Original Article

Effectiveness Of Multifaceted Care Bundle Approach To Reduce Device Associated Infection (Dai) In Critical Care Unit (Ccu) In A Multi Specialty Hospital, Mangaluru

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Abstract

Device-associated infections (DAI) can cause major medical and economic sequelae. Multifaceted care bundle is considered as an important part of routine nursing activity, not only as a measures DAI prevention, but as a crucial treatment with a profound effect on the patients general health.

Objectives

1. To measure the Device associated infection status of CLABSI, CAUTI, and VAP in pre implementation phase according to HAI surveillance guidelines.
2. To determine the compliance status of health care workers of care bundles on prevention and care of device associated infections in CCU in Phase III.
3. To evaluate the effectiveness of multifaceted care bundle approach on device associated infections status of CLABSI, CAUTI, & VAP in CCU
4. To find the risk of DAI in patients in the Post implementation phase (Phase III)

Methods: An experimental approach was adopted to study the effectiveness of multifaceted care bundle approach to reduce device associated infection (DAI) in critical care unit (CCU) in a multispecialty hospital, Mangaluru. Universal sampling technique was adopted to select the 472 sample retrospectively (MRD and HIC records of DAI patients of critically care units) and 409 samples as prospectively (current critically ill patients) then implementation of bundle was done and post implementation evaluation done.

Results: While comparing pre and post implementation phases, it is found that there was reduction in CAUTI rate /1000 catheter days and CLASBI rate/1000 central line days from Phase I to phase III and increase in VAP rate /1000 ventilator days from Phase I to phase III. Increase in device utilization ratio of CAUTI and CLASBI from Phase I to III and reduction in VAP device utilization ratio from Phase I to III, also observed that during pre-implementation phase, the VAP rate, CLABSI rate and CAUTI rate for all the ICU's taken together were 134.37/1000 ventilator days, 412/1000 central line days, and 332.92/1000 urinary catheter days, respectively. However, during the post implementation the rates reduced into 133.92, 287.98, and 242 per 1000 device days respectively. There was a month wise decreasing trend of VAP rate, CLABSI rate, and CAUTI rate during the study period.
In males CAUTI, CLABSI AND VAP rates were reported highest in the both Phases (I and III) and CAUTI, CLABSI and VAP difference in both Phases was not statistically significant according to age and gender (p=0.500) .Highest number of CAUTI was reported in Phase I compared to Phase III .Total number of device days were more (352) for CAUTI whereas 340 ventilator days for VAP, 292 central line days in the Phase I. While comparing both Phases significant difference was found in CAUTI (0.0017) CLASBI (0.002) and VAP (0.0016).

Conclusion: From the findings of the study it can concluded that multifaceted care bundle significantly reduced DAIs in critically ill patients

Keywords: Device associated infection, Hospital acquired infections, catheter associated urinary tract infections, central line associated blood stream infections, and ventilator associated pneumonia

INTRODUCTION

An intensive care unit (ICU) is a specialized section of a hospital that provides comprehensive and continuous care for persons who are critically ill and who can benefit from treatment. Intensive care unit patients, immunocompromised as a result of their critical illness are at a higher risk of developing infections and are particularly vulnerable to hospital acquired infection.[1] Device-associated infections (DAI) can cause major medical and economic sequelae. Bacterial colonization of the indwelling device can be a prelude to both infection and malfunction of the device. The pathogenesis of device-associated infection centres around the multifaceted interaction among the bacteria, the device and the host. Bacterial factors are probably the most important in pathogenesis of infection, whereas device factors are the most amenable to

modification with objective of preventing infection.[2] Care bundles are a set of three to five evidence-informed practices performed collectively and reliably to improve the quality of care. Care bundles are used widely across healthcare settings with aim of preventing and managing different health conditions.[3-5]"Care bundles" in infection prevention and safety are simple sets of evidence-based practices that, when implemented collectively, improve the reliability of their delivery and improve patient outcomes. A numbers of specific bundles are available that can be implemented at healthcare facilities in resource-limited settings. These packages of care contribute to infection prevention, reduce unnecessary antibiotic prescribing and may limit the development of antibiotic resistance in healthcare facilities.[6]

A multi-disciplinary approach coupled with an institution-wide multi-modal strategy includes: will-building, awareness, training, education, measurement and feedback are required to optimally promote and sustain the implementation of care bundles in hospital settings. The development of "how-to guidelines," and the provision of standardized data collection tools that calculate bundle compliance are advised to ensure healthcare team members are clear on the elements of each bundle, the actions required and, how compliance is measured and tracked for feedback should elements of a bundle require particular supplies or products, these should be appropriately procured prior bundle roll-out and implementation. The elements of a bundle are measured in an "all or nothing" manner to simplify assessment of compliance for feedback to providers and to emphasize the completion of every component. These measurements are different from an average compliance score. A bundle compliance percentage goal should be set for the healthcare team to work toward achieving (95% bundle compliance is recommended best practice).Care bundles include a set of evidence-based measures that, when implemented together, have shown to improve patient care and have a greater impact than that of the isolated implementation of individual measures. Specific care bundles include bundles for the prevention of central line-associated bloodstream infections (CLABSI), bundle for the prevention of catheter-associated urinary tract infections (CAUTI), bundle for the prevention of ventilator-associated pneumonia (VAP), and bundle for the prevention of surgical site infection.[6]

MATERIALS AND METHODS

Data collection is the gathering of information needed to address a research problem.

- Prior the data collection, permission is obtained from the concerned hospital to conduct the study.
- Subjects were selected according to the selection criteria and confidentiality was assured.
- Subjects were selected through universal sampling.
- In pre-implementation Phase (I), data was collected by using HAI Surveillance checklist and patient and clinical proforma from the case records of patients from medical record department in 4 months.
- In implementation phase (II), multifaceted care bundle implementation training of health workers (nurses and respiratory) for one month was done about CAUTI preventive care bundle, CLASBI preventive care bundle and VAP prevention bundle to critically ill patients who are on devices. CAUTI and CLABSI preventive care bundle training in the morning and evening is given to nurses, but VAP prevention bundle training is given onlyin morning to health workers (nurses, respiratory therapists) for the durations of 1 month.
- In post implementation phase (III), evaluation of device associated infection status (CAUTI, CLABSI and VAP) is done by HAI surveillance checklist and CPIS scoring for ventilator patients and compliance of multifaceted care bundles by health workers during 3 months.

RESULTS

Section I: Description of the Sample Characteristics

This section describes the characteristics of the sample which includes the background information of the subjects who had device related infection. The data was collected retrospectively from HIC and MRD department through case sheets.

The data is presented in the form of frequency and percentage in the Table 2(a& b)

Table 2(a): Distribution of Sample According to Patient Clinical Characteristics

N=472+409=881

		With infections (n=16)	Without infections (n=456)	With infection (n=13)	Without infections (n=396)
		f (%)	f (%)	f (%)	f (%)
1.	Age(in years)				
a	31-40	2(12.5)	176(38.59)	3(23.07)	182(45.95)
b	41-50	6(37.5)	146(32.01)	4(30.76)	149(37.62)
c	51-60	8(50)	134(29.38)	6(46.15)	65(16.41)
2.	Gender				
a	Male	10(62.5)	211(46.27)	8(61.53)	185(46.71)
b	Female	6(37.5)	245(53.72)	5(38.48)	211(53.28)
3.	Diagnosis				

		With infections (n=16)	Without infections (n=456)	With infection (n=13)	Without infections (n=396)
		f (%)	f (%)	f (%)	f (%)
a	Acute Respiratory Failure	6(37.5)	127(27.85)	5(38.48)	64(16.16)
b	Cardiovascular Disease	—	44(9.64)	—	44(11.11)
c	GI Disease	—	21(4.60)	—	21(05.30)
d	Renal Disease	6(37.5)	77(16.88)	5(38.48)	79(19.94)
e	Sepsis	—	23(5.04)	—	21(05.30)
f	Trauma	—	122(26.75)	—	122(30.80)
g	Neurological Disease	4(25)	13(2.85)	3(23.07)	14(03.53)
h	Other	—	29(6.35)	—	29(07.32)
4.	Device in Patient				
a	Foley Catheter	—	12(2.63)	—	20(05.05)
b	Central Line	—	114(25)	—	125(31.56)
c	Ventilator	—	—	—	—
d	Foley catheter +central	6(37.5)	22(4.82)	5(-38.48)	5(1.26)
e	Foley catheter+ventilator	2(912.5)	156(34.21)	1(7.69)	74(18.68)
f	Foley catheter+central +ventilator	8(50)	152(33.33)	7(53.84)	172(43.43)
5.	If the patient is on ventilator,Indications for mechanical ventilation (Applicable)				
a	upper airway obstruction	—	48(10.52)	—	51(12.87)
b	Oxygen failure	7(43.75)	32(7.01)	5(38.48)	32(08.08)
c	Airway protection	1(6.25)	39(8.55)	3(23.07)	39(09.84)
d	secretion obstruction	—	20(4.38)	—	20(05.05)
e	Ventilator failure	2(12.5)	21(4.60)	2(15.38)	21(05.30)
f	Others	6(37.5)	296(64.91)	3(23.07)	233(58.83)

*N=472+409=881(out of 472 device patients 16 had infection and out of 409 device patients 13 patients had infection)

Table 2(b): Frequency and Percentage Distribution of Sample According to Clinical Variables

		Phase I		Phase III	
Sl. No.	Variables	With infections (n=16) f (%)	Without infections (n=456) f (%)	With infection (n=13) f (%)	Without infections (n=396) f (%)
1	If the patient is on central line, Indication for central line (Applicable)				
a	Difficult peripheral intravenous access	6(37.5)	52(11.40)	7(53.84)	52(13.38)
b	Fluid resuscitation	4(25)	16(3.50)	3(23.07)	16(04.04)
c	Transfusion of the blood product	—	8(1.75)	—	8(02.02)
d	High concentration drugs	2(12.5)	20(4.38)	2(15.38)	20(05.05)
e	TPN	2(12.5)	12(2.63)	—	13(03.28)
f	0thers	2(12.5)	348(76.31)	—	287(72.47)
2.	If the patient is on Foley catheter, Indication for Foley Catheter (Applicable)				
a	Retention	6(37.5)	128(28.07)	5(38.48)	88(22.22)
b	Output monitoring	5(31.25)	109(23.90)	4(30.76)	95(23.98)
c	Pre-operative criteria	2(12.5)	53(11.62)	2(15.38)	54(13.63)
d	Urethral injury	—	48(10.52)	—	42(10.60)
e	Intra operative	2(12.5)	—	—	5(1.26)
f	Neurogenic bladder	1(6.25)	4(0.87)	2(15.38)	22(5.55)
g	Other	—	114(25)	—	90(22.72)
3.	Device days in patients				
a	Foley catheter +central line	6(37.5)	39(8.55)	5(30.76)	49(12.37)
b	Foley catheter +ventilator	2(12.5)	292(64.03)	2(15.38)	234(59.09)
c	Foley catheter+centralline+ventilator	8(50)	125(27.85)	8(61.53)	113(28.53)
4.	APACHE II score				
a	41-50(mild)	7(43.75)	172(37.71)	4(30.76)	136(34.34)
b	51-60(moderate)	4(25)	160(35.08)	5(38.46)	149(37.62)
c	61-71(severe)	6(37.5)	124(27.19)	4(30.76)	111(28.03)

NOTE: APACHE II=Acute physiology and chronic health evaluation .An integer score from 0 to 71 is computed based on several measurements; higher scores correspond to more severe disease and a higher risk of death. The point score is calculated from 12 admission physiologic variables comprising the Acute Physiology Score, the patient's age, and chronic health status.The score ranges from 0 to 71, the higher the score, the higher the severity of the patient's condition. A direct connection between increases in score and increases in mortality risk has been found in both surgical and non-surgical patients.

Age (in years): The highest number of respondents belonged to the age group of 51-60 yrs in the Phase I (50%) and Phase III (46.15%).
Gender: Majority of the sample belonged to males in both phases I (62.5%) and III (61.53%).

Diagnosis of Diseases: Maximum number of respondents were diagnosed with acute respiratory failure as well as renal failure in phases I (37.5%) and III (38.48%).

Device in the Patients: The highest number of respondents had Foley catheter, central line, ventilator in both the phases I (50%) and III (53.84%).

Indication for Ventilator: The highest number of respondents had oxygen failure (43.75%) in both the phases I (43.75%) and III (38.48%) as the indication for mechanical ventilation.

Indication for Central line: Maximum number of respondents had difficult peripheral intravenous access as the indication for central line in both the phases I (37.5%) and III (53.84%).

Indication for Foley catheter: The highest number of respondents had retention as the indication for Foleys catheter in Phase I (37.5%) and Phase III (38.48%).

Device in Patients: The highest number of respondents had Foley catheters, central lines, and on ventilator for more than 5 days in both the Phases I (50%) and III (61.53%).

APACHE II: More number of respondents had the risk of severity ranging between 41-50 in phase I (43.75%) and 51-60 in phase III (38.46%).

Section II: Device Associated Infection Status of CLABSI, CAUTI, and VAP in Phase I According to HAI Surveillance Guidelines

(a)Description of Measurement of DAI Status in the Phase I
This section describes DAI status which consists of number of device days, DUR, DAI episodes, incidence rate DA-HAI, organisms, length of stay in CCU, number of patient days ,number of cases, and CAUTI, CLASBI, VAP rate/1000 days.

Table 3: Measurement of DAI status of Study Data in Phase I

N=472

DAI Status	Foley catheters (FC)	Central lines (CVC)	Mechanical Ventilator (MV)
No of Device Days/Duration of Device	352	292	340
Device utilization ratio	0.83	0.87	0.93
DAI Episodes	7	6	3
Device associated incidence density	45.45	67.41	44.77
Infective organisms	4	3	3
Length of stay in CCU/ No of patient days	368	321	387
No of cases	7 (CAUTI)	6 (CLASBI)	3 (VAP)
CAUTI, CLASBI, VAP rate per 1000 device days	45.45	67.41	44.77

Note: Patient-days= total number of days that patients are in the CCU during the selected time period, Device-days = total number of days of exposure to the device (central line, ventilator, or urinary catheter)for all of the patients in the ICUs during study time period, device utilization ratio (DUR)for each device =number of device-days divided by the total number of patient-days, DAI episode= number HAI infection according to the type assessed in patient in CCU, Device-associated incidence density (incidence rate of DA-HAI) = number of DAI episodes × 1000 / number of device-days, The incidence density rates of CLABSI (number of cases per 1000 central line days), VAP (number of cases per 1000 mechanical ventilator-days) and CAUTI (number of cases per 1000 urinary catheter.)

*****N=472 (Total number of device patients in phase I)

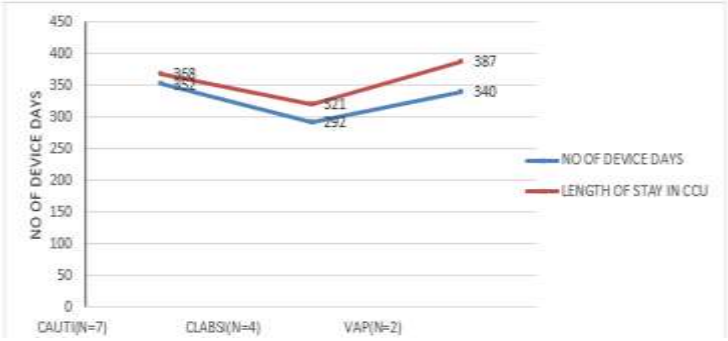

Figure 4: Line Graph Representing Patients Length of Stay in CCU and Number of Device Days

Data in Table 3 and figure 4 show that the highest device days were found more in foley's catheters (FC) (352) compared to mechanical ventilators (MV) (340) and central line (CVC)(292). The highest duration in length of stay was seen in patients with mechanical ventilators (387) compared to urinary catheters (368) and central lines (321).

(b) Description of Device Utilization Ratio of Patient with Infections

This section describes the total number of infections, patients days, device days, CAUTI/CLASBI/VAP rate/1000 days and device utilization ratio Phase I and III. Data collected retrospectively (472 samples) and prospectively (409 samples) of critically ill patients who were on devices.

Table 4: CAUTI, CLABSI and VAP Rate and Device Utilization Ratio of Patients With Infection in the Phase I and III

N =472+409=881

Phase	Number of cases (CAUTI)	Patients days	Catheter days	CAUTI rate /1000 Catheter days	Device utilization ratio
I	7	185	154	45.45	0.832
III	6	132	147	40.81	1.11
Phase	**Number of cases (CLABSI)**	**Patients days**	**Central line days**	**CLABSI rate/1000 central line days**	**Device utilization ratio**
I	6	102	89	67.41	0.86
III	5	94	88	56.81	0.94
Phase	**Number of cases (VAP)**	**Patients days**	**Ventilator days**	**VAP rate/1000 ventilator days**	**Device utilization ratio**
I	3	72	67	44.77	0.93
III	2	52	30	66.66	0.57

Note: VAP rate =VAP cases /total number of ventilator days x1000, CLASBI rate =CLASBI cases/total number of central line days, CAUTI rate =CAUTI cases /total number of urinary catheter daysx1000

*****N=881(total device patients in phase I and Phase III)

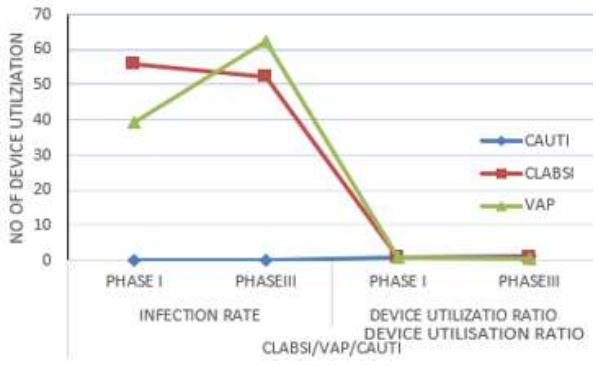

Figure 5: Line Graph Showing Device Utilization Ratio of Patient With CAUTI, CLABSI and VAP

Data in Table 4 and Figure 5 provides a summary of the CAUTI, CLASBI and VAP rates and device utilization ratio before and after the implementation of the multifaceted bundles. While comparing both phases, reduction in CAUTI rate/1000 catheter days and CLASBI rate/1000 central line days from Phase I to Phase III and increase in VAP rate /1000 ventilator days from Phase I to Phase III was found .While comparing both the phases, increase in device utilization ratio of CAUTI and CLASBI from Phase I to III and reduction in VAP device utilization ratio from Phase I to III was found.

(c)Description of the characteristics of CAUTI, CLASBI and VAP

This describes the type of organisms, insertion and line type, culture, Phase I and Phase III which indicates characteristic of CAUTI, CLASBI and VAP.

Table 5: Characteristics of CAUTI, CLASBI &VAP Patients /Cases in Phase I and III

N=16+13=29

	Phase-I (n=16)	**Phase-III (n=13)**
Characteristics	f (%)	F(%)
CLASBI		
1. Line type		
CVC	6(100)	5(100)
Vas cath	-	-
PAC	-	–
Other	-	–
2. Inserted in ICU	6(100)	5(100)
3. Organisms		
Staphylococcus aureus	1(16.66)	1(20)
Staphylococcus epidermidis	-	1(20)
Enterobacter	2(33.33)	1(20)
E. coli	-	
Kblesebella	3(50)	2(40)
Others	-	–
4. Culture	–	–
Peripheral	–	–
Central	6(100)	5(100)
Arterial	–	–
Unknown		–
CAUTI		
1. Line type		
Indwelling	7(100)	6(100)
Silicon	–	–
Others	–	–
2. Inserted in ICU	6(85.17)	4(66.66)
3. Organisms	7(100)	6(100)
Staphylococcus aureus	1(14.28)	1(14.28)
Staphylococcus epidermidis	1(14.28)	1(14.28)
Enterobacter	1(14.28)	1(14.28)
E.coli	4(57)	3(42.85)
Kblesebella	–	–
Others	–	–
4. Culture		
Urine	7(100)	6(100)
Unknown	–	–
VAP		
1. Type type		
ET plain	1(33.33)	1(50)
ET with subclavian	2(66.66)	1(50)
Bronchoscopy	–	–
2. Inserted in ICU	3(66.66)	1(50)
3. Organisms		
Staphylococcus aureus	1(33.33)	1(50)
Staphylococcus epidermidis	1(33.33)	1(50)
Enterobacter	1(33.33)	–
E.coli	–	–
Kblesebella	–	–
Others	–	–
4. Culture		
Tracheal aspiration	3(100)	2(100)
Bronchoscopy	–	
Unknown	–	–

Note: Phase I=pre-implementation Phase III=post implementation, CLASBI =Central line Associated bloodstream infection, VAP=ventilator associated pneumonia, CAUTI=catheter associated urinary tract infection.

*****N=29(total number of DAI in phase I and III)

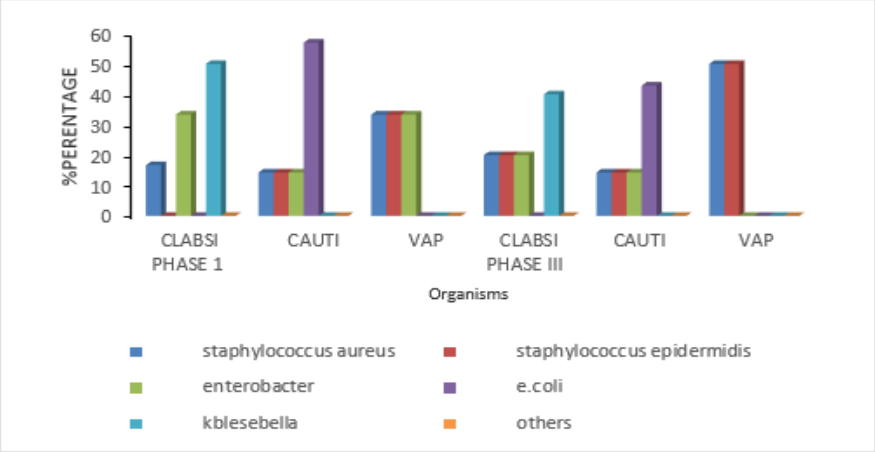

Figure 6: Bar Graph Showing Type of Organism in Phase I and Phase III

Data in the Table 5 and figure 6 show that majority of organisms seen in central line culture is Klebesella in Phase I(3) and Phase III(2)out 29 DAIs ,organisms seen in the urine culture is E. coli in Phase I (4)and Phase III (3) ; ET culture is staphylococcus aureus in both the Phases (1).

(d) Description of DAI of all critical ill patients in critical care unit on Phase I and Phase III

This section describes DAI month -wise in both the phases which includes all the months and critical care units in Phase I and Phase III.

Table 6: Description of DAI of All Critical ill Patients in Critical Care Unit on Phase I and Phase III

N=16+13=29

		VAP			CLABSI			CAUTI		
Months	**ICUS**	**Number of VAP**	**Total ventilator days**	**VAP rate**	**Number of CLASBI**	**Total central line days**	**CLABSI Rate**	**Number of CAUTI**	**Total catheter days**	**CAUTI Rate**
Phase I										
May	**MICU**	–	–	–	–	–	–	1	23	43.47
	SICU	–	–	–	1	12	83.33			
	HDU	–	–	–	–	–	–	1	26	38.46
	CCU	–	–	–	–	–	–	–	–	–
	Single ICUs	–	–	–	–	–	–	–	–	–
June	**MICU**	1	23	43.47	–	–	–	1	30	33.33
	SICU	–	–	–	–	–	–	1	20	50
	HDU	–	–	–	1	13	76.92	–	–	–
	CCU	–	–	–	–	–	–	–	–	–
	Single ICUs	–	–	–	–	–	–	–	–	–
July	**MICU**	–	–	–	1	18	55.55	–	–	–
	SICU	1	22	45.45	–	–		1	18	55.55
	HDU	–	–	–	–	–	–	1	15	66.66
	CCU	–	–	–	–	–	–	–	–	–
	Single ICUs	–	–	–	1	14	71.42	–	–	–
August	**MICU**	–	–	–	1	15	66.66	–	–	–
	SICU	–	–	–	–	–	–			–
	HDU	–	–	–	–	–	–	–	–	–
	CCU	–	–	–	1	17	58.82	1	22	45.45
	Single ICUs	1	22	45.45	–	–	–	–	–	–
Total		3	67	134.37	6	89	412.7	7	154	332.92
Phase III										
		VAP			**CLABSI**			**CAUTI**		
Months	**ICUs**	**Number of VAP**	**Total no. of ventilator days**	**VAP rate**	**Number of CAUTI**	**Total no. of Central line days**	**CLABSI Rate**	**Number of CAUTI**	**Total no. of Catheter days**	**CAUTI Rate**
October	**MICU**	–	–	–	–	–	–	1	23	43.47
	SICU	–	–	–	1	20	50	1	24	41.66
	HDU	–	–	–	–	–	–	–	–	–
	CCU	–	–	–	–	–	–	–	–	–
	Single ICUs	–	–	–	–	–	–	–	–	–
November	**MICU**	1	16	62.5	–	–	–	–	–	–
	SICU	–			1	15	66.66	1	25	40

	HDU	–			1	16	62.5			
	CCU	–						1	26	38.46
	Single ICUs	–	–	–	–	–	–	–	–	–
December	**MICU**	–	–	–	1	20	50	1	27	37.03
	SICU	–	–	–	–	–	–	–	–	–
	HDU	–	–	–	1	17	58.82	1	24	41.66
	CCU	–	–	–	–	–	–	–	–	–
	Single ICUs	1	14	71.42	–	–	–	–	–	–
Total		**2**	**30**	**133.92**	**5**	**88**	**287.98**	**6**	**149**	**242.28**

Note: CLASBI =Central line associated bloodstream infection. CAUTI-catheter associated urinary tract infection, VAP-ventilator associated pneumonia, ICU=Intensive care unit. MICU-medical intensive care unit, HDU-high dependency unit, SICU-surgical intensive care unit ,CCU-coronary cardiac unit VAP rate =VAP cases /total number of ventilator days x1000,CLASBI rate =CLASBI cases/total number of central line days, CAUTI rate =CAUTI cases /total number of urinary catheter daysx1000

*****N=29(total number of DAI in phase I and III)

Data in Table 6 show that in month of July, CLASBI(2) CAUTI(2) VAP(1) rates were high in Phase I. In month of November and December month both CLASBI (2) CAUTI (2) VAP(1) were high in Phase III Infection was more apparently reported in MICU. During pre-implementation phase, the VAP rate, CLABSI rate and CAUTI rate for all the ICU's taken together were 134.37/1000 ventilator days, 412/1000 central line days, and 332.92/1000 urinary catheter days, respectively. However, during the post implementation the rates reduced into 133.92, 287.98, and 242 per 1000 device days respectively.

Section III: Compliance Status of Health Care Workers of Care Bundles on Prevention and Care of Device Associated Infections in the CCU in Phase III.

(a)Description of compliance to multifaceted care bundle of health worker

This section describes compliance status of health workers for CAUTI bundle preventive care, CLASBI preventive care bundle and VAP prevention bundle.

Table 7: Compliance of Health Care Workers to the Multifaceted Care Bundles

N=180+120+170=470

	CAUTI Compliance	**CLABSI compliance**	**VAP compliance**
Max.	46	62	55
Min.	33	48	46
Range	33-46	48-62	46-55
Median	42	58	51
Mean± SD	42±2.7	58±2.8	52±5.8

Note: CLASBI =Central line associated blood stream infection, CAUTI-catheter associated urinary tract infection, VAP-ventilator associated Pneumonia.

*****N=470 multifaceted bundle implemented, (75 compliance status assessed in 180 CAUTI preventive care bundle ,58 compliance status assessed in 120 CLABSI preventive care bundle and 82 compliance status assessed in VAP prevention bundle)

Data in the table 7 show that compliance was higher (58±2.8) in CLASBI bundle (MCB) and the least (42±2.7) in CAUTI bundle (MCB) .

(b) Description of Month Wise Compliance of Health Workers to the Multifaceted Care Bundles (CAUTI Preventive Care Bundle, CLASBI Preventive Care Bundle and VAP Prevention Bundle)

This section describes the assessment of compliance of health workers in Foleys catheter care, central line care and ventilator care .This compliance assessment has done in phase III.

Table 8: Month wise compliance of health workers to the multifaceted care bundle (CAUTI preventive care bundle, CLASBI preventive care bundle and VAP prevention bundle) in phase III

N=180+120+170=470

		CAUTI		
		Total MCB	**MCB compliance**	
Phase III	**Months**	**Observed**	**(f)*****	**%**
	October	61	28	45.9016
	November	60	25	41.6667
	December	59	22	37.2881

Median		60	25	
Mean±SD		60±11.4	25±10.8	
		CLABSI		
			MCB compliance	
Phase III	**Months**	**Total MCB Observed**	**(f)*****	**%**
	October	41	19	46.3415
	November	41	20	48.7805
	December	38	19	50.0000
Median		40	19	
Mean±SD		40±14.3	19.3±12.8	
		VAP		
			MCB compliance	
Phase III	**Months**	**Total MCB Observed**	**(f)*****	**%**
	October	57	27	47.3684
	November	57	27	47.3684
	December	58	28	48.2759
Median		57	27	
Mean± SD		56.7±8.6	27.3±9.4	

***Total MCB performed, MCB=multifaceted care bundle (CAUTI preventive care bundle, CLABSI preventive care bundle and VAP prevention bundle) Phase III=Post–implementation phase, CLASBI =Central line associated blood stream infection. CAUTI-catheter associated urinary tract infection, VAP-ventilator associated pneumonia

*****N=470 multifaceted bundle implemented, (75 compliance status assessed in 180 CAUTI preventive care bundle, 58 compliance status assessed in 120 CLABSI preventive care bundle and 82 compliance status assessed in VAP prevention bundle

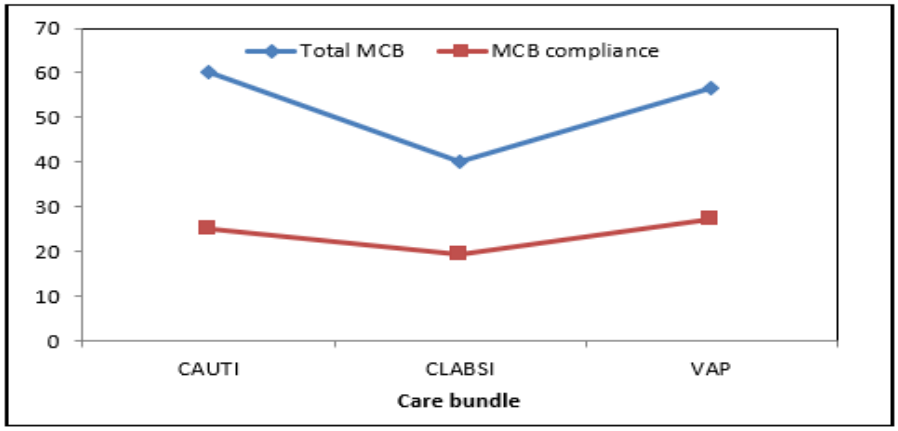

Figure 7: Line Graph Showing Total Multifaceted Care Bundle Implementation and Compliance

Data in table 8 and figure 7 show that in the CAUTI preventive care bundle compliance was the highest in the month of October (45.9%) but decreased in December (37.3%), contrarily in the CLABSI preventive care bundle compliance from October (46.34%) to December (50%) increased, but in the VAP prevention bundle compliance was similar in all the 3 months (around 47%).

Section IV: Effectiveness of multifaceted care bundle approach on device associated infections status of CLABSI, CAUTI, & VAP in CCU

To find out the significance of difference between phase I and III in DAI status the following null hypothesis is stated
$H0_1$: There is no significant reduction in infection status in post implementation phase (phase III) compared to pre-implementation phase (Phase I) infection status scores of device associated infection of CAUTI, CLASBI and VAP in CCU.

(a) Comparison of DAI status from Phase I to Phase III

This section describes total number of infection, patient days, device days, CAUTI/CLASBI/VAP rate /1000 days and device utilization ratio Phase I and III.

Table 9: Effectiveness of Multifaceted Care Bundle in DAI status in Phase I and III

N=472+409=881

	Foleys catheters			**Central lines**			**Ventilators**		
DAI Status	**Phase I**	**Phase III**	**p Value**	**Phase I**	**Phase III**	**p Value**	**Phase I**	**Phase III**	**p Value**

Number of device days/ Duration of device	352	272	0.003*	292	211	0.0034*	340	242	0.0028*
Device utilization ratio	0.83	1.11	0.0037*	0.87	0.93	0.0021*	0.93	0.57	0.0026*
DAI episodes	7	6	0.0017*	6	5	0.002*	3	2	0.0016*
Device associated incidence density	45.45	40.81	0.0034*	67.41	56.81	0.0015*	44.77	66.66	0.0019*
Organisms	7	6	0.003*	6	5	0.0037*	3	2	0.0034*
Length of stay In CCU/Number of patient days	368	288	0.0025*	321	226	0.002*	387	272	0.0034*
Number of cases	7 (CAUTI)	6 (CAUTI)	0.0012*	6 (CLASBI)	5 (CLASBI)	0.0029*	3 (VAP)	2 (VAP)	0.0013*
CAUTI, CLASBI, VAP Rate/1000 device days	45.45	40.81	0.0027*	67.41	56.81	0.0016*	44.77	66.66	0.0029*

*= Significant

Note: Patient-days= total number of days that patients are in the CCU during the selected period, Device-days = total number of days of exposure to the device (central line, ventilator, or urinary catheter)for all of the patients in the ICUs during study period, device utilization ratio (DUR)for each device =number of device-days divided by the total number of patient-dayside episode= number HAI infection according to the type assessed in patient in CCU, Device-associated incidence density (incidence rate of DA-HAI) = number of DAI episodes × 1000 / number of device-days, The incidence density rates of CLABSI (number of cases per 1000 central line days), VAP (number of cases per 1000 mechanical ventilator-days) and CAUTI (number of cases per 1000 urinary catheter

Data in table 9 show that while comparing both the phases (Phase I and III) significance difference is found in DAI status of CAUTI, CLASBI and VAP.

CAUTI .CLASBI and VAP rates were reduced per 1000 device days. During pre-implementation phase, the VAP rate, CLABSI rate and CAUTI rate for all the ICU's taken together were 44.77/1000 ventilator days, 67.41/1000 central line days, and 45.45/1000 urinary catheter days, respectively. However, during the post implementation, CLASBI and CAUTI rates reduced to 56.81/1000 central line days, 40.81/ 1000 catheter days respectively, but whereas VAP rates were increased to 66.66/1000 ventilator days from Phase III to Phase II. The signifies that the use of care bundle approach has a great impact on reducing DAIs. Effect of bundle care implementation on CAUTI (p=0.0027) and VAP (p=0.0029) CLASBI (0.0016) was statistically significant. Hence the null hypothesis ($H0_{1)}$ was partially accepted.

(b) Comparison between CAUTI, CLABSI, and VAP patients of Phase I and Phase III according to sample characteristics

This section deals with the comparison of CAUTI, CLASBI and VAP patients in the both phases according to gender and age.

Table 10: Comparison between CAUTI, CLABSI, and VAP patients of Phase I and Phase III according to sample characteristics

N=13+16=29

		CAUTI				
		Phase I (n=7)		**Phase III (n=6)**		**Test of Sig**
Gender		**f**	**(%)**	**f**	**(%)**	
	Male	4	(57.14)	3	(50)	p=0.500**
	Female	3	(42.86)	3	(50)	
Age						
	30 -40	1	(14.29)	1	(16.67)	
	41 -50	2	(28.57)	1	(16.67)	p=1.00**
	51-60	4	(57.14)	4	(66.67)	
		CLABSI				
		Phase I (n=6)		**Phase III (n=5)**		**Test of Sig**
Gender		**f**	**(%)**	**f**	**%**	
	Male	4	(66.67)	3	(60)	p=0.500**
	Female	2	(33.33)	2	(40)	
Age						
	30 -40	1	(16.67)	1	(20)	
	41 -50	2	(33.33)	2	(40)	p=1.00**

	51-60	3	(50)	2	(40)	
VAP						
		Phase I (n=3)		**Phase III (n=2)**		**Test of Sig**
Gender		**f**	**%**	**f**	**%**	
	Male	2	66.67	1	50	p=0.500**
	Female	1	33.33	1	50	
Age						
	30 -40	1	33.33		0	p=1.00**
	41-50	1	33.33	1	50	
	51-60	1	33.33	1	50	

Phase I=Pre-implementation, Phase III=Post implementation**,** CLABSI =Central line associated bloodstream infection. CAUTI-catheter associated urinary tract infection, VAP-ventilator associated pneumonia**.**

**= Non Significant

Data in the Table 10 show that highest in males of CAUTI, CLABSI and VAP were reported in both the phases(I and III) and CAUTI,CLABSI and VAP difference in both the phases was not statistically significant according to age and gender (p=0.500, 1.00).

(c) Comparison between DAI between in Phase I and Phase III according to device days

This section deals with the total number of infections/1000 days.

Table 11: Comparison between DAI between in Phase I and Phase III according to device days

N=16+13=29

		No. of infection patients	**No. of device patients**	**Infection/ 1000 days**
Phase I	CAUTI	7	352	19.89
	CLABSI	6	292	20.55
	VAP	3	340	8.82
Phase III	CAUTI	6	272	22.05
	CLABSI	5	211	23.70
	VAP	2	242	8.26

Phase I=Pre-implementation Phase, Phase III=Post implementation, CLABSI =Central line associated bloodstream infection. CAUTI-catheter associated urinary tract infection, VAP-ventilator associated Pneumonia**.**

Data in Table 11 show that the highest number of CAUTI was reported in Phase I compared to Phase III Total number of device days were more (352) for CAUTI, but only 340 ventilator days for VAP, 292 central line days in the Phase I.

(d) Comparison of DAI Status of Phase I and Phase III

This section deals with DAI status in total number of infection patients in Phase I and Phase II.

Table 12: Comparison of Patients With DAIs of Phase I and III

N=16+13=29

	Total no. of patients in Phase I	**Total no. of patients Phase III**	**P Value**
CAUTI	7	6	0.0017*
CLABSI	6	5	0.002*
VAP	3	2	0.0016*

*= Significant

p= Value for comparing between the Phase I and III (pre implementation and post implementation, (p=<0.0500)
Data in Table 12 show that while comparing both the phases a significant difference was found in CAUTI (p=0.0017) CLASBI (p=0.002) and VAP (p=0.0016). In all 3 DAIs, i.e., showed significant reduction in phase III from phase I.

Section V: Risk of DAI in Patients in the Phase III

This section describes the patients who exposed to bundle and not exposed to bundle having risk for DAI in Phase III.
$H0_2$: There is a significant reduction in risk of developing device associated infection in patients in CCU in the implementation period

.

Table 13: Risk of DAI in patients in the Phase III

Patient exposed to	**Patient exposed to**	**Patient non exposed to**	**Patient non exposed to**	**Odd ratio**

	bundle infective	bundle, non infective	bundle infective	bundle, non infective	
CAUTI	2	178	4	156	0.44
CLASBI	2	118	4	87	0.37
VAP	1	169	1	131	0.78

Note: Phase III= Post-implementation Phase, CLASBI =Central line associated bloodstream infection CAUTI-catheter associated urinary tract infection, VAP-ventilator associated infection**.**

Data in Table 13 shows that patients on Foley's catheter who are not exposed to the bundle have 44 times risk for infection than patients who are exposed to bundle; central line patients who not are exposed to bundle have 37 times risk for infection than patients who are exposed to bundle and patients on ventilator patient who not are exposed to bundle have 78 times risk for infection than patients who are exposed to bundle.
Hence, $H0_2$ rejected and H_2 is accepted, i.e., multifaceted care bundle was effective in reducing risk for DAIs.

DISCUSSION:

Description of Sample Characteristics

In the present study majority of sample in the Phase I (50%) and Phase III (46.15%) were in the age group of 51-60 years. Majority of sample in Phases I (62.5%), III (61.53%) were males**.** These study findings are supported by a study conducted in Republic of Cyprus on surveillance of device associated infections and mortality in a major intensive care units that showed majority were males and majority of hospitalized patients in the ICU for 2269 days and their median age was 68 years.[7]
But a study conducted on device-associated nosocomial infection in general hospitals, Kingdom of Saudi Arabia (2013–2016) showed that majority of admitted patients were females (70.7%) and the average age of women was 44.6 years and men 52 years.[8]

These suggest that age and gender are not specific to any type of infection and rather it is as per the admission that takes place to these units.

The present study findings showed that maximum number of respondents were diagnosed with acute respiratory failure as well as renal failure in phases I (37.5%) and in the phase III (38.48%). These study findings are supported by study conducted at Salem among patients on mechanical ventilator where in experimental group 2 (10%), 1 (5%) and in control group 3 (15%), 4 (20%) were ventilated due to renal disease and due to other diseases respectively.[9]

Device Associated Infection Status of CLABSI, CAUTI, and VAP in Phase I According to HAI Surveillance Guidelines

In the present study highest device days were found more in Foley catheters (FC)(352) compared to mechanical ventilators(MV)(340) and central line (CVC)(292). Even a study conducted in medical college hospital in South India also showed that CAUTI had more device days. Highest duration in length of stay (LOS) was seen in patients with mechanical ventilators(MV)(387) compared to Foley catheters(FC)(368) and central lines(CVC)(321) in Phase I, but in a study conducted in ICUs of 4 tertiary-care teaching hospitals in Tehran, LOS was 44 days in patients with CAUTI.[77] Device utilization ratio in phase I was highest for mechanical ventilator 0.93 which is reiterated in a study conducted in Cyprus.[7] In the present study while comparing both phases, reduction in CAUTI rate /1000 catheter days and CLASBI rate/1000 central line days and increase in VAP rate /1000 ventilator days from Phase I to III is observed, whereas increase in device utilization ratio of CAUTI and CLASBI and reduction in VAP device utilization ratio from Phase I to III .

These study finding is Supported by a study an evaluation of an intervention program to prevent hospital-acquired catheter-associated urinary tract infections in an ICU in a rural Egypt hospital that showed the infection rate showed as non-significant reduction (p=0.167, Mann Whitney test), though the average infection rate was reduced from 90.12 cases per 1,000 in the first phase to 65.69 cases per 1,000 catheter days in the second one. The device utilization ratio did not have a statistically significant reduction in comparison to both phases of the study (p=0.643, Mann Whitney test).[10]

The study findings also supported by assessment of device associated infection rates in four teaching hospital that showed device utilization ratio for central line, ventilator and urinary catheter was higher in the ICUs and reduction involved from pre-implementation for central line, ventilator and urinary catheter was 0.62,0.47, 0.84 respectively to post implementation device utilization ratio for central line, ventilator and urinary catheter was 0.53,0.38 and 0.62 respectively .[11]

Findings in the present study showed that in Klebesella, E. Coli, S. Aureus were found both the phases of study in central line, urinary catheter, ET culture respectively. These findings are supported by a study on assessment of device associated infection rates in four teaching hospitals of Iran where a total of 52 pathogens were isolated from blood cultures as CLABSI agents; Acinetobacter [12 (23.1%)] and Klebsiella [10 (19.2%)] were the most common isolates; Acinetobacter [38 (48.1%)] and Klebsiella [14 (17.7%)],were more commonly implicated in VAP; in CAUTI, among the 48 detected

organisms, E.coli [15 (31.3%)] was the most prevalent isolate detected.[77] Similar findings are also seen in another study in 760-bedded teaching hospital in Eastern India..[12]

In the present study, during pre-implementation phase, the VAP rate, CLABSI rate and CAUTI rate for all the ICU's taken together were 134.37/1000 ventilator days, 412/1000 central line days, and 332.92/1000 urinary catheter days, respectively whereas during the post implementation the rates reduced into 133.92, 287.98, and 242 per 1000 device days respectively and there was a month wise decreasing trend of VAP rate, CLABSI rate, and CAUTI rate during the study period and while comparison of DAI rates between all medical, surgical, cardiac, high dependency and single room ICU's showed that the declining trend was more pronounced in medical ICU's as compared to surgical, cardiac, high dependency and single room ICU's.

These current study findings is supported by study of Care bundle approach to reduce device –associated infection in a tertiary care teaching hospital where during pre-implementation phase, the VAP rate, CLABSI rate and CAUTI rate for all the ICU's taken together were 14.79/1000 ventilator days, 4.98/1000 central line days, and 4.86/1000 urinary catheter days, respectively. During the post implementation the rates reduced into 11.91, 3.49, and 2.36 per 1000 device days respectively. There was a month wise decreasing trend of VAP rate, CLABSI rate, and CAUTI rate during the study period. Comparison of DAI rates between all medical, surgical, and paediatric ICU's showed that the declining trend was more pronounced in medical ICU's as compared to surgical, and paediatric ICU's.[14] Similarly a study on reduction and surveillance of device-associated infection in adult intensive care units at Saudi Arabian hospital is also showed similar findings.[13] It suggest that infections are more apparently in MICU due to more number of patients and chance of cross infection is more in close proximity compared to CCU, HDU, SICU and single room ICUs.

Compliance Status of Health Care Workers of Care Bundles on Prevention and Care of Device Associated Infections in CCU in Phase III

In the present study compliance was higher (58±2.8) in CLABSI preventive care bundle (MCB) and least (42±2.7) in CAUTI preventive care bundle (MCB).

In the CAUTI Preventive care bundle compliance was highest in the month of October (45.9%) but decreased in December (37.3%). Contrarily in the CLABSI preventive care bundle form October (46.34%) to December (50%) increased, but in the VAP prevention bundle compliance was similar in all 3 months (around 47%). These findings is supported by study conducted on Care bundle approach to reduce device-associated infections in a tertiary care teaching hospital in South India, where compliance to bundle components was lower in surgical ICUs in post implementation phase, which could be the reason for their lower decrease in DAI rates. In the paediatric ICUs, on the other hand, the infection control measures were much better than other ICUs even before implementation of bundles, and therefore, a reduction DAI was not noticed in post implementation phase.[14]

Failure for effective reduction in DAI is also seen in study in Iran, citing possible reasons, including relative low compliance of hand hygiene, lack of proper training and deficiency in continuous supervision, no strict control on antibiotic therapies (stewardship), some limitations for isolation (e.g., absence of private room in most ICUs), insufficient number of nurses to implement proper cohorting of staff and patients.[11]

Evaluation of an intervention program to prevent hospital-acquired catheter-associated urinary tract infections in an ICU in a rural Egypt hospital also showed that the compliance rate of the ICU nurses to the catheter insertion and maintenance bundle elements in the pre and post intervention phases was good .The percentage of nurses, compliance for both insertion bundle elements (IBE) and maintenance bundle elements (MBE) were highest in the post intervention months November and December (100%), compared to other months of the study and this proved to be statistically significant. CAUTIs rate was inversely proportional (negative relationship) with IBE and MBE compliance rate.[10]

Over all it suggest compliance of health workers play an important role in prevention of DAIs and lack of compliance increases length of stay, reduces patient outcome and prevention of DAIs.

Effectiveness of Multifaceted Care Bundle Approach on Device Associated Infections Status of CLABSI, CAUTI, & VAP in CCU

Catheter associated urinary tract infection, central line associated blood stream infection and Ventilator associated pneumonia rates were reduced per 1000 device days .During pre-implementation phase, the VAP rate, CLABSI rate and CAUTI rate for all the ICU's taken together were 44.77/1000 ventilator days, 67.41/1000 central line days, and 45.45/1000 urinary catheter days, respectively. However, during the post implementation, CLASBI and CAUTI rates reduced into 56.81/1000 central line days, 40.81/1000 catheter days respectively, but where as VAP rates were increased to 66.66/1000 ventilator days from phase III to phase II .This signifies that the use of care bundle approach has a positive impact on reducing DAIs, CAUTI (p=0.0027), VAP (p=0.0029), CLASBI (0.0016).

This study findings is supported by study on evaluation of intervention/ Program to prevent hospital–acquired catheter – associated urinary tract infections in an ICU in a rural Egypt hospital showed that CAUTI rate/1000 device days was 0.04

in both phases but a significant 50% decrease in the CAUTI rate was also reported earlier after the implementation of a closed system and daily cleansing of the perineal area as a part of basic elements for catheter care.[10]

In the current study, CLABSI rate / 1000 device days decreased form phase I to III and even the length of stay duration of central line also decreased in phase III. Similarly, this study supported by bundle approach used to achieve zero central line –associated blood stream infections in an adult coronary intensive care unit showed CLABSI rate per 1000 patient-days dropped from 3.1 per 1000 device-days to 0.4 per 1000 device-days. The two-tailed $p<0.05$ was significant. Bundle compliance increased from 64% to 100% and was sustained in a study done in Qatar CCU.[15]

These similar findings supported by another study on the impact of implementation of bundle to reduce catheter –related bloodstream infection rates showed even after care bundle in VAP there was increase in VAP contrary to a previous study that reported a drop in VAP rate from 32.0 to 12.0 cases per 1000 ventilator -days after implementation of the bundle.[16]

So, these study describe a significant reduction in the CAUTI, CLASBI and VAP from Phase I to Phase II. So multifaceted care bundle helped in prevention of DAIs rates.

Majority of respondents in phase I and III were males and nearly equally distributed for CAUTI, CLABSI and VAP, but the difference between neither the gender or the age of subjects were significant .These findings are compatible with a study conducted in an intensive therapeutic unit of an Indian hospital where sex did not much correlate with the occurrence of DAIs but increasing with age the incidence increased.

A study on evaluation of an intervention program to prevent hospital-acquired catheter-associated urinary tract infections in an ICU in a rural Egypt hospital showed a significant difference between elderly and younger patients in the development of infection.[10] In the present study researcher did not find age and gender had any influence in occurrence of infection in patients.

Decreased number of CAUTI was been reported in Phase III compared to Phase I and increased total number of device days were (352) for CAUTI, whereas only 340 ventilator days for VAP, 292 central line days in the Phase I. These study findings supported by study conducted on Care bundle approach to reduce device-associated infections in a tertiary care teaching hospital, South India that showed during pre-implementation phase, the VAP rate, CLABSI rate, and CAUTI rate for all the ICUs taken together were 14.79/1000 ventilator days, 4.98/1000 central line days, and 4.86/1000 urinary catheter days, respectively . Rates were reduced to 13.03/1000 ventilator days, 3.98/1000 central line days, and 3.39/1000 urinary catheter days.[14]

These study findings is supported by a study on reduction and surveillance of device-associated infection in adult intensive care units at Saudi Arabian hospital, from 2004-2011, which showed CAUTI was the most common DAI (42.2%), followed by CLASBI (38.5%) and VAP (19.3%) and overall rate of each infection was considered per 1000 device days.[13]

So the present study suggested more number of infection reported in more number of device days mean while less number of infection reported in less number of device days. So it indicates more number of length of stay of device will cause more infection.

Risk of DAI in Patients in the Phase III

In the present study, patients on Foley's catheters who are not exposed to the bundle have 44 times risk for infection than patients who are exposed to bundle. Central line patients who not are exposed to bundle have 37 times risk for infection than patients who are exposed to bundle and patients on ventilator who not are exposed to bundle have 78 times risk for infection than patients who are exposed to bundle.

These study findings supported by Care bundle approach to reduce device-associated infections in a tertiary care teaching hospital, South India showed that impact of care bundle approach had greater approach in DAI rates. Care bundle approach prevents avoidable patient morbidity and reduced length of hospital stay and reduced risk for DAI rate .[14]

Even in another study it is also frame that at least one of the invasive devices, invasive devices were constitute significant risk factors for development of DAIs without implementation of care bundles.[17]

This suggests that patients who were exposed to multifaceted care bundles have lesser chance of getting infection than who were not exposed to multifaceted care bundles.

CONCLUSION

The following conclusions were drawn on basis of the findings of the present study:

1. Majority of patients were males compared to females

2. The highest device days were found more in Foley catheters (FC) (352) compared to mechanical ventilators (MV) (340) and central line (CVC) (292); highest Length of stay seen in patients with mechanical ventilators (387) compared to urinary catheters (368) and central lines (321).
3. There was a reduction in CAUTI rate /1000 catheter days and CLASBI rate/1000 central line days from Phase I to III and increase in VAP rate /1000 ventilator days from Phase I to phase III.
4. There was an increase in device utilization ratio of CAUTI and CLASBI from phase I to III and reduction in VAP device utilization ratio from Phase I to III.
5. Commonly seen organisms were in urine culture was Klebesella, E. coli in central line, staphylococcus aureus in ET culture.
6. Compliance was higher (58±2.8) in CLASBI preventive care bundle (MCB) and least (42±2.7) in CAUTI preventive care bundle (MCB).
7. There was signifies that the use of multifaceted care bundle (CAUTI preventive care bundle, CLASBI preventive care bundle and VAP prevention bundle) approach which has a great impact on reducing DAIs. Effect of bundle care implementation on CAUTI (p=0.0027) and VAP (p=0.0029) CLASBI (0.0016) was statistically significant.
8. Catheter associated urinary tract infection, central line associated blood stream infection and Ventilator associated pneumonia rate in the both phases(I and III) were highest in males and CAUTI, CLABSI and VAP but the difference between both the phases was not statistically significant according to age and gender (p=0.500, p=1.00).
9. During comparison of patients with DAIs , significance difference was found from phase I to III of CAUTI (0.0017), CLASBI (0.002), and VAP (0.0016).

RECOMMENDATION

- The duration of study can be more than few months.
- The similar study of effectiveness of multifaceted care bundle can be assessed in Implementation and post implementation phases of study.
- Similar study on Compliance of health workers of care bundles (MCB) can be assessed in implementation phase.

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