Virtual Humans for Inter-Ethnic Variability Training in Sedation and Analgesia

Jason Jendrusch¹, Samsun Lampotang², David Lizdas², Nikolaus Gravenstein², Benjamin Lok², Dwayne Ham³, John Quarles¹

¹University of Texas at San Antonio, Department of Computer Science; ²University of Florida; ³UT Health Science Center

Presented by: John Quarles, Ph. D

UTSA Department of Computer Science
How much should the dose be?

- We are sedating them with propofol
- Same weight (75kg), age (47yrs)
- (HINT: the propofol paper insert says 1mg/kg)

1kg/mg is correct

1kg/mg will over-sedate him!
Motivation

• Propofol (Fechner, 2003)
  – Dose-dependent progressive alterations of awareness
  – Excessive administration can result in respiratory failure
• Inter-ethnic variability in Humans
  – Significant inter-ethnic differences in responses to propofol
• Demand for inter-ethnic variability in simulations
  – Inter-ethnic Sedation and Analgesia Training is minimally available
  – Variability is not often addressed in medical education
Related Work

• Simulations are standardized
  – Consistent modeling (Riley, 2008)
  – Reproducible results (Tendick et al. 2000)
  – Procedural based training (Egan et. Al 2003)

• Virtual Humans (Kotranza et al. 2007)
  – Painstakingly pre-programmed (Huang et al. 2009)
  – Rigid interactions (Rizzo et al. 2010)
  – Minimal variability of responses (Johnsen et al, 2007)
Overview

- **Our Approach**
  - Utilize mathematical models to drive virtual human responses
  - Case Study
    - Study how variable virtual humans teach inter-ethnic variability

![Image of a virtual human simulation setup with labels for endoscope video, VH Rendering, Passive mannequin, Virtual physiologic monitor, and abstract visualization of propofol in the body.](image-url)
Video Demonstration
Integrating Variability

- Pharmacokinetic/Pharmacodynamic (PK/PD) Mathematical Modeler
  - Configured based on inter-ethnic patient demographics
  - Input - Dosages of propofol
  - Output - sedation levels over time

- Virtual Human
  - Wide ranges of variability of responses
  - Under sedation results in cries of pain, animations of discomfort.
Study Design and Results

• Design (n=22, Medical Students)
  – Each participant performed 3 procedures
  – 3 different patients of different ethnicities
  – Total study time ~60 minutes
  – Minimal experience with Propofol

• Results
  – Participants over sedated the more propofol sensitive ethnicities:
    • African American patient was over sedated
      – Longer than Caucasian (p=.003)
    • Asian patient was over sedated
      – Longer than Caucasian (p < .05)
Qualitative Results

• Participants Recognized
  – Inter-ethnic pharmacology variability per patient
  – Unsure how to adapt to variability
  – Used visualizations to make judgments

• Participant Feedback
  – "For the first two patients I added propofol when they showed signs of distress, and noticed the initial dose was not high enough. For the last patient the initial dose and maintenance doses I gave seemed to be correct."
Conclusion

• Virtual Humans with inter-ethnic variability in sedation response
  – Increases awareness of variability
  – Awareness is not equal to adaption for novice users

• Future Work
  – Training Transfer, Medical Residents
Questions?

Computer Science at UTSA

• BS-MS-PHD
  – 22 faculty, 89 master students, and 70 doctoral students
  – Two CS faculty in the top 35 cyber security educators in the world
  – Strong bioinformatics research program
  – Big data and cloud computing initiatives

• Financial support:
  – Full support for PhD students, paying tuition and fees and offering teaching and research assistantships with a generous stipend
  – Teaching and research assistantships are also available for qualified Masters students

• Focus Options
  – Software engineering
  – Cyber security
  – Cloud computing
  – Big data
  – Entrepreneurship

Contact
http://www.cs.utsa.edu/
cs@utsa.edu  210-458-4436