American Journal of Infection Control 41 (2013) 1209-13

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

Itemizing the bundle: Achieving and maintaining "zero" central line-associated bloodstream infection for over a year in a tertiary care hospital in Saudi Arabia

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Key Words:
CLABSI
Zero
Intensive care unit
Asia

Background: "Zero" central line-associated bloodstream infections (CLABSI) have not been reported from Asian countries, which usually have predominance of difficult to curtail gram negative infections. It also remains unclear whether lowering CLABSI rates below National Healthcare Safety Network (NHSN) benchmarks in such countries is even possible. In this study, we evaluated effects of a quality improvement initiative to achieve "Zero CLABSI" in our intensive care unit.

Methods: A root cause analysis in February 2010 identified problems with clinical practice, environment, and products. Extensive education sessions were followed by implementation of strategies in the form of "itemized" bundles derived from practice guidelines, with complete enforcement starting August 2010. Results were benchmarked against NHSN data. Data were analyzed in a preintervention (1 year) and postintervention (2 years) fashion, using Poisson regression analysis to generate incidence-rate ratio (IRR).

Results: In the preintervention period, CLABSI rate was 6.9/1,000 catheter-days (CDs) (35 CLABSI/5,083 CDs). In the postintervention year 1, rate was 1.06/1,000 CDs (4 CLABSI/3,787 CDs) with IRR of 0.15 (95% confidence interval: 0.04-0.44, $P < .001$) and reduction of 85%. In postintervention year 2, rate was 0.35/1,000 CDs (1/2,860 CDs) with IRR of 0.05 (95% confidence interval: 0.001-0.31, $P < .001$). There was a period of "Zero CLABSI" for 15 consecutive months, surpassing NHSN benchmarks.

Conclusion: : CLABSIs can be eliminated in any intensive care unit regardless of the location and type of organism. NHSN data should be a realistic CLABSI benchmarking target for developing countries.

Eliminating the central line-associated bloodstream infection (CLABSI) has become one of the most important targets in modern health care and rightly so. Costs associated with CLABSIs include expenses of up to $2.3 billion annually.[1] It adversely impacts patients with an 18% increase in mortality and an 11- to 13-day increase in intensive care unit (ICU) length of stay.[2]

The idea of incorporating different quality improvement strategies and combining them into a "bundle" or "checklist" was tested in the Michigan Health and Hospitals Association Keystone ICU project and showed significant reductions in the CLABSI rates.[3] These reductions were not only achieved but also were sustained and improved with time.[4,5] Similar interventions in the form of bundles were adopted and tested in different populations with varying results.[6-9]

In the last few years, the "myth" of achieving the landmark of "zero" CLABSI has been debunked. It has now been shown that, with the help of these quality improvement strategies, achieving "zero" CLABSI is not only probable but sustaining it is very much possible in both adult and pediatric populations.[5-9] However, these studies are from developed countries, mainly the United States. In developing countries, CLABSIs are still a huge problem, and, even though some reductions in the rates have been reported, achievement of "zero" CLABSI still has not been attained.[10-13] Moreover, the health care-associated infections reported from the developing countries are predominantly from gram-negative bacteria.[12,13] As per the reported data from the hospitals in the United States by Centers for Disease Control and Prevention (CDC), these are the most difficult to curtail. With the improved measures where there is a 73% reduction in *Staphylococcus* infections, the reduction in CLABSI because of gram-negative organisms is a modest 37%.[14]

This raises a few questions. Is it possible that failure to achieve "Zero CLABSI" in Asian countries is because of the difference in microbiologic organism prevalence? The National Healthcare Safety

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Conflicts of interest: None to report.

http://dx.doi.org/10.1016/j.ajic.2013.05.028

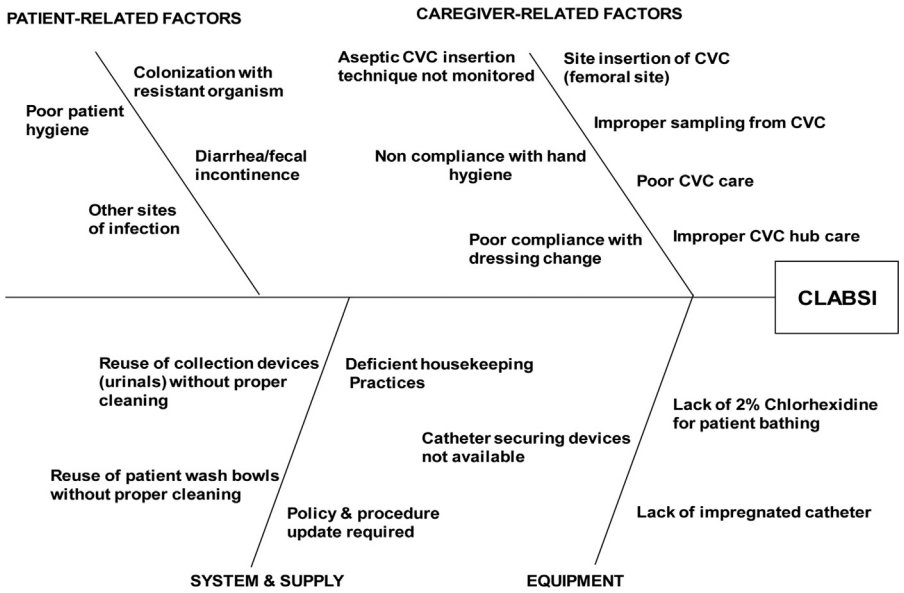

Fig 1. Flowchart depicting the root causes for the high central line-associated bloodstream infection (CLABSI) in the intensive care unit. CVC denotes "central venous catheter."

Network "NHSN" data are used for benchmarking by many international hospitals. Is NHSN data a realistic achievable target for these countries outside the United States because most reported results from these international hospitals are above the NHSN benchmarks? Do these countries need a local revised benchmarking tool to monitor their CLABSI rates? Is there a need for different strategies and additional techniques to bring down the CLABSI rates in developing countries if the prevalent strategies have failed to achieve the desired results?

In this study, we evaluated the effects of a quality improvement initiative based on prevalent guidelines to achieve "Zero CLABSI" in our medical-surgical intensive care unit (MSICU). The idea was that, if we could achieve "Zero CLABSI," then all the above questions would automatically be answered.

METHODS

The ethical and scientific approval for the study was obtained from the Institution Review Board of the hospital.

Setting

The quality improvement project was conceived and implemented in the MSICU of our hospital. The hospital is a 419-bed, Joint Commission International-accredited, tertiary care facility. The MSICU has 18 fully equipped beds, with 1:1 or 1:2 nurse-to-patient ratio and 24/7 in-house intensivist physician coverage. The nursing staff is extremely diverse, comprising 101 nurses from 13 different nationalities. The bloodstream infections in our hospital and ICU are predominantly from gram-negative organisms, with more than half of the isolates are from these organisms.

Surveillance

The hospital has a written policy in place for surveillance and identification of health care-associated infections including CLABSI. The CLABSI rate in the hospital has been monitored by the Hospital Infection Control Department (HICD) since 2001. The HICD does daily surveillance of CLABSI for all units in the hospital. An infection control professional responsible for MSICU generates the daily report of all the cultures obtained from the patients from the electronic medical record. He or she then isolates the positive cultures and does a daily patient round using a screening sheet as per the CDC criteria and identifies the suspected cases of CLABSI. These are then reviewed and confirmed by the HICD, which includes an infectious disease consultant. The results are then benchmarked utilizing the NHSN data (formerly, "National Nosocomial Infection Surveillance System").

Definitions

We defined a central line as a catheter inserted via an internal jugular, subclavian, femoral, or peripheral vein that terminated in proximity of the heart in the superior or inferior vena. The catheters included central venous catheters (CVC), peripherally inserted central catheters, and tunneled and nontunneled dialysis catheters, excluding arterial catheters for blood pressure monitoring. Number of patients in the MSICU at midnight was used to calculate total patient-days and catheter-days (CD). The presence of at least 1 central line in a patient was counted as 1 CD in accordance with the NHSN guidelines.[15] The HICD staff and CLABSI definition during the study period remained the same.

Cause analysis

A multidisciplinary CLABSI task force involving MSICU nurses, unit physicians, infectious disease physicians, and the HICD personnel was formed in February 2010 to analyze the problem of high CLABSI. The team did a root cause analysis of the problem, which is a recognized investigation and problem-solving approach. A flowchart was developed to identify the steps in the process and discover the potential weak links in the process (Fig 1). Three main areas of concern were identified as contributors to the high rate of CLABSI in MSICU and represented problems mainly related to poor and improper technique. The first issue was problem with clinical practice that included low compliance with proper hand hygiene, deficiency in appropriate patient hygiene, placement of central venous lines in femoral veins, deficiency in proper sampling from the central venous lines, dressings not being changed on time based on best practices recommendations, reusing plastic basins for