

ACS 2022 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

Research In-Progress

Designing a Full Procedural Simulator for Central Venous Catheterization

Haroula M. Tzamaras; Jessica M. Gonzalez-Vargas; Dailen Brown; Jason Moore, PhD; and Scarlett R. Miller, PhD

Penn State University, State College, PA

Introduction: Central venous catheterization (CVC) involves four key steps: preparation, aseptic technique, needle insertion, and catheter placement. Doctors who have performed this procedure less than 50 times are twice as likely to incur an error - demonstrating a need to rethink training. The state-of-the-art training method is the Dynamic Haptic Robotic Trainer (DHRT) which provides training on patient anatomical variability through simulated ultrasound, haptic feedback, and a personalized graphical-user interface (GUI). While this system has been shown to have benefits over traditional training methods, it does not address all four key steps of CVC.

Methods: A whole procedure DHRT+ prototype was created including a CVC medical kit, a false vein channel, and a personalized GUI to focus on CVC training from start (patient consent) to finish (suturing and monitoring). Two rounds of interviews were conducted on the prototype. The initial interviews with 10 experts included a pre-survey on attitudes and perceptions of simulation, a demonstration of a medium fidelity GUI prototype, a semi-structured interview, and a post survey comparing the demonstrated system to existing methods. A second set of interviews with 6 experts was conducted following the development of a high-fidelity prototype using Blender 2.79 and incorporating physical elements based on the first round of interviews using the same procedures.

Preliminary Results: Ninety percent of doctors from the initial interviews and 100% from the second round indicated that the DHRT+ would be more useful for acquiring an understanding of best practices over current training methods and either strongly agreed or agreed that the simulator was an improvement over existing methods. All of the participants indicated that they would encourage their residents to train on this simulator when available.

Next Steps: The DHRT+ system was deployed in summer 2021 to train 22 surgical residents. Prototype iterations and development are ongoing.