RESEARCH BRIEFS

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

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.

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

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.

https://doi.org/10.1086/677165 Published online by Cambridge University Press

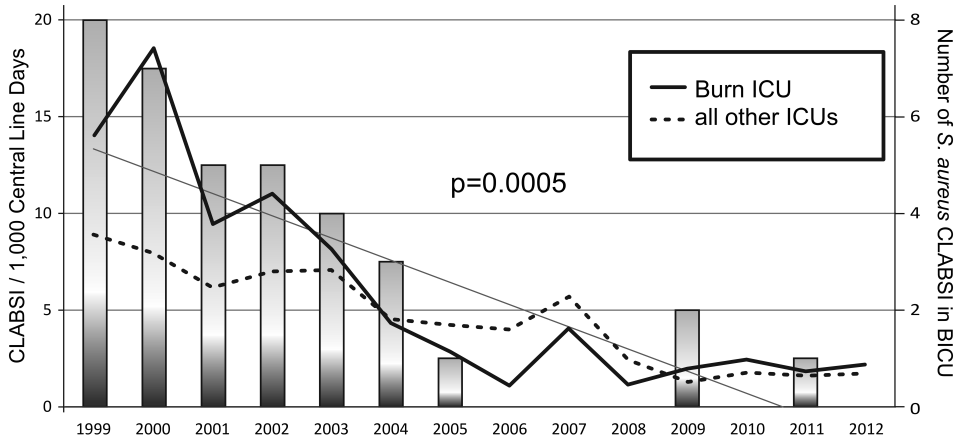

FIGURE 1. Trends in overall central line–associated bloodstream infection (CLABSI) rate and number of *Staphylococcus aureus* CLABSIs in the burn intensive care unit (BICU). The solid black line indicates the rate of CLABSI in the BICU, and the dashed line indicates the rate of CLABSI in all other intensive 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*.

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.

ACKNOWLEDGMENTS

Potential conflicts of interest. All authors report no conflicts of interest relevant to this article. All authors submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and the conflicts that the editors consider relevant to this article are disclosed here.

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Received February 4, 2014; accepted March 29, 2014; electronically published June 20, 2014.

Infect Control Hosp Epidemiol 2014;35(8):1066-1068

 0899-823X/2014/3508-0021$15.00. DOI: 10.1086/677165

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Microbial Contamination on Used Surgical Instruments

Surgical instruments are considered critical items because they enter sterile body tissues or the vascular system, and if contaminated with any microorganism, including bacterial spores, this could result in an infection. Critical items are generally sterilized by steam sterilization if heat resistant. If heat sensitive, the object may be sterilized with ethylene oxide, hydrogen peroxide gas plasma, or vaporized hydrogen peroxide. However, these technologies have a lower margin of safety than steam sterilization.[1] Because the level of microbial contamination of the object to be sterilized plays a critical role in determining the efficacy of the sterilization process, we evaluated the microbial load on used surgical instruments before cleaning and sterilization.

This study was conducted at the University of North Carolina Health Care, an 810-bed medical center. A variety of stainless steel surgical instruments were chosen, including Mayo straight scissors, forceps (eg, curved tip, large, and Debakey), rake, scissors (eg, curved), small-prong fork, small-pronged clamps, hemostats, knife handles, retractor, and needle holders. These instruments were all used in our operating rooms. After use in surgical procedures, the instruments were transported in peel packs to the hospital epidemiology laboratory and aseptically fully immersed in trypticase soy broth (Remel). The broth and instruments were agitated on a shaker at 150 rpm. After 30 minutes of agitation, two 500-μL samples were removed and plated onto sheep blood agar (SBA; Remel). The remaining broth was filtered through a disposable 0.45-μm cellulosic membrane filter unit (MSI Savur). Any colonies in the 500-μL samples were identified, and the total number on the device was calculated by multiplying by the volume of fluid. Any colonies on the SBA or filter were enumerated and identified using standard microbiological techniques.

Fifty surgical instruments were obtained from 12 operations. Less than 10 colony-forming units (CFUs) per device were recovered from 58% of the used instruments (Table 1). Eleven to 100 CFU were recovered from 20% of the used instruments, and greater than 100 CFU (median, 207 CFU) were recovered from 14% of the instruments. In 4 cases (8%), greater than 1,000 CFU were recovered from the instruments (ie, 2.4×10^3 *Bacillus cereus* on forceps; 4.4×10^3 *B. cereus* on a rake; 1.94×10^4 on a pronged clamp (containing 5.4×10^3 coagulase-negative *Staphylococcus*, 6.6×10^3 *α-Streptococcus*, 5.8×10^3 *Streptococcus pneumoniae*, and 1.6×10^3 *Micrococcus* species); and 4.98×10^4 on a hemostat (containing 5.4×10^3 *S. pneumoniae*, 4.4×10^4 *α-Streptococcus*). The most common contaminating organisms were coagulase-negative *Staphylococcus* species, *α-Streptococcus*, diphtheroids, *Micrococcus* species, *B. cereus, Escherichia coli*, and *Bacillus* species (Table 1).

The data revealed that the microbial load on used surgical instruments before cleaning was generally low; 58% had 10 CFU or less, and 78% had 100 CFU or less. In a study of contamination levels on used surgical instruments before

TABLE 1. Microbes Contaminating Used Surgical Instruments and Microbial Load When Submitted to Central Sterilization Services

Variable	No. (%) of instruments (n = 50)
Colony count, CFU	
0–10	29 (58)
11–100	10 (20)
101–1,000	7 (14)
>1,000	4 (8)
Microbe	
Coagulase-negative *Staphylococcus* species	24 (48)
α-Streptococcus species	13 (26)
Diphtheroids	10 (20)
Micrococcus species	10 (20)
Bacillus cereus	9 (18)
Bacillus species (not *cereus*)	5 (10)
Escherichia coli	5 (10)
Enterococcus (vancomycin susceptible)	2 (4)
Pseudomonas aeruginosa	2 (4)
Streptococcus pneumoniae	2 (4)
Enterococcus species (vancomycin resistant)	1 (2)
Pantoea species	1 (2)
Serratia marcescens	1 (2)
Staphylococcus aureus (oxacillin susceptible)	1 (2)

NOTE. Instruments were used in a total of 12 operations. Of the 50 instruments cultured, 9 (18%) showed no growth. CFU, colony-forming unit.

https://doi.org/10.1086/677165 Published online by Cambridge University Press