



## Major article

## Sustained reduction of central line–associated bloodstream infections outside the intensive care unit with a multimodal intervention focusing on central line maintenance



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**Background:** Central venous catheter use is common outside the intensive care units (ICUs), but prevention in this setting is not well studied. We initiated surveillance for central line–associated bloodstream infections (CLABSIs) outside the ICU setting and studied the impact of a multimodal intervention on the incidence of CLABSIs across multiple hospitals.

**Methods:** This project was constructed as a prospective preintervention–postintervention design. The project comprised 3 phases (preintervention [baseline], intervention, and postintervention) over a 4.5-year period (2008–2012) and was implemented through a collaborative of 37 adult non-ICU wards at 6 hospitals in the Rochester, NY area. The intervention focused on engagement of nursing staff and leadership, nursing education on line care maintenance, competence evaluation, audits of line care, and regular feedback on CLABSI rates. Quarterly rates were compared over time in relation to intervention implementation.

**Results:** The overall CLABSI rate for all participating units decreased from 2.6/1000 line-days pre-intervention to 2.1/1,000 line-days during the intervention and to 1.3/1,000 line-days postintervention, a 50% reduction (95% confidence interval, .40–.59) compared with the preintervention period ( $P$ .0179).

**Conclusion:** A multipronged approach blending both the adaptive and technical aspects of care including front line engagement, education, execution of best practices, and evaluation of both process and outcome measures may provide an effective strategy for reducing CLABSI rates outside the ICU.

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Central line–associated bloodstream infections (CLABSI) are serious health care–associated infections, leading to increased morbidity, mortality, and costs.<sup>1,2</sup> In 2001, an estimated 43,000 CLABSI cases occurred in intensive care units (ICUs) across the United States.<sup>1</sup> Several ICU-targeted interventions using a straightforward central venous catheter (CVC) insertion bundle of

**Table 1**  
Characteristics of the hospitals, units, device use, and type of needleless connector

Hospital	Hospital beds	Hospital type	Medical/surgical units		Specialty care units		ICU stepdown		Fluid displacement of needleless connector
			Number of units	Mean DUR	Number of units	Mean DUR	Number of units	Mean DUR	
1	739	Major teaching	6	0.25	3	0.53	1	0.73	Negative/neutral
2	528	Graduate teaching	10	0.16	1	0.25	1	0.32	Negative*
3	261	Major teaching	4	0.13			1	0.26	Neutral
4	256	Graduate teaching	4	0.22	1	0.26			Positive/neutral
5	113	Nonteaching	3	0.10					Positive
6	61	Nonteaching	2	0.08					Positive

\*Split septum connector.

best practices have been effective in reducing the incidence of CLABSIs in ICUs. Most previous studies have shown reductions of 20%-75% across disparate hospitals and types of ICUs.<sup>3-5</sup> The success of these interventions has been attributed to such factors as education, collection and feedback of CLABSI rates, creation of multidisciplinary teams, identification of physician and nurse champions, leadership support, and unit safety culture changes.<sup>6</sup> The increasing number of statewide and local ICU prevention collaborative efforts successfully implementing the foregoing interventions led to a nationwide 58% reduction in CLABSIs in 2009 compared with 2001.<sup>1</sup>

CVC use is not limited to the ICU, however; CVCs are also prevalent on surgical and medical wards.<sup>7,8</sup> CLABSI rates outside the ICU are similar to those in the ICU,<sup>8-10</sup> but the number of non-ICU patients at risk is substantially larger, leading to a greater burden of infection compared with the ICU setting.<sup>1</sup> In 2008, the Joint Commission recommended expanding surveillance for CLABSIs beyond the ICU, and a 50% reduction in CLABSI rates hospitalwide by 2013 was set as a national target by the US Department of Health and Human Services.<sup>11</sup> In addition, starting in 2015, the Centers for Medicare and Medicaid Services will require hospitals enrolled in the Hospital Inpatient Quality Reporting (IQR) Program to report CLABSI rates in medical-surgical units.<sup>12</sup>

Prevention of CLABSI outside the ICU requires a unique approach owing to the greater variability in type and duration of CVC use compared with the ICU setting. Outside the ICU, peripherally inserted central catheter (PICC) use is more common,<sup>7</sup> and catheters may remain in place for longer periods.<sup>13</sup> Prolonged catheter use may increase the risk of catheter colonization and subsequent CLABSI,<sup>14-16</sup> as may lapses in CVC care, such as the presence of a nonintact site dressing and inadequate care of needleless connectors.<sup>11,17-19</sup> Although the level of CLABSI risk with different types of needleless connectors (positive, negative or neutral) is controversial, standardizing the care of all needleless connectors and educating nurses on the best practices for maintaining a variety of CVCs will improve their skills and likely lead to reductions in CVC-related complications, such as bloodstream infections.<sup>20,21</sup> Here we report on a quality improvement project involving 6 hospitals in the Rochester, NY area that collaborated to evaluate the CLABSI burden in selected adult units outside the ICU and to prevent these infections through engagement, education of nursing staff, and standardization of best practices for CVC line care and maintenance.

## METHODS

### Setting

In April 2008, 6 hospitals in the Rochester region initiated CLABSI surveillance and prevention interventions on non-ICU units. Participating hospitals included 1 tertiary care hospital, 3 community hospitals with a medical teaching program, and 2 rural

hospitals ranging in size from 61 to 739 beds. The hospitals selected non-ICU units in which CVCs were regularly used to participate in the project, for a total of 37 adult units. Hospital size, number and type of units, mean central line device use ratio (DUR), and types of needleless connectors used are summarized in Table 1. This project was approved by the Institutional Review Board of each hospital before project initiation.

### Study design

This quality improvement collaborative project had a prospective preintervention-postintervention design. The project comprised 3 phases—preintervention (baseline), intervention, and postintervention—as summarized in Table 2 and described in detail below. Implementation of the intervention was guided by a translating evidence into practice model that focuses on strategies for engagement, education, execution, and evaluation of the prevention effort.<sup>22</sup>

### Phase 1 (baseline work): April 2008 to March 2009

**Collaborative team.** A collaborative team consisting of hospital epidemiologists and infection preventionists (IP) from the 6 hospitals was formed in April 2008. The collaborative team met monthly to discuss education implementation, progress in CLABSI reduction, and the need for additional interventions. Each team member was responsible for disseminating information to other IPs and frontline staff at his or her hospital.

**CVC maintenance bundle.** The collaborative team members reviewed the evidence-based literature and CLABSI prevention guidelines and created a CVC maintenance bundle. In accordance with the Healthcare Infection Control Practices Advisory Committee (HICPAC) CLABSI prevention guidelines,<sup>23,24</sup> the bundle included 5 evidence-based components: hand hygiene; aseptic technique during use of needleless connectors; CVC dressing changes; frequency of needleless connector, IV line, and dressing changes; and regular assessment of the need for the CVC (Table 3). Although thorough disinfection of the catheter hub and needleless connector is recommended every time the catheter is accessed, there was no consensus on the recommended duration of disinfection at the initiation of this study<sup>23</sup>; therefore, based on a review of the literature available at the time, the collaborative team recommended scrubbing for 10-15 seconds to disinfect needleless connectors.<sup>25-28</sup> Owing to variations in the types of needleless connectors and CVCs used across the participating hospitals, flushing and clamping methods were individualized by each hospital based on the manufacturer's recommendations. None of the hospitals introduced alcohol caps for needleless connector disinfection or chlorhexidine bathing during the study period.

**Education.** To prepare for the educational intervention, collaborative team members reviewed each hospital's CVC care policies and

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