

## Knowledge and Practices Regarding the Prevention of Central Line-Associated Bloodstream Infection (CLABSI) among Critical Care Nurses

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### Abstract

*One of the most common causes of healthcare-associated infections in Intensive Care Units (ICUs) is Central Line-Associated Bloodstream Infections (CLABSI). Nurses play a pivotal role in preventing CLABSI, must be informed about the Central Venous Catheter (CVC) care guidelines, and must provide meticulous CVC care. This study assessed the knowledge and practices on preventing central lines associated with bloodstream infection among critical nurses at selected Private Hospitals in Johor, Malaysia. A quantitative cross-sectional study was conducted among 68 nurses working in seven (7) different hospital' ICU settings. All seven hospitals belong to KPJ Health Care Group, Malaysia. A purposive sampling method was used to recruit the participants. The data collection instrument was a self-administered questionnaire consisting of 3 parts: demographic characteristics of the participants and knowledge and practice related to CLABSI. The data were analyzed using the IBM Social Packages for the Social Sciences (SPSS) software version 24. For the CLABSI knowledge level, 5.9% of the respondents have good knowledge of the CLABSI bundle, and 83.8% have a moderate knowledge level. The practice related to CVC care had huge variations among the registered nurses. However, there was no association between knowledge and practice with gender, age, service area, level of education, and clinical experience. In conclusion, the study indicated that most nurses had moderate knowledge of CLABSI and good practice related to CLABSI bundle care. However, continuous professional development training is needed to enhance nurses' CLABSI prevention-related knowledge. It is also suggested that direct observation be conducted to determine the practices for future studies.*

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## **1. Introduction**

Central lines may be essential to the patient's care, with nurses responsible for using and maintaining these devices. Central Line-Associated Bloodstream Infections (CLABSI) are a problem both on the project site and internationally. Many state and federal regulations are in place to address this issue, supported by expert recommendations [1]. CLABSI is an often preventable complication resulting from improper care and maintenance of central lines. Nurses are primarily responsible for these activities and contribute to the incidence of CLABSI. Central Line-Associated Bloodstream Infections (CLABSIs) are common hospital-acquired infections with 12-25% reported mortality. The use of antibiotics and strict aseptic techniques can significantly reduce the rate of infection. Adequate knowledge of the prevention of CLABSI among staff nurses and adherence to Central Venous Catheter (CVC) care guidelines can halt the incidences to a significant level [2]. CLABSI prevention training in many organizations has improved knowledge and practice with highly statically significant differences [3][4][5][6][7]. There was a relationship between years of experience and knowledge of nurses, and there was a relation between the level of education and practice of nurses [8]. There has yet to be an adequate assessment of healthcare practitioners' understanding of CLABSI, and not much is known regarding the relationship between knowledge and practices among critical care nurses. Critical care nurses must possess in-depth knowledge about CLABSI prevention. This study aimed to ascertain the knowledge and practices of Intensive Care Units (ICU) Accident & Emergency (A&E) and High Dependent Unit (HDU) nurses. The study also investigated the relationship between the knowledge and practice of ICU nurses regarding CLABSI with selected demographic variables.

## **2. Methodology**

### **2.1. Design and sampling**

This research used a cross-sectional survey design, and data was collected among 68 registered nurses working in ICU, A&E HDU from 7 private hospitals in Johor. Purposive sampling was used in this study. The questionnaires consist of 3 parts. Part 1: Socio-demographic data (age, gender, service areas, year of experience and highest education). Part 2: A validated questionnaire on knowledge related to CLABSI was used for data collection [10]. The questionnaire related to CLABSI prevention knowledge had 11 multiple-choice questions. Part 3: Practice questionnaires were related to the prevention of CLABSI (4 Likert scales). The practices questionnaire was pre-validated [11]. Permission, explanation and informed consent were stated in the Google form. SPSS version 24 software was used in the statistical package to analyze the data.

### **2.2. Ethical considerations**

Ethical approval was obtained from the Research Management Centre of the University College. Moreover, permission was obtained from the hospital network headquarters and all seven private hospitals. The purpose of the study, informed consent, and statement regarding privacy and confidentiality were attached and briefly explained in the Google form.

### 3. Results

#### 3.1. Demographic profile

[Table 1] shows the distribution data collected on demographic information. For the gender, 95.6% of the respondents were females. For the age group, 50.0% (34) were from 31 – 40 years old, followed by 38.2% (26) from 21 – 30 years old, 11.8% (8) from 41 – 50 years old and no respondents from the group age of 51 years old and above.

Table 1. Demographic profile of the respondents

Variables	Frequency	Percentage
Gender	3	4.4
Male	65	95.6
Female		
Age		
21-30	26	38.2
31-40	34	50
41-50	8	11.8
>50 years	0	0
Area of service		
ICU	49	72.1
A&E	18	26.5
HDU	1	1.5
Working experience		
< 1 year	6	8.8
1-3	8	11.8
3-5	11	16.2
6-10	19	27.9
>10 years	24	35.3

For the area of service data, 49 (72.1%) of the respondents are ICU staff, followed by 18 (26.5%) are working in A&E, and there are 1 (1.5%) from HDU. For the working experience in a critical area, most respondents have worked for > 10 years, with 24 (35.3%) respondents. Nineteen (27.9%) respondents have worked for 5 - 10 years. Eleven (16.2%) respondents have been working for 3 - 5 years, and 8 (11.8%) and 6 (8.8%) have been working for 1 - 3 years and < 1 year, respectively.

#### 3.2. Knowledge regarding the CLABSI bundle

[Table 2] shows the Level of Knowledge Regarding the CLABSI Bundle among RN in Critical Areas of Private Hospitals in Johor. For the CLABSI knowledge level, 57 (83.8%) of the respondents have a moderate level of knowledge. In comparison, 7 (10.3%) have poor knowledge, and only 4 (5.9%) of the respondents have good knowledge of the CLABSI bundle.

Table 2. Level of knowledge on CLABSI prevention

Level of knowledge	Frequency	Percentage
Good(1-4 marks)	7	10.3
Moderate (5-8 marks)	57	83.8
Poor(9-11 marks)	4	5.9

[Table 3] shows an itemized analysis of the knowledge regarding CLABSI prevention bundle care.

Table 3. Knowledge of CLABSI prevention

No.	Items	Frequency (%)	
		Correct	Wrong
1.	Change Central Venous Catheters (CVCs) only when indicated.	24 (35.3%)	44 (64.7%)
2.	Use a CVC coated or impregnated with an antiseptic agent in patients whose CVC is expected to remain in place for >5 days.	52 (76.5%)	16 (23.5%)
3.	Changing the dressing on the catheter insertion site at least weekly when indicated (e.g., soiled, loosened) is recommended.	49 (72.1%)	19 (27.9%)
4.	Covering the catheter insertion site with polyurethane (transparent, semipermeable) or gauze dressing is recommended.	13 (19.1%)	55 (80.9%)
5.	It is recommended that the catheter insertion site be disinfected with 2% chlorhexidine gluconate and alcohol.	42 (61.8%)	26 (38.2%)
6.	Applying an antibiotic ointment at the insertion site of CVC is not suggested because of the risk of antibiotic resistance.	11 (16.2%)	57 (83.8%)
7.	When blood, blood products, or lipid emulsions are administered through a CVC, replacing the administration set within 24 hours is recommended.	56 (82.4%)	12 (17.6%)
8.	When liquids other than blood, blood products, or fat emulsions are administered continuously, the administration set should be replaced every 96 hours.	11 (16.2%)	57 (83.8%)
9.	It is suggested that an antiseptic agent of 70% alcohol solution or alcohol and chlorhexidine solution be used for no less than 15 seconds to clean the access hub or connector before the connection of the administration set or after unscrewing the dead-end cap and closing the catheter.	54 (14%)	14 (20.6%)
10.	Clean or sterile gloves and alcohol solutions are recommended when manipulating the catheter insertion site and hubs.	40 (58.8%)	28 (41.2%)
11.	Replacing pressure transducers and tubing routinely every four days is recommended.	8 (11.8%)	60 (88.2%)

Only 11.8% (n = 8) of participants correctly responded that Replacing pressure transducers and tubing routinely every four days is needed for patients with CVC lines. Meanwhile, 82.4 (n = 56) of respondents stated that replacing the administration set within 24 hours is recommended when blood, blood products, or lipid emulsions are administered through a CVC.

[Table 4] shows the Level of Practice in preventing CLABSI among RN in Critical Areas of Private Hospitals in Johor.

Table 4. Practice survey results in preventing CLABSI

No.	Items How often do you practice the following?	Frequency (%)				
		Never	Rarely	Sometimes	Mostly	Always
1.	Maximum barrier precautions (cap, mask, sterile gown, sterile gloves, and a sterile full-body drape).	1 (1.5%)	3 (4.4%)	12 (17.6%)	22 (32.4%)	30 (44.1%)
2.	2% Chlorhexidine gluconate for antiseptis of the insertion site.	0	1 (1.5%)	5 (7.4%)	12 (17.6%)	50 (73.5%)
3.	Use of suture-less securement devices.	8 (11.8%)	4 (5.9%)	8 (11.8%)	18 (26.5%)	30 (44.1%)
4.	Use of sterile, transparent, semipermeable dressing to cover the catheter site.	0	0	1 (1.5%)	12 (17.6%)	55 (80.9%)
5.	Transparent dressing should be replaced at least every seven days.	2 (2.9%)	2 (2.9%)	13 (19.1%)	26 (38.2%)	25 (36.8%)
6.	Administration sets are replaced no more frequently than at 96-hour intervals, but at least every seven days.	2 (2.9%)	3 (4.4%)	15 (22.1%)	32 (47.1%)	16 (23.5%)
7.	Prompt removal of the catheter when no longer essential.	0 0	1 (1.5%)	9 (13.2%)	23 (33.8%)	35 (51.5%)
8.	Routine catheter changes, even if there is no suspicion of a CLABSI.	5 (7.4%)	8 (11.8%)	12 (17.6%)	22 (32.4%)	21 (30.9%)

Most respondents practiced maximum barrier precautions in preventing CLABSI (44.1%). Most nurses (73.5%) also used 2% Chlorhexidine gluconate for the insertion site’s antiseptis and suture-less securement devices (44.1%). Most nurses used sterile, transparent, semipermeable dressing to cover the catheter site (80.9%). The nurses practiced almost all catheter care guidelines, mostly or always.

Table 5. Relationship between knowledge, practice, and selected demographic variables.

Variables	Level of significance (P-value)	
	Knowledge	Practice
Age	0.280**	0.867**
Gender	0.063*	0.309*
Area of service	0.294**	0.199**
Years of working in the critical area	0.759 **	0.954**
Level of education	0.103**	0.205

\* Mann-Whitney test; \*\* Kruskal-Wallis test

[Table 5] shows the relationship between knowledge, practice, and selected demographic profiles. The findings show a significant relationship between gender and knowledge with a p-value of 0.013 ( $p < 0.05$ ). As well as there is a significant difference in the area of service and practice (p-value 0.199).

## **4. Discussion**

### **4.1. Knowledge related to CLABSI prevention**

The study findings highlighted that nurses have moderately adequate knowledge regarding evidence-based guidelines for preventing CLABSIs. The majority of the registered nurses were knowledgeable about the major recommendations regarding the care of patients with CVCs, such as the use of antiseptic-coated CVCs (76.5%), change of catheter dressing (72.1%), disinfection of the catheter site(61.8%), change of infusion set for blood, blood products, or lipid emulsions using CVCs (82.4%), disinfection of catheter sites and hubs (58.8%).In contrast, there are many areas where the registered nurse's knowledge was lower, particularly regarding the frequency of change of CVCs(35.3%), use of transparent film dressings or gauze over the insertion site(19.1%), use of antibiotic ointment at the catheter insertion site(16.2%), frequency of change of fluid administration set(16.2%), and frequency of replacement for pressure transducers (11.8%).

The findings suggest the need to include the current evidence-based practice guidelines in the nursing education curriculum and the continuous professional development programs for nurses to improve their knowledge regarding catheter-associated infections. This is also supported by the fact that 83.8% of the nurses only have moderate knowledge regarding preventing CVCs-associated CLABSI infections. Moreover, providing information about the guidelines for preventing CLABSIs influences nurses' knowledge because they could answer correctly if they had been equipped with adequate information from training, workshops, or other learning resources. Nurses have been reported to need more knowledge regarding CVCs associated with CLABSI in similar studies from other countries [12][13][14].

The findings show that nurses still need more knowledge regarding caring for patients with central venous catheters and using CVC care bundles to prevent catheter-associated infections. This study's findings agree with a similar study in which nurses needed more knowledge related to CLABSI care. ICU nurses reported having significantly higher knowledge than physicians and nurses in other areas [6]. The study findings contrast the findings of a similar study [8]. The study done in Malaysia reported that nurses had good knowledge of CLABSI bundle care. This agrees with the findings of another similar study in Italy, in which most nurses had good knowledge regarding the care of patients on Central venous catheters [15]. Another study using a quasi-experimental design bundle care demonstrated significant improvement in nurses' knowledge post-training on CVC care using a care bundle [6].

### **4.2. The practice of CLABSI prevention bundle care**

One of the major responsibilities of nurses in caring for patients with CVC includes catheter site care. The study findings showed that most participants mostly or always practiced all 11 nursing interventions. However, there are wide variations in practice with inconsistent adherence to the CVC care guidelines. There are significant variations in the infection control practices in this study. Among the different care-related activities related to caring for patients with CVC, most were involved in catheter site care. The majority of them self-reported that they always use transparent dressings at the catheter insertion site (80.9%), use chlorhexidine gluconate for the disinfection of the catheter site (73.5%), and prompt remove of the catheter when no longer in use (51.5%). The practices that were not consistent with the CLABSI bundle care guidelines were the replacement of fluid administration sets (23.5%), frequency of change of CVC catheter (30.9%), frequency in the replacement of

transparent dressing at the catheter insertion site (36.8%), use of suture less devices and use of maximum and use of barrier precautions (44.1%). Similar findings were reported in previous studies in which nurses' compliance with the practice of CLABSI prevention guidelines was inconsistent in all aspects of CVC care [16][17].

#### **4.3. Association of knowledge and practice with demographic variables**

The relationship was tested using the Mann-Whitney test. The p-value is 0.013, as shown in the table, where  $P < 0.05$ . Knowledge is considered the backbone of preventing nosocomial infections, especially CLABSI. The goal of continuous education in nursing is to enhance learning and to promote the quality of healthcare delivery to patients. The study findings also revealed that demographic variables like age, gender, area of service, years of experience, and level of education have no bearing on nurses' knowledge related to CLABSI prevention bundle care. The study findings also highlighted that the self-reported compliance to the CLABSI prevention bundle care was not associated with registered nurses' age, gender, area of service, years of experience, and level of education. The study's finding aligns with a study that reported no association between demographic variables and the knowledge level of nurses [4]. This finding also agrees with a comparative study which reported that nurses' knowledge of CLABSI was not significantly related to their education [6][12][13]. However, the findings differed from a study which reported that there was a significant association ( $p < 0.05$ ) between gender and practice [18]. The nursing staff shortage, work overload, and inadequate supervision by the nursing supervisors could contribute to poor compliance with the CLABSI prevention bundle care. Aloush and Alsaraireh (2018) reported poor compliance with CLABSI prevention guidelines to the nurse-patient ratio, in which one to one nurse-patient ratio had the best outcome regarding compliance.

#### **5. Limitations and recommendations**

The main limitation was that it was conducted in many hospitals and on a small sample size due to limited critical care nurses. The validity of the findings of this study is limited to self-reporting, and therefore, results may not be generalizable. Intentional insincerity, poor recall, or misinterpreting the questions can all lead to an incorrect interpretation of real behavior. Healthcare workers could describe behaviors that differ from what they do daily.

The study can be repeated to analyze the knowledge related to all aspects of CVC care. The practice can be studied by directly observing the CVC care practices. Also, pre and post-training effectiveness can be studied to see if there is any significance. More importantly, factors contributing to inconsistent adherence to CLABSI prevention practices must be explored to help improve overall performance in adhering to CLABSI prevention guidelines.

#### **6. Conclusion**

Catheter-associated blood infections are a common cause of nosocomial septicemia and are one of the fatal complications of using central venous catheters. CVCs are commonly associated with hospital-acquired bloodstream infections, leading to prolonged hospitalization and mortality. Early diagnosis and treatment are critical to minimize the morbidity and mortality involved. The study assessed the knowledge and practice of Registered nurses in CLABSI prevention. The findings demonstrated moderate knowledge of CVC bundle care and inconsistent compliance with CLABSI prevention bundle care guidelines. The findings help understand the level of knowledge and compliance in CLABSI prevention among

registered nurses, clearly show the need for regular in-service training, and reinforce the CLABSI prevention bundle care guidelines. Besides that, the study also highlighted the importance of ongoing compliance monitoring by registered nurses in adhering to CLABSI bundle care and appropriate remedial measures. Establishing continued education for trained SRNs and competency might help improve nursing knowledge and practices toward preventing CLABSI. Ongoing training at the organizational level for registered nurses working in critical care areas is essential to achieve and maintain good practice regarding CVC catheter insertion and maintenance.

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