Simulation-Based Curriculum Development for Mass Casualty Triage Training

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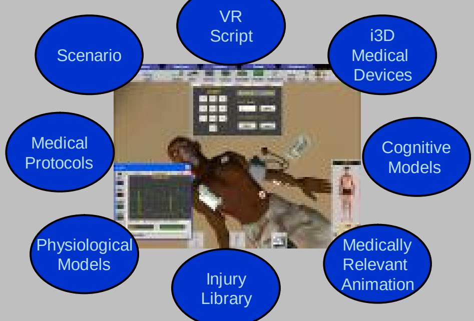
Introduction

Medical simulation can be used to enhance the educational experience and effectively train health care personnel to triage victims in the setting of a Mass Casualty Incident (MCI), providing valuable experience with an appreciation of coordinated disaster response, and ultimately improving the competence of skills across various occupations and scopes of practice.

Mass casualty triage is the dynamic process of establishing a priority of care when the number of injured exceeds available resources. Considered to be the cornerstone of effective disaster management, the process of enacting early, effective triage is not only critical to determine the scope of an event, but is considered to be essential for good disaster medical care. Although no significant treatment should occur while enacting triage, rapid and accurate performance of the process is essential to minimize mortality among survivors. Casualty evaluations provide the information necessary to establish the framework for subsequent response to an incident. Triage results are used to influence resource allocation and sector development, including onsite medical treatment and transport to definitive care. Once triaged, casualties are tagged and moved to the patient collection or treatment area.

The Sim-Patient simulation platform presents users with graphically intense casualties that demonstrate signs and symptoms related to mechanism of injury and physiologic status. Scenarios are comprised of an interactive 3D scene, an incident that produces traumatic conditions and one or more patients. The caregiver can navigate and survey the scene, as well as interact and converse with the virtual patient. Using medical tools, administering medications, monitoring diagnostic data and performing treatment interventions, users may exercise their patient management skills. Health care providers can sharpen their assessment and decision-making skills to develop an appreciation for patient responses to appropriate and inappropriate patient management.



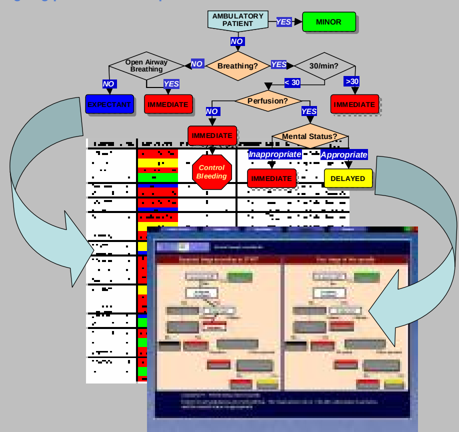
The characters demonstrate dynamic facial expressions, gestures, body movements and can portray anger, fright, confusion or other behaviors based upon cognitive, emotional, physiological, and pathological models. Additional attributes which provide effective portrayal of casualties include:

- Dynamic skin texturing of clinical signs and injuries
- Full body medically-relevant animations
- Multi-layered, deformable and removable clothing
- Breathing chest motion integrated with real-time physiology
- Interactive body regions for patient assessment
- Appropriate physiologic response to medical interventions
- Real-time pharmacokinetic modeling of medication administration

Methods & Development

Most emergency services and civilian disaster response teams in the United States employ the Simple Triage & Rapid Treatment (START) method in the setting of the MCI. Developed in the 1980's by the Newport Beach (CA) Fire Department & Hoag Memorial Hospital for use by civilian responders in the aftermath of earthquakes, the START method is universally recognized as a highly accessible and easy to use algorithmic approach to performing primary disaster triage.

The START method provides responders with an objective framework of categorizing the acuity of patients in a systemic manner to identify victims who have immediately life-threatening injuries *and* who have the best chance of surviving. Minimal training is needed to learn how to successfully apply the START method and no specialized equipment is required. Once proficient, responders are able to complete a casualty assessment and reach a triage determination within thirty seconds per patient encounter. This approach allows for rapid identification of the critically injured without the need for detailed examination of all involved persons by evaluating an individual's ability to obey commands, respiratory rate, and palpability of the radial pulse to assign a triage category. Physiologic systems of triage such as the START method have been favored in the MCI setting because they aim to identify patients with current instability and are based on the assumption that triage will be an ongoing process with frequent reassessments.

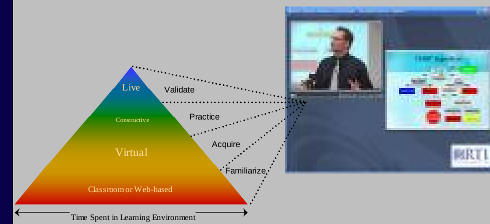


The START method's deterministic algorithm provides seven potential assessment paths and four terminal categorizations of a casualty's priority of care. In the development environment, we used this framework to drive the design a total of twenty eight casualties. The individual cases consisted of adult patients and focused on various mechanisms of injury, including blunt and penetrating traumas, thermal burns, and blast injuries. All cases were clinically straightforward and presented a clear, unambiguous problem with a single corresponding triage category.

In addition to applying the algorithm in the design phase of the synthetic character development, the START method is used to capture and present real-time progress to the end user, as well as serving as graphical after-action review. Student performance is presented alongside the expected triage path for comparison, as well as application of weighted and non-weighted scoring assessment methods.

Learning Management System (LMS)

Mass casualty triage is a perishable cognitive skill which is not a regular part of any health care provider's job and frequently opposes core concepts of single or low-volume patient care and management. Current triage training relies upon didactic sessions and tabletop training prior to live actor exercises which require significant advanced planning and coordination. The LMS integrates didactic learning content, knowledge assessment and case-based scenarios in a SCORM compatible framework. The LMS employs the Familiarize, Acquire, Practice and Validate (FAPV) educational scaffolding for self-paced learning by doing. The LMS tracks student activity and fulfillment of learning requirements for continuing education recordkeeping. A hierarchical content structure, organized as course-module-segments, presents learning material in various media formats. Assessment questions and interactive 3D simulation scenarios are linked to training information.



A comprehensive set of learning modules was developed comprising prehospital trauma care, the START triage methodology, how to use the Sim-Patient simulator, and how to employ Sim-Patient for training others. The latter module supported the Train-the-Trainer objective of the overall USAID program for Training Model Primary Providers (TMPP). The learning modules were developed in Microsoft PowerPoint format, and with annotated learning objectives and teaching points.

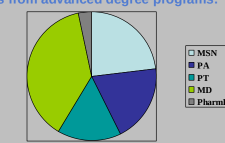
Screen captures of the seven scenarios developed to ensure that each student user to encounters every possible patient condition while training to enact triage using the START method of primary disaster triage.

Results

Proof of concept was demonstrated after successfully incorporating the simulation in an interdisciplinary disaster preparedness program for advanced degree health science students at Duke University.

Two hundred sixty-one students from advanced degree programs:

Nursing	22.9%	(n=60)
PA	19.9%	(n=52)
DPT	15.7%	(n=41)
Medicine	37.9%	(n=99)
Pharmacy	3.4%	(n=9)



Twenty-two graphics-intensive laptop computers were configured with the Sim-Patient software and delivered to the Iraqi Ministry of Health (MOH) for use in the triage course, and subsequent turn-over to the planned Centers of Excellence for training of other medical personnel. In cooperation with the MOH, select physicians were recruited to attend one of two 2-day short courses on triage and using the Sim-Patient triage simulator. The two courses were conducted in July of 2006.

Thirty-one physicians, identified by the MOH, participated in the blended didactic and simulation-based curriculum in multiple-casualty triage. Participants evaluated the curriculum using a questionnaire comprising qualitative measures (Likert-scale: strongly disagree=1 to strongly agree=5), and requested comments. Summary statistics were developed for the qualitative measures and comments as follows (the physicians were not followed after their participation, so assessment of transfer of learning was not possible):

Category	Mean	Std. Dev.
[illegible]	[illegible]	[illegible]
Simulator [illegible] Navigation	[illegible]	[illegible]
Simulator Content & Engagement	[illegible]	[illegible]
Simulator Learning Content	[illegible]	[illegible]
Overall	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	
[illegible]	[illegible]	

Conclusions

A curriculum has been developed, blending didactic content and case-based simulation for START triage training. The course has been delivered to medical students and primary care physicians in the US and Iraq. Course evaluations have been overwhelmingly positive. It has been suggested that this training, if made readily available to more clinicians and first responders, would make an immediate and measurable impact on the survivability of mass casualty events.