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Reduction in Central Line–Associated Bloodstream Infections in Patients with Burns

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Central line–associated bloodstream infections (CLABSIs) remain a threat to hospitalized patients.[1] Patients with burn injuries are especially vulnerable to CLABSI, because the burn wound area can become colonized with pathogens, and prolonged hospital stays are common. In addition, large surface burns have a systemic immunomodulatory effect, such as skewing the immune system toward an interleukin 17–mediated response.[2] In this study, we evaluated CLABSI incidence trends in a large burn intensive care unit (ICU).

This study was conducted at the University of North Carolina (UNC) Hospitals using surveillance data from 1999 to 2012. UNC Hospitals is an 806-bed tertiary care academic facility. All patients admitted to the Jaycee Burn Center ICU, which is a 21-bed ICU dedicated to the care of severely ill patients with burns or extensive exfoliating skin conditions, were included. The number of ICU beds was 10 during the period 1999–2007 and increased to its current number of 21 beds in 2008. From 200 to 2009, a number of interventions directed toward decreasing the CLABSI rate were implemented (Table 1).

Infection control at UNC Hospitals is provided by 5 infection preventionists and 3 faculty members. Comprehensive hospital-wide surveillance was conducted using the most recent definitions recommended by the National Nosocomial Infection Surveillance[3] and the National Healthcare Safety Network.[4] Rates of CLABSI were calculated as the number of infections per 1,000 central line–days. Simple linear regression models (least-squares method) were used to examine decreases in the rate of CLABSI over time. Statistical significance was assessed by comparing these regression lines with a line with a 0 slope.

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The annual number of central line–days in the burn ICU increased from 1,493 days in 1999 to 3,223 days in 2012. At the same time the absolute number of CLABSI decreased from 21 CLABSI in 1999 to 7 CLABSI in 2012. This resulted in a substantial decrease in the rate of CLABSI in the burn ICU from 14.07 to 2.17 CLABSI per 1,000 central line–days (Figure 1). Over the period 2000–2012, we prevented an estimated 428 infections at a total cost savings of $9,947,576, based on published cost data and 118 deaths.[5] When evaluating the other ICUs during the study period, a reduction in the rate of CLABSI was also noted. Of note, since 2004, the rates of CLABSI in the burn ICU have been very similar to those in other ICUs. When the specific microbiologic etiologies were evaluated, a decrease in the number of CLABSI caused by *Staphylococcus aureus* was noted (Figure 1).

A sustained decreased CLABSI rate was observed in the burn ICU. Most interventions were implemented hospital-wide, and their effect was observed not only in the burn ICU, but in all ICUs, as previously reported.[6] Some interventions were unique to the burn population. The frequency of line changes remains controversial in this population. The 2008 Society for Healthcare Epidemiology of America (SHEA)/ Infectious Diseases Society of America (IDSA) guidelines do not recommend routine line changes.[7] A small study using historical controls was performed among burn patients to compare line changes every 3 days with line changes every 4 days.[8] This study suggested that increasing the interval was associated with an increase in episodes of CLABSI.[8] A survey of CLABSI-prevention practices across 51 adult burn units in the United States certified by the American Burn Association showed that 61% of burn units practice routine prophylactic line changes with an interval ranging from 3 to 7 days.[9] In our cohort, line change practice included a guidewire exchange every 3 days and changing to a new site every 6 days.

Antibiotic-impregnated central venous catheters were used in our cohort as well as in 43% of burn units surveyed.[9] The use of antibiotic-impregnated catheters is recommended in the 2008 SHEA/IDSA guidelines in hospital units with a CLABSI rate higher than the institutional goal, despite compliance with basic CLABSI-prevention practices.[7]

In 2006, universal glove and gown use was implemented in our burn ICU. This measure was not implemented in any other type of ICU in our hospital. The relative impact of this intervention on our CLABSI rate was likely modest, because most of the reduction in CLABSI rates occurred before this intervention. A recent cluster-randomized trial evaluated the impact of universal glove and gown use in non-burn ICUs.[10] Their findings included a reduction in the acquisition of MRSA, but not of VRE. No changes in CLABSI rates were observed.[10] We noted that most of the reduction was driven by a dramatic reduction in gram-positive organisms, mirroring the national trends.[1]

In summary, we observed a large, sustained, and prolonged reduction in the rate of CLABSI in the burn ICU. This reduction was temporally associated with the implementation of a multifaceted proactive approach to CLABSI prevention.

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References

1. Fagan RP, Edwards JR, Park BJ, Fridkin SK, Magill SS. Incidence trends in pathogen-specific central line–associated bloodstream infections in US intensive care units, 1990–2010. Infect Control Hosp Epidemiol. 2013; 34:893–899. [PubMed: 23917902]
2. Neely CJ, Maile R, Wang MJ, Vadlamudi S, Meyer AA, Cairns BA. Th17 (IFNγ− IL17+) CD4+ T cells generated after burn injury may be a novel cellular mechanism for postburn immunosuppression. J Trauma. 2011; 70:681–690. [PubMed: 21610359]
3. Garner JS, Jarvis WR, Emori TG, Horan TC, Hughes JM. CDC definitions for nosocomial infections, 1988. Am J Infect Control. 1988; 16:128–140. [PubMed: 2841893]
4. Centers for Disease Control and Prevention. [Accessed January 20, 2014] National Healthcare Safety Network: tracking infections in acute care hospitals/facilities. http://www.cdc.gov/nhsn/acute-care-hospital/index.html
5. Anderson DJ, Kirkland KB, Kaye KS, et al. Underresourced hospital infection control and prevention programs: penny wise, pound foolish? Infect Control Hosp Epidemiol. 2007; 28:767–773. [PubMed: 17564977]
6. Weber DJ, Brown VM, Sickbert-Bennett EE, Rutala WA. Sustained and prolonged reduction in central line–associated bloodstream infections as a result of multiple interventions. Infect Control Hosp Epidemiol. 2010; 31:875–877. [PubMed: 20590455]
7. Marschall J, Mermel LA, Classen D, et al. Strategies to prevent central line–associated bloodstream infections in acute care hospitals. Infect Control Hosp Epidemiol. 2008; 29(suppl 1):S22–S30. [PubMed: 18840085]
8. King B, Schulman CI, Pepe A, Pappas P, Varas R, Namias N. Timing of central venous catheter exchange and frequency of bacteremia in burn patients. J Burn Care Res. 2007; 28:859–860. [PubMed: 17925654]
9. Sood G, Heath D, Adams K, et al. Survey of central line–associated bloodstream infection prevention practices across American Burn Association–certified adult burn units. Infect Control Hosp Epidemiol. 2013; 34:439–440. [PubMed: 23466921]
10. Harris AD, Pineles L, Belton B, et al. Universal glove and gown use and acquisition of antibiotic-resistant bacteria in the ICU: a randomized trial. JAMA. 2013; 310:1571–1580. [PubMed: 24097234]

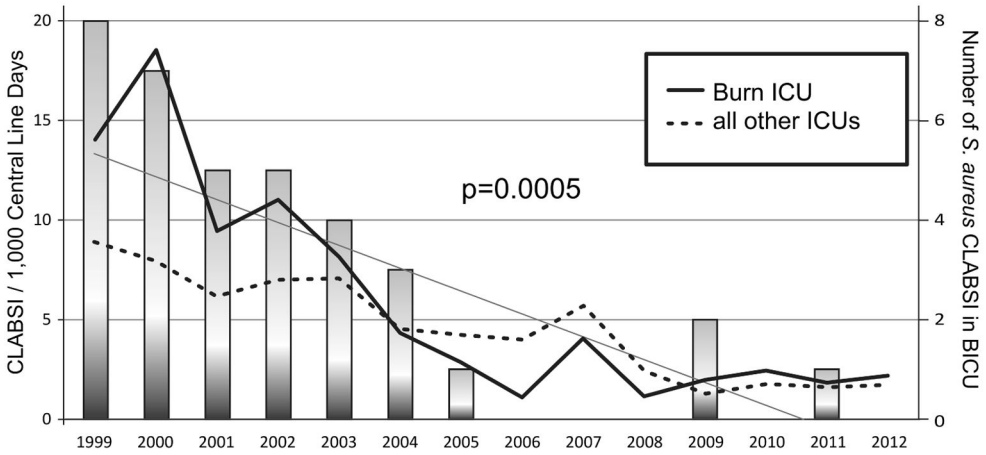

FIGURE 1.

Trends in overall central line–associated bloodstream infection (CLABSI) rate and number of *Staphylococcus aureus* CLABSIs in the burn intensive care unit (BICU). The solid black line indicates the rate of CLABSI in the BICU, and the dashed line indicates the rate of CLABSI in all other intensive care units (ICUs). The gray line is the regression line of the rate of CLABSI in the BICU ($P = .0005$). Shaded bars show the number of CLABSIs in the BICU per year caused by *S. aureus*.

TABLE 1

Interventions to Reduce Central Line–Associated Bloodstream Infections (CLABSIs) at University of North Carolina Hospitals, 2000–2009

Year(s)	Intervention(s)
2000	Enhanced education of medical staff regarding central lines; addition of 2% chlorhexidine plus 70% isopropyl alcohol for skin preparation to central line kits
2001	Mandatory training for nurses on IV line site care and maintenance
2003	Central line changes over a guidewire every 3 days with use of a new site every 6 days becomes standard practice;[a] use of full body drape for line insertion and changes
2003–2005	Introduction of antibiotic-impregnated central venous catheters for all patients
2004	Enhanced nursing education on central line insertion and maintenance
2005	Customized catheter-insertion kits
2006	Universal glove and gown use for all patient encounters[a]
2007	Implementation of the Institute for Healthcare Improvement bundle to prevent CLABSI
2009	Use of chlorhexidine patch at insertion site

NOTE. IV, intravenous.

[a]Specific to the burn ICU.