DESIGNING SIMULATION-BASED TRAINING SCENARIOS FOR EMERGENCY MEDICAL FIRST RESPONDERS

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Simulation-based training is a promising instructional approach for training military and civilian medical first responders such as EMTs. There is a need for first responder training in cognitively-based skills such as situation assessment and decision making. We are developing a training program for first responders that uses mannequin-based simulation technology effectively to fill this training need for valid meaningful scenarios that can be integrated into the curriculum and applicable for a variety of EMT skill levels. The program will provide detailed scenarios, instructions for administering the program, and measures for performance feedback. Each scenario will exercise a combination of skills and the set of scenarios will span all of the higher-level skills that have been identified as benefiting from targeted training. We discuss here the iterative process of designing and developing the first of these scenarios which has been shown to be capable of tapping into and measuring different skill levels.

INTRODUCTION

Medics and other trauma care providers play an important role in stabilizing patients in event of injury whether on the battlefield or in the civilian environment. An enormous responsibility falls to these first responders, who treat the wounded in the so-called “golden hour” when the chance of saving the person is the greatest. The greatest risks exist in getting the patient from the point of injury to the field hospital, and a number of complex judgments must be made. Situation assessment, prioritization, and decision making are critical skills at this time. Medical first responders such as Emergency Medical Technicians (EMTs) work in an arena that is fast-paced, dynamic, uncertain, and usually stressful. They must acquire and maintain such critical skills without compromising patient safety. Simulation promises to provide a training solution.

Simulation has been used successfully for training in many clinical specialties, especially in anesthesia (Jha et al., 1999; Holzman et al., 1995). In recent years there has been a call for the enhancement of EMS training with a 2001 EMS Division of the National Highway Traffic Safety Administration (NHTSA) roundtable identifying EMS patient safety related issues including “limited access to simulation training technology” (Kleiner, 2001). There have been several initiatives and successes in the use of simulators both PC-based interactive simulators (Hemman et al, 2002) as well as mannequin-based simulators for EMT training (Takuhiro et al., 2003). The use of mannequin-based simulators for EMT training is being explored at many of the larger EMT training facilities. However, a stumbling block for widespread incorporation of simulators into EMT training includes the unavailability of curricula infrastructure linking the key components of skills, scenarios, and measures as well as the expertise required to run such programs. Our program attempts to meet these needs.

This paper describes the training needs for first responders that have been identified and the iterative process of designing scenarios for simulation-based training of medical first responders. We discuss the design, conduct, and subsequent refinement of one scenario. We then offer some insights and general implications of this process that can be leveraged for developing other scenarios for our program as well as for helping others developing scenario-based training programs.

Training Needs Analysis

Through examination of the curriculum for the Army combat medic military occupational specialty and the civilian counterpart National Registry of Emergency Medical Technicians (NREMT) EMT-Intermediate and EMT-Paramedic programs, input from an expert advisory panel of stakeholders (including EMTs, instructors, emergency medicine clinicians), preliminary field observations, and the instructor experience of one of our team members (Dierks), we identified three major classes of activities and tasks that first responders/EMTs must master:

• Procedure-based and taskwork skills
• Decision-making, information gathering, situation awareness, and planning
• Teamwork, coordination-logistics and communication

From inspection of the medic proficiency examinations and discussions with EMTs we learned that much of the focus in existing first responder curricula is on training and evaluating procedure-based and taskwork skills. At the current time there is an identified need for more emphasis on cognitively based skills such as situation assessment and decision making, and on team-based skills such as communication and coordination at each of the stages of planning, survey, triage, treatment, and handoff. Examples include prioritizing of limited treatment resources, assessment of threats, deciding upon the need for immediate procedural intervention versus deferring intervention until arrival at a higher level care facility, ongoing reassessment of the situation, seeking direction from on-line medical direction (OLMD), and communicating the patient’s situation at handoff. Skills such as these have special relevance in mixed conventional/bioterrorism exposure situations, where the presentation is more diffuse, producing a larger range of situations and resulting in increased diagnostic and management uncertainty. Based on these learning objectives we developed a taxonomy of errors and cognitive model of first responder decision making that we used as the basis for our program and scenario design.

A second area in which we identified a need is in enabling practice in environments that more realistically mimic chaotic, degraded, or dangerous situations. At present, there is little systematic training for degraded conditions, both in terms of coping with dangerous or overwhelming situations such as hazards, threats or adverse weather conditions and in terms of administering medical help in these situations. Simulation-based training can be of particular value in this regard. Scenario-based practice provides an excellent opportunity for EMTs to gain experience dealing with uncommon, degraded, and/or dangerous conditions without exposing them to risk.

**The First Responder Simulation Training (FIRST) Program**

To address these needs we are developing FIRST, a simulation-based, cognitive skills training program for medics in a full-protocol environment. The program will provide all the components required to conduct a training program without the need for an expert trainer, and can therefore be administered as an ‘off-the-shelf package’ by individuals responsible for training. Scenarios are being designed to tap the requisite cognitively-based skills not currently being trained. Each scenario will exercise a combination of these skills and the set of scenarios will span the domain of all the higher-level skills that have been identified as benefiting from targeted training. In addition to the complete set of scenarios, the package will include defined linkages to the simulator, instructions for manual or automated collection of performance metrics, and general guidelines as well as specific scenario-by-scenario notes for conducting effective feedback sessions.

The development of appropriate scenarios is a key component of any training program. In developing scenarios we need to insure that they:

- Tap the cognitive skills we want to train
- Encompass a range of degraded and dangerous situations
- Address realistic situations
- Are appropriate for varying EMT skill levels
- Accommodate variations in regional EMT protocols
- Can be conducted realistically using a high-fidelity mannequin simulator and are adaptable to lower fidelity (and therefore lower cost) simulators as well
- Can be carried out without need for many role players or significant ancillary equipment
- Can be directed by regional instructors who may not have extensive training experience

**METHODS**

**Scenario Design**

For our first scenario we focused on the following training objectives:

- communication with OLMD
- decision making
- allocation of limited resources
- adaptation to a dynamic clinical situation
- biochemical hazard protection.

Based on these objectives we developed and tested Scenario 1 which simulates decision making in rescue and clinical care in conjunction with a localized environmental threat—exposure to an industrial chemical agent (phenol) in close proximity to the victims. This civilian threat corresponds to a military threat such as a chemical weapon. In the scenario, the EMTs are called to an industrial site where there has been an accident. They are met at the door by a distraught manager. Two individuals are visible within the room. One individual (Victim 1) is lying on the floor motionless and the other (Victim 2) is leaning over the first victim, agitated and confused. Both victims are within a demarcated zone in direct contact with the chemical agent. Outside of the room is a simulated Material Safety Data Sheet (MSDS) hanging on the door.

The EMT trainees are expected to assess the danger and protect themselves before entering the room to perform the primary survey and triage of acuity. Situation assessment and decision making for Victim 1 entail mitigating the chemical hazard, immediate airway protection and ventilation support, and cervical spine (C-spine) immobilization precautions. After a short period, the second victim yells out that his eyes are...
burning and he cannot see, and the student team must decide how to deal with his problem while still attending to Victim 1. The students must decide whether to initiate a Standing Field Treatment Protocol (SFTP) or to call OLMD, and whether they should recruit the Facility Manager or other persons in the area to assist. The decision of SFTP versus OLMD and at what point in time the decision is made are important learning points for EMTs. If they call in to OLMD they must communicate the nature of the emergency accurately to the medical director on the phone. If they choose to administer a SFTP, they have to select the appropriate one and be capable of administering it properly.

The students are expected to get the second victim to an eyewash station, and to stabilize and ‘package’ the first victim and prepare for simulated evacuation. After they indicate they are ready to transport Victim 1, there is a simulated ambulance ride, in which the trainees should continue to monitor and treat the victim. When they arrive at the hospital, simulating staffing shortfalls, the receiving nurse is preoccupied with other patients, and refuses to attend to them. The EMT trainees must get the nurse’s attention, communicate the situation, and hand off the patient to the hospital staff.

**Physical Setup**

We conducted three demonstrations of this scenario at the Center for Medical Simulation. The scenario was conducted in three rooms—EMT Station, Rescue Site (Figure 1), and Tertiary Care Hospital Site. In the scenario Victim 1 is represented by the mannequin simulator. Members of the design team played the non-EMT roles included in the scenario, such as the manager, the second (non-mannequin) victim, and the hospital nurse. In order to allow discrete communication between team members, some of the confederates were given headsets to allow communication amongst themselves. Video cameras were present in every room to tape the scenario for use in debrief as well as for documentation. The rest of the study team, when not in role, stayed in the Control Room (Figure 2) observing the scenario through video image feeds from the different rooms. Note that these facilities were used in order to facilitate the scenario specification and development process but that the training scenarios are being designed so that such sophisticated facilities are not required for administering the program.

**RESULTS AND DISCUSSION**

**Realism and Simisms**

In the first two demonstrations we conducted we found that some of the participants were unfamiliar with a simulated environment, and had difficulty in dealing with a simulated patient. Even those who had prior experience with simulators needed some time to adjust to the particular mannequin simulator that we were using. The EMT-Bs in particular were confused when a monitor reading did not correlate with what they saw as physical findings. In order to familiarize the participants with the simulator being used for the training program, we can first expose them to one or two “simulator training” scenarios that would orient the students to the simulation environment as well as to help them recognize the behaviors, constraints, and idiosyncrasies of the mannequin simulator that is being used for training, for example the fact that the mannequin simulator may not manifest certain physical symptoms (e.g., it does not open/close its eyes).

The participants had difficulty in distinguishing between “simisms” that are artifacts of the simulation and what is supposed to be real in the scenario. An example of a confusion was when participants were not sure what objects in the physical environment could be called upon in solving the problem. We saw this in the arrival at the hospital when participants were not sure whether all the treatment options...
and equipment in the room were fair game. An orientation scenario that introduces participants to the “rules” of the simulated world may help to reduce this kind of confusion. It is important to establish expectations in the pre-brief that everything has a purpose and if things seem amiss that is how it is supposed to be perceived. To avoid responses such as “that’s not how we do it in our unit”, or “I would have had more help”, it may also be helpful to set ground rules, for example an orienting statement such as “you are not in your home unit.”

In general Scenario 1 was successful in engaging participants and getting them to suspend reality, but after conducting the first two demonstrations we concluded that the segment of the scenario in which the EMTs are supposed to be in transport to the receiving hospital did not seem realistic to the participants, and thus compromised the sense of realism the simulation created. For this reason we decided to eliminate the simulated ambulance ride. For the third demo we segmented the original scenario into two parts with each part ending in a debrief—Part 1 concluding when the patient is packaged and ready for transport to the hospital, and Part 2 focusing on the handoff of the patient to the hospital staff. In doing this we were concerned that the debriefing after Part 1 would break the sense of realism, but we found that participants were able to reengage in Part 2.

As part of the debriefing process we asked for reactions to whether the scenario was realistic to participants. Participants at all levels were excited about the realism of the scenario and opportunities that simulation-based training such as this would provide in allowing them to practice responding to challenging situations before they encounter them in real-life. Almost all said they would recommend the training to their colleagues.

The Art of Directing a Scenario

A delicate balance needs to be struck to make a simulated world open in terms of decision points and options and yet make sure that the scenario follows certain directions to ensure that the requisite skills are trained and learning objectives are met. Scenario design and direction is as much an art as a science, much akin to directing a stage production where the outcome is determined dynamically in real-time. Scenarios need to be carefully directed so that the participants are “funneled” or led towards the appropriate possible paths. One learning objective of this scenario was to have participants recognize that this situation might require skills they do not possess and that they will need call in to OLMD for instructions, and to look at the communication between EMT and OLMD. We found, however, that despite our initial orientation, most of our participants did not perceive the option of calling in to OLMD. We learned that if we want to ‘force’ that action, we need to embed a precipitating factor into the scenario such as worsening the patient’s condition or create a pretext to have medical dispatch initiate contact instead.

We must also design for contingencies, for example, what to do when a team refused to enter the room without the presence of firefighters to first decontaminate the hazardous area. Scenario designers will need to anticipate in advance what a variety of teams from various training backgrounds and differing local protocols might do and how those different reactions will be handled, e.g. how/whether to continue the scenario if teams refuse to enter a contaminated area. Even then, in trial runs of the scenario designers will see actions they did not anticipate and must handle.

Stratification of Performance Levels

The EMT-B teams performed adequately but felt that the scenario tapped skills required at the EMT-P level, and was therefore quite challenging for their skill and experience level. These participants noted that the simulated events were more serious events than they were used to dealing with on the limited number of runs they had made. They were not comfortable with intubation or IV access. One of the participants did not believe that a real situation could be as complex as this scenario. In general the EMT-B participants found the experience useful and noted that they didn’t realize a real call could be so chaotic.

The EMT-P teams handled the scenario well, making appropriate decisions at each juncture. They acknowledged the chemical hazard, protected themselves accordingly, and handled the emergence of the second victim. They also seemed to be able to adapt to the simulation situation more readily, being able to focus in on the most salient cues of the situation and tune out extraneous distractions from the environment. But the scenario still provided some challenges such as efficient control and utilization of bystanders.

Taken as a whole, the three demonstrations showed that Scenario 1 was successful at tapping into quite a range of different levels of expertise and experience. The relatively inexperienced EMT-Bs and somewhat more experienced EMT-Is performed the scenario at low to moderate levels of proficiency. The EMT-Ps performed the scenario well, but it still provided some challenges as was conveyed in the debrief by the participants.

Over and beyond the differences in performance across the EMT levels, we found that we could identify a range of skills within a given EMT level. As recently trained, college-based EMTs, the EMT-Bs who participated in the demonstrations had not had much experience. However we found that the two teams varied in their level of performance. For example, one EMT-B team acknowledged the need for chemical protection gear and also recognized the emergence of a second patient and treated him accordingly. The other EMT-B team, on the other hand, walked right into the chemical spill without looking at MSDS. The scenario design was thus found to be able to successfully distinguish even these two levels of expertise within EMT-B.

We are developing detailed measures of performance to accompany this scenario as well as the scenarios under development for this training program. The challenge in measure development in this domain is that there is rarely only one right answer or only one path to success in a simulated
scenario, so that in many situations there may not be an absolutely correct or incorrect action. Hence a consideration in designing measures is the need for branching according to actions taken and decisions made by participants in the scenario. The emphasis of the measures is thus to see whether reactions of participants are within the bounds of what an expert would define as reasonable.

CONCLUSIONS

Our experience with Scenario 1 emphasizes that scenario design is an iterative process and that it is vital to try out the scenarios with various levels of participants. As scenario designers we are too close to the scenario to anticipate the actual spectrum of reactions that is possible. We as the design team constantly found ourselves surprised by the reactions that we witnessed in participants.

This set of initial insights into meta-cognition of scenario design and development is being leveraged for the design of the other training scenarios we are in the process of developing for the FIRST program, and can be applied to the development of scenarios in other healthcare domains as well. In developing our program further intensive scenario development and testing will be taking place through which process we will undoubtedly uncover more lessons to be learned and disseminated about such scenario development.

Simulators have the ability to enhance training but have not taken root because of the lack of curriculum infrastructure and validation and until recently the prohibitively high cost of simulators (Satava, 2004). The FIRST program represents an important step towards helping the integration and incorporation of simulation-based training into medical first responder curriculum.

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REFERENCES


