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Repeated multimodal supervision programs to reduce the central line-associated bloodstream infection rates in an Indian corporate hospital

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Abstract. ***Background*:** Central line-associated bloodstream infections (CLABSI) are associated with significant morbidity, mortality and costs. Multimodal intervention programs are effective in bringing down the rates of CLABSI, but they are difficult to sustain. In an attempt to improve sustainability, we implemented two multimodal intervention programs focusing on high-yield measures and assessed their effect on monthly CLABSI rates over a period of 42 months.

***Methods*:** The CLABSI rates were tracked on a monthly basis in a 300-bed Indian Corporate hospital and an analysis of the various contributing variables was done. The first intervention program in July 2009 put into practice the central line bundle. The second program went beyond the bundle and introduced high-yield measures like dedicated central line team and trolley, involved the senior management and promoted the 'Scrub the Hub' campaign while rectifying deficiencies observed in the first intervention program. The rates of CLABSI were statistically analysed in both the pre- and post-intervention periods.

***Results*:** The CLABSI rates varied between 0 to 9.8 infections per 1000 catheter days in the 42 months period, the mean being 2.9. The difference in mean CLABSI rates before and after the first intervention program was not significant (5.2 versus 4.4 infections per 1000 catheter days ($P > 0.05$)). However, the next intervention program saw a significant decrease in the mean rates of CLABSI in the subsequent 24 months (0.7 infections per 1000 catheter days ($P < 0.05$)). An overall 86.3% reduction in CLABSI rates in the entire study period was observed.

***Conclusions*:** Repeated multimodal intervention programs with a focus on high-yield measures resulted in a sustained reduction in CLABSI rates (86.3%).

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Background

Central line-associated bloodstream infections (CLABSIs) are the first or second most common hospital-acquired infections (HAI) in intensive care units (ICU) (30 to 40%)[1] and a predominant infection in chemotherapy units and dialysis. They are costly and potentially lethal with a mortality rate of 12 to 25%.[2] CLABSI rates in ICUs range from 0.0 to 5.4 throughout the world:[3] 1.5 to 2.9 in developed countries[4] and 7.7 to 17.6 in developing countries[5].

Centers for Disease Control and Prevention[6] (CDC) defines CLABSI as bacteraemia and/or fungaemia in a patient with an intravascular catheter with at least one positive blood culture obtained from a peripheral vein, clinical manifestations of infections (i.e. fever, chills, and/or hypotension), and no apparent source for the bloodstream infection except the catheter. CLABSI has been identified by CDC as one of its seven healthcare safety challenges with a goal to reduce such complications by 50% in 5 years.[7]

Many factors influence CLABSI,[8] including catheter-related factors such as the material of the lines, patient-related factors[9] and pathogenic mechanisms of the microbe.[10] An intervention by Pronovost *et al.*[11] demonstrated that the incidence of CLABSI could be significantly reduced by skin antisepsis with chlorhexidine (2%), maximal sterile precautions, hand hygiene, optimal catheter site selection and daily review of line necessity.[6,11]

Traditionally in the western world, Gram-positive isolates predominate in CLABSIs (80%) with coagulase-negative Staphylococci (CONS), *Staphylococcus aureus*, and *Enterococci* being the commonly isolated ones.[12] However, some studies indicate a Gram-negative preponderance.[13] The Gram-negatives include *Pseudomonas* spp., *Enterobacter* spp., *Serratia* spp., *Klebsiella* spp., *E. coli* and *Acinetobacter baumannii*. *Candida* spp., especially *Candida albicans* and *Candida glabrata* are the common fungal pathogens in patients receiving parenteral nutrition fluids.[12]

Implications

- Successive intervention programs bring about a reduction in CLABSI rates.
- High-yield measures (hand hygiene, daily review of line necessity and needleless connectors) may prove effective.
- Involvement of senior management is an effective strategy to facilitate a sense of responsibility and a safety culture within the organisation.

To study the impact of repeated multimodal intervention programs involving bundled interventions on CLABSI rates, we undertook this study for a period of 42 months (January 2009 to June 2012) in the form of a 6-month pre-intervention period (January 2009 to June 2009) followed by two interventions: Phase I (July 2009 to June 2010) and Phase II (July 2010 to June 2011) in a tertiary-care hospital in India. A 1-year post-intervention period (July 2011 to June 2012) was also included in the study. In our interventions we moved beyond the bundle and looked at other factors which could positively impact CLABSI.

Methods

Setting

A 300-bed tertiary-care private hospital in India.

Study design

The present study was carried out for a 3.5-year period (January 2009 to June 2012) in patients from the ICU and wards (admitted under cardiology, neurology, oncology and nephrology specialities) which involved retrospective analysis for the first 6 months followed by the prospective analysis of the CLABSI rates. We also introduced multimodal intervention programs in the form of CLABSI prevention bundle and observed its impact on reduction of CLABSI in the subsequent months.

The study was divided into the following phases.

Pre-intervention

The study began with a retrospective analysis of CLABSI rates for a period of 6 months (January 2009 to June 2009). Diagnosis of a CLABSI case was done by utilising the appropriate clinical and laboratory diagnostic criteria as recommended by CDC- NNIS (National Nosocomial Infections Surveillance System) and NHSN (National Healthcare Safety Network).

CLABSI rates were calculated as:

$$\text{CLABSI rate} = \frac{\text{Number of CLABSI}}{\text{Central line days}} \times 1000$$

Intervention

Phase I: *first intervention program* (*July 2009*). The first intervention program introduced the 'Central line bundle'– a set of evidence-based interventions for patients with central lines that, when implemented together have been shown to result in better outcomes than when implemented individually.[14] Implementing the bundle involved establishing a culture of safety among clinicians, ensuring access to resources, knowledge and competence among all healthcare workers associated with central line.

Bundle components:

- use of chlorhexidine skin antisepsis (2% chlorhexidine w/v in 70% alcohol)
- maximal barrier precautions (patient: sterile drape covering from head to toe with a small opening and operator: cap, mask, gown and gloves)
- hand hygiene (WHO 5 moments of hand hygiene were used as standards: particularly at the point-of-care and during high-risk procedures (before and after contact with central line)).
- optimal catheter site selection (subclavian site preferred)
- daily review of line necessity
- introduction of needleless connectors (neutral displacement, luer-activated, mechanical valve with internal blunt cannula offering a closed system)

Protocols were established before, during and after insertion of the central line (Table 1) based on the Society for Healthcare Epidemiology of America (SHEA) and Infectious Diseases Society of America (IDSA) guidelines[15] and incorporated into the CLABSI checklist (attached as Appendix).

Process surveillance was conducted to see the compliance achieved to the bundle components. The impact of the intervention on the CLABSI rates was prospectively analysed in the subsequent 1-year period (July 2009 to June 2010) and deficiencies noted.

Phase II: *second intervention program* (*June 2010*). The second intervention program in June 2010 saw us moving beyond the bundle and the following interventions were included:

(1) Rectification of the deficiencies observed in the first intervention program and reiteration of all the components of bundle

Table 1. Areas focused on for implementation of the prevention bundle

Procedure	Protocols
Before insertion	Patient education, protocol, competency of staff.
	Knowledge and adherence of infection control guidelines
	Filling of check lists – team leader/doctor
	Infrastructure
	Appropriate manpower
	Appropriate device
During insertion	Hand hygiene
	Maximal barrier precautions
	Cleaning of the site
	Maintenance of a sterile field throughout the procedure
After insertion	Appropriate dressings
	Change of IVs, connectors, dressings at recommended time interval.