BodyExplorer: An Initial Report On Usability of a Novel Simulator Being Developed at the University of Pittsburgh

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Objectives

• Review simulation educational literature
• Compare current simulator systems with the BodyExplorer system
• Describe system development and the relevance of components to nurse anesthesia practice
• Describe methods of Usability Testing, including participant sampling, data collection, results and product refinement
• Apply lessons learned to refinement of current modules and development of future applications
• Co-Principal Investigators:
  • Dr. John O’Donnell - School of Nursing
  • Dr. Joseph Samosky - Swanson School of Engineering
  • Douglas Nelson - Swanson School of Engineering

• Site of Project: University of Pittsburgh School of Nursing, Robert Morris University School of Nursing

• Duration of Research: October 2014 to present

• Funding sources:
  • Coulter Translational Research Partners II, Clinical & Translational Science Institute
  • Department of Bioengineering
  • Department of Nurse Anesthesia
  • Undergraduate Research Mentorship Program (URMP)
Literature Review

• Simulation allows learners to:
  • Practice clinical skills, critical thinking, and psychomotor skills without endangering patients
  • Learn in a non-threatening environment
  • Build confidence
  • Create readily transferable skills
    • NCSBN longitudinal study
  • Train for both individual and team based skills
What is BodyExplorer?

- An augmented reality enhanced mannequin simulator
  - Memorable anatomy, physiology and procedural education with instant feedback
  - Reduce barriers seen with current simulators
  - Increase learner interaction with self-directed and customized curriculum
BodyExplorer
Augmented Reality and Sensor Enhanced Mannequin Medical Simulator

Interaction Techniques and Integrative Application Example

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Goals of BodyExplorer

• Engaging, customizable experiences to accelerate learning
• On-demand, interactive system without the need for continued instructor presence
• Incorporate tutorials and feedback that promotes self-directed learning
BodyExplorer versus Current Simulation

- Barriers of current simulation:
  - Cost
    - Initial simulator, upgrades to diversify curriculum
    - Personnel to staff simulation
  - Educational component
    - Lack of customization to curriculum
    - Limited time for learner/system interaction
    - Less than realistic
- BodyExplorer:
  - Reduced cost
  - Almost infinite possibilities for module creation
  - Flexible
Usability Testing

Ease of use

System testing

Future

BodyExplorer
IRB Approval

- University of Pittsburgh Institutional Review Board (IRB)
  - Usability testing Nov-Dec 2014, Dec 2015, Feb 2016-present

- Robert Morris University Institutional Review Board (IRB)
  - Support obtained from the Director of the RISE Center for Simulation
  - BodyExplorer usability testing conducted on May 6-7, 2015
Methods of Usability Testing

- **Sample**
  - University of Pittsburgh
    - Students, instructors
  - Robert Morris University
    - Instructors, RISE Center faculty
  - Sign-Up Genius, WePay debit card
Methods of Usability Testing

- One-hour session:

<table>
<thead>
<tr>
<th>Time sequence (minutes)</th>
<th>Duration (minutes)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00 - 00:03</td>
<td>3</td>
<td>User Demographic Tool, purpose, introductions</td>
</tr>
<tr>
<td>00:03 - 00:06</td>
<td>3</td>
<td>Think-Aloud, introduction to system</td>
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<tr>
<td>00:06 - 00:35</td>
<td>29</td>
<td>System testing</td>
</tr>
<tr>
<td>00:35 - 00:45</td>
<td>10</td>
<td>Debriefing questions, GAS-1 Survey</td>
</tr>
<tr>
<td>00:45 - 00:60</td>
<td>15</td>
<td>Buffer time, reset system</td>
</tr>
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Usability Testing Session
Data Collection
Phases of Usability Testing

- **UT0** (Oct 2014): Initial system testing by research team at the University of Pittsburgh
- **UT1** (Nov/Dec 2014): Testing by study participants at the University of Pittsburgh
- **UT2** (May 2015): Testing by study participants at Robert Morris University
- **UT3** (Dec 2015): Tested by study participants at the University of Pittsburgh

- After each round of usability testing: team meeting
Current Modules in Development

- Rapid sequence induction module(s)
- General anatomy and physiology exploration module(s)
- Facemask ventilation module
- Medication administration, drug dilution safety modules
Medication Administration Module

• Automated drug recognition system:
  • Goal: demonstrate the effects of commonly administered medication categories on specific body systems
  • Allows users to administer simulated medications
  • Visualize real-time physiologic responses to IV medications
Drug Dilution Safety Module

- Developed towards integration into the Pitt Nurse Anesthesia curriculum
- Proper medication dilution into safe concentrations for IV administration
HYDROMORPHONE

This module will guide you through preparing a dilution of Hydromorphone (Dilaudid).

While you should always be vigilant about checking labels before injecting, extra caution should be taken with Hydromorphone.

Hydromorphone concentrations may not be standardized across clinical sites or among clinicians.

Common Dilution Doses:
- 0.2 mg/mL
- 0.4 mg/mL
- 0.5 mg/mL

DILUTION TASK: HYDROMORPHONE

In this module, you will dilute 2.0 mg/mL Hydromorphone to a concentration of 0.4 mg/mL in a syringe and administer 0.8 mg via IV push during the case.

2 mg/mL Hydromorphone
1 mL

NSS
10 mL

0.4 mg/mL Hydromorphone dilution
DILUTION MATH

GOAL 1: Dilute 2 mg/mL vial of Hydromorphone to 0.4 mg/mL dose in a syringe.

Hydromorphone (Dilaudid)

Initial Dose: 2.0 mg/mL

If you draw up 1.0 mL from the vial...
you will have 2.0 mg of Hydromorphone in the syringe.

NSS (0.9% Sodium Chloride)

How much NSS should you draw up to make the dilution?

Enter value mL

Submit Clear

ADMINISTER HYDROMORPHONE

Scrub the IV hub with the alcohol swab for up to 15 seconds and allow to dry.

Remove the capped needle, connect the syringe to the port, open the stopcock, and administer the medication.

Injecting? Status: CORRECT
Drug Dilution Pilot Testing

- Pilot Testing (Feb 2016):
  - SRNA Medication Safety Workshop, 22 participants
  - Data collected by undergraduate/graduate research team
  - Likert-type and open-ended questions

- Initial results indicated that > 90% of participants agreed:
  - Effective at teaching how to make a proper dilution
  - Allowed the participant to work at his/her own pace
  - Provided instruction without an instructor present
Future Work

• Developing advanced curriculum for new learning modules
• Enhancing automated tutoring capabilities
• Expanding usability testing to other off-site venues
• Research in head-to-head testing with standard practices
• Commercialization