Virtual Reality Enhanced Mannequin (VREM) for clinical risk management and healthcare personnel training in immersive simulation

La Medicina incontra la Realtà Virtuale: Applicazioni in Italia della Realtà Virtuale in Medicina e Chirurgia

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Disclosure

Federico Semeraro - Medical Doctor /Geek
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Mini-VREM Crowdfunding Project Campaign
iCPR Scientific Consultant

Share and fund this project !!!
www.indiegogo.com/mini-vrem
Dedicated to the Next Generation

Andrea was born 20th November 2010
20th November 2010 6.35 his first photo with iPhone

21st November 2010 Private dedicated Facebook Group
23th November 2010 He slept with music from iPod
Key points

- Error in Medicine
- Medical Training
- High Fidelity Simulation
- Virtual Reality
- VREM prototype

Once upon a time…
Error in Medicine

Healthcare errors impact 1 in every 10 patients around the world

Simulation
Simulation has been shown to be useful at both the undergraduate and postgraduate levels. Students often find it difficult to acquire the range of experience they need. Simulation of procedures, ranging from venepuncture to laparoscopic cholecystectomy, offers the opportunity for turning standard operating procedures into habits and allows practice of manual skills without the risk of causing harm to a real patient.

Simulation has also been successfully used in the training of teams and in the familiarisation of daily routines. For many years, the Advanced Life Support courses have assessed trainees in simulated scenarios, where practical skills, teamwork and leadership are required to ensure safe and high-quality outcomes.
“Like aviation, 65-70% of all incidents in anaesthesia are attributed at some level to human error”.... David Gaba
Use Simulations Whenever Possible

As described under Principle 4, health care organizations and teaching institutions should participate in the development and use of simulation for training novice practitioners, problem solving, and crisis management, especially when new and potentially hazardous procedures and equipment are introduced. Crew resource management techniques, combined with simulation, have substantially improved aviation safety and can be modified for health care use. Early successful experience in emergency department and operating room use indicates they should be more widely applied.
Medical Training
Advanced Life Support

- Lectures
- Closed discussions
- Skill station
- Scenarios / role-playing
HF Simulation training

Crisis Resource Management

1. Know the environment
2. Anticipate and plan
3. Call for help early
4. Exercise leadership and followership
5. Distribute the workload
6. Mobilize all available resources
7. Communicate effectively
8. Use all available information
9. Prevent and manage fixation errors
10. Cross (double) check
11. Use cognitive aids
12. Re-evaluate repeatedly
13. Use good teamwork
14. Allocate attention wisely
15. Set priorities dynamically

Gaba & Rall, 2008
Learning Pyramid

- Lecture: 5%
- Reading: 10%
- Audio Visual: 20%
- Demonstration: 30%
- Discussion Group: 50%
- Practice by Doing: 75%
- Teaching Others: 90%

Average Learning Retention Rates

Simulation Training

NTL Institute
The future vision of simulation in health care

D M Gaba

Qual. Saf. Health Care 2004;13;2-10
doi:10.1136/qshc.2004.009878

Text box 1: Key messages

- Systematic training and assessment of health care personnel should become a major priority of the health care system.
- Simulation has a multitude of applications categorised by 11 dimensions.
- Simulation training will be applied not only to individuals, but more importantly also for crews, teams, work units, and organisations.
- Simulation will be an important “bottom up” tool for creating and maintaining a culture of safety and for fostering changes in work procedures and systems.
- Simulation will facilitate criterion based competency driven clinical training and practice.
- Costs of simulation based training will vary widely depending on the details of the application.
- Benefits of simulation applications may be hard to measure, especially those that will probably involve long term cumulative effects.
- Key drivers of the simulation vision include the public, liability insurers, professional societies, accrediting organisations, and governmental regulatory agencies.
Virtual Reality vs High fidelity simulation
High Fidelity Simulation

- **Advantages**
  - provision of a safe environment for training
  - multidisciplinary team training and specific behavioural skills

- **Disadvantages**
  - difficulty in evaluating some findings in physical examination, for example, patient skin colour
  - hypervigilance & cavalier behaviour
  - limited sense of immersion and presence
Virtual Reality

• **Advantages**
  - improve fidelity
  - increase involvement
  - increase the sense of immersion

• **Disadvantages**
  - virtual reality in medicine is a subject of active research
  - high cost
  - high complexity
  - cybersickness
Utilization of virtual reality for endotracheal intubation training

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Viki & VREM

- To develop a prototype simulator system in virtual reality environment to improve the perception of realism.

- To design standardized training scenarios for training of healthcare personnel in handling unexpected adverse events.

- To compare the effectiveness of simulation training for professionals randomly assigned to one of two groups: simulation training with and without the addition of virtual reality.

- To evaluate the level of behaviour interaction achievable in highly immersive virtual environments with virtual animated characters and perception of realism.
Virtual reality enhanced mannequin (VREM) that is well received by resuscitation experts

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**A B S T R A C T**

*Summary:* The objective of this study was to test acceptance of, and interest in, a newly developed prototype of virtual reality enhanced mannequin (VREM) on a sample of congress attendees who volunteered to participate in the evaluation session and to respond to a specifically designed questionnaire.

*Methods:* A commercial Laerdal HeartSim 4000 mannequin was developed to integrate virtual reality (VR) technologies with specially developed virtual reality software to increase the immersive perception of emergency scenarios. To evaluate the acceptance of a virtual reality enhanced mannequin (VREM), we presented it to a sample of 39 possible users. Each evaluation session involved one trainee and two instructors with a standardized procedure and scenario: the operator was invited by the instructor to wear the data-gloves and the head mounted display and was briefly introduced to the scope of the simulation. The instructor helped the operator familiarize himself with the environment. After the patient’s collapse, the operator was asked to check the patient’s clinical conditions and start CPR. Finally, the patient started to recover signs of circulation and the evaluation session was concluded. Each participant was then asked to respond to a questionnaire designed to explore the trainee’s perception in the areas of user-friendliness, realism, and interaction/immersion.

*Results:* Overall, the evaluation of the system was very positive, as was the feeling of immersion and realism of the environment and simulation. Overall, 84.6\% of the participants judged the virtual reality experience as interesting and believed that its development could be very useful for healthcare training.

*Conclusions:* The prototype of the virtual reality enhanced mannequin was well-liked, without interference by interaction devices, and deserves full technological development and validation in emergency medical training.
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Results

The VREM was tried by 39 users. The sample consisted of 27 (69.2\%) men and 12 (30.8\%) women, with an average age of 41.9 ± 10.8 years. Only 20.5\% had previous experience with Virtual Reality, 51.3\% had a previous experience of training in simulation centres. The sample included 54\% medical doctors, 23\% nurses and 23\% lay rescuers. Sixty-seven percent were CPR instructors. The evaluation for each question is reported in detail in Table 1 and questions are grouped according to three areas: user-friendliness, realism, and interaction/immersion.
Virtual reality enhanced mannequin (VREM) that is well received by resuscitation experts

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Table 1
User responses to VREM manikin. Participants rated the following statements using a 7-point Likert scale (1 = completely disagree, 7 = completely agree).

<table>
<thead>
<tr>
<th>Statement</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>User-friendliness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q5: It has been very difficult to wear and use the helmet and the gloves</td>
<td>39</td>
<td>2.59</td>
<td>2.221</td>
</tr>
<tr>
<td>Q8: It has been difficult to perform external cardiac compressions</td>
<td>39</td>
<td>2.64</td>
<td>2.071</td>
</tr>
<tr>
<td>Realism</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q6: I had the feeling that the patient was really present in front of me</td>
<td>39</td>
<td>5.31</td>
<td>1.280</td>
</tr>
<tr>
<td>Q7: I had the feeling that my hands were positioned and oriented as the virtual ones</td>
<td>39</td>
<td>5.44</td>
<td>1.744</td>
</tr>
<tr>
<td>Q9: The patient presented the classical signs of cardiac arrest (mydriasis, pale skin)</td>
<td>39</td>
<td>6.08</td>
<td>1.384</td>
</tr>
<tr>
<td>Q10: I had the feeling that the virtual hands began to look like the real ones, in terms of shape, colour, wrinkledness and other visual features</td>
<td>39</td>
<td>4.55</td>
<td>1.688</td>
</tr>
<tr>
<td>Q11: I had the impression to be in a real hospital room</td>
<td>39</td>
<td>5.08</td>
<td>1.634</td>
</tr>
<tr>
<td>Q12: The environment of the operation room was very realistic</td>
<td>39</td>
<td>5.08</td>
<td>1.282</td>
</tr>
<tr>
<td>Interaction/immersion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q13: The perception of the three-dimensional space was very high</td>
<td>39</td>
<td>5.71</td>
<td>1.037</td>
</tr>
<tr>
<td>Q14: It was difficult to reach and touch the patient</td>
<td>39</td>
<td>2.79</td>
<td>2.002</td>
</tr>
<tr>
<td>Q15: The interaction with the patient was very realistic</td>
<td>39</td>
<td>5.53</td>
<td>1.133</td>
</tr>
<tr>
<td>Q16: The involvement in the resuscitation procedure was high</td>
<td>39</td>
<td>5.86</td>
<td>1.146</td>
</tr>
</tbody>
</table>

* The perception of the three-dimensional space was very high.

** The involvement in the resuscitation procedure was high.
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Augmented Reality
Gaming platform

• Advantages
  – common in all age groups
  – easy to use
  – precision and motion-sensing capabilities
  – motion tracking feedback

• Disadvantages
  – field research in progress
  – development is still poorly defined
Purpose of the study

The research project involves the construction of a self-learning software specifically dedicated on quality cardiopulmonary resuscitation for lay people and healthcare personnel for the maintenance of CPR skills (chest compression and ventilation) and for self-evaluation. Used on web online through the use of existing MiniAnne mannequin and through use webcams and augmented reality technology.
NEW TECH OR OLD STYLE
IN EMERGENCY TRAINING
Italian Resuscitation Council Poll

• Questions:
  1. In which areas related to new technologies should
     Italian Resuscitation Council invest in the coming
     years
  2. It is possible in the near future that virtual reality
     will become the standard training in CPR

• Methods:
  – Survey Methods (IRC web site – Facebook – Mailing list)
  – From May to November 2010
1. In which areas related to new technologies should Italian Resuscitation Council invest in the coming years?

![Bar Chart](chart.png)

- Social Network: 4.11%
- Web Site: 6.99%
- 3D Virtual World: 2.88%
- E-learning: 10.02%
- Smartphone software: 8.65%
- HF simulation: 25.23%
- Virtual Reality: 23.00%
- Gaming Platform: 0.87%
- Others: 0.00%

**n = 1387**
2. It is possible in the near future that virtual reality will become the standard training in CPR

n = 1417
Grazie per la vostra attenzione !!!!

Mini-VREM Project

I've seen things you people wouldn't believe...

Share and fund this project !!!
www.indiegogo.com/mini-vrem

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