A Virtual EMS Simulator for Practice of Emergency Medical Care

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EMS education is generally provided using classroom lectures, multimedia materials, printed materials, and on-the-job mentoring. For infrequent trauma and medical conditions, gaining and sustaining clinical experience is largely dependent on chance patient encounters. To help fill this experience gap, a virtual EMS simulator (VirtualEMS™) has been developed that presents responsive, simulated patients in a scenario context using a desktop virtual reality architecture.

Methods:

VirtualEMS comprises a number of innovations that integrate virtual reality, medical protocols, multimedia, physiological simulation, and caregiver-patient dialogue in real-time case-based scenarios. The virtual reality simulator presents a scenario comprising a 3D scene, patients with trauma or medical conditions, and patient management resources.

The caregiver can survey and manage the scene, assess the patient, administer medications, monitor diagnostic data, apply medical devices, and perform interventions as needed to stabilize the patient for pre-hospital transport.

The caregiver can perform interactions with the virtual patient (e.g., taking a pulse) using a mouse-click interface. A caregiver–patient dialogue adds the dimension of conversation, which is important in assessing level of consciousness and increases the perceived realism of the patient. Medical providers can sharpen their assessment and decision-making skills, as well as develop an appreciation for patient responses to appropriate or inappropriate treatment. VirtualEMS guides the user through standardized protocols, then challenges the user with complex scenarios. User interactions are recorded for after-action reviews, as are the pertinent physiological data.

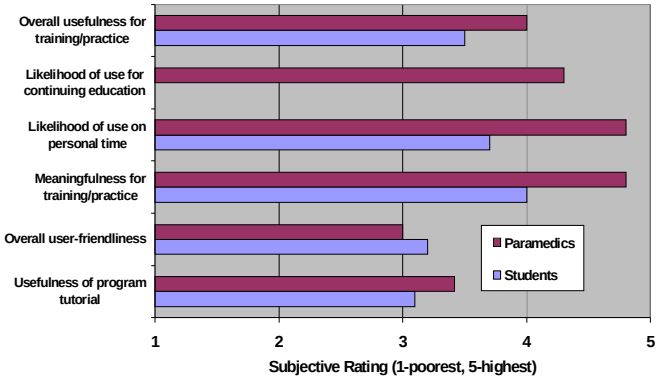
Physiological modeling comprises two layers, the VirtualEMS meta-model and the BODY Simulation™ physiology model. The meta-model provides overall control of the simulation, provides supervisory control over the BODY simulation, and stores physiological data for subsequent review and scoring.

BODY integrates multiple physiological models. The multiple-compartment transport architecture represents physiological functions and pharmacological actions and interactions. Just like the human body, the physiology model centers around a cardiovascular model that consists of a beating heart; blood with which to transport gases, ions, chemicals, drugs, etc.; and compartments such as the brain, heart, and liver. The cardiac function provides blood pressures and flows that resemble the real cardiovascular system, adding immeasurably to the realism of the simulation.

Evaluation and Results:

VirtualEMS was evaluated by subject matter expert (SME) review and student usability testing. For usability testing, a small cohort of emergency medical technician students (n=6) and firehouse paramedics (n=5) were allotted a brief period to learn how to use the simulator, then asked to complete a series of specific tasks including completing one trauma patient scenario. Usability testing methods included scripted scenarios, pre-test and post-test questionnaires, data logs, the think-aloud protocol, and test monitor observations.

After the student tests were competed, several priority changes were implemented in the software. As shown below, subsequent firehouse paramedic testing revealed an increase in the users' perception of the software's meaningfulness, overall usefulness, and the likelihood that users would use the software. Whether the improved results were due to the software changes or the paramedics' preferences is not known.



Conclusions:

VirtualEMS provides cost-effective training and practice for pre-hospital emergency care. User testing showed a general satisfaction with the simulator for both initial training and continuing education. The efficacy of this tool for improving EMS training is yet to be evaluated.

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