

Association for Surgical Education

Do more with less: a surgery directed institutional model for resident central line training

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Resource utilization

Abstract

BACKGROUND: Simulation training can improve proficiency in central line placement, but it is expensive and resource intensive. The authors developed a 3-phase approach to central venous catheter placement training, including an online module, mannequin-based simulation using a single faculty member, followed by department directed clinical observation. The hypothesis was that standardizing institutional central venous catheter placement training would maintain training efficiency and reduce faculty and resource demands.

METHODS: Preintervention and postintervention assessments of the trainees' performance were collected to evaluate program effectiveness. Program surveys were collected to evaluate residents' satisfaction and comfort with the procedure. Resource utilization was compared between the period before program implementation and the 2 following years.

RESULTS: Mean pretest to posttest scores for the online module improved significantly from 7.0 to 8.4 in 2010 and from 7.1 to 8.4 in 2011. Video evaluation demonstrated significant improvement across all postgraduate year levels. Surveys revealed high resident satisfaction and increased procedural confidence. Overall resource costs and faculty requirements decreased.

CONCLUSIONS: A standardized training program for an entire institution can maintain quality while being more cost effective than traditional central venous catheter placement training.

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The Accreditation Council for Graduate Medical Education developed the Clinical Learning Environment Review in 2012, as a part of the Next Accreditation System, to promote safety and quality of care throughout graduate medical education.¹ Two important focuses of the Clinical Learning Environment Review are engagement of residents in patient safety and promotion of appropriate resident supervision, particularly when performing critical patient care and procedures. Invasive procedures performed by residents are associated

with increased complication rates, leading to longer lengths of stay and higher health care costs.²⁻⁴ Historically, instruction of these potentially dangerous procedures involved bedside training on live patients without prior practice or skills assessment.⁵ This accepted philosophy was the "see one, do one, teach one" model. There was little or no faculty supervision of residents when these procedures were performed. As the antiquated philosophy was replaced by more stringent "standards," residents began to be required to perform an arbitrary number of supervised procedures before they were allowed to perform the procedure independently.²

Over the past 2 decades, simulation in graduate medical education has become more prevalent^{6,7} to teach trainees to perform these potentially dangerous procedures in a safe environment, which allows deliberate practice without the

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possibility of patient harm.⁸ The resources required for this type of competency simulation are immense with respect to expense and faculty dedication.

Residents, regardless of specialty, perform central venous catheter placement. In academic medical centers, residents commonly perform central venous catheter placement⁵ in critically ill patients, and the procedure has potentially catastrophic complications, including pneumothorax, catheter-related bloodstream infections, vascular injury, hemorrhage, and even death.^{9,10} Simulation-based training has been applied to central venous catheter placement and has been shown to decrease complications and improve operator comfort level compared with historic techniques.^{11–13} Techniques shown to improve knowledge of proper central venous catheter placement include online modules,¹⁴ procedural checklists,² and central venous catheter placement into training mannequins.^{5,13,15} Many institutions have since adopted these types of simulation but individual residency programs often direct the training curriculum, which consumes resources and faculty time.

We hypothesized that a curriculum, centralized in the Department of Surgery with a single faculty member, using Web-based modules, video assessment, and simulation would maintain or improve the quality of training for central venous catheter placement among major residency programs at a university hospital while reducing institutional and faculty resource utilization.

Methods

The study was approved by the institutional review board at our medical center.

Curricular development

The Department of Surgery developed a 3-phase standardized curriculum that included an online module (cognitive), mannequin-based simulation (psychomotor), and department-directed clinical training (clinical application). A single faculty director conducted the program and was directly involved with all the trainees. The trainer had 2 protected afternoons per week away from clinical duties to conduct the training. The curriculum user groups included the surgery, family practice, pediatric, emergency medicine, internal medicine, and anesthesia residency programs and involved resident year levels 1 to 4, but the program focused primarily on residents in their 1st year.

The online module consisted of a multimedia-driven course covering all aspects of central venous catheter placement, including indications, contraindications, steps of proper placement, and complications. Pretest and posttest examinations were given electronically, including 10 questions randomly chosen from a central question bank. The residents were then divided into small groups for mannequin simulation. The faculty trainer demonstrated proper central venous catheter placement, as seen in the online video modules. Individual

trainees practiced the procedure after the faculty demonstration. The faculty trainer conducted the training sessions 2 afternoons each week throughout the first 3 months of each academic year during the study period. Training mannequins were arranged in a semicircular pattern to ensure direct observation and easy access for instruction with all groups. Videotaping the trainee practicing the steps for central venous catheter placement assessed procedural understanding. Initially, the videos were recorded before and after simulation training, but once the program appeared to be effective at instruction, the videos were limited only to posttest evaluation. Independent observers viewed the videos to ensure adherence to a procedural checklist composed of 25 specific tasks (Fig. 1). The faculty trainer created the components of the checklist independently. Resident satisfaction with the simulation training was evaluated using an online survey at the completion of the course. To ensure adequate patient safety for the transition to clinical application, each resident's respective department's faculty member individually observed the trainees while placing central venous catheters in live patients. These faculty members' evaluation and measures of competence were judged subjectively with no data collected. A detailed description of the program is included in the [Appendix](#)

Design

The effectiveness of the curriculum was assessed using the online module pretest and posttest. The pretest and posttest means were calculated and compared by resident year level and collectively using a 2-tailed *t* test. Three separate evaluators graded the video assessments, and reliability was calculated using the intraclass correlation coefficient. The means of the preprocedural and postprocedural videos were compared using a 2-tailed *t* test. Statistical analysis was performed using MedCalc (MedCalc Software, Ostend, Belgium). An online survey using Likert-type scales was used to measure resident comfort levels.

There was no standardized training assessment used before incorporating this common training curriculum. Central line-associated bloodstream infections were used as a surrogate for effectiveness. At our institution, the Department of Epidemiology and Infection Prevention collects data on infection rates and reports them to the hospital administration. Specifically, this department has followed central line-associated bloodstream infection rates in all institutional intensive care units during the study period. Rates of central line-associated bloodstream infections were defined as the number of infections per 1,000 catheter days and recorded quarterly. The mean rate for all intensive care units for the 2 years before implementation was compared with the mean rate during the 2-year study period.

Resource utilization

Resource utilization was evaluated by estimating the equipment costs and staff productivity of central venous

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