Sustained Reduction and Prevention of Neonatal and Pediatric Central Line-Associated Bloodstream Infection Following a Nurse-Driven Quality Improvement Initiative in a Pediatric Facility

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Abstract

Purpose: *Hospitals devote significant resources developing protocols to minimize the incidence of central line-associated bloodstream infections (CLABSIs), a source of increased patient morbidity and health care costs; however, few of these protocols, especially centralized protocols, are reported in the literature. This study characterizes the development and effectiveness of a pediatric hospital's centralized CLABSI prevention bundle.*

Design and Methods: *The study was designed as a retrospective interrupted time series to quantify the effectiveness of the prevention bundle that was developed and implemented by nursing leadership in infection control, and both the neonatal and pediatric intensive care units between 2006 and 2014. The study period was subdivided into pre-, peri-, post-, and second peri-intervention periods based on the implementation status of the bundle. Segmented linear regression was used to model and compare the CLABSI rates for each intervention period overall as well as the 5 individual hospital units.*

Results: *The hospital's modeled CLABSI rate during the preintervention period was 3.80 out of 1000 line days and was significantly reduced to 0.45 ($P < 0.001$). Clear decreases in unit CLABSI rates were observed and all units were below corresponding National Healthcare Safety Network CLABSI rates after the study.*

Conclusions: *The centralized CLABSI prevention bundle reduced and sustained low CLABSI rates overall and within each hospital unit demonstrating the success of the bundle.*

Practice Implications: *A centralized CLABSI prevention bundle can universalize central line care, simplify infection control, and improve quality of care to help sustain low CLABSI rates throughout the hospital.*

Keywords: *CLABSI, reduction, prevention, hospital wide prevention bundle, central line infection*

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Introduction

Approximately 250,000 central line-associated bloodstream infections (CLABSIs) are acquired each year in US hospitals with death occurring in 28,000 cases.[1,2] The estimated cost to treat each patient is $29,156 and places a $2.3 billion burden on the US health care system each year.[1] Additionally, the Centers for Medicare and Medicaid Services classify CLABSIs as never-events preventing hospitals from obtaining

reimbursement for treating these infections, amplifying the burden on the health care system.[3] The personal suffering of patients and families from a hospital-acquired bloodstream infection is immeasurable, highlighting the importance of preventing these nosocomial infections.

Hospitals and individual units within a hospital devote significant resources to develop protocols to decrease the incidence of CLABSIs. Epidemiology studies combining CLABSI statistics from multiple hospitals clearly establish the efficacy of CLABSI bundles through a significant reduction in overall CLABSI rates.[4-7] However, few hospitals publish their bundles in the literature, especially bundles designed to reduce risk of CLABSIs in pediatric patients. Studies that report on the effectiveness of a specific CLABSI bundle are either limited to an entire hospital without information for individual units,[8-11] or are limited to 1 hospital unit or patient type.[12-18] Further, success of a specific bundle at 1 facility may not translate to another due to differences in patient types between facilities.

Effectiveness of each individual bundle varies with some hospitals experiencing significant success, whereas others are less effective. A recent comprehensive review helps demonstrate the variety of effectiveness of CLABSI bundles through meta-analysis of results from 14 pediatric intensive care units (PICUs) and 14 neonatal intensive care units (NICUs).[7] The bundles in the identified studies mostly focused on implementation of improved education and well-established CLABSI prevention interventions (ie, checklists, hand hygiene, and skin antisepsis). The meta-analysis found that CLABSI bundles are effective in critically ill pediatric patients, but the reductions seen in 11 PICU bundles and 5 NICU bundles were not clearly significant. Only 10 of the PICU and NICU studies demonstrated sustainment with an adequate follow-up period. Elements of continuous improvements were implemented or discussed in 4 studies that aimed to further reduce CLABSI rates after bundle implementation.[12,18-20] The review only considered critical care and did not consider bundle effectiveness for other hospitalized patients.[7] These observations support the need for continued dissemination of successful CLABSI bundles, especially for pediatric patients.

We developed a hospitalwide CLABSI prevention and maintenance bundle that uses a unique combination of interventions that includes well-established interventions and interventions not reported extensively in the literature. The primary objective of this article is to report the overall effectiveness of the hospitalwide CLABSI prevention bundle, and the secondary objective is to assess the effectiveness of the CLABSI prevention protocol in each unit. Following an interrupted time series design, analysis of CLABSI rate data between 2006 and 2014, corresponding to development, implementation, and evaluation of the bundle, demonstrate these objectives through sustained reduction of CLABSI rates. Analysis of results for each individual unit further illustrates the applicability of the infection prevention interventions on the diverse patient population treated at the study hospital. Unit data compared with CLABSI rates reported by the National Healthcare Safety Network (NSHN) demonstrate how the hospital CLABSI prevention bundle reduced CLABSI rates to, at, or below national benchmarks. We report on the development and success of our CLABSI prevention bundle in significantly reducing CLABSI rates throughout our Children's Hospital.

Methods

Study Facility

The study hospital is a 152-bed hospital freestanding not-for-profit pediatric medical center located in Tennessee. During the study period from 2006-2014, there was a yearly average of 38,454 patient days, 6664 admissions, and 11,085 central line days. The hospital has 5 main units, the PICU, NICU, a general inpatient unit serving hematology-oncology patients, a medical unit, and an inpatient surgery unit. Figure 1 displays monthly patients with lines and central line days by unit to demonstrate distribution of central lines throughout the hospital. The hospital institutional review board approved the study protocol and waived the requirement of informed consent.

Study Design

This retrospective study followed an interrupted time series design to assess the effectiveness of a pediatric hospitalwide

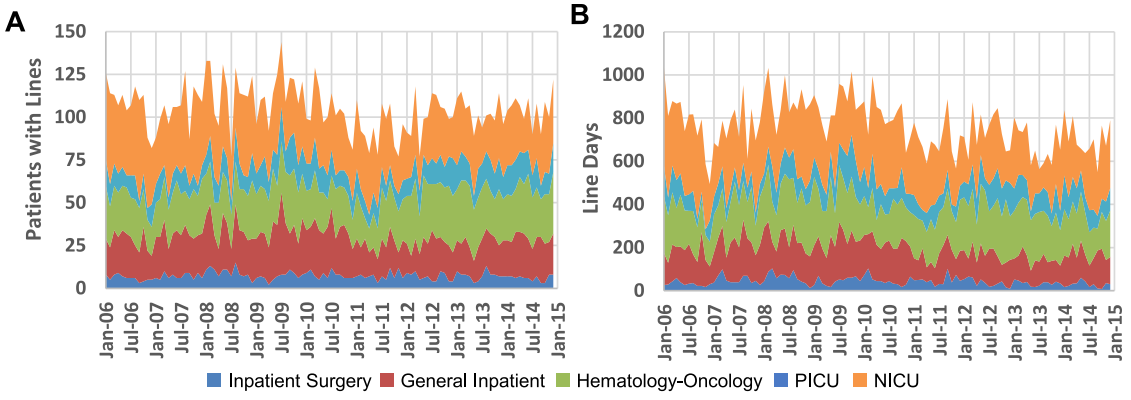

Figure 1. **Distribution of central line utilization in the hospital by unit. A, Number of patients with a central line by month B, Number of line days in each unit by month. PICU = Pediatric intensive care unit; NICU = Neonatal intensive care unit.**