Fidelity Considerations when Developing a Severe Trauma Female Simulation

ITEC 2018

Teresita M. Sotomayor, Ph.D.
U.S. ARL-HRED ATSD

Angela M. Alban
SIMETRI, Inc.

Outline

- Background
- Importance of Fidelity
- Importance of Simulating Injury Patterns
- Technology Development
- Technology Assessment
- Results
- Path Forward

WARNING: GRAPHIC INJURIES

Background

- Recent studies have highlighted a need to explore the impact of sex and gender in clinical training to improve outcomes for female patients (McGregor and Choo, 2015)
- A recent review of the Department of Defense Trauma Registry (DoDTR) over an 8-year span determined that:
  - 1.9% of all casualties were female service members
  - 2.4% of all deaths were female service members
  - 26% higher mortality rate for females after a traumatic injury than males (Cross, et al., 2011)
- Treatment at the point of injury must be immediate and without reservation, regardless of gender

Background

- The number of female soldiers serving in combat arms continues to increase
  - As of 2016, 15.5% of the United States' active-duty military force was comprised of females
  - Female engagement teams played a prominent role in conflicts over the past ten years

Background

- Human Patient Simulators (HPSs) currently used by the U.S. Army are male-centric
- Current female and male HPSs and Part Task Trainers (PTTs) lack anatomical and physiological fidelity
- ***Women are now serving in combat roles***

Importance of Fidelity

- Defense Health Board (DHB) emphasized:
  - Trauma training should be emotionally demanding, physically intense and realistic
  - Scenario-based exercises must include basic critical tasks and focus on mastery of skills, not merely familiarization

Importance of Fidelity

- “Trauma simulation needs to be realistic. Students should have the ability to practice life-saving interventions on a realistic manikin to develop skills and confidence. The first time they have to care for a casualty with bilateral amputations should not be on a real person. Having treated similar wounds on a simulator gives them a little picture in the back of their mind that they have done this before, successfully, and they now have the confidence to perform”

Donald L Parsons PA-C
Deputy Director,
Department of Combat Medic Training
Ft. Sam Houston

Importance of Simulating Injury Patterns

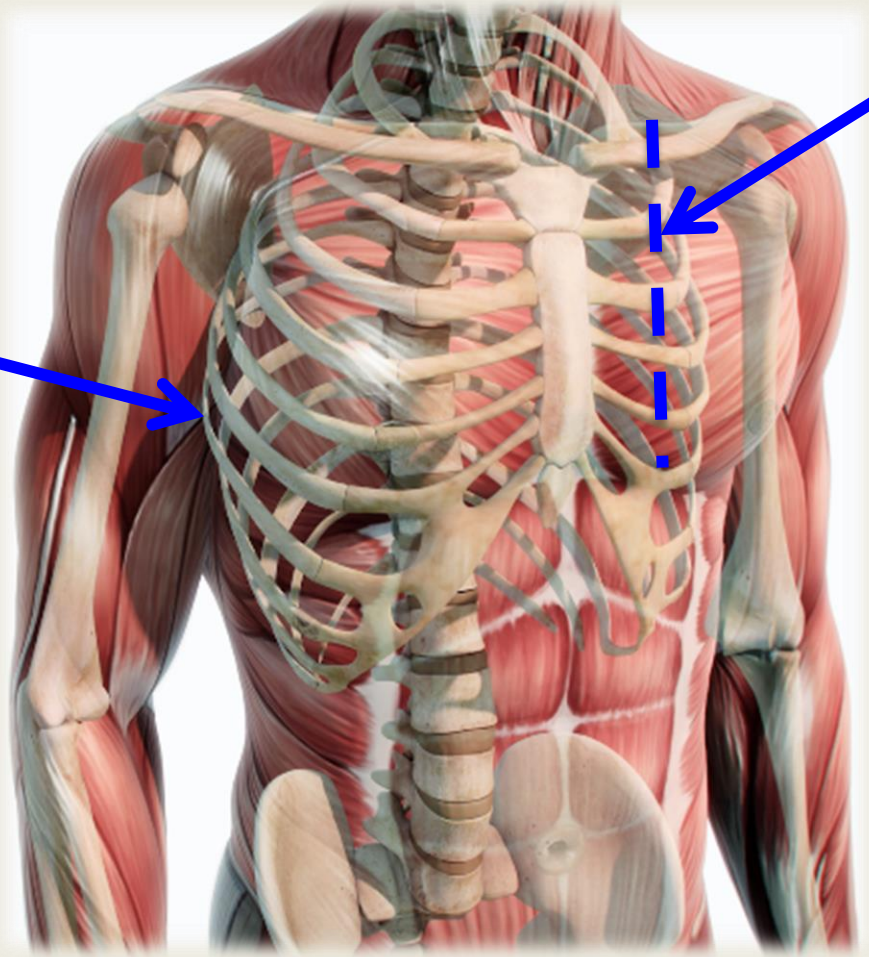
- Desensitize
- Create reluctance
- Create difficulties
- Improve realism
  - Visual and tactile
  - Anatomical
  - Physiological

Importance of Simulating Injury Patterns

- Tension pneumothorax is a life-threatening condition that can occur with chest trauma
  - Female patients may not be properly examined for a chest wound

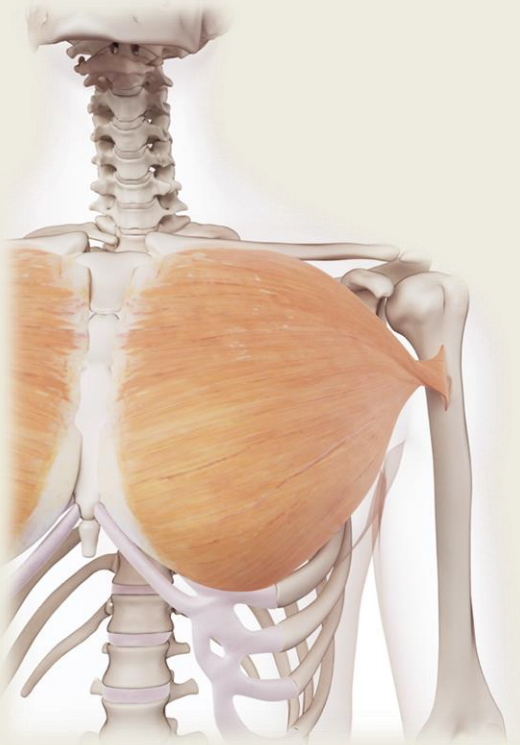
- First responders may hesitate to respond to the medical needs of female patients
  - Ingrained societal taboos are preventing first responders from being prepared for female casualties

Tension Pneumothorax



Needle Chest Decompression

- Need to insert needle through the chest wall (using a 14 gauge cannula)
- Males and females have different chest wall thicknesses
  - Current needle not long enough for full penetration to release pressure
  - Negative training when holes from previous attempts remain visible (Boyle, et al, 2016)



Boyle, Malcolm, Brett Williams, and Simon Dousek. "Do Mannequin Chests Provide an Accurate Representation of a Human Chest for Simulated Decompression of Tension Pneumothoraxes?" World J Emerg Med World Journal of Emergency Medicine 3.4 (2012): 265. Web. 8 Mar. 2016.

Technology Development

- Develop a high fidelity female anatomical model for practicing Needle Chest Decompression (NCD) psychomotor skills
- Interface the anatomical models with already existing HPSs currently fielded at the MSTCs,
- Low-cost, rugged solutions

Technology Development

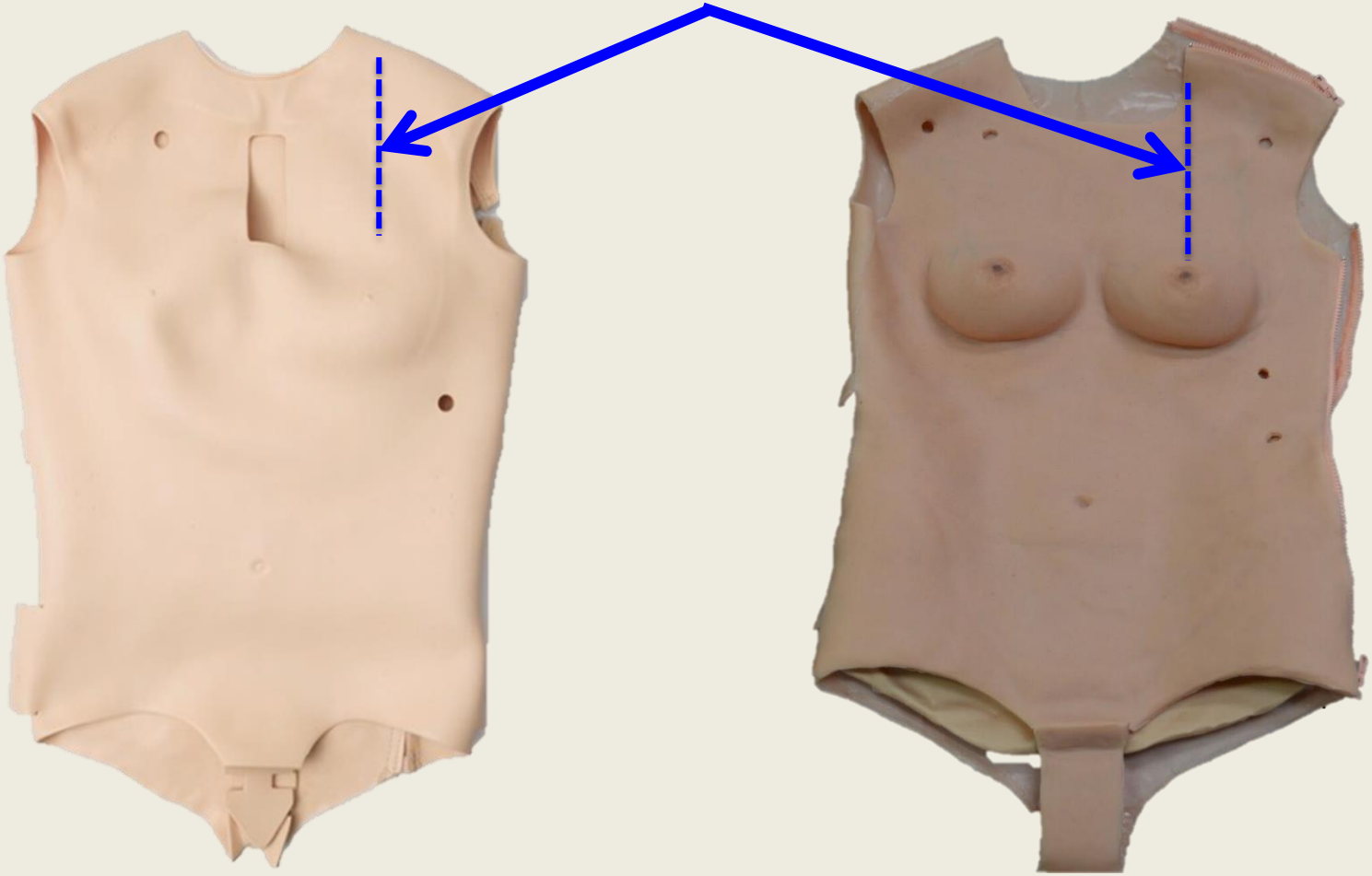
- Surveyed DoD and Civilian sectors to identify training gaps
- Conducted research and examined commercially available PTTs
- Conducted material science basic research
- Designed and developed a prototype based on user requirements
- Conducted usability testing

- Developed more realistic and compatible female anatomy

Simple Susie Female Manikin

Skin Vest with Breasts on Laerdal Manikin

Mid-clavicular Line



Original Skin from Laerdal SimMan 3G

New Vest Skin

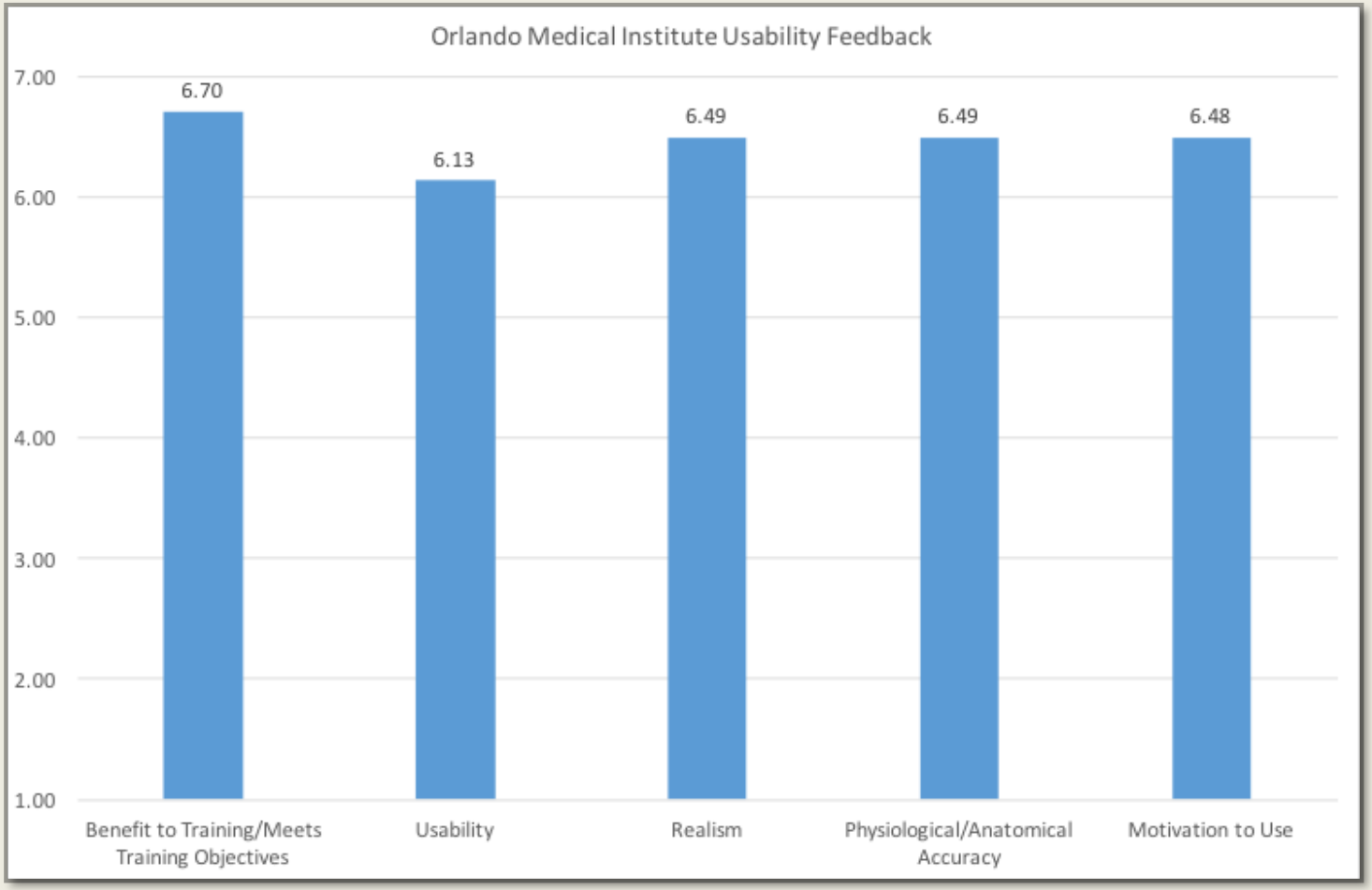
- A usability study was performed at the Orlando Medical Institute on a noninterference basis. Test users included Paramedics and Nursing students (*n* = 15)
- Focused on evaluating the usability of the system to support training objectives and to assess if the system is intuitive, effective, and subjectively acceptable to users (Nielsen, 1993)

- Participants provided feedback using a survey questionnaire
  - Participants were given a usability questionnaire with 16 questions assessing system utility
  - Participants answered the questions on a scale from 1 (strongly disagree) to 7 (strongly agree), with higher scores signifying a better experience

Summary of Results (Mean Responses)

Category	Response
Benefit to Training/Meets Training Objectives	6.70
Usability	6.13
Realism	6.49
Physiological/Anatomical Accuracy	6.49
Motivation to Use	6.48

Average Scores per Category



Path Forward

- Expand the capability to provide more realistic breast examination training
- Develop female face mask for HPS
- Refine and test genitalia design
- Conduct usability testing planned to solicit feedback from combat medics, paramedics, EMTs, and physicians

Conclusion

- Severe trauma injuries create major challenges for front line military medical personnel

- High fidelity simulations immerse trainees into realistic scenario-driven events to provide stress inoculation training

- Relevant scenarios must incorporate gender specific differences

Q&A

References

- Boyle, M. (2012). Do mannequin chests provide an accurate representation of a human chest for simulated decompression of tension pneumothoraxes? *World Journal of Emergency Medicine,3*(4), 265. doi:10.5847/wjem.j.issn.1920-8642.2012.04.005
- Cross, J. D., MD, Johnson, A. E., MD, Wenke, J. C., PhD, Bosse, M. J., MD, & Ficke, J. R., MD. (2011). Mortality in Female War Veterans of Operations Enduring Freedom and Iraqi Freedom. *Clinical Orthopaedics and Related Research,469*(7), 1956-1961. doi:10.1007/s11999-011-1840-z
- Jenkins, M. R., Herrmann, A., Tashjian, A., Ramineni, T., Ramakrishnan, R., Raef, D., Shatzer, J. (2016). Sex and gender in medical education: a national student survey. *Biology of Sex Differences,7*(S1). doi:10.1186/s13293-016-0094-6
- Mcgregor, A. J., & Choo, E. (2012). Gender-specific Medicine: Yesterday's Neglect, Tomorrow's Opportunities. *Academic Emergency Medicine,19*(7), 861-865. doi:10.1111/j.1553-2712.2012.01389.x
- Nielsen, J. (1993). Usability engineering. Boston: Academic Press.