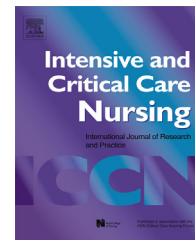




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# Simulation-based paediatric intensive care unit central venous line maintenance bundle training<sup>☆</sup>



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## KEYWORDS

Bundle;  
Blood stream  
infection;  
Central line;  
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## Summary

**Objective:** Research has demonstrated that additional reduction in paediatric catheter associated blood stream infection (CA-BSI) rates can be achieved through improving compliance with maintenance bundle care for central venous lines. Our objective was to improve maintenance bundle compliance rates and nursing competency surrounding central venous line (CVL) care in our paediatric intensive care unit (PICU).

**Methods:** A multidisciplinary team developed a bedside simulation-based training programme to improve compliance with standard PICU CVL maintenance bundle. We then performed a randomised comparison study comparing a standard CVL bundle training process for bedside PICU nurses in a control group (CG) to an intervention group (IG) receiving bedside training to simulate a CVL dressing change and maintenance bundle followed by intermittent training refreshers. Groups were assessed for compliance with prescribed components of the CVL bundle maintenance (CVL score).

**Results:** At baseline the CG and IG had similar mean CVL scores ( $p=0.725$ ). At twelve months mean CVL bundle compliance score in the IG was significantly higher than in the CG ( $p<0.0001$ ). The largest CVL score increase for IG occurred between zero and three months. Coincidentally,

**Abbreviations:** CA-BSI, catheter associated blood stream infection; CVL, central venous line; IG, intervention group; CG, control group.

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CA-BSI rates in the Egleston PICU significantly decreased from  $1.9 \pm 2.2$  BSIs per 1000/CVL days, prior to the study, to  $0.6 \pm 1.6$  BSIs per 1000/CVL days following implementation of the intervention ( $p = 0.034$ ).

**Conclusions:** Bedside simulation based training in CVL dressing change is associated with improved compliance with CVL maintenance bundle practice. Enhanced CVL maintenance bundle practice could contribute to reduction in CA-BSI rates.

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### Implications for Clinical Practice

- Previous studies demonstrated that additional reduction in paediatric catheter associated blood stream infection rates could be achieved through improving compliance with maintenance bundle care for central lines. Maintaining competence and performance of central venous line care can be challenging.
- Simulation based training initiative makes a significant impact on maintenance bundle care performance.
- Simulation may be a rapid and effective method for educating bedside nurses on a key factor in the fight against catheter associated blood stream infections (CA-BSI). Further studies are needed.
- Bedside simulation helped contribute to reduction in catheter associated blood stream infections in a busy paediatric intensive care unit.

### What is known on this subject?

- Previous studies have demonstrated that additional reduction in paediatric catheter associated blood stream infection rates could be achieved through improving compliance with maintenance bundle care for central lines.
- Maintaining competence and performance of central venous line care can be challenging.

### What this study adds

- The simulation based educational initiative can significantly impact upon maintenance bundle care performance and contribute to reduction in catheter associated blood stream infections in busy paediatric intensive care units.

## Introduction

Catheter associated blood stream infections (CA-BSI) remain a source of significant morbidity and mortality in adult and paediatric critical care units (Burke, 2003; Pittet et al., 1994; Siempos et al., 2009; Wylie et al., 2010). These infections with *Staphylococcus aureus*, *Streptococcus* species and other skin flora are a significant source of morbidity and mortality. In addition to the impact on patient care and outcome, CA-BSIs add significant cost to a patient's hospitalisation (Dominguez et al., 2001; Margolin et al., 2011; Nowak et al., 2010). Miller et al. demonstrated that insertion bundles alone were not adequate to consistently lower CA-BSI rates, and that focus on maintenance bundles, which are checklists of tasks needed for proper catheter care and dressing change, were essential to drive change (Miller et al., 2010). After adjusting for region and PICU demographics, the only significant predictor of CA-BSI rate decrease was maintenance-bundle compliance (RR: 0.41 [95% CI: 0.20–0.85];  $p = 0.017$ ). While it has been established that central venous line (CVL) maintenance bundles are pivotal to achieving and maintaining low CA-BSI rates,

training and retention of proper bundle compliance remains a challenge. Simulation training has been a rapidly growing tool for healthcare quality to promote clinical competency and allow reflective thinking to improve skill acquisition (Gaba, 2007; Haskvitz and Koop, 2004; Long, 2004). We prospectively compared this simulation-based programme to a standard training approach. Our purpose was to improve compliance with CVL maintenance bundle procedure. We hypothesised that implementation of bedside simulation-based training of CVL dressing changes by registered nurses would improve CVL maintenance bundle compliance.

## Methods

### Process improvement and development

In 2010, our PICU quality committee performed a retrospective review of 10 identified CA-BSIs, of which six (60%) demonstrated significant issues with CVL maintenance bundle compliance. Dressing change training was identified as a key opportunity for improving compliance. Beginning in 2010, a revised nursing training programme was developed which included didactic training on the maintenance bundle, followed by competency assessment, post-test evaluation and required observation of a dressing change on an annual basis. Simultaneously, in cooperation with the Children's Healthcare of Atlanta Simulation Center and its medical director (KBH), unit leadership developed an alternative training approach utilising an intensive bedside-based simulation teaching method. We made use of a low fidelity mannequin with a central line in place. Several studies have identified skill deterioration within six months for technical and basic skill principles among paramedics and respiratory care personnel (Long, 2004; Skelton and McSwain, 1977; Tuttle et al., 2007; Zautcke et al., 1987). Therefore we elected to build the simulation based training strategy to provide systematic refreshes at three, six and twelve months.

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