Perspective

Implementation of a Hospital Mandated Central Venous Catheter (CVC) Training Program

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Abstract

Background: Central venous catheters (CVC) are routinely inserted by house staff from a broad array of specialties. CVC insertion is associated with several complications. Simulation training has been shown to increase operator efficiency, success, and reduce complications. Many hospitals have a variety of CVC training programs varying in rigor and content instituted at the discretion of the departments within.

Objective: Our institution has instituted a mandated, centralized simulation training program for CVC insertion that must be completed, regardless of specialty, before house staff are allowed to insert CVCs in the clinical space. We discuss the content and administration of this course as well as assess cost and look toward future directions.

Methods: A structured, rigorous CVC training course was established at the university simulation center. All new house staff is required to complete the course and become certified.

Results: In the first year, the possible number of participants was 102; all 102 completed the training for a completion rate of 100%. Residents from 14 specialties went through the mandated CVC training course. Ten trainees failed on their first attempt at completion and required further training (10% failure rate). The total cost of administering this program was $30,938.

Conclusions: The medical simulation center operates a mandatory hospital-wide CVC training program. 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.

ABBREVIATIONS

CVC: Central Venous Catheter

INTRODUCTION

Over 5 million Central Venous Catheters (CVC) are placed annually in the United States [1]. There is significant morbidity associated with this procedure including direct injury and subsequent infection. Improvements in selective use of CVCs, placement, and maintenance have sought to reduce these complications. Although measures should be taken to address all of the facets implicated in CVC complications, an obvious point of intervention is the formal training of staff responsible for the placement of CVCs within the hospital system.

Up to 17% of catheters are estimated to result in minor catheter-related mechanical complications (arterial puncture, hematoma) and as many as 3% of CVC placements may result in a major complication (pneumothorax requiring chest tube, mediastinal hematoma, air embolus) [1,2].

Infection directly resultant from CVC placement is harder to quantify. There are an estimated 30,000 central line associated blood stream infections (CLABSI) annually [3]. CLABSI, however, is a multifactorial problem. Reductions in CLABSI are supported by multiple interventions from the pre-procedure (practice bundles, education, instituting a culture of safety) to insertion (skin preparation, maximal barrier precautions, adherence to sterile technique, use of ultrasound, choice of dressing) to maintenance (number of times and manner in which CVC is accessed) to duration of the CVC catheter [4]. It is clear that no single intervention will eliminate CLABSI, but rather an effort on all of these fronts must be undertaken. Nonetheless, infection attributable to the insertion of the CVC can be minimized with strict adherence to sterile protocols, proper training in the use of maximal barrier precautions, and facility with ultrasound to minimize the number of skin punctures.

The cost of these complications from injury and infection on the healthcare system is considerable. The estimated extra health care cost per CLABSI is $16,500 [5]; an iatrogenic pneumothorax may cost between $17,000-$45,000 per incident [6]. Added to this is the potential medico-legal cost, which for iatrogenic pneumothorax may be as high as $143,000 per case [7].
METHODS

In the winter of 2015, the Director of Procedural Simulation at our institution met with the administration of the health system to discuss the feasibility of a new concept: a hospital mandated CVC training course that was a prerequisite to placing a CVC within the health system, regardless of specialty. The proposal called for a standardized, rigorous course constructed specifically on previously published research on simulation-based CVC training at our institution [14]. This discussion was fostered by a desire on the part of hospital administration to address the ever-present morbidity associated with CVC placement.

The design of the simulation-based CVC training course splits the instruction into two sessions. The first session lasts approximately two hours, and the second session lasts approximately one hour. The first session requires one instructor with as many as eight trainees. The second session matches one instructor to one trainee.

Prior to engaging in the first session, learners must first watch an instructional CVC video available online (NEJM.org). The first session starts with a small group discussion reviewing informed consent, complications (with special attention paid to CLABSI and the hospital’s initiatives to address this type of hospital acquired infection), CVC relevant anatomy, ultrasound and vascular access, Seldinger technique, and post-procedure steps.

Next, the trainees undergo hands-on training with ultrasound and the vascular access models. Trainees receive instruction and practice cannulating opaque blocks with simulated vasculature (CAE Healthcare, Sarasota, FL). These ultrasound able models help the learner acquire the psychomotor skills necessary to cannulate a deep vessel using ultrasound. The skill set involves transducer placement and manipulation, recognition of vessels in soft tissue, and the ability to translate two-dimensional imaging into success in accessing deep vessels in three dimensions. Competency is demonstrated when the trainee successfully cannulates the model five times consecutively.

The first session concludes after the instructor leads an interactive demonstration of CVC placement on a task trainer from start to finish while modeling complete sterile procedure with maximal barrier precautions throughout. The instructor highlights technical nuances and common pitfalls.

The second session of the course is a one-on-one session with an instructor. Proper gowning and gloving is emphasized along with careful skin preparation and draping. The learner has the opportunity to practice the skills necessary to place the CVC, repeating all steps and is able to stop and ask questions at any point. The instructor also has the opportunity to correct technique and offer advice and solutions to commonly encountered problems. Completion of the course is achieved once learner competency can be demonstrated in a testing situation.

The testing is done against a previously published predetermined checklist [14,15] coupled with an evaluator global assessment to establish passing. If the competency evaluation is unsuccessful, the learner has the opportunity to retake their evaluation. If a trainee is unable to successfully complete the course in the allotted time, a separate session is scheduled. The entire testing encounter is captured on video from two cameras and subsequently archived.

RESULTS

The possible number of participants was 102; all 102 completed the training for a completion rate of 100%. Residents
from 14 specialties went through the mandated CVC training course in its first year. 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 demonstrated that trainee’s 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 (Table 1).

**DISCUSSION**

Based on the mounting evidence that simulation training reduces operator error and improves patient care, our institution has mandated the completion of a standardized CVC training program. This program requires a significant investment of faculty time and financing. The requirement of a uniform CVC training program required of all house staff hospital-wide, regardless of specialty, is rare and fairly novel.

The cost of instituting our program was $30,938. This is less than the published cost of a similar large-scale program by Burden et al., ($36,540.20 not including salary support) [16]. Cohen et al., report a cost of $54,144 to train 68 residents over the course of a year; the significant cost differences between our program and the one reported by Cohen are attributable to a one-time ultrasound cost (not dispersed over several years) and higher facility fees [17]. Our cost includes supplies, equipment (ultrasound and task trainers), and simulation space. Importantly, this cost does not include instructor remuneration because this is considered in the umbrella of protected time for educational faculty.

As discussed previously, the cost of instituting this type of program is offset by the prevention of two episodes of CLABSI or one instance of iatrogenic pneumothorax [5,6]. It is, perhaps, an obvious progression for hospital systems to embrace the evidence for simulation training and formulate policy toward this requirement. A purely economic appraisal of this type of policy confirms its worth.

Assessment in our program is done with a combination of checklist and global rating scale. Indeed, assessment in procedural training is a hot topic in medical education. There is extensive literature supporting the use of checklists for CVC training [15,18-20], and the Accreditation Council on Graduate Medical Education (ACGME) endorses assessing procedural skills through checklists [21].

The assessment of procedural skills through checklists has come under criticism. Some authors wonder if the attention to detail necessary in a multi-point checklist comes at the expense of overall clinical aptitude [22]. Global rating scales have been used to judge overall ability (that perhaps might be missed by checklist alone) based on expert observation.

Few would argue that the goal in procedural training is to produce skilled technical operators who are safe. Ma et al. observe that procedural checklists may fall short of this goal; it is possible, they note in their comparative study on the performance of checklists versus global rating scales in CVC insertion, to be technically proficient and simultaneously unsafe based on expert judgment [23]. Very few authors have combined checklists with some form of global rating scale in assessing CVC insertion [24,25].

We believe the answer to assessing procedural ability therefore requires some combination of these assessment tools. The authors feel strongly that a well-constructed checklist can identify technically skilled individuals. We also believe that these individuals do not always actively troubleshoot, adapt to unanticipated difficulties, or necessarily act in the interest of their patients. Ultimately, an expert observer must answer the question, “can this trainee complete the procedure in a manner that is reliably safe and technically sound without assistance?” We believe that a binary judgment by an expert, in addition to a minimum standard on a checklist, helps ensure the combination of technical fluency and safe reliability that is required.

This study is limited in addressing the feasibility of instituting a comprehensive CVC training program as policy. This, of course, is its limitation: the study does not assess whether the program has reduced CVC related complications by mandating rigorous universal training. That endpoint is difficult to ascertain, as multiple interventions on various levels are being enforced simultaneously at our institution. However, this measure is not unattainable, although it will take several years to accurately judge. Rather, we contend that implementation of such a program is already justified by the existing literature. The literature demonstrates that this is the right approach to take for our patients. Certainly, there is a cost that accompanies this type of sweeping administrative decision; we believe that this cost is supported by the structure of payment, penalty, and scrutiny in our current healthcare economy.

Future studies should focus on the fine detail of cost and benefit. Additionally, we hope to train our attention to the question of skill retention, especially in those operators who place CVCs infrequently. This data could be used to inform broad questions, such as who should be trained in the first place.
CONCLUSIONS

Our institution is in its second year of operating a mandatory hospital-wide CVC training program and will continue training all new house staff and fellows 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.

REFERENCES