

modestly greater benefits than uncoated catheters made of silicone. Perhaps silicone catheters simply have better properties than latex catheters and they are only minimally improved by silver coating.

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## Barriers to and Facilitators of Implementing an Intervention to Reduce the Incidence of Catheter-Associated Bloodstream Infections

There are several published reports showing that educational interventions to standardize catheter insertion and care are effective in reducing the incidence of catheter-associated bloodstream infection (BSI), with reported decreases ranging from 28%-67%.<sup>1-4</sup> However, none of these reports have completely delineated the steps for implementing each intervention. Given the complexity of today's healthcare system, understanding the perceived barriers to and facilitators of implementing an intervention may streamline future implementation of similar interventions at other institutions, allow future implementers to replicate and/or enhance successful interventions or to modify and improve unsuccessful interventions.

In 2002, a multicenter BSI educational intervention was implemented in intensive care units (ICUs) at 6 centers of the Prevention Epicenters Program. The Prevention Epicenters consisted of 7 academic medical centers that work with the US Centers for Disease Control and Prevention (CDC) under a cooperative agreement to assess the effectiveness of interventions to prevent healthcare-associated infections. The Epicenter BSI educational intervention was designed at one center, the originating institution, and then implemented at the other 6 centers. In total, the study included a 3-month baseline period, 6-month implementation period (ie, the period during which intervention was introduced), and 6-month follow-up period. The intervention consisted of 3 components: a 9-page self-study educational module summarizing prevention strategies for BSI (some Prevention Epicenters also presented slide shows); a pretest and a posttest to measure knowledge of BSI prevention; and informational posters and fact sheets developed by the institutions. The institutions could implement each of the components as designed or modify them on the basis of specific organizational needs of the facility.

This report describes the perceived barriers to and facilitators of implementing this multicenter intervention at these

7 academic medical centers, with the purpose of providing a valuable guide for future patient safety interventions and evaluations.

Qualitative data were gathered retrospectively from the 6 participating centers and the originating institution. We conducted key informant interviews in November 2002 via telephone with personnel from each of these sites: the principal investigator (PI), co-PI, and/or a third staff member who was involved with the intervention and identified by the PI or co-PI. The median length of interviews was 45 minutes (range, 32–56 minutes). Question topics included the process of getting the intervention introduced and started, infection control policies for central-line care and BSI prevention, recruitment and implementation, and barriers and facilitators. Data were qualitatively analyzed and themes were identified, and these are reported herein according to institution.

Nineteen respondents representing 7 institutions were interviewed. Seven (37%) of these 19 were PIs, 7 (37%) were co-PIs, and 5 (26%) were other staff. Thirteen (68%) of these 19 respondents were physicians, 5 were (26%) nurses, and 1 was a research assistant. Six of the 7 institutions implemented the intervention in 2 ICUs; the other implemented it in 3 ICUs. The self-study module and the pretest and posttest components were implemented by all 7 institutions; posters and/or fact sheets were used by 6 institutions.

“Buy-in” from nursing and medical leadership was mentioned by a majority of respondents in all institutions as necessary for getting the intervention introduced to, and accepted by, the institution. Respondents also reported the need to acquire assistance from other committees and to change or implement a policy to facilitate the intervention. Six institutions reported that they modified at least 1 of the original components or materials (the seventh was the originating institution). These changes were made to tailor the materials to specific hospitals, to strengthen the content of slides, to increase interest, to make the self-study module more concise, and to improve wording.

When respondents were asked to select only one component, the self-study module was rated most useful by respondents from all institutions, the most time consuming by respondents from 6 institutions, and the most costly by respondents from 5 institutions. Respondents from all institutions identified logistics and scheduling as barriers to implementing the interventions. Respondents from most institutions also mentioned low levels of involvement and lack of “buy-in” from clinicians as barriers to implementation.

Perceptions about sustainability varied. At least 1 respondent from each institution indicated that they “would do the intervention over again.” Of those reporting a reduced BSI rate as a result of the intervention thus far, all would do it again. At least 1 respondent from each institution thought that the intervention was sustainable over time, but an additional person from each institution was unsure whether it was sustainable, and respondents from 3 institutions did not

believe it was sustainable. The majority of respondents would recommend the intervention in its entirety to other hospitals, whereas some respondents would recommend only certain components of the intervention.

Understanding the perceived barriers to and facilitators of initiating and implementing an intervention, such as this one for the prevention of catheter-associated BSI, can provide valuable insight into the success of recommended prevention strategies.<sup>5–8</sup> These findings suggest that engaging hospital leadership, allowing for flexibility in implementation, and anticipating barriers before they occur are key components to consider in any intervention. However, one major limitation of the study is that information on adherence to all recommended practices for prevention of BSI was not collected. Thus, we cannot explain the differences in outcomes observed by individual units or institutions. Furthermore, data were collected retrospectively. Process data on adherence should be collected prospectively as part of intervention studies and other trials to assist in explaining variabilities in outcomes and to ensure that successful interventions can be replicated.

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## Catheter-Associated Bloodstream Infections in 2 Long-Term Acute Care Hospitals

TO THE EDITOR—Catheter-associated bloodstream infections (BSIs) are a well-known source of excess morbidity and mortality.<sup>1</sup> The National Nosocomial Infections Surveillance (NNIS) System Report contains data on the rates of catheter-associated BSI that occur in intensive care units (ICUs) in US hospitals.<sup>2</sup> This information is important for establishing comparison rates that facilities can use to set thresholds for intervention. However, there are no comparable data available on catheter-associated BSI rates for long-term acute care hospitals (LTACHs).

An LTACH is defined by the Center for Medicare Services as a hospital that has an average inpatient length of stay of greater than 25 days. The number of LTACHs in the United States has grown significantly in the past decade, and there are currently more than 275 of these facilities.<sup>3</sup> LTACHs provide extended medical and rehabilitative care for clinically complex patients, including patients with multiple organ dysfunction,<sup>4</sup> and those who require prolonged weaning from mechanical ventilation. One recent study demonstrated that rates of antimicrobial resistance and device use in LTACHs are comparable to those seen in ICUs.<sup>5</sup>

The purpose of our study was to determine the central line-associated BSI rate for a cohort of patients with respiratory failure who were admitted to 2 LTACHs for ventilator weaning and to compare this rate to rates determined by the NNIS for ICUs in the United States. Data were collected from November 2004 through July 2005 as part of a prospective, observational study in 2 LTACHs. One LTACH had 12 beds, the second had 30. Catheter-associated BSI was defined according to Centers for Disease Control and Prevention criteria.<sup>6</sup> To ensure that only infections acquired in LTACHs were included, we excluded infections with symptom onset within 48 hours after admission. Approval from the institutional review board of Emory University was obtained for this study, and written consent was obtained from all subjects.

Data were collected for 93 patients. The total number of patient-days was 2,685, and the total number of central line-days was 2,007, yielding a central line use rate of 74.7%. This rate is equivalent to the 90th percentile of central line use rates for medical and combined medical-surgical units re-

ported in the latest NNIS report.<sup>2</sup> There were 33 BSIs during the study period, yielding a central line-associated BSI rate of 16.44 cases per 1,000 central line-days. This is higher than the reported 90th percentile rate for ICUs of all types and is roughly double the 90th percentile rate reported for medical and medical-surgical units.<sup>2</sup> Enterococci and coagulase-negative staphylococci were the most common pathogens recovered from blood cultures (Table). *Staphylococcus aureus* and *Candida* species each accounted for 12% of the total number of isolates.

It is possible that our data are skewed toward higher rates because all of the patients admitted to our facilities had a primary admission diagnosis of respiratory failure. Hence, our patients may be sicker than the overall LTACH population. However, the median length of stay among our patients (24 days) was comparable to or shorter than those reported in other studies.<sup>5,7</sup> Our data may also reflect suboptimal catheter insertion and care techniques. Much progress has been made in recent years to improve these practices in short-term acute care hospitals. LTACHs are a comparatively new care setting, and hence these best practices for catheter insertion and care may not yet be widely implemented.

Because patients had acute illnesses and prolonged lengths of stay, we hypothesized that the rates of catheter-associated BSI in LTACHs would be comparable to those seen in ICUs. In fact, we found that catheter-associated BSI rates at 2 LTACHs exceeded the 90th percentile of rates for all ICUs reporting data to the NNIS system. The rate of 16.44 cases per 1,000 central line-days was approximately double the 90th percentile rate for medical and combined medical-surgical ICUs, the units whose patient populations most closely resemble those of LTACHs. The majority of organisms recovered were gram-positive bacteria; more than 10% of these BSIs were cases of fungemia. Our findings demonstrate the need for more data on rates of catheter-associated BSIs in LTACHs. This information, collected from a variety of LTACH types, will allow for comparison of infection rates between LTACHs and will help determine thresholds for interventions. Though limited by a small sample size and by possible se-

TABLE. Pathogens Isolated From 33 Patients With Catheter-associated Bloodstream Infections

Organism	No. (%) of isolates <sup>a</sup> (N = 40)
<i>Enterococcus</i> species	13 (32)
Coagulase-negative staphylococci	12 (29)
<i>Staphylococcus aureus</i>	5 (12)
<i>Candida</i> species	5 (12)
<i>Klebsiella oxytoca</i>	3 (8)
<i>Acinetobacter baumannii</i>	1 (3)
<i>Alcaligenes xylosoxidans</i>	1 (3)

<sup>a</sup> Some patients had 2 organisms recovered.