Simulation in Disaster Medicine
INTRODUCTION

For most of the twentieth century medical education was about a mere accumulation of facts.

This encouraged a superficial learning style and promoted short-term recall instead of a deep understand of subjects.

Leinstar S. Medical education and the changing face of healthcare delivery. Medical Teacher 2002: 24(1); 13 - 15
INTRODUCTION

In discipline like Disaster Medicine, where the main goal is the patients’ care, learners are supposed to use a combination of knowledge and professional skills and attitudes.

The ultimate goal of the medical discipline is enhanced performance, not increased knowledge.

Leinstar S. Medical education and the changing face of healthcare delivery. Medical Teacher 2002: 24(1); 13 - 15
Competency-based education has progressively emerged in medical setting. It has been found to be equally effective in both didactic and self-learning approaches.

Schlomer RS et al. Teaching strategies and knowledge retention. Journal of Nursing Staff Development 1997: 13(5); 249-253
"competence requires knowledge, appropriate attitudes and observable mechanical or intellectual skills which, together account for the ability to deliver a specified professional service”

WHO, 1988

Collaborative problem solving activities that involve interactions among a group of individuals in which no single individual possesses all the resources and no single individual is likely to solve the problem or accomplish the task objectives without at least some input from others in the group.

INTRODUCTION

Physicians, like other adults, fare better with experiential learning such as participatory learning

Newman P. Valuing learners’ experience and supporting further Growth: educational models to help experienced adult learners in medicine. BMJ 2002;325;200-202
INTRODUCTION

“I am always willing to learn, however, I do not always like to be taught”
INTRODUCTION

The disaster environment is complicated and stressful. It is characterized by situational uncertainty, time compression and high demand of qualified cares.
MCI/Disaster simulations have been the fundamental tools for education and improvement of response capacity
**Simulation**

A realistic environment in which trainees perform a meaningful task and experience appropriate consequences as feedback for their behavior in that environment.

- It provides a useful, meaningful context for a task or problem-solving situation, complex enough to be believable, but not so complex as to be unmanageable.
- It requires trainees to apply skills or integrate knowledge.
- In response to trainees’ actions and decisions, the environment must respond with plausible, real, believable reactions or consequences.

*Burstein JL. The Myths of Disaster Education. Ann Emerg Med. 2006;47:50-52*
Piramide di Miller per le competenze cliniche

Noricini JJ. ABC of learning and teaching in medicine. British Medical Journal 2003:326; 753 -755 c
INTRODUCTION

Simulation has been used since the early days of modern medicine.
Simulation technology can help with not only the enhancement of motor skills, but also the retention of cognitive knowledge*

Retention of knowledge and skills is much higher when an interactive simulation system is used **

* Issenberg Sb, et al. *Simulation and new learning technologies*. Medical Teacher 2001: 23(1); 16-23

The technology can produce a cognitive surplus as consequence of the use of the technological instrument itself

Knowledge as co-product of computer using

Salomon G. Cognitive effects with and of computer technology. Communication Research 1990:17(1); 26 - 45
Real size exercise on Nov 27, 2006

Fonte: Dr. Zulfiqar’s thesis (EMDM VII edition), 2007
LITERATURE SUPPORT

Figure 7: Three SOPs of Hospital Disaster Plan – putting together

Fonte: Dr. Zulfiqar’s thesis (EMDM VII edition), 2007
**Classification**

- "virtual" simulation
  where real people use simulated equipment in a simulated world (or "virtual environment")

- "live" simulation
  where real people use simulated (or "dummy") equipment in the real world
Collaborative Virtual Environments (CVEs)*
human-computer and human-human interactions occur in a virtual scenario

- Users are virtually embodied into “Avatars”

Collaborative Virtual Environments (CVEs)*
human-computer and human-human interactions occur in a virtual scenario

- Users are virtually embodied into “Avatars”
- key element in CVEs is Social Interaction

where real people use simulated equipment in a simulated world (or "virtual environment")
It aims to develop a training instrument to train a number of medical disaster management competencies linked to training objectives and to events embedded in a simulated training scenario.
ISEE PROJECT

An extensive study of the literature and medical disaster plans identified 14 core competencies

- assessment of immediate needs
- alert procedures
- coordination procedures
- medical transportation
- medical resources management
- medical information management
- medical management at the site
- hospital management
- disposition of dead
- medical care at reception centres
- mental health for victims, relatives and rescuers
- public and environmental health
- social welfare
- protection and safety

NMFRDisasters. November 10th-12th 2008, Turin
ISEE PROJECT

EUROPEAN SURVEY ON TRAINING OBJECTIVES IN DISASTER MEDICINE

Delooz H and Debacker M (Vrije Universiteit Brussel), G. Moens and K. Johannik (IDEWE) and the I SEE Partnership.

ISEE Partnership:
VUB (Michel Debacker, coordinator, Herman Delooz)
EPES (Eladio Gil Pinero, Luis Pedregal, Louis Roberto Jimenez Guadarrama)
CSCI (Barbara Tosi, Alessandro Varallo)
UPO (Francesco Della Corte, Pierluigi Ingrassia)
E-SEMBLE (Martijn Boosman, Daniel van Geloven,)
SMUCR (Raed Arafat, Cristian Boeriu)
KMC (Thore Wikström).
ISEE PROJECT

Objectives of the survey

Primary
- which type of disaster
- which competencies to be included as training objectives

Secondary
- actual training situation in teaching institutions
Methodology

Questionnaire addressed to training centers (min. 5) in I SEE partner’s countries (5) for target groups (6):

- medical coordinators
- physicians
- nurses
- ambulance personnel
- EMS dispatchers
- first responders
Please rank out of the following list the training objectives that should be included in the simulation exercise.

- assessment of immediate needs
- alert procedures
- coordination procedures
- medical transportation
- medical resources management
- medical information management
- medical management at the site
- hospital management
- disposition of dead
- medical care at reception centres
- mental health for victims, relatives and rescuers
- public and environmental health
- social welfare
- protection and safety
Please rank out of the following list the training objectives that should be included in the simulation exercise.
ISEE PROJECT

Results

Competencies to be included in the pilot training exercise.

The highest priority was given to
- medical coordination procedures (33%)
- medical alert procedures (19%)
- immediate needs evaluation (16%)
- protection and safety (14%)
- medical transportation (8%)
Please rank out of the following list from 1 to 3 the type of disaster you prefer to be included in the simulation exercise to be developed.

- Earthquake
- Flooding
- Wind-storms
- Tornado
- Volcanic eruption
- Mass gathering
- Major road traffic accident
- Rail accident
- Airplane accident on/near airport
- Explosion
- Chemical accident
- Nuclear accident
- Hospital fire
- Chemical terrorism
- Radiological terrorism
- Terrorist explosion
Please rank out of the following list from 1 to 3 the type of disaster you prefer to be included in the simulation exercise to be developed.

Type of disaster

- Earthquake
- Flooding
- Wind storm
- Tornado
- Volcano
- Road traffic accident
- Rail accident
- Airplane crash
- Mass gathering
- Explosion
- Chemical accident
- Nuclear accident
- Road traffic accident
- Hospital fire
- Chemical/Terrorism
- Nuclear accident
- Terroristic explosion

First choice
Second choice
Third choice
Conclusions

The European countries surveyed through the I SEE partnership, put the emphasis for disaster medicine training on a mass casualty scenario, rather than on a true disaster. Following this choice they want the exercise to concentrate mainly on the pre-hospital aspects of medical care and management.
Translation of the competencies into tasks needed to elicit observable behaviors.

Tasks
1. Efficient mobilization of adequate resources in a MCI.
2. Perform on-scene initial actions in an MCI.
3. Assess and monitor hazards and unsafe situations and develop measures to ensure personnel safety in a MCI.
4. Perform scene security and traffic control in a MCI in collaboration with police forces.
5. Manage and coordinate all medical personnel and resources responding to the MCI.
6. Manage in a MCI the ambulance staging area and move ambulances into loading area as needed.
7. . . .
We developed a pre-hospital disaster management model which can be customized so that the model ties the competencies to a local plan and local responders.

Based on the list of observable behaviors in the simulation environment, we defined internal or simulation-based performance measures and observer-based rating scales associated to tasks in the scenario.
1. System design: layout

ISEE PROJECT

trainees

instructor

... more trainees

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**ISEE PROJECT**

1. System design: resources

The simulation environment contains resources.
1. System design: resources

Trainees are "Actors" in the exercise
For example:
- medical incident officer
- triage officer
Instructor plays other Actors in the exercise.
For example:  - incident commander
             - police commander
The rest of the resources are "virtual characters" which can be affected by:

1. the scenario
2. trainees
3. instructor
ISEE PROJECT

1. System design: user interface

The student has 3 screens: (1) Maps, (2) Communication window and (3) Event Screen
1. System design: maps

Resources are situated in locations in the simulation environment.
Every Actor is shown by an image. The image can be changed per country.

<table>
<thead>
<tr>
<th>Actor</th>
<th>Time</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>LÅK</td>
<td>12:31</td>
<td>Received</td>
</tr>
<tr>
<td></td>
<td>12:42</td>
<td>Received</td>
</tr>
<tr>
<td></td>
<td>13:01</td>
<td>Received</td>
</tr>
<tr>
<td>RÅDDN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POL</td>
<td>12:31</td>
<td>Received</td>
</tr>
<tr>
<td></td>
<td>12:42</td>
<td>Received</td>
</tr>
<tr>
<td>AMB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The trainees can send messages to other Actors in the exercise (played by trainees or the instructor).
ISEE PROJECT

1. System design: event screen

The trainees receive events on the multimedia events screen.

- List of previous events
- Multimedia event:
  - picture
  - movie
  - test message
ISEE PROJECT

1. System design: event screen

Possibility to link virtual reality into the scenario.
The color bars show which events are scheduled and which events have been completed.
1. System design: Instructor screen

<table>
<thead>
<tr>
<th>Time</th>
<th>From</th>
<th>To</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:34</td>
<td>MIC</td>
<td>1AMB</td>
<td>Let me know when you have indication of chem …</td>
</tr>
<tr>
<td>09:35</td>
<td>1AMB</td>
<td>MIC</td>
<td>Chemical risk is probable says the fire cdr</td>
</tr>
<tr>
<td>09:38</td>
<td>DISP</td>
<td>1AMB</td>
<td>Please send met situation report asap</td>
</tr>
</tbody>
</table>

The instructor can monitor all chat communication taking place between the trainees.
### EVENTLOG

<table>
<thead>
<tr>
<th>Time</th>
<th>Action</th>
<th>Status Change</th>
<th>Status Change To</th>
<th>Verhaalijn</th>
<th>Event</th>
<th>Actor</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:14</td>
<td>11:00</td>
<td>R. Clubbers</td>
<td>OLDH-RCI</td>
<td>OK</td>
<td>AnnA</td>
<td>V</td>
</tr>
<tr>
<td>11:57</td>
<td>11:45</td>
<td>Wim Sijtsma</td>
<td>Sijtsma</td>
<td>OK</td>
<td>AnnA</td>
<td>V</td>
</tr>
<tr>
<td>12:00</td>
<td>11:45</td>
<td>R. Clubbers</td>
<td>OLDH-RCI</td>
<td>OK</td>
<td>AnnA</td>
<td>V</td>
</tr>
<tr>
<td>12:04</td>
<td>11:45</td>
<td>Dave Garbeta</td>
<td>ES-DGA</td>
<td>OK</td>
<td>AnnA</td>
<td>V</td>
</tr>
<tr>
<td>12:23</td>
<td>12:30</td>
<td>R. Clubbers</td>
<td>OLDH-RCI</td>
<td>OK</td>
<td>AnnA</td>
<td>V</td>
</tr>
<tr>
<td>12:34</td>
<td>12:30</td>
<td>Dave Garbeta</td>
<td>ES-DGA</td>
<td>OK</td>
<td>AnnA</td>
<td>V</td>
</tr>
<tr>
<td>12:38</td>
<td>12:33</td>
<td>Hans Bulters</td>
<td>Bulters</td>
<td>OK</td>
<td>AnnA</td>
<td>IVD</td>
</tr>
<tr>
<td>12:38</td>
<td>12:32</td>
<td>Hans Bulters</td>
<td>Bulters</td>
<td>OK</td>
<td>AnnA</td>
<td>IVD</td>
</tr>
<tr>
<td>12:40</td>
<td>12:35</td>
<td>R. Clubbers</td>
<td>OLDH-RCI</td>
<td>OK</td>
<td>AnnA</td>
<td>V</td>
</tr>
<tr>
<td>12:50</td>
<td>12:37</td>
<td>Wim Sijtsma</td>
<td>Sijtsma</td>
<td>OK</td>
<td>AnnA</td>
<td>V</td>
</tr>
<tr>
<td>12:54</td>
<td>12:31</td>
<td>Dave Garbeta</td>
<td>ES-DGA</td>
<td>OK</td>
<td>AnnA</td>
<td>V</td>
</tr>
<tr>
<td>12:56</td>
<td>12:40</td>
<td>Hans Bulters</td>
<td>Bulters</td>
<td>OK</td>
<td>AnnA</td>
<td>V</td>
</tr>
</tbody>
</table>

Printed by Crisisim Manager

**Strikt Vertrouwelijk**
ISEE PROJECT

Learning objectives

Scenario

Events

Event log

Measure

Performance indicators
HDPnetS

Hospital
Disaster
Preparedness
Networked Simulator
HDPnetS

HDPnetS™
Multi-Player
HDPnetS
HDPnetS

Now create a territory, real or invented

manage rescue team and vehicle movements
Millin City Community Hospital

Founded in 1971, Community Hospital is a 100-bed hospital serving the people of Millin City. It admits more than 3000 patients annually and treats more than 9,000 patients in the emergency department each year. About 300 people (doctors, nurses, and other caregivers, administrative staff, etc.) work in the hospital.
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Poisoned. She was walking around her car involved in the accident. Patient in middle respiratory distress.

Name: 046 Status: [Critical]
Age: 25
Sex: Female
Patient available.
HDPnetS

A1
Cardiologie, Reumatologie, Dermatologie en Neurologie
HDPnetS

- Allows you to re-create your own environment and the Hospitals and the facilities located in your area
- With the available personnel (working and on-call)
- Positioning the available resources
- Possibility to replay the simulation for effective debriefing
where real people use simulated (or "dummy") equipment in the real world

**St. Christophe**
**May, 19th 2006**
Workshop introduction
Tuesday
Prof. Della Corte
Live Simulation

Power ECE (Exercise Creator and Evaluator)

- Create/Modify Victims
- Stamp
- Choose an event
- Create Lab/Radiology
- Manage Lab/Radiology
- Start data analysis
- Continue data analysis
- Publish on Excel Extra-H
- Publish on Excel In-H

NMFRDisasters. November 10th-12th 2008, Turin
There is insufficient evidence to support firm conclusions about the effectiveness of specific training methods.

Hsu EB et al. *Training of hospital staff to respond to a mass casualty incident (evidence report/technology assessment)* No. 95, prepared by the Johns Hopkins University Evidenced-based Practice Center under contract No. 290-02-0018, AHRQ publication No. 04-E015-2). Rockville (MD): Agency for Healthcare Quality and Research; 2004
CASE STUDY

UNDERGRADUATE COMPLEMENTARY COURSE IN DISASTER MEDICINE: ASSESSMENT OF STUDENTS KNOWLEDGE RETENTION AND PRACTICAL ATTITUDE AND SKILLS.

Hypothesis

✓ - Simulation exercise in MCI management is more effective in terms of knowledge retention and practical skills

✓ - Which learners would be most likely to benefit from the simulation
**CASE STUDY**

**METHODS**

4th, 5th, and 6th-year medical students enrolled in a 24-hr complementary course on basic principles of disaster medicine at the University of Eastern Piedmont and University of Palermo

Students were randomized into two groups (control(C)/intervention(I)) matched by year of education to ensure that the student level of education was equally distributed between the two groups.
CASE STUDY

A web page for distance learning was created: text files and .ppt presentations were available for students. Fora were also available to promote interaction.
six 45-minute didactic lectures discussing principle of mass-casualty incident (MCI) and disaster management were designed

1. Disaster Medicine: medical management and rescue chain
2. Triage: principles and methodologies
3. Command & Control
4. Principles of medical treatment in pre and in-hospital setting
5. Crush, Blast e Burns injuries
6. Mass Casualty Incidents: case studies
CASE STUDY

Disastermed.Ca emergency department simulation was used either as training instrument and assessment tool for practical attitudes and skills at the mid and at the end of the course.


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CASE STUDY

METHODS

Learning styles were assessed using Felder and Solomon’s Index of Learning Styles.

The ILS provides a separate score for each of four dimensions (1) active-reflective, (2) visual-verbal, (3)sensing-intuitive, (4)sequential-global)

Multiple-choice questionnaire was used to assess the knowledge retention in both groups (control and intervention).

Questions were grouped in 5 categories according to the related topic, were block randomized and two 28-item questionnaires were created and delivered to the two groups at the beginning (pre-test) and at the end (post-test) of the course.

Disastermed.Ca emergency department simulation was used to assess practical skills

Triage accuracy, mean time to triage, mean time to bed assignment, mean time to physician assessment, and mean time to disposition were compared.
CASE STUDY

RESULTS

Whole

\[ p = 0.0028 \]
\[ d = 1.9 \]

<table>
<thead>
<tr>
<th></th>
<th>d (post-pre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>1.77</td>
</tr>
<tr>
<td>V</td>
<td>1.454</td>
</tr>
<tr>
<td>VI</td>
<td>2.166</td>
</tr>
<tr>
<td>FC</td>
<td>4.666</td>
</tr>
</tbody>
</table>

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CASE STUDY

RESULTS

d = 2.76 + 0.159 Grp”I” – 3.43 preB – 0.0059 AR – 0.165 SI – 0.0846 VV + 0.248 SG
CASE STUDY

RESULTS

Time from Arrival to Triage

\[ p = 0.98 \]

\[ p < 0.001 \]
CASE STUDY

RESULTS

Time from Arrival to MD

- Control

- Intervention

\[ p = 0.12 \]

Time from Arrival to Room Assignment

- Control

- Intervention

\[ p = 0.40 \]
CASE STUDY

RESULTS

Time from Arrival to Disposition

\[ p < 0.001 \]

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Simulation exercise in MCI management do not increase knowledge retention

Simulation exercise in MCI management is effective in terms of practical skills acquisition

Learning styles did not affect test score

Although the course was globally effective, it is more suitable for senior medical students

Probably simulation exercise in ED management is recommended for medical students
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pierluigi.ingrassia@med.unipmn.it

www.hdpnets.com
www.dismedmaster.com