

An Intervention Based Prevention of Catheter Associated Blood Stream Infection in Adult Critical Care Unit

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Abstract

Central line associated blood stream infection (CLABSI) is a device associated infection posing a serious threat among critically ill patients. It also increases the cost of hospital stay, morbidity and mortality. The aim of the study was to implement bundle care approach and identify CLABSI rates post intervention in comparison with the retrospective data. All the patients who were admitted in the ICU with central line (CL) in place were included in our study. The bundle care approach was implemented for all the patients when CL was introduced. We compared the CLABSI rates during the implementation period with the previous year CLABSI rates. The CLABSI rates were compared during the pre-intervention and during the intervention. The pre-intervention rate was 7.48 per 1000 catheter days, whereas the post intervention rates were 1.01 and zero per 1000 catheter days. The etiological agents isolated from CLABSI were *Enterobacter aerogenes* (30%) followed by *Klebsiella pneumonia* (20%) and *Pseudomonas aeruginosa* (20%). Similarly the antibiotic resistance was highest in ceftriaxone (55.5%) and lowest in piperacillin tazobactam (11.1%). A strict adherence to bundle care and proper education of the ICU team members including the doctors and nurses would effectively reduce infection rates. The CLABSI rates were 7.48 per 1000 catheter days in the previous year. However after implementation of bundle care the CLABSI rates reduced to zero.

Keywords: Central line, Bundle care, Infection control, CLABSI rate.

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INTRODUCTION

The infections which are acquired 48 hours post admission to the hospital and not in incubation at the time of admission to the hospital are termed as Health Care Associated Infections (HAIs). It is quite alarming that Device associated infections contribute a majority of HAIs. Out of which Central Line Associated Blood Stream Infection (CLABSI) pose a serious threat and increases the cost of hospital stay, morbidity and mortality among the hospitalized patients¹. A central line is an intravenous access device which is introduced into the great vessels of the heart for diverse purposes such as administration of medication, intravenous fluids, blood products and total parenteral nutrition among critically ill patients². However it is crucial that blood stream infections arise as a sequel of central line in place. The risk factors for CLABSI include host factor, interventional factor and catheter related factors. Often a breach in aseptic precautions during insertion and handling leads to infection³. Comparatively the infection rates are higher among the developing countries rather than the developed countries. As per the International Nosocomial Infection Control Consortium (INICC) there is a fivefold rise in infection rates compared

to United States⁴. In a study conducted in North India the mortality rate was 56%. A strict surveillance and bundle care approach can prevent such infection rates and mortality among critically ill patients. The aim of the study was to implement bundle care approach and identify CLABSI rates post intervention in comparison with the retrospective data.

MATERIALS AND METHODS

Study design

The study was conducted from January 2016 to December 2018 at our tertiary care hospital in Puducherry. The study population includes all adult patients admitted with various surgical and medical conditions at the intensive care units (ICUs). Central Line (CL) insertion done as a part of their Medical management by our Critical care specialists and to whom the Central line were at place in-situ for at least 48 hours were only included in this study. The bundle care approach was implemented for all the patients when CL was planned to introduce. We followed CDC guidelines for implementation of bundle care⁵. The prevention bundle was observed in two phases as insertion phase and maintenance phase (Table 1, 2). The insertion

Table 1. Insertion bundle

Day	Hand hygiene	Optimum site for insertion of Central line catheter	Proper skin preparation with chlorhexidine and maximal sterile barriers during Central	Staff Nurse Name & Signature
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Table 2. Maintenance bundle

Day	Hand hygiene performed before handling	Chlorhexidine 2% for dressing change at the insertion	Decontamination of hub before handling	Any signs of infection	Dressing changed on	Utility of CVC	Staff Nurse Name & Signature
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Table 3. CLABSI rates during the pre-intervention and intervention period

CLABSI data	Pre-intervention		Intervention	
	2016	2017	2017	2018
CLABSI episodes	9	1	0	0
Catheter days	1202	987	879	
CLABSI rate	7.48	1.01	0	

phase included proper hand hygiene, optimum site for insertion of catheter, proper skin preparation with chlorhexidine and maximal sterile barriers during insertion. The maintenance bundle included hand hygiene, sterile dressing change and aseptic accession of the CL with periodic review for the line in place⁶. We compared the CLABSI rates during the implementation period

with the previous year CLABSI rates.

CLABSI identification

CLABSI was identified when any laboratory confirmed pathogen isolated 48 hours after the CL insertion from one or more percutaneous blood culture, provided no other source of infection was identified⁷.

Data collection

The ICU nurses and doctors were trained to follow bundle care approach. The bundle adherence was verified by a checklist distributed among the ICU nurses. The study was done with co-operation of the hospital infection control team at our institute. The maintenance phase was critically observed by the infection control nurses and liaison nurses regularly.

In case of suspected infection, around 5 to 10 ml of blood was collected from patients in brain heart infusion broth (BHI) and sub-cultured

on blood agar, Mac-conkey agar and chocolate agar after 24 hrs, 48 hrs and one week of aerobic incubation⁸. The organisms were identified by standard bacteriological procedure. The antimicrobial sensitivity was identified by Kirby-Bauer disc diffusion method.

Statistical methods

The CLABSI rate during the intervention period was compared with the previous rate. The statistical analysis was done with SPSS for windows version 16. The CLABSI rates were calculated by the formula total number of CLABSI episodes per thousand central line days. p value was calculated by Repeated measures Anova test.

RESULTS

The CLABSI rates during the pre-intervention and intervention period is shown in the table 3, 4 and Fig. 1.

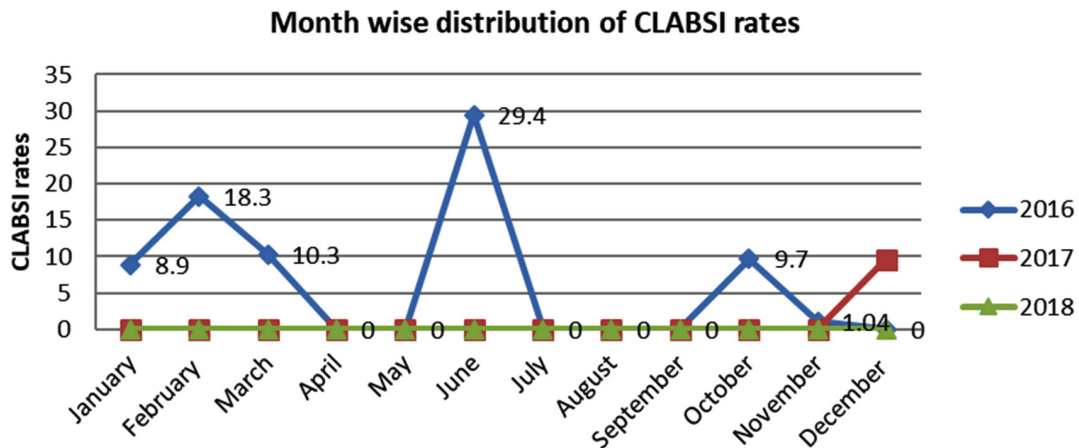


Fig. 1. Month-wise distribution of CLABSI rate

Table 4. Quarterly distribution of CLABSI rates

Months	Number of CLABSI cases			Total number of central line days			CLABSI rate		
	Pre-intervention 2016	Intervention		Pre-intervention 2016	Intervention		Pre-intervention 2016	Intervention	
		2017	2018		2017	2018		2017	2018
January to April	4	0	0	408	329	341	9.08	0	0
May to August	3	0	0	413	255	251	7.26	0	0
September to December	2	1	0	381	403	287	5.24	2.48	0

Table 5. Etiological agents for CLABSI

Organism	Frequency	Percentage
<i>Acinetobacter baumannii</i>	1	10%
<i>Klebsiella pneumoniae</i>	2	20%
<i>Pseudomonas aeruginosa</i>	2	20%
<i>Enterobacter aerogenes</i>	3	30%
<i>Escherichia coli</i>	1	10%
Staphylococcus, coagulase negative	1	10%
Total	10	100%

The CLABSI rates were compared with the preintervention period and p value was calculated by using Repeated measures Anova test. The p value was < 0.001 which was statistically significant.

The etiological agents isolated from CLABSI are shown in table 5. The common organism isolated were *Enterobacter aerogenes* (30%) followed by *Klebsiella pneumoniae* (20%) and *Pseudomonas aeruginosa* (20%). Similarly the antibiotic resistance is shown in table 6. The resistance was highest in ceftriaxone (55.5%) and lowest in piperacillin tazobactam (11.1%).

DISCUSSION

CLABSI is a blood stream infection with a CL in place for more than two calendar days. This term has been endorsed by the National Health care Safety Network (NHSN) for surveillance purpose. The patient should have signs of sepsis such as fever, chills and hypotension, with a positive culture from CL and peripheral line.

Device Associate Infection is a major threat increasing the morbidity and mortality among critically ill patients. A care bundle involves a set of sequential steps which focus both infection prevention and control. It aims at a prompt delivery of quality clinical care⁹. Quite often the breach in the continuity of the skin acts as a source of infection. In addition, frequent intervention by the health care team also acts as a source of infection.

Implementation of proper bundle care for CL has reduced the CLABSI rates as reported from various studies around the world.

Table 6. Susceptibility pattern of isolates

Antibiotic	Resistance percentage of isolates n=9
Ceftriaxone	5 (55.5%)
Piperacillin tazobactam	1 (11.1%)
Ciprofloxacin	3 (33.3%)
Cotrimoxazole	4(44.4%)
Amikacin	2(22.2%)
Gentamicin	3(33.3%)
Imipenem	4(44.4%)
Meropenem	2(22.2%)

In a study conducted in Columbia there was a significant reduction in CLABSI rate of 73% after intervention¹⁰. Similar other studies from New Zealand and Kuwait have proved reduction in CLABSI rates from 3.32 to 0.28 per 1000 catheter days and 14.9 to 11.08 per 1000 catheter days respectively^{11,12}. In India around 53% reduction in CLABSI rates had been proven with CLABSI rates from 6.4 to 3.9 per 1000 catheter days. These studies show a positive impact on bundle care approach to prevent CLABSI¹³. With available data, developing countries can also prevent infection rate with strict adherence to the bundle care in comparison to the developed countries.

However the aim of bundle care is to totally curb CLABSI rate to zero. The zero CLABSI rate though attained has to be sustained so that mortality is reduced.

In this study we aimed at reduction of CLABSI in comparison to the previous year. The CLABSI rates were 7.48 per 1000 catheter days in the previous year. However after implementation of bundle care the CLABSI rates reduced to zero. There are studies which show that zero rates could be attained and sustained with proper bundle care^{14,15}.

The common organism isolated were *Enterobacter aerogenes* (30%) followed by *Klebsiella pneumoniae* (20%) and *Pseudomonas aeruginosa* (20%). However in contrast, based on NHSN data the common organism isolated are Gram-positive organisms such as coagulase-negative staphylococci which accounts for 34.1%; followed by *Klebsiella*, *Enterobacter* and *Pseudomonas* which accounts for 5.8%, 3.9% and

3.1% respectively^{16,17}. In this present study the common isolates were Gram negative followed by gram positive organism.

CONCLUSION

CLABSI is a device associated blood stream infection which can be prevented by strict bundle care adherence. A proper education of the ICU team members including the doctors and nurses would effectively reduce infection rates. However to sustain reduced CLABSI rates ample support from the ICU team in cooperation with the infection control team is mandate.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR'S CONTRIBUTION

PCMV is the Primary investigator and KR is the Co. Investigator in this study. PCMV did the literature review and carried out this study. KR and VJ also intellectually contributed to this study and involved in all training programs. PCMV compiled and analyzed the data. MH and JME act as quality control officers. PCMV drafted the manuscript. All authors read and approved the manuscript for publication.

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None.

DATA AVAILABILITY

All datasets generated and analyzed during this study are included in the manuscript.

ETHICS STATEMENT

Institute Research Committee and Institute Human Ethical Committee approval was

obtained for conducting this study and to publish the findings.

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