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An educational intervention to increase CLABSI bundle compliance in the ICU

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Title: An Educational Intervention to Increase CLABSI Bundle Compliance in the ICU

Context: "Forty-eight percent of patients in intensive care units (ICU) require central line placement for administration of fluids and medications" (How-to Guide, 2012). However these lines potentially pose serious complications for patients including central line-associated bloodstream infections (CLABSI). Hospitals have placed great emphasis on preventing CLABSI by use of evidenced based central line bundles. **Objective:** The purposes of this study were to evaluate nursing documentation compliance rates with central line bundle adherence, and to determine if the CLABSI rates significantly decreased post central line bundle educational intervention in the ICU. **Design:** This study consisted of a retrospective and prospective analysis of electronic record documentation of central line bundle compliance and CLABSI rates. **Setting:** The study took place in a hospital ICU in Northwest Arkansas. **Patients:** This study utilized a convenience sample of selected patients admitted to the ICU who required a central line placement during the study period of October and November of 2012 and March and April of 2013. A combined pre and post 100 electronic charts were audited. **Interventions:** Chart reviews of randomized ICU patients with central lines inserted were examined to determine CLABSI rates two months pre and post educational intervention. Medical record numbers were selected by the hospital sponsor and based on patients in the ICU who received a central line or peripherally inserted central line. Chart reviews audited electronic record documentation compliance with the five central line key components (hand hygiene, maximal barrier precautions, chlorhexidine skin antisepsis, optimal catheter site selection, and daily review of line necessity) to prevent CLABSI two months pre and post educational intervention. Patient charts were given a random number assignment for the audit and information was de-identified. **Main Outcome Measures:** The audit was used to produce pre and post intervention compliance rates with central line bundle documentation during the study period. A *t*-test, z-tests, and chi square test were used to determine if a significant change in the dependent variables, percentage of electronic medical record compliance rates for the five bundle components and CLABSI rates, pre-and post- educational intervention. The level of significance was established at $p < 0.05$. **Results:** The study did not reveal any significant change pre and post educational intervention for daily review of line necessity ($p = 0.0581$), maximal barrier precautions ($p = 0.36$), chlorhexidine antisepsis ($p = 0.36$), hand hygiene ($p = 0.47$), or CLABSI rates ($p > 0.05$). **Conclusion:** This study did not reveal any significant change in documentation compliance or CLABSI rates. However, future studies could help provide evidence to the effectiveness of central line bundle educational interventions in the ICU, as well as provide recommendations for streamlining documentation to increase compliance in nurses.

An Educational Intervention to Increase CLABSI Bundle Compliance in the ICU

According to the Institute for Healthcare Improvement (IHI), *forty-eight percent of intensive care unit (ICU) patients have central lines* (How-to Guide, 2012). This accounts for approximately fifteen million central lines annually in ICU's in the United States. Central line infections can cause hemodynamic changes, organ dysfunction, and severe sepsis possibly leading to death. It is estimated that 82,000 central line-associated bloodstream infections (CLABSI) occur every year in ICUs. These infections are accredited with killing about 31,000 patients annually in the United States (How-to Guide, 2012).

The average cost of a patient with a CLABSI is $45,000 with annual United States healthcare costs of up to $2.3 billion (Pronovost et al., 2006). Moreover, the mortality rate of CLABSI is 12-25% in the United States. This makes a central line infection one of the most deadly and expensive nosocomial infections. However, in 2009 compared to 2001, there were 58% fewer incidences of CLABSI in hospital ICU patient. The Center for Disease Control (CDC) estimates the incident reduction in ICUs alone has saved 3,000-6,000 lives and around $414 million in United States annual health care costs (Dumont & Nesselrodt, 2012).

The improvement in CLABSI rates has been linked to the implementation of evidenced based practices and recommendations for bundling protocols (Dumont & Nesselrodt, 2012). The Institute for Healthcare Improvement (IHI) central line bundle is part of an effort to improve patient safety (Furuya et al., 2011). Increasing compliance with central line bundle adherence is crucial to ensure bundle efficiency, lower the incidence of infection, and decrease the cost. One method of increasing compliance with central line bundles is the use of educational interventions focused on prevention of infection. A 30% reduction in CLABSI rates was demonstrated in a study focused on a pre-post-educational intervention program which discussed the main points of

the CDC guidelines for prevention (Parra et al., 2010). Pronovost et al., (2006) demonstrated a significant overall decrease in CLABSI infections after an educational intervention was found. The intervention focused on five evidenced based procedures identified by the CDC as having greatest effect on infection rates of central lines. The study also incorporated a checklist to ensure adherence to bundle practices (Pronovost et al., 2006). Marstellar et al. (2012) used a multifaceted approach to reduce CLABSI rates. This multifaceted intervention included the five key elements of CLABSI bundle protocol and ICU interdisciplinary team to lead the intervention activities. The team emphasized dressing change checklist, a preplanned curriculum to educate staff, nurses as the forefront of the intervention, and new data collection tools. This study found a 70% reduction rate in CLABSI at the end of the study phase, as well as an increasing trend of infection prevention behaviors (Marstellar et al., 2012).

Purpose

The purpose of this study was to evaluate nursing documentation compliance rates with bundle adherence post educational intervention in the ICU. A second purpose of the study was, to determine if the CLABSI rate significantly decreases following central line bundle education intervention in the ICU.

Research Questions

1. Is there a significant change in pre and post two month documentation compliance rates following a central line bundle educational intervention in ICU nurse documentation?
2. Is there a significant change in pre CLABSI rates and post two month CLABSI rates following a central line bundle education intervention given to ICU nurses?

Methods

The study was conducted during the Fall 2013 semester from August to December 2013.

Sample

The experimental units for this study were a convenience sample of randomly selected patients admitted to an ICU in an urban hospital in Northwest Arkansas who required a central line placement during the specified study period of October and November of 2012 and March and April of 2013.

Design

This study consisted of a retrospective and prospective analysis of electronic record documentation of central line bundle compliance and central line-associated bloodstream infection rates in an ICU in a hospital in NWA. The study examined electronic record documentation compliance with central line bundle site care and CLABSI rates two months prior to an educational intervention in the ICU, and two months post educational intervention. There are five key central line bundle components (hand hygiene, maximal barrier precautions, chlorhexidine skin antisepsis, optimal catheter site selection, and daily review of line necessity) which were examined to determine compliance with the protocol (How-to Guide, 2012). Documentation in the medical record of all CLABSI bundle components constituted compliance. These components were used in statistical analyses to compare compliance rates and infection rates before and after an educational intervention. Demographic data including age, gender, and comorbidities was also collected and used in statistical frequencies.

Procedure

During the study period chart reviews of randomized ICU patients with central lines inserted were examined to determine CLABSI rates two months pre and post educational intervention. Medical record numbers were selected by the hospital sponsor and based on

patients in the ICU who received a central line or peripherally inserted central line. The hospital sponsor was responsible for keeping and protecting those chart numbers. Chart reviews audited electronic record documentation compliance with the five central line key components to prevent CLABSI two months pre- and post- educational intervention. Patient charts were only accessed once and given a random number assignment for the audit with no identifying information obtained. In addition, all audit information was password protected. The audit was used to produce pre and post intervention compliance rates with central line bundle documentation during the study period. Pre and post compliance rates were used in statistical analyses to determine if compliance significantly increases infection rates.

Data Analysis

This study compared the change in percentage of electronic medical record compliance rates and CLABSI rates pre-and post- educational intervention in the ICU. A *t*-test, z tests, and chi square test were used for analysis. The value for determining significance is $p < 0.05$. The groups being compared were the rates of pre and post educational intervention with documentation compliance and CLABSI infection.

Timeline	
August 26, 2013-October	Chart review
October-December 2013	Data Analysis
January-April 2014	Write-up

Results

Patient age in Group 1- pre education group (N = 47) ranged from 21 to 88 with a mean age of 61.79 (SE*M* = 1.94) and age range for Group 2-post education group (N = 53) was 21 to 87 with a mean age of 60.75 (SE*M* = 2.23). See Figure 1 and Table 1.

Group 1 Pre Education Intervention **Group 2 Post Educational Intervention**

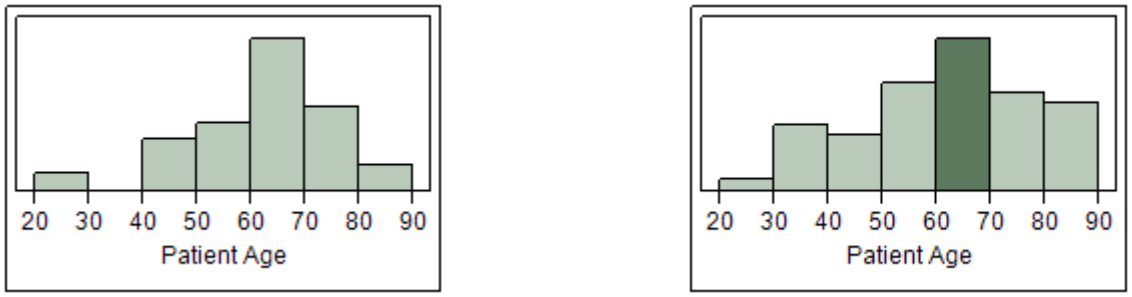

Figure 1. Patient age by Group

Table 1. Patient age by Group

Group	Mean	Std Err mean	Upper 95% mean	Lower 95% mean
Group 1 Pre (N=47)	61.79	1.94	65.68	57.89
Group 2 Post (N=53)	60.75	2.23	65.23	56.28

Of the 47 patients in Group 1- pre education group, 34 cultures for CLABSI were obtained, with a total of 6 reporting positive (Table 2). At total of 13 patients did not receive cultures (Table 2). Following the educational intervention, Group 2- post education group, a total of 34 cultures for CLABSI were obtained with only 3 positive cultures. See Table 2.

Table 2. CLABSI culture by Group

Group	Not Cultured	Negative Culture	Positive Culture
Group 1 Pre (N = 47)	13 (28%)	28 (60%)	6 (13%)
Group 2 Post (N = 53)	19 (36%)	31 (58%)	3 (6%)

A Chi-square was used to compare the proportions of Group 1-pre education, Group 2-post education. The chi-square value was found to be equal to 0.118 and $p > 0.05$ ($df = 2$). See Table 3. Therefore this study failed to reject the null hypothesis, which states there is no significant difference in the pre- and post- educational intervention CLABSI cultures.

Table 3. CLABSI chi-square analysis

Group	**Negative**	**Positive**	**Not Cultured**	**Chi Square (df=2)**
Group 1 Pre (N=47)	28	6	13	
Group 2 Post (N = 53)	31	3	19	
				0.118

The number of days the central line was inserted in Group 1- pre education group (N = 51) ranged from 2 to 32 with a mean of 8.31 (SE*M* = 0.73). Following intervention group 2- post education group (N = 46) ranged from 1 to 21 with a mean of 10.3 (SE*M* = 1.0). See Table 4.

Table 4. Number of Days the Line Was Inserted Pre and Post Education Intervention

Group	**Mean**	**Std Err Mean**	**Upper 95% Mean**	**Lower 95% Mean**
Group 1 Pre (N=51)	8.31	0.73	9.77	6.85
Group 2 Post (N=46)	10.30	1.00	12.32	8.28

The percent of days the central line was assessed for necessity in Group 1- pre education group (N = 46) was 0% for 13 patients (28% of patients). Group 2- post education group (N = 51) was 0% for 15 patients (29% of patients). See Table 5.

Table 5. Frequency for % of days the line was assessed for need

Group 1 Pre Education		**Group 2 Post Education**	
Percent of days line was assessed for need	**Number of patients**	**Percent of days line was assessed for need**	**Number of patients**

0	13	0	15
6	2	6	1
9	1	13	1
11	1	14	1
13	3	16	1
14	1	17	1
16	1	18	1
17	1	20	2
18	2	22	1
20	3	23	1
21	1	25	4
22	2	27	3
25	3	29	1
27	1	30	1
28	2	32	1
29	1	33	3
31	1	38	1
33	2	40	2
43	1	43	1
50	1	50	3
60	1	67	3
62	1	75	1
67	1	80	1
		100	1

Results were analyzed using an independent-samples t-test (Table 6). This analysis failed to reveal a significant difference between the two groups, $t(94) = -6.682$; $p = 0.0581$. The sample means are displayed in Figure 2, which shows the percent of days/number of days the line was inserted and did not demonstrate a significant difference in terms of documentation of the assessment of need for the central line in the electronic medical record.

Table 6. T-test for assessing lines pre- and post- educational intervention

Difference	-6.682	**t Ratio**	-1.5857697
Std Err Dif	4.214	**DF**	93.913767105
Upper CL Dif	1.684	**Prob > |t|**	0.1162
Lower CL Dif	-15.048	**Prob > t**	0.9419
Confidence	0.95	**Prob < t**	0.0581

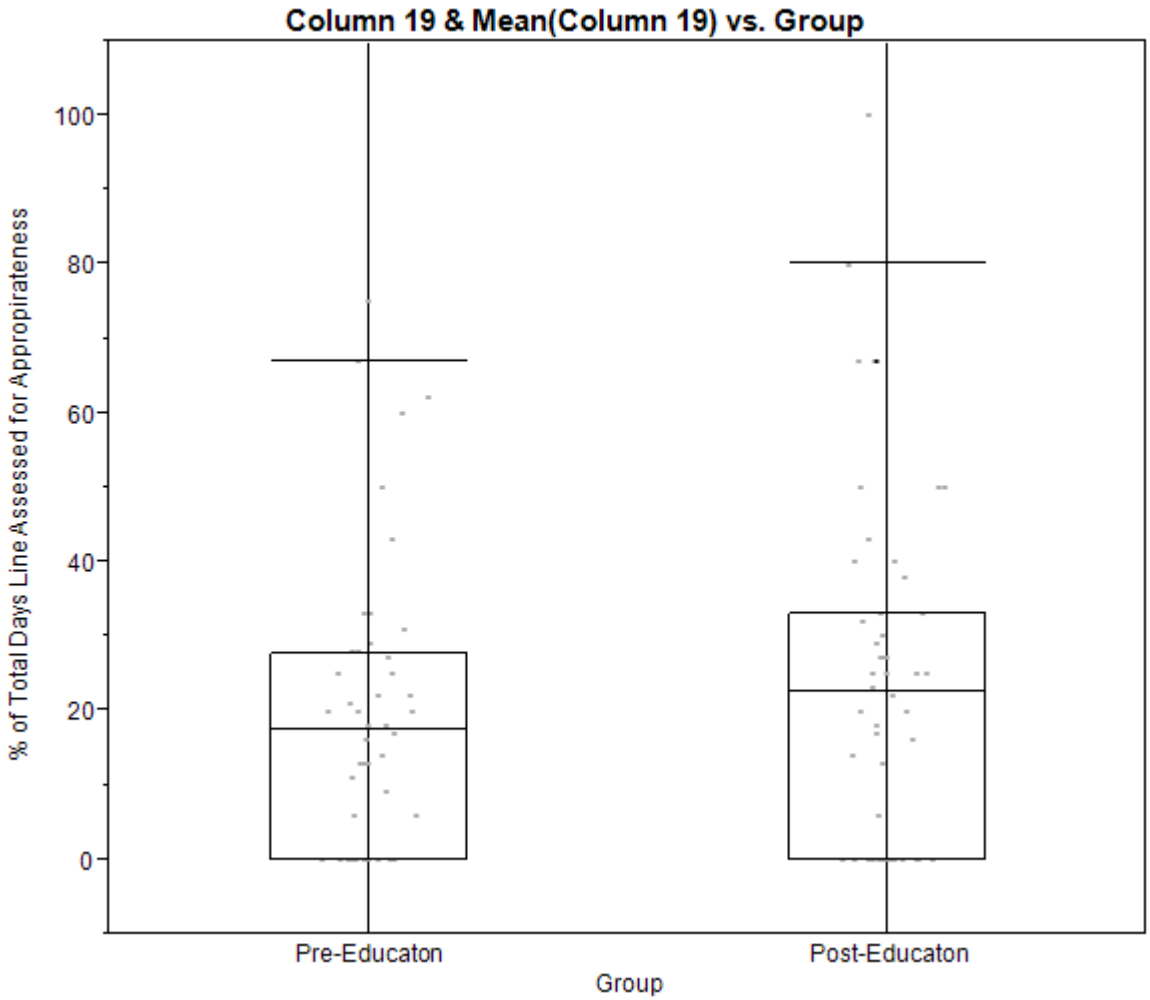

Figure 2. Comparison of Group 1- Pre-education and Group 2- Post education means of percent of total days line was assessed for appropriateness.

The use of maximal barrier precautions was compared between Group 1- Pre education and Group 2 Post education using a z test to determine equal proportions across the sample. This analysis failed to demonstrate a significant difference between the two groups in relation to the use of maximal barrier precautions. See Table 7.

Table 7. Use of maximal barrier precautions

Group	Mean	Std Err	Z	P>|Z|	95% Conf	Interval
Group 1 Pre (N=47)	0.745	0.064			0.62	0.87
Group 2 Post (N = 53)	0.66	0.07			0.53	0.79
Diff	0.08	0.09				

	Under HO:	0.09	0.92	0.36		

The use of chlorhexidine was compared between Group 1- Pre education and Group 2 Post education using a z-test to determine equal proportions across the sample. This analysis failed to demonstrate a significant difference between the two groups in relation to the use of chlorhexidine antisepsis. See Table 8.

Table 8. Use of chlorhexidine

Group	**Mean**	**Std Err**	**Z**	**P>|Z|**	**95% Conf**	**Interval**
Group 1 Pre (N=47)	0.745	0.064			0.62	0.87
Group 2 Post (N = 53)	0.66	0.07			0.53	0.79
Diff	0.08	0.09				
	Under HO:	0.09	0.92	0.36		

The use of hand hygiene was compared between Group 1- Pre education and Group 2 Post education using a z-test to determine equal proportions across the sample. This analysis failed to demonstrate a significant difference between the two groups in relation to the use of hand hygiene. See Table 9.

Table 9. Use of hand hygiene

Group	**Mean**	**Std Err**	**Z**	**P>|Z|**	**95% Conf**	**Interval**
Group 1 Pre (N=47)	0.745	0.064			0.62	0.87
Group 2 Post (N = 53)	0.68	0.06			0.55	0.80
Diff	0.07	0.09				
	Under HO:	0.09	0.72	0.47		

Catheter site selection was examined for both groups, Group 1-pre education group (N = 45) used non preferred sites of jugular or femoral 6%. Group 2- post education group (N = 51) used non preferred sites of 4%. See Table 10.

Table 10. Catheter site selection percentages

Group 1 Pre education		**Group 2 Post education**	
Catheter site	**% of patients**	**Catheter site**	**% of patients**
Subclavian	29	Subclavian	33
Basilic	56	Basilic	47
Femoral	0	Femoral	2
Internal Jugular	4	Internal Jugular	2
External Jugular	2	External Jugular	0
Cephalic Vein	0	Cephalic Vein	2
Brachial Vein	9	Brachial Vein	14

Discussion

There was no significant change in pre- and post- two month documentation compliance rates following a central line bundle educational intervention in ICU nurse documentation. The study did not demonstrate a significant change in pre- CLABSI rates and post- two month rates following a central line bundle education intervention given to ICU nurses. The study also failed to reveal any significant change in any of the bundle components. Daily review of line necessity, maximal barrier precautions, chlorhexidine, and hand hygiene documentation compliance did not significantly change post educational intervention.

Parra et al. (2010), Pronovost et al. (2006), and Marstellar et al. (2012) found a significant decrease in CLABSI rates post an educational intervention on bundling protocols. This study did not find similar results. However, Dumont & Nesselrodt (2012) and Furuya et. al (2011) both agree that implementing IHI recommendations for central line bundle protocol improve CLABSI rates and patient safety. CLABSI continues to be an important issue in intensive care units. It is a costly and deadly infection with an estimated 82,000 infections in the United States annually (How-to Guide, 2012). Therefore, it stands as a recommendation to

continue to increase bundling protocol documentation adherence in hospitals in an effort to improve the CLABSI rates and quality improvement nationally.

Some important trends to note were discovered. There was an increase post intervention in the percent of daily line review for necessity. The number of days a line was reviewed ≥ 50% of days doubled post educational intervention. Therefore, lines were reviewed with greater frequency and at a higher percent than pre intervention although it was not a significant finding. Although it was not a significant finding the number of positive CLABSI cultures also dropped by 50% post intervention from 6 positive cultures pre- to 3 positive cultures post-.

Limitations

This study had several limitations. One limitation was the short study period that only allowed for a relatively small number of chart reviews. Another limitation is that patient charts were randomly selected and an audit of all patient charts with central lines during the study period was not feasible. The set-up of the patient chart could also be seen as a possible limitation. There was not one area to find all of the five key CLABSI bundle elements. That could have led to misleading or absent data. Another limitation of the study could be that not all patients who were audited received a culture to determine CLABSI. Therefore, we could not accurately gather information about the infection rates pre and post educational intervention.

Recommendations

An observation throughout the auditing of patient charts in this study led to a recommendation of a standardized all-encompassing checklist for documentation of central line insertion and care. Pageler et al. (2014) used an electronic medical record–enhanced CLABSI prevention checklist coupled with a unit-wide real-time display of adherence was associated with

increased compliance, and the study found significant decreases in CLABSI rates and significant increases in CLABSI documentation compliance. This would aid nurses in the ability to quickly and efficiently document all the key elements of the bundle along with a place designated for daily line review of central line necessity.

Wise et al. (2013) discusses how CLABSI prevention up until now has focused on sterile central line insertion. This study recommends that to further improve CLABSI prevention catheter maintenance may need to be included in bundle protocol (Wise et al., 2013). This would help nurses with everyday maintenance of the line as well as remembering to document their daily care and review of the line. Adding everyday maintenance to the bundle protocol could enhance documentation compliance and aid in lowering CLABSI rates.

Munoz-Price et al. (2012) study includes a stepwise approach to central line maintenance. The three interventions in the approach were chlorhexidine "scrub-the-hub," chlorhexidine daily baths, and daily nursing rounds aimed at assuring compliance with an intensive care unit goal-oriented checklist. Nurses were told to do a fifteen second "scrub-the-hub" with a chlorhexidine swabstick before any intravenous access. The daily nursing rounds including nurses using a standardized checklist with all goals of CLABSI prevention, and nurses modified hand off reports to include the checklist as well. The study found a decrease in CLABSI rates associated with the use of all three interventions (Munoz-Price et al., 2012). Implementing more maintenance protocols and using a standardized checklist for central line care may be needed to increase documentation compliance with nurses and decrease CLABSI rates in ICU's.

Conclusion

Central line bundle protocol has significantly decreased CLABSI rates (Dumont & Nesselrodt, 2012). Although this study did not reveal any significant findings in documentation adherence of the five key bundle components (hand hygiene, maximal barrier precautions, chlorhexidine skin antisepsis, optimal catheter site selection, and daily review of line necessity) or CLABSI rates two months pre and post educational intervention in the ICU, it remains a crucial research topic. Hospitals should continue to do quality improvement studies within their units to improve patient safety as well as documentation adherence.

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