Technology Innovations to be Presented at the 13th Annual International Meeting on Simulation in Healthcare

January 26th–30th, 2013
Orlando, Florida

1st Place – 1395

An iPad Simulation of Skin Prepping

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2nd Place – 975

An In Situ Tele-mentoring System for Training Endoscopic Surgery in the Operating Room

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3rd Place – 461

Development of Computer-based Simulation and Gaming for Teaching Emergency Medicine in Tanzania: A Resource Limited Environment

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3rd Place – 1363

Testing a Hand Hygiene Compliance Monitoring System Utilizing a Depth-Sensing Camera in a Simulated Clinical Environment

David Birnbach, MD, MPH,[6] Maureen Fitzpatrick, MSN, ARNP-BC,[3] Ruth Thomas, MSN[3] Jose Ramirez, BS,[5] Jill Sanko, MS, ARNP-BC,[1] Lisa Rosen, MA,[2] and Ilya Shekhter, MS, MBA.[4]
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The Creation of an Isovolumetric Exchange Transfusion Task Trainer

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Introduction/Background: Although neonatal jaundice remains a common diagnosis, severe hyperbilirubinemia resulting in kernicterus has become a rare occurrence. At bilirubin levels beyond a threshold, or with signs of acute bilirubin encephalopathy, exchange transfusion is indicated. Performing a successful exchange transfusion requires a multitude of steps, and complications carry significant morbidity and mortality. In addition, in the current clinical and training setting, pediatric residents may finish training without ever having performed an exchange transfusion. We present a simple, cost-effective technique to build a task trainer for an isovolumetric exchange transfusion.

Description: An incision was made at the anatomical site for an umbilical cord on a standard skin flap of a high-fidelity simulation mannequin. A prosthetic umbilical cord was passed through this incision and then through an exit site at the mannequin's flank. Standard umbilical arterial and venous catheters were passed into the prosthetic umbilical cord, and IV catheters of similar size were attached at the distal (internal) ends of the umbilical catheters so to create waterproof connectors. These IV catheters were then connected to two reservoirs: one for collection of infused "donor" blood (umbilical venous line); the other for removal of "patient" blood during the procedure (umbilical arterial line). The external ends of the umbilical lines were connected to an exchange transfusion kit in standard fashion. The task trainer along with a setup checklist was beta-tested by the study group to ensure accuracy and realism.

Conclusion: With this technique, a cost-effective task trainer for isovolumetric exchange transfusion was created. After the initial construction, the task trainer was found to be self-contained, mobile, easily stored, and reusable. Thus, it is feasible to utilize this model in scheduled and impromptu sessions in pediatric residency training programs as well as in non-academic settings for the purpose of skill maintenance by pediatric providers in the field. With the integration of this system into a simulation mannequin, the task trainer can be used to address the different needs and skill levels of various health care providers including those who need to learn how to set-up for an isovolumetric exchange transfusion to those who need practice in performing this procedure and managing its possible complications. In addition, the task trainer can be easily adapted to high-fidelity simulation scenarios to allow for multidisciplinary simulation team training for physician, nursing, and ancillary staff so to identify targets for improvement in point-of-process care during isovolumetric exchange transfusion.

References:

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Disclosures: None

1662

The Electronic Data Generation and Evaluation (EDGE) Platform for Laparoscopic Skills Training and Evaluation

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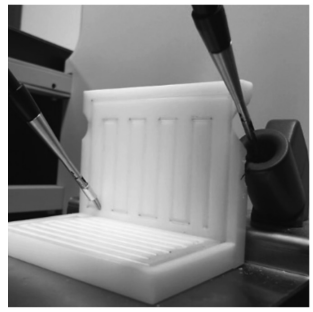
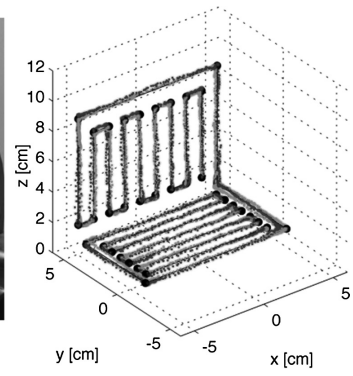
Introduction/Background: Simulation is a valuable tool in training laparoscopic technical skills, a crucial prerequisite for successful surgical training. A plethora of virtual reality (VR) trainers aim to meet this need along with their reality-based (RB) counterparts, such as the widely adopted and validated Fundamentals of Laparoscopic Skills (FLS) system.[1,2] VR trainers offer quantitative analysis but suffer from high development cost and substantial effort to simulate new procedures. RB trainers are substantially lower cost, use real surgical tools on real wet-lab or dry-lab physical models, and promptly adapt to any new skill exercise. Yet, they lack the automated, immediate feedback or quantitative rigor native to VR counterparts. Ideally, a simulator should combine the benefits of VR and RB trainers, notably accurate measurement, immediate evaluation feedback, quick integration of new procedures or anatomy, and avoid high cost. Prior art fails to do so. Instrumentation schemes such like ICSAD[3] and ADEPT[4] provide a means of precisely tracking surgical motion but lack tool-tissue force information or a computer system, which conveniently accrues, processes, or displays skill evaluation information. The ProMIS[5] system offers some performance metrics like tool path length, but still lacks tool force information and suffers from limited accuracy due to the computer vision-based position sensing it adopts. We introduce an instrumented, laparoscopic RB simulator which aims to combine the benefits of VR and RB trainers. Most notably, it can measure and record tool force information from any desired dry-lab task. This enables novel quantitative research for metrics and curriculum design in the area of force use characteristics.

Description: The University of Washington BioRobotics Lab developed the Blue- and Red-DRAGON mechanisms[6,7] and Hidden Markov Modeling quantitative skill evaluation software approach[8] to provide quantitative measures to laparoscopic educators and researchers. These technologies were combined and commercialized as the Electronic Data Generation and Evaluation (EDGE) platform (Simulab Corporation, Seattle WA). The EDGE mechanism accurately tracks the position (x,y,z in cm), orientation (degrees), grasp angle (degrees), and grasping force (Newtons) of two off-the-shelf laparoscopic tools as they interact with any reality-based task at 30 Hertz. It automatically starts and stops procedures and data collection based on tool location and records synchronized video of each task. In addition EDGE software provides data logging, data management, and real-time quantitative skill evaluation and immediately computes and displays a configurable variety of performance measures, including a Hidden Markov Model-derived metric. A battery of diagnostic tests reveals the tool tracking can detect tool tip position movement thresholds as low as 0.095 mm, rotation at a resolution of 0.056 degrees, and grasping force at a resolution of 0.036 Newtons in a range between 0 and 40 Netwons. To verify the positional accuracy in a typical laparoscopic workspace, a rectilinear 3D-toolpath block





was manufactured and traced with the EDGE. Results indicate the recorded tool path overlays the actual target as expected throughout the entire space (see Figure 1). The system has been successfully used in capturing over 23 hours of continuous video from over 90 surgeons at three geographically distinct sites.

Conclusion: We conclude EDGE is an accurate laparoscopic data acquisition system that can provide valuable data for research in laparoscopic skill metrics and simulation curriculum design. It addresses a gap among VR and RB trainers. We are currently studying if its automatic evaluation and immediate feedback are shown to aid or accelerate training.

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Disclosures: Timothy Kowalewski, PhD, is a consultant for Simulab Corporation. Thomas Lendavy, MD, is co-founder of Spi Surgical, Inc. Blake Hannaford, PhD, discloses that the Edge technology (described in this abstract) has been licensed from my laboratory at the University of Washington.

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Transvenous Pacer Insertion A Using High Fidelity Human Patient Simulator

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Introduction/Background: Temporary transvenous pacing (TVP) is a high risk, low frequency procedure for emergency medicine residents and nurses. This procedure is critical when needed but, due to the low frequency, residents sometimes complete their training without performing this skill on a live patient. This can cause a lack of skill and confidence when they need to use this skill as an attending emergency room physician. There is limited availability of commercial TVP task trainers and no commercially available high fidelity human patient simulator designed for TVP insertion. The gap between putting all the skills together in one seamless, scenario-based training experience continued to be a problem for EM residents. Increasing the residents' confidence and competence in this procedure, which is potentially lifesaving, may directly impact patient outcomes.

Description: We developed a modification to Laerdal's high fidelity human patient simulator (SimMan3G) by adding a self-contained basic venous system that allowed the learner to introduce a TVP into the SimMan3G. Learners are able to perform the TVP procedure as they would on a real patient. Learners are able to see a flash with the needle stick, are able to insert the introducer and float the pacer wire to the desired depth, all with the ECG changes expected during insertion. In order to simulate the venous system needed, we used tubing from several old used task trainers, filled it with simulated blood and housed it inside of an outer shell made from a section of corrugated tubing from our respiratory cart, to protect the interior electronics of SimMan3G. (See images. Inset photo shows sheath placed and ready for TVP placement, with blood return. Red blood used for photo only). We then used the Laerdal scenario programming feature to develop a scenario that the simulation