
	Average	10%	20
	Below average	5%	10
	Bad	5%	10
Knowledge Acquisition	Excellent	51%	102
	Above average	39%	78
	Average	10%	20
	Below average	0%	0
	Bad	0%	0
Overall (reach students' expectations)	Absolutely agree	54%	108
	Agree	37%	74
	Neither agree – not disagree	9%	18
	Disagree	0%	0
	Absolutely disagree	0%	0
Willingness for future participation in similar disaster management courses organized by the MSc	Yes	81%	162
	No	15%	30
	Not sure	4%	8
Willingness for becoming trainer	Yes	67%	134
	No	33%	66
	Not sure	0%	0

FIGURE 5

Perception of Skills Value for Optimal Field Exercise Performance.



advantages include offering learners an opportunity to develop know-how, not only know-what; developing skills and not just knowledge; helping in developing team spirit and communication skills under conditions closely matched to a real emergency event. Its disadvantages include requirements for careful and lengthy development and testing, a great deal of preparation and resources which can limit the number of learners and full engagement on behalf of tutors.[13] Overall, reported results are in line with existing literature, as multiple personal benefits from exercise participation have been reported with evidence of positive post-exercise change in participant knowledge, perceptions, and attitudes.[17,32] Our self-reported data showcased increased confidence, an improved perception of preparedness and an improved understanding,

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TABLE 5

Improvement of Technical and Nontechnical Skills

Characteristics	Values	Percentage	Frequency
Improvement of technical skills acquired during preparatory training	Yes	82%	164
	No	8%	16
	Not sure	10%	20
Technical skills improved	Identification of critically patients	30%	60
	Triage	35%	70
	Prehospital patients management in the field	28%	56
	Administrative expertise	7%	14
Improvement of nontechnical skills acquired during preparatory training	Yes	87%	174
	No	6%	12
	Not sure	5%	10
Nontechnical skills improved	Communication	15%	30
	Team working	36%	72
	Situational awareness	17%	34
	Task management	6%	12
	Decision making	7%	14
	Leadership	12%	24
	Collaboration	6%	12
Perception of skills value for optimal MCI performance before the field exercises	Knowledge	60%	120
	Technical skills	21%	42
	Nontechnical skills	10%	20
	All the above	9%	18
Perception of skills value for optimal MCI performance 2 weeks after the exercises	Knowledge	8%	16
	Technical skills	11%	22
	Nontechnical skills	63%	126
	All the above	12%	24
Perception of skills value for optimal MCI performance 10 months after the exercises	Knowledge	13%	26
	Technical skills	15%	30
	Nontechnical skills	66%	132
	All the above	6%	12

not only from the respective trainee roles, but also from all stakeholders involved in pre-hospital care. There were reports of significant improvements in participant knowledge of emergency activities, policies and procedures, post-exercise. Significant improvements in competence and perceptions of network effectiveness, training, equipment adequacy, and teamwork were also reported. Our study goes even further as it provides initial evidence that in a medium term of 10 months to 1 year after the exercises, the positive impact of these benefits persists.

We consider therefore that blending theory and practice, practicing technical skills, and empowering nonclinical competencies through cross-sectoral and multidisciplinary training can be a remedy to the apparent disconnection between theory and methodology used in disaster preparedness training. The fact that the training took place in a multidisciplinary environment, in which trainees were deeply engaged in skills training by attempting to solve problems in an environment that was similar to the ones to be encountered in real life was of high educational value. Additionally, elements such as detailed briefing and debriefing, repetitive practices, and escalation of difficulty levels for the exercises, allow multiple learning strategies, provides a range of clinical scenarios, ensures a safe and educationally supportive learning environment, and allots both team and individualized learning, which have been defined as our outcomes and are scientifically validated.[17]

Evidence of the impact of the exercises on individuals is limited in the short term and continues to decrease with time.[19] Immediate post-exercise measures are flawed indicators of learning as they may only indicate temporary change rather than lasting learning.[20] Taking all the above mentioned into account, we consider that our results are of significant value, improving mainly non-technical skills, persisting over time and potentially able to be translated into an improved emergency response.

CONCLUSION

This study points out immediate and medium term results showcasing positive impact regarding technical and mainly non-technical skills, and multiple personal benefits from trainee participation in the described set of interprofessional field exercises organized and implemented in the framework of the MSc Global Health-Disaster Medicine yearly, from 2016 to 2019. As such, the proposed set aforementioned

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can be considered for replication in other geographical areas, and for other types of disasters.

LIMITATIONS

Certain limitations should be taken under consideration in the interpretation of this study. Sample population was small and consisted mainly of health care providers, partially because it was conducted in the context of an MSc program of the Faculty of Medicine. Nevertheless, it makes generalization to other professionals cumbersome. It is crucial to expand disaster training to other actors involved in disaster management. The second limitation is that this study was performed over 4 years. Although analysis of the participants characteristics did not demonstrate significant differences, lack of synchronous, blinded, randomized controlled trials present the possibility of potential bias. Questionnaires reveal participant perceptions regarding the effectiveness of these methodologies. Although mass casualty drills provide a realistic real time evaluation among participants, lack of objective standardized assessment tools do not allow further generalization. The evaluation process was developed by the same group that developed the training.

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REFERENCES

1. Mortelmans LJ, Lievers J, Dieltiens G, Sabbe MB. Are Belgian military students in medical sciences better educated in disaster medicine than their civilian colleagues? *J R Army Med Corps*. 2016;162(5):383-386.
2. Heinrichs WL, Youngblood P, Harter P, Kusumoto L, Dev P. Training healthcare personnel for mass-casualty incidents in a virtual emergency department: VED II. *Prehosp Disaster Med*. 2010;25(5):424-432.
3. Tan Y, Liao X, Su H, Li C, Xiang J, Dong Z. Disaster preparedness among university students in Guangzhou, China: Assessment of status and demand for disaster education. *Disaster Med Public Health Prep*. 2017;11(3):310-317.
4. Tavan H, Menati W, Azadi A, Sayehmiri K, Sahebi A. Development and validation of a questionnaire to measure Iranian nurses' knowledge, attitude and practice regarding disaster preparedness. *J Clin Diagn Res*. 2016;10(8):IC06-IC09.
5. Nasrabadi AN, Naji H, Mirzabeigi G, Dadbakhs M. Earthquake relief: Iranian nurses' responses in Bam, 2003, and lessons learned. *Int Nurs Rev*. 2007;54(1):13-18.
6. Yang YN, Xiao LD, Cheng HY, Zhu JC, Arbon P. Chinese nurses' experience in the Wenchuan earthquake relief. *Int Nurs Rev*. 2010;57(2):217-223.
7. Baack S, Alfred D. Nurses' preparedness and perceived competence in managing disasters. *J Nurs Scholarsh*. 2013;45(3):281-287.
8. Thorne CD, Oliver M, Al-Ibrahim M, Gucer PW, McDiarmid MA. Terrorism- preparedness training for non-clinical hospital workers: Tailoring content and presentation to meet workers' needs. *J Occup Environ Med*. 2004;46(7):668-676.
9. Daily E, Padjen P, Birnbaum M. A review of competencies developed for disaster healthcare providers: Limitations of current processes and applicability. *Prehosp Disaster Med*. 2010;25(5):387-395.
10. Ripoll Gallardo A, Djalali A, Foletti M, et al. Core competencies in disaster management and humanitarian assistance: A systematic review. *Disaster Med Public Health Prep*. 2015;9(4):430-439.
11. Hsu EB, Jenckes MW, Catlett CL, et al. Effectiveness of hospital staff mass-casualty incident training methods: A systematic literature review. *Prehosp Disaster Med*. 2004;19(3):191-199.
12. Gioffrè-Florio MA, Murabito LM, Crupi G, Famà F. Come gestire i disastri: Proposta di gestione economica degli eventi catastrofici [How to manage disasters: Learning from recent experiences in the emergency department of a university teaching hospital, Italy]. *Ig Sanita Pubbl*. 2015;71(6):621-628.
13. Khorram-Manesh A, Ashkenazi M, Djalali A, et al. Education in disaster management and emergencies: Defining a new European course. *Disaster Med Public Health Prep*. 2015;9(3):245-255.
14. Leaming JM, Adoff S, Terndrup TE. Computer simulation as a tool for assessing decision-making in pandemic influenza response training. *West J Emerg Med*. 2013;14(3):236-242.
15. Cannon-Diehl MR. Simulation in healthcare and nursing: State of the science. *Crit Care Nurs Q*. 2009;32(2):128-136. doi: 10.1097/CNQ.0b013e3181a27e0f.
16. Bond WF, Deitrick LM, Arnold DC, et al. Using simulation to instruct emergency medicine residents in cognitive forcing strategies. *Acad Med*. 2004;79(5):438-446. doi: 10.1097/00001888-200405000-00014.
17. Skryabina El, Reedy G, Amlôt R, Jaye P, Riley P. What is the value of health emergency preparedness exercises? A scoping review study. *Int J Disaster Risk Reduct*. 2017;21:274-283.
18. Bruner RF. Repetition is the first principle of all learning. Published August 17, 2001. https://ssrn.com/abstract=224340. Accessed October 7, 2020.
19. Skryabina E, Reedy G, Amlôt R, et al. What is the value of health emergency preparedness exercises? A scoping review study. *Int J Disast Risk Re*. 2017;21:274-283.
20. Ford JK, Schmidt AM. Emergency response training: Strategies for enhancing real-world performance. *J Hazard Mater*. 2000;75(2-3):195-215.
21. Kolb DA. *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall; 1984.
22. Peller J, Schwartz B, Kitto S. Nonclinical core competencies and effects of interprofessional teamwork in disaster and emergency response training and practice: A pilot study. *Disaster Med Public Health Prep*. 2013;7(4):395-402.
23. Ingrassia PL, Foletti M, Djalali A, et al. Education and training initiatives for crisis management in the European Union: A web-based analysis of available programs [published correction appears in *Prehosp Disaster Med*. 2014;29(4):38. Khorrram-Manesh A (corrected to Khorram-Manesh A)]. *Prehosp Disaster Med*. 2014;29(2):115-126.

https://doi.org/10.1017/dmp.2020.282 Published online by Cambridge University Press

24. Khorram-Manesh A, Lupesco O, Friedl T, et al. Education in disaster management: What do we offer and what do we need? Proposing a new global program. *Disaster Med Public Health Prep*. 2016;10(6): 854-873.
25. Alfred D, Chilton J, Connor D, et al. Preparing for disasters: Education and management strategies explored. *Nurse Educ Pract, Special Section: Disaster Management Nursing Education*. 2015;15:82–89.
26. Liaw SY, Chen FG, Klainin P, Brammer J, O'Brien A, Samarasekera DD. Developing clinical competency in crisis event management: An integrated simulation problem-based learning activity. *Adv Health Sci Educ Theory Pract*. 2010;15(3):403-413.
27. Kaufman DM. Applying educational theory in practice. *BMJ*. 2003; 326(7382):213-216.
28. Gardner AK, DeMoya MA, Tinkoff GH, et al. Using simulation for disaster preparedness. *Surgery*. 2016;160(3):565-570.
29. Kleiboer M. Simulation methodology for crisis management support. *J. Contingencies Crisis Manag*. 1997;5:198–206.
30. Miller JL, Rambeck JH, Snyder A. Improving emergency preparedness system readiness through simulation and interprofessional education. *Public Health Rep*. 2014;129(Suppl 4):129-135.
31. Walker WE, Giddings J, Armstrong S. Training and learning for crisis management using a virtual simulation/gaming environment. *Cogn Technol Work*. 2011;13:163-173.
32. Coles TR, Dumas C, Fielding D, Watson M. Outside observer, an enhanced training methodology: Bringing back the expert's eye whilst training alone. *Stud Health Technol Inform*. 2014;196:69-75.

https://doi.org/10.1017/dmp.2020.282 Published online by Cambridge University Press