RAPID COMMUNICATION

The long-term impact of a program to prevent central line-associated bloodstream infections in a surgical intensive care unit

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INTRODUCTION

Central line-associated bloodstream infections (CLABSIs) are an important type of healthcare-associated infection in intensive care units (ICUs) with high mortality rates and high healthcare costs (1). According to the World Health Organization (WHO), CLABSIs are also the most common cause of healthcare-associated infections of the bloodstream (2).

In the United States, the median rate ranges from 1.8 to 5.2 per 1,000 catheter days, according to the Centers for Disease Control and Prevention (CDC) (3). Each year, 100,000 cases and 30,000 deaths occur among patients in ICUs (4).

In limited-resource countries, CLABSI rates range from 1.6 to 44.6 cases per 1,000 central line days in adult and pediatric ICUs and from 2.6 to 60.0 cases per 1,000 central line days in neonatal ICUs. CLABSIs are associated with significant additional mortality, with an odds ratio ranging from 2.8 to 9.5 (5).

The optimal intervention method for reducing the incidence of CLABSIs has not been definitively identified, but some studies have proven that many practical, low-cost, low-technology educational measures related to inserting and maintaining central lines not only may be successful and effective but can also be sustained (3,4,6–11). Within this scenario, the CDC has recommended that an education program be implemented for healthcare personnel (6).

The objective of this study was to describe the long-term impact of a program for decreasing CLABSI rates in a surgical ICU in São Paulo, Brazil.

METHODS

For this interrupted time-series analysis, we compared the CLABSI rates during an 18-month baseline period (from September 2005 to February 2007), an 18-month intervention period (from March 2007 to August 2008) and an 18-month post-intervention period (from September 2008 to February 2010) in a cohort of patients who received central line catheterization in a 10-bed surgical ICU located in a tertiary hospital specializing in orthopedic care in São Paulo, Brazil.

The intervention consisted of an 18-month program of weekly visits to the ICU by professionals from an infection control board. The visits consisted of the inspection of all patients with central lines and guidance for the ICU team on the correct techniques for inserting and maintaining these catheters, including the following: full-barrier precautions during the insertion of central venous catheters; the use of a fixation hub with suturing; hand washing before manipulating the device (e.g., for blood sampling and drug infusion); cleaning the skin with chlorhexidine; avoiding the femoral site if possible; and removing unnecessary catheters or those in poor condition. During these visits, all of the professionals belonging to the medical and nursing staff were approached individually to ensure that they had understood the instructions.

A bloodstream infection was defined according to the CDC criteria [11]. CLABSIs were considered to be ICU related if detected at least 48 hours after admission to the unit or less than 48 hours after discharge from the unit. The CLABSI incidence rates were expressed as the total number of CLABSI episodes over the number of catheter days. The statistical analyses were performed using an ANOVA with a Bonferroni (*post-hoc*) correction. Statistical significance was defined as $p<0.05$. SPSS 10.0 for Windows (SPSS Statistics, IBM, Chicago, IL, USA) and Microsoft Excel 2007 (Microsoft Inc., Redmond, WA, USA) were used for data collection and statistical analyses.

RESULTS

During the pre-intervention period (baseline), the mean incidence rate of CLABSI events per 1,000 catheter days observed was 15.85 ($\pm$ standard deviation [SD]: 19.44; 95% CI: 6.19–25.52), ranging from 0 to 60.98 events. The median and interquartile range were 12.66 and 27.24, respectively (Table 1).

During the intervention period, the mean incidence rate fell to 4.98 ± 7.11 (95% CI: 1.45–8.52), and the median reached 0 (interquartile range: 12.53), ranging from 0 to 22.30. This reduction trend was maintained in the post-intervention period, during which 3.91 ± 8.21 events (95% CI: -0.18–7.99) were observed, ranging from 0 to 31.58. A 68% reduction in the mean CLABSI rate occurred during the intervention, and a 75% decrease was observed after this period.

No potential conflict of interest was reported.

Table 1 - A comparison of the incidence rate and catheter days among the study periods.

	Baseline	Intervention period	Period after intervention
Period	18 months	18 months	18 months
Catheter days			
Mean (± standard deviation)	98.44± 41.03	99.78±37.05	87.72±38.46
Median (± interquartile range)	107±77.75	95±56.75	84±49.5
Range	36–156	44–186	34–163
Incidence rate (per 1,000 catheter days)			
Mean (± standard deviation)	15.85±19.44	4.98±7.11	3.91±8.21
Median (± interquartile range)	12.66±27.24	0±12.53	0±31.58
Range	0–60.98	0–22.30	0–31.58

There were statistically significant differences among all of the periods ($p = 0.013$) and between the first and second periods ($p = 0.022$) and first and third periods ($p = 0.045$) (Figure 1). The number of catheter days did not differ between any of the periods ($p = 0.598$, ANOVA).

DISCUSSION

CLABSIs are associated with high mortality and costs for healthcare systems around the world, and educational strategies are regarded as the cornerstone of infection control. This strategy has been supported by several studies (2,3,5–9), even in settings with a low baseline incidence of CLABSIs (6), although some studies have shown that non-educational measures have been confounders (4,9,10,11). A single study in Brazil found no statistically significant reduction in the incidence of CLABSIs despite good compliance with educational measures, most likely due to the use of an open-infusion system (7).

In this study, we achieved lower CLABSI rates through educational measures without increasing costs to the hospital. In this approach, every health professional was approached individually regarding the insertion technique and maintenance of central venous catheters. Thus, each professional felt valued and motivated, which contributed toward the success of the intervention. Importantly, even after the intervention, the rates remained lower than the baseline.

Provonost et al. (3) found a sustained reduction of up to 66% in CLABSI rates after 18 months of follow-up in a larger study with an educational intervention based on a similar approach, although their baseline incidence was lower than in the present study.

The present study has limitations. The absence of randomization, the involvement of just one service and the absence of detailed statistical intervention analyses make it difficult to establish a causal connection between the intervention and the reduced CLABSI rates, although the long-term follow-up reduced any effect from seasonal trends. The possibility of CLABSI underreporting was minimized through the active surveillance of signs and symptoms, microbiological data and the prescribing of antibiotics in the ICU, although the microorganisms identified were not reported in this study. Furthermore, staff compliance was not evaluated, either by a written test or by statistical analysis, because the infection control team was actively monitoring the ICU to ensure the accomplishment of the educational approach.

Our program produced sustained long-term decreases in the CLABSI rate. This success shows the importance of interactions between infection control and ICU professionals for achieving the goal of reducing infections in this setting.

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