Effect of a Multidisciplinary Team Approach to Eradicate Central Line Associated Blood-Stream Infections (CLABSI)

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Hypothesis: that a multimodal approach to the insertion and care of central venous catheters will result in significant reduction in rates of CLABSI. However, our number of catheterizations differed significantly by type, with approximately eight times as many CVCs being performed when compared to PICCs (p < 0.0009); from 2009 to 2011 catheter usage significantly increased whereas from 2010 to 2011 it dropped significantly (p < 0.0015). However, the number of PICCs did not significantly change in frequency over time (Figure 2). Table 3 shows the longest CLABSI-free time and APACHE III scores for individual units. Microbiology data are presented in Table 4.

Introduction

Central venous catheters are essential for the care of the critically ill patient. However, serious complications can occur with their use. One such complication is central line associated bloodstream infection (CLABSI). Although the attributable mortality and cost of care is likely affected, the economic costs and morbidity can be substantial.

In 2009, the estimated number of CLABSI in intensive care units (ICU) in the United States per year was 80,000. Since that time, both behavioral and technological interventions have resulted in reductions in CLABSI rates. For example, an estimated 25,000 fewer CLABSI occurred in 2009 in US ICUs than occurred in 2007. Hand hygiene, education programs and use of maximum barrier precautions, protocol compliance and check lists are some of the behavioral changes that have resulted in reductions in CLABSI. Technological advances include aqueous or alcoholic chlorhexidine skin solutions for skin preparation, chlorhexidine sponges for catheter site care and antiseptic or antibiotic impregnated catheters.

Although these aforementioned studies showed significant reductions in CLABSI, the rates remain relatively low. In this study we describe our approach toward reducing CLABSI rates in the intensive care units at UMass Memorial Medical Center, Worcester, MA.

Methods

In 2004, a critical care operations committee (CCOC) was formed at UMass Memorial Health System to provide the infrastructure to our critically ill patients by developing clinical practice guidelines based on the best published medical evidence. This committee is multidisciplinary and includes physicans, nurses, physical therapists, hospitalists, hospital administrators and patient representatives. One of the earliest developed committees was the CLABSI task force (CLABSI T). The first goal of the CLABSI T interventions (Table 1) that were incorporated into the initiative over time included an education program (that also emphasized hand hygiene), use of a dedicated catheter that had all of the necessary elements to reduce the risk of maximum barrier precautions, pre-procedural time out, use of a check list during catheter insertion, empowering the bedside nurse to stop the procedure if elements in the checklist were not followed, incorporation of chlorhexidine solutions for skin preparation and chlorhexidine sponges for catheter dressings, tracking of high risk catheters (i.e. those were inserted during emergencies or in the femoral vein), treating a CLABSI as a critical event and holding a root cause analysis for each one to discern the cause, use of the subclavian vein as the preferred site of catheter insertion, documentation of the catheter insertion with a standardized procedure note, and daily assessment as to the need of the central venous catheter.

We were attacked by infection control practitioners and were put into a database that was managed by the eICU data coordinator. Definitions of CLABSI were those published by the Centers for Disease Control and Prevention (Table 2). A panel of physicians that was led by the hospital epidemiologist adjudicated cases of suspected CLABSI. Data were presented to the CCOC on a quarterly basis and to the individual units on monthly basis by means of an electronic newsletter. In addition, the data could be viewed on the CCOC intranet website.

The number of catheterizations was modeled using general linear models with first and second order slopes fit for each type of catheter type to detect linear trends and change points. The number of infection rates were evaluated with a Poison test. The trend in catheter blood infection rates was modeled using Poison regression.

The distributional assumptions of methods used were evaluated using the Kolmogorov-Smirnov goodness of fit test and by visual inspection of frequency histograms. Outliers and influential cases from models fit to the appropriate design. Poison regression was performed using LogPcat. Linear models were fit using the Mixed procedure (SAS).

Results

From 2004 to 2011 the rate of CLABSI declined from 5.86 to 0.6 infections per 1000 catheter days (p < 0.0001). There was a 90% reduction in bloodstream infections (SBIs) (p < 0.0001) (Figure 1). The number of catheterizations differed significantly by type, with approximately eight times as many CVCs being performed (p < 0.0009); from 2009 to 2011 catheter usage significantly increased whereas from 2010 to 2011 it dropped significantly (p < 0.0015). However, the number of PICCs did not significantly change in frequency over time (Figure 2). Table 3 shows the longest CLABSI-free time and APACHE III scores for individual units. Microbiology data are presented in Table 4.

Discussion

Similar to other published reports, the primary finding of our study is that a multimodal approach to the insertion and care of central venous catheters has been effective in reducing infection rates in CLABSI. However, our study is different in several important ways from previous investigations. Other investigations included a single ICU that did not use antiseptic catheters or any of the behavioral changes. In addition to the use of the Provence guidelines, the majority of CLABSI were from the femoral saphenous and antibiotic impregnated catheters. The time period in our study is also the longest for studies of this type.

Our neuro-trauma unit has one of the highest CLABSI rates in the medical center yet has one of the lowest APACHE III scores. The lower APACHE III score likely reflects the fact that stroke patients are also admitted to this unit, which would “dilute” the acuity of the patient population. Since the protocol as to how we care for these catheters does not change from unit to unit, it is surprising that the rates are as high as they are in the neuro-trauma unit and the Medical 2 ICU particularly since similar units have a much lower rate. We do not have ready explanations for this finding.

Our CVC utilization rate peaked in 2010 and decreased in 2011. This observation is most likely the result of better adherence to catheter removal when indicated and an increasing reliance on PICCs.

The data in this trial can be used as a model for other similar trials. A report of a similar study is now being prepared for publication and a manuscript is currently in preparation.

References


# Abstract

Introduction: CLABSI remains a significant problem in the intensive care units. Hypothesis: A multimodal approach for the insertion and care of central lines will prevent central line associated bloodstream infections (CLABSI). Methods: A Critical Care Operations Committee was formed to transfer care in eight intensive care units (ICUs) on an academic medical center in 2004. One goal was to reduce CLABSI. Using evidence-based medicine, a clinical practice guideline was developed that incorporated the use of maximum barrier precautions, a dedicated catheter insertion site, education of caregivers, and a dedicated catheter cart. A recommendation was made to use ultrasound guidance when inserting a CVC in the internal jugular vein. Results: CLABSI rates were significantly reduced. The protocol was adapted by the hospital epidemiologist and CVC days were tracked. Rates of CLABSI followed from 2004 to 2011 (Table 1). The network of ICUs in the system was significantly reduced. Conclusions: CLABSI rates per 1000 catheter days declined dramatically from 2004 to 2011 (p < 0.0001). The protocol was adapted in 2009 and was tracked for 4 years. Additionally, 5/6 ICU had not had a CLABSI for over 3 years. The number of catheterizations differed significantly by type, with approximately eight times as many CVCs being performed as compared to PICCs (p < 0.0009); from 2009 to 2011 catheter usage significantly increased whereas from 2010 to 2011 it dropped significantly (p < 0.0015). However, the number of PICCs did not significantly change in frequency over time (Table 2). Table 3 shows the longest CLABSI-free time and APACHE III scores for individual units. Microbiology data are presented in Table 4.