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Mini Review

Training in Disaster Medicine and Emergencies; a Short Review

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Abstract

Disasters and major incidents are inevitable, but can be mitigated by good planning and education. The educational approach to emergencies must be multidisciplinary and engage all organizations involved. It should consist of ancillary material, but also practical sequences, in which participants may exercise their knowledge, skills and competency individually and in group, based on diverse scenarios.

In this short review, major types of simulation training are discussed with regard to their effectiveness in teaching and knowledge retention.

Keywords: Education; Emergency medicine; Disaster management; Simulation

Introduction

Major incidents and disasters, referred to as emergencies in this paper, are inevitable, but their impact can be mitigated by preparedness and appropriate education. Management of emergencies engages many organizations and the whole chain of actions from the scene and the pre-hospital healthcare to the hospitals and their leaderships. A good preparedness can be achieved by better planning and a "close to real" education. The multidisciplinary nature of emergency management challenges the choice of education and the planning process due to the needs and diverse personal and educational background of participants. Furthermore, the individual or organizational knowledge and skills should be put together and into practice to reflect the competency in decision-making and in dealing with the consequences of a failure [1-3].

An emergency has different phases and its management is played out in certain sequences and phases in real-time. Every action taken in one phase, based on personal or organizational knowledge, skills and competency, has an impact on coming phases and for the final outcome. The results are normally visible and evaluable and may be used as a marker to identify strengths and weaknesses in an organization/individual. Clinical and procedural skills and competency incorporated into medical training is the foundation of medical management of victims in an emergency and also an adequate basis for disaster training [3]. The same is valid for other organizations [4-7].

Dealing with emergencies, it is important that a given program; covers all steps and phases in management e.g. command and control, communication, resource assessment, teamwork, etc. in all phases i.e. pre-event to recovery phases; provides possibilities to experience and realize the consumed time for each action taken e.g. time needed for establishing an IV-line; offers a predictable data (input and outcome) that reflects the actual situation and can be used as indicators for final evaluation; has a reproducible result; offers an environment for practical learning by identifying the outcome of decisions made without hesitation; offers enough time for reflection and reinforcement of correct behavior. Finally, it should be feasible with regard to course length, number of participants, and instructors, costs and the organizational belonging [8-11].

Earlier experiences in teaching emergencies and disaster preparedness have shown that blended learning increases staff´s knowledge and their satisfaction [1,12-15]. Blended learning simply combines two or more teaching methods, normally ordinary lectures together with practical exercises. The latter allows learners to experience the reality by simulation (imitation of some situation or process for a study or training of staff e.g. military), to make controlled errors, and to develop an understanding of the doable and the undoable [8,16-18]. Simulation exercise is an important part of blended learning and its benefits has been demonstrated in other fields than healthcare, where outcomes are also dependent on individual and team skills e.g. aviation and nuclear power industries [9,10,16,17,19-20].

Aim

The purpose of this study was to review the available teaching methods and identify an appropriate simulation training method to be recommended for training of multidisciplinary teams in emergencies.

Methods

A short literature review was conducted by using internet and medical library at Gothenburg University. Following keywords were used; "Disaster management" "Disaster simulation techniques" "Major incident training", "Real-time simulation", "Simulation training", "Teaching methods in disaster medicine", alone or all together, on Pub Med, Scholar, and other search engines at the University of Gothenburg. Reports, non-scientific publications were excluded primarily and the result was narrowed from over 15000 publications to over 200. All publications were gathered and sorted out in two groups; 1- publications dealing with teaching methods and 2-publication dealing with course based on Simulation Based Training (SBT). Review of the first set of publications resulted in following set of criteria, which were used to assess the final question,

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which courses are appropriate? These criteria were; *feasibility of the simulation method, capacity of the method, time accuracy, resource accuracy, the outcome of simulation*. These criteria were then used to evaluate current courses with SBT concept. The final evaluation was based on the presence (or absence) of these specific topics.

Results

Teaching methods

Traditionally classroom lectures have been the dominant type of teaching method. However, the frontal lecture paradigm's dominance has been challenged by new teaching methods, notably during the last two decades [21-27]. New technologies have revolutionized the whole teaching system. The main change has been brought about by the introduction of computer-based learning. Utilization of new media sources has made it possible to use internet as a communication source and natural education platform. There are two intersecting dimensions of teaching. The first is passive/active dimension of student participation. At the passive pole ("lecture/document") the teacher sets the agenda and the student absorbs information directly, with little contribution. At the active pole, the student actually has a hands-on experience, with the teacher facilitating the learning process. Cross-cutting this dimension is a second dimension of technology-mediation. At the technology poor pole, the student and the teacher are engaged directly. At the technology rich pole, the teacher-student interaction is largely mediated by technology such as IT and audio-visual media.

Face to face environment: In this setting, there is an interaction between teacher and learner with both positive and negative aspects [12, 28-32]. Face to face teaching environment ranges from teaching a single student or a small seminar to large lectures.

Pros: It is easier to make social contact and establish trust between learner and teacher. There is more freedom in generating new ideas and discoveries during the course and interaction, however;

Cons: This setting is usually performed in a limited space and does not allow large numbers of participants. Exceeding the size of face-to-face interaction group (<~12) is likely to affect the course of teaching and ability to take part in different issues, especially if there are dominating personalities in the group. There is limited time and flexibility, limited time for feedback, which in turn leaves some issues unspoken and unclear.

Skill stations: Skill stations in which learners pass through a sequence of face to face interactions with defined achievement requirements represent a slightly more active form of learning. In such a method, the focus is on the individual achievements of the learner, able to learn at her/his own pace [30].

Pros: Individualized teaching and adjustment to the student's level of understanding.

Cons: Limited number of participants, large number of teachers and huge time investment.

Video lectures

Video Lectures have a major advantage in terms of student time management. They allow students to access lectures at any time, go over the lecture, and rethink the instruction. The Video allows the teacher an opportunity to present the major message before a face-to-face meeting which will focus on discussion [24,25].

Pros: Can be used by working students or regular students when missing lectures due to work or elective absences. Assist students having difficulties with lecture's spoken language, by giving them a possibility to review critical sections and check their notes.

Cons: Lack of interaction level between students and teachers or students and their colleagues unless supplemented by discussion.

Low tech: A great deal of learning takes place with few or no technological mediation, thus, high-tech is not a necessary prerequisite for learning. Blackboards, slates, even dirt drawings are a form of low technology that supports learning. In the 21st century, even such formerly considered high-tech devices such as slide and overhead projectors have become low tech as they have been replaced by more advanced technologies. As a general principle tech mediates (and therefore affects) the direct relationship between teacher and learner. Thus low/no tech methods also have their place, notably to supplement individual learning by allowing the teacher to directly and without mediation inject knowledge/experience/advice into the teacher-learner relationship, and to receive immediate feedback [31].

Pros: Allows direct, unmediated communication between learner and teacher, Provides student example and allows careful examination of immediate student difficulties.

Cons: works better with smaller groups or with single individuals. It is heavily dependent on skill of teacher. It might not allow student expression and be difficult to allow for large groups.

Computer-mediated environment: At the technology-rich end of the technology dimension is the use of IT in learning, often termed "Computer Mediated Learning". In the polar version of this method, there might be no interaction between teacher and learner. However, the method can be improved if each or limited number of students has their own instructor. In this method a course trajectory, including ancillary material (readings), simulation exercises (see below) and programmed learning are presented to the student without the presence of a human teacher or trainer. Sophisticated e-learning programs might offer semi-AI responses (an intelligent response system), suggest routes to explore, and control the speed of learning depending on the student's input. In practice, the student only requires a computer of given power. A less technologically-mediated system would include internet-broadcast lectures, films, or demonstrations, and the provision of work (e.g. written papers) to a human teacher [26, 32-35].

Pros: Every student has the opportunity to learn at her/his own pace and time. Sufficiently sophisticated programming can evaluate students, guide them, and provide all necessary materials. Course materials easily updated. No limitation in number of participants, as they use their own space and time to catch up with the lessons. Learners have thus time to carefully reflect and provide evidence for their feedback.

Cons: Requires huge resources and lengthy time to develop initial course. Atomization and anomie of students without human contact with teacher. Serendipity arising from interaction not likely to occur. Tendency towards procrastination. Lower learner satisfaction.

Practical exercises

Practical exercises with little or no technical input have been a feature of learning for millennia. Critically, they allow learners to simulate the experience of reality, to make controlled errors, and to develop an understanding of the doable and the undoable [4-5, 36-37].

Pros: Offer learners an opportunity to develop know-how, not only know-what. Develop skills and not just knowledge. Help in developing team spirit and communication skills.

Cons: Require careful and lengthy development and testing. Require a great deal of preparation and can limit numbers of learners. Teacher must ensure full participation.

High–fidelity simulation training should be integrated within the course curriculum to allow multiple learning strategies. It must provide a range of diverse scenarios to learn rationale of complex problem solving, decision-making, and resource management. It must also offer time and capacity for reflection and self-discovery and giving feedback in a realistic environment [38]. Furthermore, it should allow repetitive practice, be adaptable and provide a safe, educationally supportive learning environment, offering active learning based on individual needs and defined outcomes [5, 8, 17, 39-42]. Three major types of SBT were identified;

Table-top simulation: In this type of simulation the intellectual and communicative environment, but not the physical one is replicated. As a rule, table-top simulations allow a mix of face to face teaching with the addition of *some* practical exercises which provide the learners with the possibility of putting their gained knowledge into *limited* practice. Largely, these simulations are scenario-based. In this form of teaching the degree of reality can be varied to elucidate real-time issues such as lack of communication. Studies on the effects of table top simulation on student perception of disaster preparedness and management has shown that compared to field operation exercises, this method provides better possibilities to link the results of exercises to appropriate changes in terms of training, equipment, supplies, and plans and also provides additional benefits for communications, coordination, assignment of responsibilities, and post-event mitigation priorities [4,13].

One example for such training model is MIMMS (Major Incidents Medical Management and Support) [43]. MIMMS has been and is used as a training course in many countries and is one way of standardizing the major incident management. However, it has basically been healthcare-oriented and lacks the real-time concepts with regard to consumed time for different measure such as putting IV-line or stabilization of the cervical spine. It is accurate for showing the scene organization and to an extent how the organization of the hospital can be built up, but the possibilities of interactive training of other parts of the chain of response to major incidents is limited [43].

Computer-based simulation: In this type of simulation there might be *no human interaction*. However, the method can be improved if each or limited number of students has their own instructor. In this method accessory material, simulation exercises and programmed learning are presented to the student without the presence of a teacher or trainer. Sophisticated e-learning programs might offer semi-AI responses (an intelligent response system), suggest routes to explore, and control the speed of learning depending on the student's input. In practice, the student only requires a computer of given power. A less technologically-mediated system would include internet-broadcast lectures, films, or demonstrations, and the provision of work (e.g. written papers) to a human teacher [18-19, 31, 44]. The strength of the system is that every student has the opportunity to learn at her/his own pace and time. Sufficiently sophisticated programming can evaluate students, guide them, and provide all necessary materials. Course materials can easily be updated. There is no limitation in number of participants, as they use their own space and time to catch up with the lessons. Learners have thus time to carefully reflect and provide evidence for their feedback [38-39]. The weaknesses of the system are the *huge resources* it needs and the lengthy time it takes to develop initial course. Other points to consider are isolation and loneliness of students without human contact with teacher, which leads to *less motivation and slower progression and lower learner satisfaction*. There have been many attempts to make this kind of simulation available for training with limited success. The overall experience to date indicates that working with this kind of training does not fulfill the demand for interactive involvement of students [43].

Real-time simulation: In this type of simulation over 50% of the course emphasis is on the crisis resource management and different aspects of the crisis such as personnel, resource and time management are trained in specific situations. The nucleus of the course is realistic simulations followed by detailed debriefings. Simulation training can be supplemented by additional modalities such as videotapes and role-playing to enhance the maximal learning. Simulation strives for high degree of realism and therefore is conducted with staff and participants typically located at their ordinary working environment. Scenarios engage participants in appropriate interactions and *enhance teamwork, vertically in own organization and horizontally in collaboration with other organizations*. These scenarios aim to establish inter-individual and inter-disciplinary interaction by asking and receiving helps. Staff may rotate among different stations to learn each positions possibilities and limitations to gain different perspectives. Debriefing are led by one or more instructors with special training or experience and can be performed in whole group or individually to explore aspects of behaviour and emphasize constructive critique and gives participants opportunity to learn from each other and to rehearse and train to learn. Training is intense and feasible and the number of instructors can be adjusted to number of participants and the structure of the course [6-9, 16-17, 45-46].

This kind of training can be conducted by using figurants or patient cards.

a. Simulation training using figurants or "Field Exercises". This model is very resource consuming and thus expensive. It often needs large amount of figurants to test all levels in a disaster management system and disturb the ongoing and daily medical care activities [5, 36].

b. Simulation training using patients 'card is one type of simulation system which can be used to train and evaluate the whole chain of response (Scene, transport, hospitals, command and communication) and coordination between different components of the chain and the obtained results (outcomes). The coordination is

by experience one of the most critical parts of the response and its failure is frequently mentioned as the main reason for non-optimal outcome [43].

Discussion and Conclusion

Published data from the Agency for Healthcare Research and Quality (AHRQ) from 21 studies in 2004 suggested that simulated drills were the most effective teaching method for emergencies. There was insufficient evidence to recommend computer-based simulation or table-top exercises as the superior choices of teaching [20, 47-48].

This short review suggests that the best method for teaching emergencies may be real-time SBT. The method can be integrated with other teaching strategies and skill levels vary based on the participants background. It offers learners an opportunity to develop know-how and not only know-what; to develop skills and not just knowledge and helps in developing team spirit and communication skills. It is an ideal supplement for improving the quality of management by bringing out complex applied competencies in a reduced time frame and a realistic learning environment than other training strategies. It is simple, manageable and relatively risk-free environment for learning and experimentation and allows to train infrequently engaged but critical skills with a defined outcome. It is learner-controlled, more engaging, and quite affordable. However, to accurately measure the success of SBT, there is a need for performance measures to continuously assess the outcome of the training scenarios and give feed-back all along the play by providing a detailed learning-focused feedback and evaluation. Finally, scenarios must be realistic with no exaggeration and what happens before, during and after the training intervention must be considered equally critical in making a successful SBT [1, 5, 8, 12, 16, 19, 39, 45, 49-52].

These features and the criteria mentioned in the method section of this study match the desired training in a multidisciplinary environment, in which students are deeply engaged in skills training by attempting to solve problems in an environment that is similar to the ones to be encountered in real life [53-54]. One such training that has already gained interests in European countries is MRMI (Medical Response to Major Incidents), which is based on MacSim (Mass Casualty Simulation). It fulfills all criteria proposed in the literature for a desirable simulation training; it provides feedback by instructors, creates opportunities for repetitive practice, can be integrated in the educational curriculum, presents a range of difficulty levels, allows multiple learning strategies, provides a range of clinical scenarios, ensures a safe and educationally supportive learning environment, provides both team- and individualized learning, has defined outcomes and is scientifically validated [38, 55].

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