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Impact of Training on Central Line Associated Blood Stream Infection Maintenance Bundle on Central Line Associated Blood Stream Infection Rates - A Retro-prospective Study in a Selected Hospital, Hyderabad

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ABSTRACT

Background: Central line-associated bloodstream infections (CLABSI) are a very common cause of healthcare-associated infections (HAI). CLABSIs will not only increase mortality and morbidity but also increases length of stay (LOS) and financial burden to ICU patients. Infection control practices play a major role in preventing CLABSI. Research indicates that quality improvement initiatives have helped in reducing CLABSI rates. CLABSI rates have been successfully reduced in ICU settings however, there is still significant variability in practice due to poor adherence to evidence-based CLABSI maintenance bundle components. However, nurses frequently struggle to follow evidence-based preventive practices, thus it is necessary to understand better the behavioral influences on implementing CLABSI prevention measures. Additionally, it has been emphasized that implementation studies must consider or quantify the potential impact on CLABSI rates. Before taking up the study, we have noticed increase in CLABSI rates for 1month Period, for which the Retrospective data was collected and analyzed to understand the gaps to implement CLABSI maintenance bundle components. Therefore, this study helped us identifying gaps in maintenance bundle and observed infections rates before and after study

Aim: To evaluate the effect of central line (CL) bundle compliance on central line-associated bloodstream infections (CLABSIs)

To evaluate the knowledge and practices of physicians and nurses working in all ICUs and wards regarding the components of central line maintenance bundles (ref table I)

Design: Used a retro prospective study, to reduce the CLABSI rates and to increase awareness on maintenance bundle components in intensive care units (ICU) and wards. we have initiated a structured training program to all nurses and doctors. Two tools were prepared. one is to assess the knowledge of nurses and doctors working in ICUs and wards on CLABSI. The second tool consists of components related to central line maintenance bundle to evaluate the effectiveness in reducing incidence of CLABSI. A total 489 Registered nurses and 10 intensivists and 15 ward doctors were included in the current study. Phase I was the pre-interventional period during this period audits were conducted, we observed lacunae in implementing CLABSI Maintenance bundle. Phase II was the intervention period lasting for 2

month, during this period, the entire nursing staff and doctors working in ICUs and Wards underwent a continuous teaching and training. Phase III was the post-intervention period- In this period questionnaire was given in September and again in December. This was to check for the impact of training on knowledge and awareness level which will further lead better implementation of the practices. Observed CLABSI rate reduced from17.2. to 6.8 per 1000 central line days.

Result: Knowledge assessment- Comparison data between June 2021 and September 2021 mean knowledge score significantly higher in September (9.1) than June (6.4) .similarly, December (9.9) score significantly higher than June and September to determine the difference between the mean of various observations in the pre and post intervention period with 95% confidence interval, the difference in the knowledge level and CLABSI rate in the pre and post intervention period was found significant($p<0.001$) .During this 6 months period(July 2021 to December 2021) there were a total of 1120 patients on central lines, for all the patients line care was observed after implementation of structured training programme. The rate of CLABSI significantly declined from 17.2 per 1000 catheter days to 6.8 per 1000 catheter days.

Conclusion: This study clearly indicated that the educational interventions in structured formats are imperative when imparting trainings in Infection control practices and should be implemented frequently to bridge the gap between knowledge and practice. With the dynamics of infection control and the challenges faced in its implementation continuing this type of trainings will ensure all use evidence-based interventions.

Recommendations: Continues Training program should be carried out for nurses and doctors related to implementation of CLABSI Bundle.

Key words: CLABSI, Catheter hub care, Hand hygiene, Training, Maintenance bundle, Teaching, Implementing, Structured program

INTRODUCTION

Central venous catheters (CVCs) are the most important devices used in ICU patients and they enable the administration of medications, fluids and blood products directly to the central venous system as well as hemodynamic monitoring [1]. Although they are extremely necessary tools, CVCs can expose critically ill patients to the risk of central line-associated bloodstream infections. In conjunction with the increasing use of central venous catheters (CVC) among critically ill patients, the occurrence of central line-associated bloodstream infections (CLABSI) is increasing. Recent studies have shown that this serious complication could result in increasing mortality, morbidity and hospital stay [2],CLABSI is one of the common and preventable Health care associated infections (HAIs) [3] . Despite the fact that CLABSIs are largely preventable [4] .CLABSI occur due to breaches in sterile technique while insertion of the catheter or during maintenance of the catheter [5]. Physicians and nurses are responsible for the insertion and maintenance of central lines. Reducing CLABSI incidence will not only improve patient outcome but also reduce ALOS in ICU. Efforts to reduce and eliminate such infections over the past years have been successful by applying evidence-based guidelines.

Several studies have shown reduction of CLABSI rates after the utilization of central line insertion and maintenance bundle [6] . that simple interventions such as hand hygiene, maximal sterile barriers during catheter insertion, Chlorhexidine skin disinfection, optimal catheter site selection, scrub the hub practices and daily review of line necessity with prompt removal of unnecessary lines can decrease the risk of CLABSIs. These studies showed that the staff was aware of the bundles, but they lacked adherence and application to these practices [7].

Several educational interventions such as training program have been organized with the aim to reduce CLABSI rates. The present systematic review examines the impact of educational interventions on

CLABSI rates in ICUs and wards [8]. The association between effectiveness and several characteristics of educational programs on maintenance bundle was discussed. We relied that educational interventions will have a positive effect on the prevention of CLABSI rates.

METHODS

This is a retro prospective study done in our institute which is a 450 bedded hospital out of which 115 are ICU beds. Baseline data was collected retrospectively for one month and was found that CLABSI rate was high and then central line improvement team was formed consisting of Infection control officer (ICO), microbiologist and infection control nurses. Any issues related to central lines (CL) were escalated to this team like presence of femoral line, unused lines, not following aseptic precautions while handling lines. Study continued for 6 months prospectively from July to December 2021.

Questionnaire was prepared based on CDC guidelines for CLABSI prevention and was distributed to doctors and nurses in ICU and wards from 1 July2021 to 5th July 2021. On analysis it was found that HCWs had knowledge on CLABSI bundle and prevention but during audit major findings were noncompliance to Hand hygiene and scrub the hub. The study was conducted in three phases.

Phase I was the pre-interventional period done in the month of June. In this period CLABSI rate was high which was captured by continuous audits on maintenance bundle components and active surveillance of CLABSI cases among ICUs and wards. CDC NHSN guidelines were followed for calculating CLABSI rates. Overall bundle compliance was 79% for the month of June

Table 1 explains the CLABSI maintenance bundle each component compliance percentage during pre intervention period (June).

Table -1

S.no	Components	Pre Intervention %
1	6 steps of hand hygiene	65
2	Dressing is changed as per protocol (7 days and when its dirty)	88
3	2% Chlorhexidine used during dressing change changed in aseptic manner	85
4	Condition of dressing (Good, Not dump,loosened,soiled)	80
5	Scrub the hub before each access	65
6	Flush the line before and after (Tubing's clear of blood and drugs)	88
7	Daily review of line necessity, with prompt removal of unnecessary lines	80

Phase II was the intervention period lasting from July 21 to August 21.

Questions were prepared based on CDC /NHSN guidelines Jan 2021. Objective questions were prepared and test was conducted to 489 Registered nurses and 10 intensivists and 15 ward doctors Training programme was created by ICT. Education material was taken from WHO 2009 guidelines for hand hygiene and CDC NHSN and guidelines on CLBSI bundles Jan 2021 and IHI guidelines on central line 2021.

During this period, the entire nursing staff and doctors working in ICUs and Wards underwent a continuous teaching and training course. Department wise bed side training was conducted by ICT on maintenance bundle and class room sessions were conducted.

The training included educational teaching in the form of lectures and training as practical demonstration on hand hygiene. Alcohol disinfection of the scrub "before and after" each access was emphasized. In house Online HAI tracking sheet was introduced. Ward line team was formed and justification for femoral line usage (more than 5 days in place) to be documented by primary team, one on one discussions with primary consultant for early removal of central lines, daily visit by ICNs those who

were on central lines and Continuous surveillance of CLABSI cases was monitored by the ICNs as per the standard protocol of CDC/NHSN for all the patients admitted to the ICUs and wards.

Phase III was the post-intervention period conducted from September 2021 to December 2021. After completion of training, we selected two link nurses from each department to monitor the compliance of hand hygiene practices and central-line hub care by the healthcare workers.
Repeat questionnaire was given to the trained staff to see for improvement in awareness of CLABSLI bundles. (Once in September and once in December 2021).
Simultaneously, data was collected on CLABSI rates, Patient days, central-line days, and, compliance with maintenance bundles.
The CLABSI rate and device utilization ratios per 1,000 patient days were calculated using the following formulas:

CLABSI Rate
Total number of CLABSI/Total number of central-line catheter day's × 1000

Device Utilization Ratio (DUR)
Number of central-line catheter days/Total number of patient days

RESULTS

A total 489 Registered nurses and 10 intensivists and 15 ward doctors were included in the current study. Knowledge assessment was done by using structured questionnaire.

Table -2 shows the Rates before structured training program (June-2021) and Rates after implementation of structured training program and maintenance bundle awareness (July 2021-December 2021) this study was conducted for 6 months. During this period we collected data on how many patients on central lines and central line days from ICUs and wards. Audits done on CLABSI maintenance bundle in the wards and ICUs and compared the CLABSI rates.

Table -2

	Rates before structured training program (June-2021)	**Rates after implementation of structured training program and Maintenance bundle awareness (July 2021-December 2021)**					
Infection control parameters	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21
Central line patients	350	283	186	192	162	150	147
Central line days	1890	1173	811	756	776	628	709
CLABSI Trend in DD	17.2	14.1	16.1	10.4	6.1	0	6.8
CLBSI Bundle Maintenance compliance	79%	85%	88%	91%	95%	97%	99%

In phase I CLBSI rate was 17.2 and bundle compliance was 79%, in phase II that is during training period bundle compliance was around 85% and CLBSI rate reduced to 16.1% and in phase III bundle compliance rate increased to 99% and rate reduced to 6.8.

Table 3 shows the Socio demographic data

Questionnaire was distributed to 514 health care workers in ICU and wards out of which 94.2 % were female, 5.8% were males. Experience wise less than 1 year 31.1%,1-2 years 26.3%,2-3 years 17.1%,3-5years 15.2%,>5 years 10.3%.

Majority of the participants were B.SC nursing (75.9%), GNM nursing were (19.1%) and MBBS (5.1%). Majority of participants were working as a staff nurse (95%) and remaining 5% were doctors. Number of participants from ward were 54.3% and ICU were 45.7

Table-3		
Assessing the knowledge of health care workers by demographic General characteristic of study population		
Variables	Categories	%
Education	GNM	19.1
	BSC	75.9
	MBBS	5.1
Area	Ward	54.3
	ICU	45.7
Gender	Male	5.8
	Female	94.2
Experience	<1	31.1
	1y-2y	26.3
	2y-3y	17.1
	3y-5y	15.2
	>5	10.3

Table –4 shows Variations in superscripts indicate significance of mean differences across experience groups ,<1 year 159 staff,1-3 years 224 staff,>3 years 131 staff total assessment done for 514 , it's a significant difference in experience wise knowledge >3 years experience staff have good knowledge than <1 year and 1-3years staff.

Table-4 Mean ± SD values of knowledge assessment by experience at baseline				
Experience	N	Knowledge	F'	P Value
<1	159	a5.0 ± 0.16		
1y-3y	224	b7.0 ± 0.13	1804.3	0
>3	131	c7.2 ±0.66		
Total	514	6.4 ± 1.01		

Table –5 Shows that in Pre intervention period ICU Staff had 70% knowledge and ward staff had 59% knowledge, in post intervention period observed that ICU staff had 100% knowledge and ward staff had 98% knowledge. ICU staff had good knowledge when compared to ward staff.

Table -5 Mean ± SD values of knowledge assessment Different times and areas					
Time	Area	N	Knowledge	t'value	p value
Jun-21	Ward	279	5.9± 1.13	14.77	0.001
	ICU	235	7.0± 0.25	15.97	0.001
Sep-21	Ward	279	8.99± 0.5	4.2	0.001
	ICU	235	9.18± 0.38	4.3	0.001
Dec-21	Ward	279	9.88± 0.3	5.7	0.001
	ICU	235	10± 0.0	6.2	0.001

Table-6 Demonstrates the knowledge level done three times during study period. In September 2021 mean knowledge score was significantly higher (9.1) than in June (6.4) similarly December score (9.9) significantly higher than June and September.

Table-6 Mean ± SD values of knowledge assessment by time						
S.no	N	Jun-21	Sep-21	Dec-21	Paired 't' value	p value
1	514	6.4± 1.01	9.1± 0.51		74.6	0.001
2	514	6.4± 1.01		9.9± 0.25	84.3	0.001
3	514		9.1± 0.51	9.9± 0.25	45.2	0.001

Statistical Analysis

Figure 1 shows the paired t-test was applied to determine the difference between the mean of various observations in the pre and post intervention period with 95% confidence interval, the difference in the knowledge level and CLABSI rate in the pre and post intervention period was found significant($p<0.001$)

Figure-1

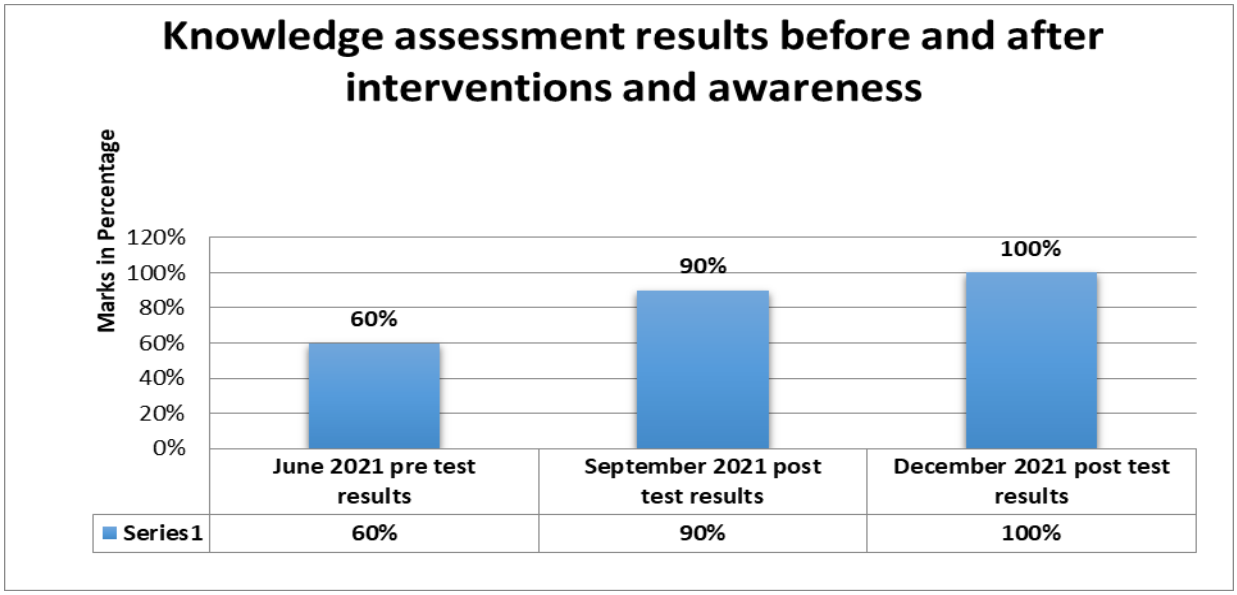
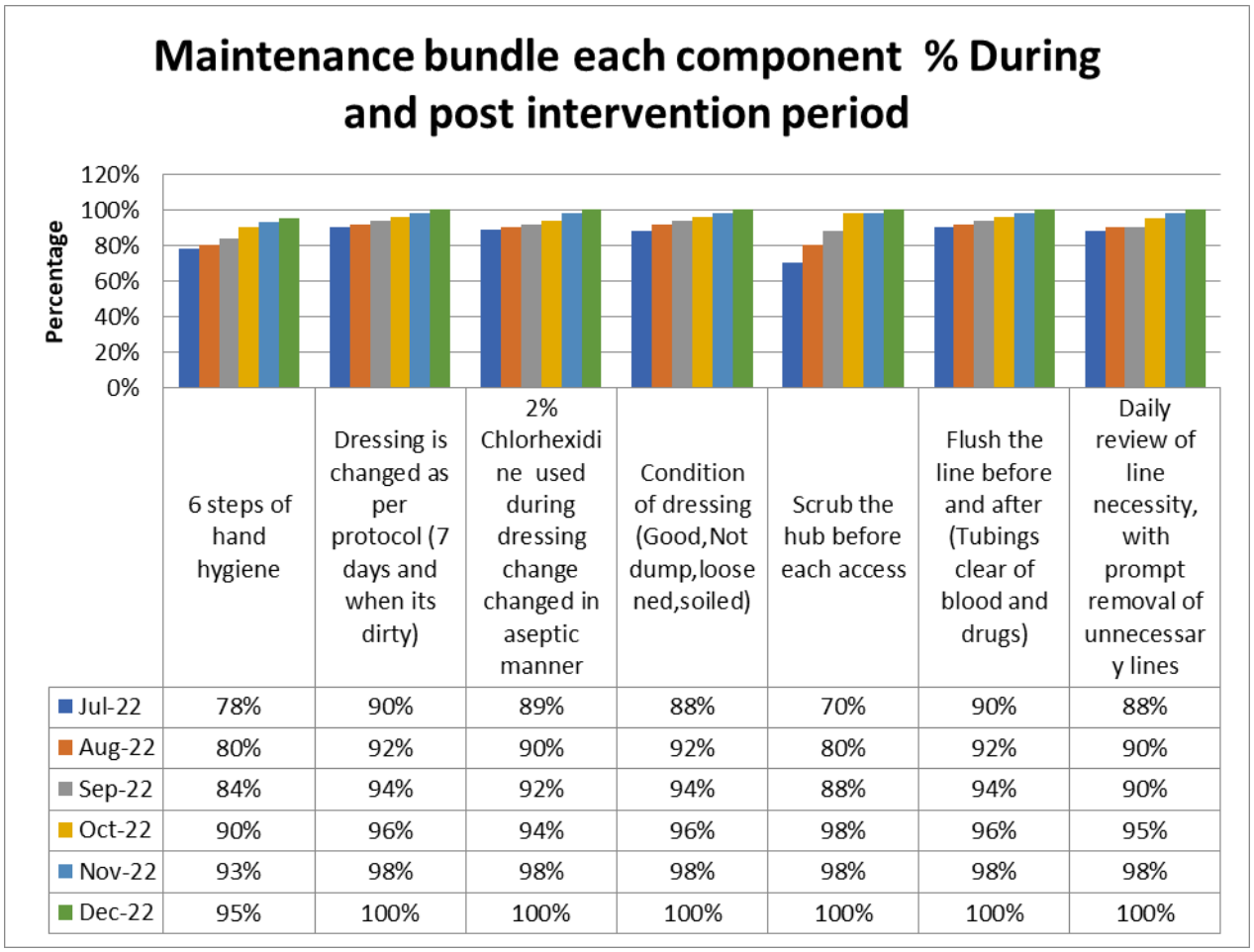


Figure-2: During and Post interventions Audit Compliance



	6 steps of hand hygiene	Dressing is changed as per protocol (7 days and when its dirty)	2% Chlorhexidine used during dressing change changed in aseptic manner	Condition of dressing (Good,Not dump,loosened,soiled)	Scrub the hub before each access	Flush the line before and after (Tubings clear of blood and drugs)	Daily review of line necessity, with prompt removal of unnecessary lines
Jul-22	78%	90%	89%	88%	70%	90%	88%
Aug-22	80%	92%	90%	92%	80%	92%	90%
Sep-22	84%	94%	92%	94%	88%	94%	90%
Oct-22	90%	96%	94%	96%	98%	96%	95%
Nov-22	93%	98%	98%	98%	98%	98%	98%
Dec-22	95%	100%	100%	100%	100%	100%	100%

Figure 2 shows the significant improvement in bundle compliance as Comparing the pre- and post-intervention period as shown in Table -1. Pre intervention period overall bundle compliance was 79%. Figure 2 shows that audit compliance increased data

from July to December 2021. It was found that the knowledge and practice of hand hygiene and scrub the hub practices had been drastically increased and primary team was involved in early removal of lines and checking for line necessity .There was significant decrease in the CLABSI rate.

DISCUSSION

The initiative remains very effective in identifying the gaps in the knowledge as well as easy to implement in routine practice. In the current study, we realized that important of central-line maintenance bundle components such as the hand hygiene practice and catheter hub cleaning while accessing line and keeping the line for prolonged period for easy access were practiced more compared to other components.

Hence, we emphasized to strengthen these components and evaluated the role of continuous teaching and training tool on reduction of the CLABSI. This shows that there was a definite gap in the knowledge and practice toward the hand hygiene and catheter hub care, and prompt removal of line which led to increased CLABSI. In this study, data related to DAI (Device associated infections) collected and the patients followed up after being shifted from ICU to other patient care area(Wards). Our study showed that small initiative helps to find out the exact gaps in the knowledge and implementation.

CONCLUSION

Our study highlighted the key strategies, which were identified as neglected and targeted for intervention. Continuous teaching and training about why, when, where and how breaches may happen and identifying the opportunities for correcting them improves the practices among the nursing staff and doctors. Assessing the awareness on infection control practices gives a positive reinforcement for better acceptance of the bundle practices.

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