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Brief report

Beyond the intensive care unit bundle: Implementation of a successful hospital-wide initiative to reduce central line–associated bloodstream infections

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A multimodal hospital-wide central line–associated bloodstream infection (CLABSI) risk reduction strategy was implemented over a 20-month period at an Australian center. Reduced CLABSI rates were observed in both intensive care units (ICUs) (incidence rate ratio [IRR], 0.39; $P < .001$) and non-ICU wards (IRR, 0.54; $P < .001$). The median time to CLABSI onset was 7.5 days for ICU events and 13 days for non-ICU events. The timing of infection demonstrates the need for more careful attention to postinsertion care and access of central venous catheters.

Central line–associated bloodstream infections (CLABSIs) are associated with morbidity, mortality, and increased duration of hospitalization.[1] Reductions in CLABSI rates in intensive care units (ICUs) have been achieved using multimodal care bundles.[2] In Australia, monitoring for CLABSIs is performed mostly in ICU patient populations,[3] and the use of care bundles outside the ICU has not been widely reported.

METHODS

Study design and population

We refined an existing care bundle to reduce risks for CLABSI at our 700-bed tertiary referral center. Before study initiation, the following measures were in use in the ICU: hand hygiene promotion and auditing; use of 0.5% chlorhexidine gluconate (CHG) in 70% alcohol for skin preparation before central venous catheter (CVC) insertion; avoidance of femoral CVCs; use of barrier precautions, with the exception of a full-body drape; and removal of all unnecessary devices. Minocycline-rifampicin–coated CVCs were routinely used in the ICU. A range of devices were used in the other hospital units, including tunnelled CVCs used for hematology patients and peripherally inserted CVCs and Portacaths used throughout the hospital.

Data for a 24-month preintervention period (April 2009 to March 2011) were evaluated. Key measures for CLABSI risk reduction were then introduced stepwise between April 2011 and December 2012. This study was conducted as a quality improvement initiative, and thus ethical approval to review outcome measures was deemed unnecessary.

Intervention

With hospital executives' support, a CLABSI prevention committee was established and project resources allocated: nursing staff (1.8 full-time equivalent [FTE]), supported by an infectious diseases physician (0.1 FTE) for 18 months. The following actions were implemented in the ICU: (1) monthly feedback of surveillance reports, (2) infection prevention education/credentialing of junior

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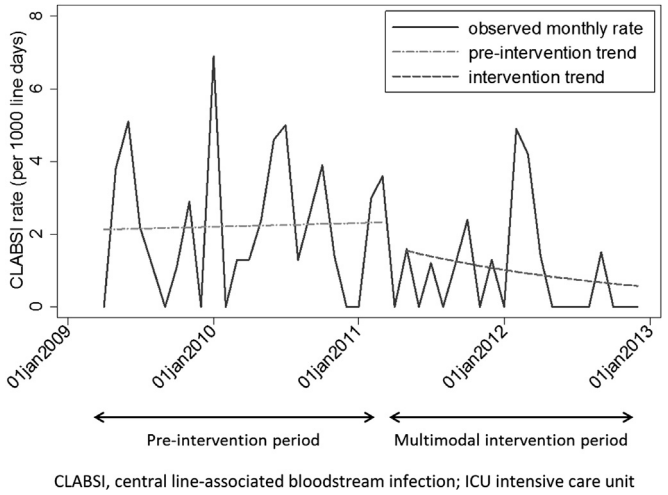

Fig 1. Interrupted time series analysis of ICU CLABSI rates in the preintervention and intervention periods.

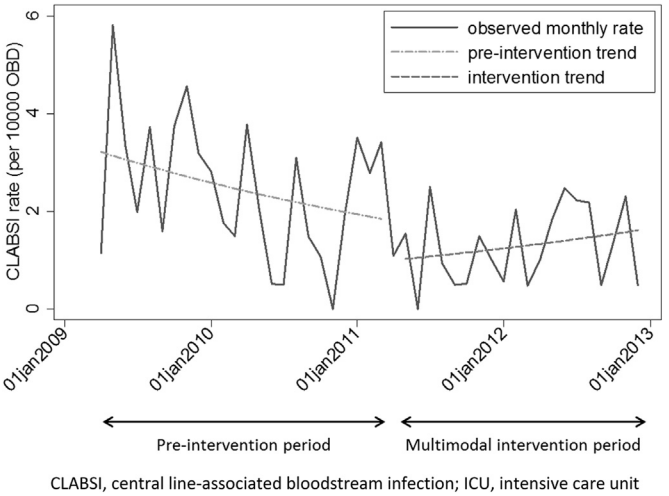

Fig 2. CLABSI rates outside of the ICU in the preintervention and intervention periods.

medical staff, (3) routine CHG body washes for patients, and (4) dedicated medical staff for CVC insertion. The following measures were introduced in the ICU and hospital-wide: (1) 2% CHG in 70% alcohol solution for skin preparation before CVC insertion[4]; (2) standardized CVC insertion packs, including full body drape; (3) CVC insertion guidelines; (4) discussion with nursing staff regarding non-ICU CLABSIs occurring more than 7 days after CVC insertion; and (5) nursing education regarding CVC care.

Definitions

A CVC was defined as an intravascular catheter terminating at or close to the heart or in a great vessel and used for infusion, withdrawal of blood, or hemodynamic monitoring. CLABSI was defined according to Centers for Disease Control and Prevention/National Healthcare Safety Network surveillance criteria.[5] ICU CLABSI rates were calculated using the denominator of cases per 1000 CVC-days. The ICU device utilization ratio (DUR) was defined as the number of CVC-days divided by number of patient-days.[6] Outside of the ICU, CLABSI rates were calculated using the denominator of cases per 10,000 occupied bed-days (OBDs).

Analysis

CLABSI rates before and after the intervention were compared assuming a Poisson distribution, with $P < .05$ deemed statistically significant. Segmental regression analysis was performed, and fitted rates for preintervention and intervention periods were compared. Analyses were performed using Stata version 12 (StataCorp, College Station, TX).

RESULTS

ICU CLABSIs

During the preintervention period, there were 43 CLABSI events and 18,575 CVC-days, corresponding to a CLABSI rate of 2.3 (95% confidence interval [CI], 1.7-3.1) per 1000 CVC-days. During the intervention period, there were 15 CLABSI events and 16,452 CVC-days, corresponding to a CLABSI rate of 0.9 (95% CI, 0.5-1.5) per 1000 CVC-days, demonstrating a significant overall reduction in CLABSI rate (incidence rate ratio [IRR], 0.39; 95% CI, 0.20-0.72; $P < .001$).

The median time to occurrence of CLABSI after CVC insertion was 7.5 days (interquartile range [IQR], 5-10 days). The ICU DUR was 0.74 during the preintervention period and 0.70 in the intervention period. Fitted ICU CLABSI rates for the preintervention and intervention periods are summarized in Figure 1, showing a 43% decrease in rate ($P = .26$) and a trended decrease of 3.6% per month ($P = .39$).

Non-ICU CLABSIs

During the preintervention period, there were 110 CLABSI events outside of the ICU and 452,002 bed-days (mean rate, 4.58 per month; overall rate, 2.5/10,000 OBDs). During the intervention period, there were 56 CLABSI events outside of the ICU and 430,063 bed-days (mean rate, 2.67 per month; overall rate, 1.3/10,000 OBDs). The IRR for CLABSI in the intervention period was 0.54 (95% CI, 0.38-0.75; $P < .001$).

The median time to occurrence of CLABSI after CVC insertion was 13 days (IQR, 7-28 days). Fitted rates of non-ICU CLABSI events, summarized in Figure 2, show a 37% decrease in rate ($P = .38$) and a trended increase of 6.2% per month ($P = .13$).

DISCUSSION

The reduction in CLABSI rates observed as a result of our multimodal strategy approaches the magnitude reported by others.[7,8] We found that not all of the bundle components described by Pronovost et al[8] are necessary to successfully reduce CLABSI rates. At our institution, the timing of CLABSI onset indicates that the importance of aseptic technique during CVC insertion may be overemphasized and that postinsertion care needs more attention.

Care bundles for CLABSI risk reduction must be feasible using existing resources.[9] During the intervention period, we found it impossible to implement a CVC checklist, as described by Pronovost et al,[8] owing to time constraints on clinical staff; however, we believe that this element might not be essential, as reflected by reduced CLABSI rates and late presentation of infections, suggesting that the infections were associated with line maintenance rather than insertion.[10] Furthermore, we introduced additional measures, not included in previously published bundles (eg, CHG body washes), given the scope of practice already in place before the initiation of this study.

Study limitations include the multimodal nature of the intervention, preventing evaluation of the impact of individual components. Increased staff engagement likely affected outcomes, but this factor was not specifically evaluated. No significant changes in trended CLABSI rates were demonstrated, which is not surprising given the low preintervention infection rates. The decreasing CLABSI rate