

decade, and is well-established for the placement of central venous catheters (CVCs). Many specialties that routinely place CVCs have instituted their own simulation training courses for their trainees. These courses vary widely in rigor and content. In one hospital system there may be over five different simulation courses for training house staff. Many programs do not even have a formal training program in CVC placement.

In the winter of 2015, the Director of Procedural Simulation at the Yale Center for Medical Simulation (YCMS) met with hospital administration of the Yale Health System to discuss the feasibility of a new concept: a hospital-mandated CVC training program that was a prerequisite to placing a CVC within the Yale Health System, regardless of specialty. This discussion was fostered by a desire on the part of hospital administration to address the ever-present morbidity associated with Central Line Associated Blood Stream Infections (CLABSI) and the higher than average rate of CVC associated pneumothoraxes within the health system.

Once the hospital committed to a hospital-wide mandate, YCMS was chosen to direct the effort. In part, this was because YCMS has expertise in CVC training, having designed a CVC training course validated in an Agency for Healthcare Research and Quality (AHRQ) funded study.

Methods: The first session starts with a small group discussion reviewing informed consent, CLABSI, CVC relevant anatomy, ultrasound and vascular access, as well as Seldinger technique. Next, the trainees undergo hands-on training with ultrasound and vascular access models. Lastly, the instructor leads an interactive demonstration of CVC placement while modeling complete sterile precautions throughout. The instructor highlights technical nuances and common pitfalls.

The second session consists of one-on-one instruction with the trainee until they are ready to "test out." The testing is done against a previously published predetermined checklist coupled with an evaluator driven global assessment to establish passing. The entire testing encounter is videotaped from two cameras and subsequently archived.

Results: 102 residents from 14 specialties went through the mandated CVC training course. A total of 11 instructors taught a total of 129 hours. Ten trainees failed on their first attempt and required further training (10% failure rate). Of those who failed their first test, two failed a subsequent test (20%). Anonymous pre- and post-course surveys showed that trainees' confidence level increased from 2.4 to 4.3 on a five point Likert scale. The total cost of administering this program was \$30,938.

Conclusions: The YCMS is in its first year of operating a mandatory hospital-wide CVC training program and will continue training all new house staff, fellows, and attendings in this important procedure. We believe that with mounting scholarship as its foundation, this type of mandate is necessary for improved patient care and that other institutions can gain from our experiences in implementing simulated procedural training as policy.

## 298 Detecting Blood Loss With a Wearable Photoplethysmography Device



Darling CE, Reljin N, Zimmer G, Malyuta Y, Blehar D, Mendelson Y, Chon K/UMass Medical School, Worcester, MA; University of Connecticut, Storrs, CT; Worcester Polytechnical Institute, Worcester, MA

Study Objective: Assessing trauma patients for occult hemorrhage is central to trauma triage. Massive bleeding (> 30% of blood volume), if not promptly treated, may progress to hemorrhagic shock. Identifying patients at risk of imminent shock is a challenging task in out-of-hospital and battlefield settings given the variability of traditional vital signs, such as pulse and blood pressure. In this investigation we describe the ability of wearable, photoplethysmography (PPG) devices to detect blood loss.

Methods: Two groups of research subjects (n=23) were analyzed. Group 1: 9 consenting volunteers subjected to 900 ml of bloodletting while wearing one or more PPG sensors, resulting in 19 recordings. Group 2: 14 emergency department (ED) patients consented to wear custom-made multichannel pulse oximeters on the same locations (forehead, ear and finger) (19 recordings as well), while experiencing no net blood loss as verified by blinded physician adjudication. PPG data was stored internally in the device and later analyzed. A machine learning algorithm was used to classify the two research groups and

the performance of the algorithm was measured by calculating sensitivity/specificity.

Results: The average age of research subjects was 34, 82% were male, initial sBP averaged 130 mmHg and HR 81 bpm. The analyzed PPG data demonstrated an overall accuracy of 82.9%, a sensitivity of 89.3% and a specificity of 78.2%.

Conclusion: The preliminary results from this ongoing study of a novel, wearable PPG device demonstrate high sensitivity and moderate specificity at categorizing blood loss. Increasing the number of subjects, both with and without blood loss, will allow for a more thorough evaluation of the device's capabilities.

## 299 Withdrawn

## 300 Comparative Analysis of Five Methods of Emergency Zipper Release by Experienced Versus Novice Clinicians



Oquist M, Buck L, Keegan M, Emery M, Bush C, Ouellette L/College of Human Medicine, Michigan State University, Grand Rapids, MI

Study Objective: Penile zipper injury is usually caused by entrapment of penile tissue (foreskin, shaft, or glans) in the actuator or the teeth of the zipper. It is one of the most common genital injuries in prepubertal boys. The primary aim of this proposal was to compare five common techniques for releasing zipper-entrapped skin using an animal model.

Methods: This was a prospective, randomized trial using an animal model consisting of chicken skin firmly entrapped by a metal zipper on a pair of denim jeans. Volunteers consisted of emergency medicine physician faculty and medical students (novice clinicians). During the simulation lab, participants were taught the five common techniques for releasing zipper-entrapped skin: 1) cutting the median bar; 2) using a screwdriver to separate faceplates; 3) manipulation of the zipper using mineral oil; 4) lateral compression of the zip fastener using pliers; and 5) removing the teeth of zip mechanism using trauma scissors. Order of the techniques was chosen by a random number generator. Subjects were timed by evaluators using a digital stopwatch from the time they were told to start until successful release of the entrapped skin. Success was defined as release of the entrapped skin while minimizing trauma to the skin. Failure to successfully release the entrapped skin within 5 minutes or causing full thickness laceration to the skin was logged as failures. Comparisons were made between each technique and between training levels (ie, student versus faculty) for both success rate and time to successful release of entrapped skin utilizing Chi-Square, and 2-tailed unpaired t-tests.

Results: Volunteers consisted of 12 EM physician faculty and 18 medical students. Overall, procedure times were 16.2 sec faster for EM faculty compared to students (P<.05); however, success rates did not vary significantly. Gentle manipulation of the zipper using mineral oil lubricant was clearly the most successful technique in novice (94%) or experienced clinicians (100%). Because of the small number of successful procedures, the times in student and faculty clinicians were combined. Gentle manipulation of the zipper using mineral oil lubricant was the quickest technique among novice or experienced clinicians (53.9 +/- 25.6 sec), followed by cutting the median bar (126.0 +/- 110 sec) and use of a screwdriver to widen the faceplates (131.6 +/- 90.5 sec). The procedure that was the least traumatic to skin involved cutting the closed teeth of the zipper using trauma scissors, permitting the unzipping of the zipper from the distal end (P<.05). Using this method there is no direct manipulation of the entrapped skin, minimizing skin trauma. Gentle manipulation was the preferred technique overall, followed by cutting the closed teeth of the zipper using trauma scissors, permitting the unzipping of the zipper from the distal end.

Conclusions: This is the first randomized trial to compare the five methods for releasing zipper-entrapped skin. Based on our animal model the preferred technique is simply gentle manipulation of the zipper using mineral oil lubricant. If this is not immediately effective, clinicians may wish to try cutting the closed teeth of the zipper using trauma scissors, and unzipping the zipper from the distal end.