Knowledge and Compliance among Paediatric Nurses in the Prevention of Central Line-Associated Bloodstream Infections

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ABSTRACT

Objective: This study aimed to determine the knowledge and compliance among paediatric nurses regarding the prevention of central line-associated bloodstream infections.

Methods: The research employed a descriptive correlational approach in the government-subsidised hospitals of the Hail Region of Saudi Arabia. The participants were the staff nurses responsible for the insertion of the central line.

Results: Results showed that there were significant differences between gender with knowledge (t = -2.701; p = 0.007) and compliance (t = -3.118; P = .002), civil status with knowledge (t = 7.03; P <0.000) and compliance (t = 2.450; P = 0.015), educational background with knowledge (t = 10.938; P <0.000) and compliance (t = 11.890; P <0.000), age with knowledge (F = 63.376; P <0.000) and compliance (F = 21.178; P <0.000), and the years of working experience with knowledge (F = 101.390; P <0.000) and compliance (F = 82.452; P <0.000). It is noteworthy that there was a correlation between the knowledge and compliance of nurses on central line-associated bloodstream infections (CLABSI) (r = .552; P <0.000).

Conclusion: Gender, civil status, educational background, age and working experience were significant to knowledge and compliance. There was also a significant correlation between the knowledge and compliance of nurses on CLABSI. Therefore, programs that aim to increase nurses' knowledge and compliance with CLABSI preventive protocols need to take a number of criteria, including the nurses' gender, civil status, educational background, age and amount of previous professional experience into consideration. Given the wide range in both the CLABSI and the compliance rates across the participating hospitals, there is likely still opportunity for improvement in nurses' knowledge and compliance.

Keywords: Central line, Infection, Knowledge, Paediatric nurses, Practice

INTRODUCTION

Central line-associated bloodstream infections (CLABSIs) are a massive strain in healthcare, driving up expenditures and resulting in negative consequences, including death[1]. A CLABSI is a laboratory-confirmed bloodstream infection that occurs after a central line or umbilical catheter has been in place for more than two calendar days on the day of the incidence, and the line has been in place since the day before[2]. The incidence of such infection is 4.1 per 1000 central line days; CLABSIs are the most prevalent consequence of central venous catheters (CVCs)[3]. Such infections are prevalent healthcare-related infections in children[4]. The emergence of these infections jeopardises therapeutic success and has significant economic implications. The need to prevent the occurrence at all costs is of paramount importance. Nonetheless, it is believed that such problems could be avoided by following evidence-based guidelines.

A point-prevalence survey of 1353 paediatric patients with central-line access or assisted ventilation were conducted in Canada. One hundred and eighteen patients (8.7%) had Hospital Acquired Infection (HAI), with 38 (30.7%) of them being CLABSI. According to the World Health Organization (WHO)[5], 5.2 million children under the age of five died in 2019, mostly from preventable and treatable causes. There were 1.5 million deaths in children aged one to 11 months, 1.3 million in children aged one to four years, and 2.4 million in new-borns (under 28 days)[6]. The spread of multi-resistant bacteria as causes of healthcare-associated illnesses in children was confirmed by Venturini et al.[4]. A study by Affolter and colleagues[7] found that paediatric intensive care units have a greater prevalence of central-line-associated bloodstream infections than do other units. Children under the age of 28 days are commonly afflicted with illnesses, such as infectious diseases, which can easily be avoided or cured with proven, cost-effective solutions[5]. CLABSI rates are 3–5 times greater in resource-limited countries than in economically developed countries[8,9]. Regardless of the location or type of organism, CLABSIs can be prevented[10]. Indeed, they can be prevented and decreased by more than 30% with simple, but effective methods[11].

Due to their underdeveloped immune systems, neonates admitted to the neonatal intensive care units are at high risk for healthcare-associated infections, with infection rates in developing countries 3–20 times higher than those in high-income countries[5]. Researchers have not examined the burden posed by CLABSI adequately in resource-limited nations; moreover, although hospitals in resource-limited countries indeed adopt basic infection control programs, compliance with infection control procedures is inconsistent[3]. While paediatric nurses play a significant role in central line insertion in their units, their knowledge and compliance with infection controls are essential. They are ideally positioned to put the recommendations into action, and they

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have a unique opportunity to contribute to primary infection prevention through evidence-based best practices[11]. Because reducing CLABSIs can be achieved via efforts with adherence to suitable preventative measures in line with evidence-based guidelines, increasing the quality of healthcare is a foremost objective[12]. By increasing their knowledge and consistent good practice, nurses can help address the incidence of CLABSI. Therefore, assessing their knowledge and practice is of paramount importance.

While paediatric nurses play a critical role in the insertion of central lines, they must be knowledgeable and compliant in care and maintenance as well. Consequently, nurses are well-positioned to implement their ideas, and they have a distinct advantage. Furthermore, it is believed that nursing staff who enhance their knowledge and practice education display superior vascular-line care compliance to a procedure that minimises the chances of the significant spread of nosocomial infections. Therefore, potential intervention and preventive measures, such as assessing knowledge and practice among nurses responsible in the area, are of utmost concern. With these considerations, this study aimed to determine the knowledge and compliance of paediatric nurses regarding the prevention of central line-associated bloodstream infections.

METHODS

Design: This research employed a cross-sectional approach to determine the knowledge and practices among paediatric nurses in the prevention of central line-associated bloodstream infections.

Setting/Participants: This research was conducted in the hospitals of the Hail Region of Saudi Arabia. It included the following hospitals—coded as A, B, C and D—that are subsidised by the government. The participants were the staff nurses who had direct contact with the paediatric patients and were responsible for the insertion of the central line. There were 209 staff nurses—as a result of convenience sampling—who participated in the study. Staff nurses were included with the following criteria: (a) had experience in inserting the central line, (b) could comprehend and write in English, as the questionnaire was in the English language and (c) had a willingness to participate.

Questionnaire: This investigation adopted the following instruments for use in the research. A questionnaire developed by Esposito et al.[13] was used to gauge the nurses' awareness of CLABSI preventive guidelines. The responses were graded out of eight, with '0' denoting an incorrect response and '1' denoting a correct response. Among other, the topics covered in these questions included flushing the lumen with saline after medication administration, covering the CVC site with sterile gauze or dressing, disinfecting connectors before medication administration, changing the dressing on the CVC site every seven days or whenever it becomes soiled or loose, using topical antibiotics on the CVC site, changing the IV sets and administration sets every three days and cleaning the CVC insertion site with hydrogen peroxide[13]. The correct response to three questions was 'NO', thus, they were reverse-coded. The query topics included utilise topical antibiotic ointment on the catheter insertion site, clean the catheter insertion site with hydrogen peroxide and regularly use anticoagulant solutions.

The Matlab et al.[14] questionnaire, which was created in accordance with the CDC checklist for central line handling and maintenance, was used to assess the compliance of the nurses. Since the main emphasis of the guidelines was on the maintenance care package for nurses, which had four alternatives per item, the nurse compliance ratings were determined as follows: The nurse received two points for 'done twice', since she correctly completed the item twice while she had two chances

to do so throughout the observation. One point was awarded for 'done just once' for nurses who had two chances to complete the task during the observation and did so correctly. Zero points were awarded for 'not done' for nurses who had two chances to complete the task, but either did so incorrectly or not at all.

The Cronbach's alpha was calculated using SPSS version 25; a score of 0.6 to 0.7 was regarded as satisfactory. Based on the replies of 20 nurses in this study, the knowledge scale showed an internal reliability of 0.78 and the compliance had an internal reliability of 0.80.

Data Collection: With the approval of the University of Hail institutional review board, the researcher sought permission from the hospital directors of the participating hospitals. The researcher coordinated with the nurse supervisors to identify eligible participants based on the inclusion criteria. The information sheet contained the invitation to participate in the study and all related information about it, including ethical issues regarding anonymity and confidentiality. All eligible participants were sent a Google linked invitation to participate; it included informed consent and the questionnaire. It was implied that the participants gave their consent by answering the questions and clicking submit. This study was conducted between August and November 2022.

Ethical Considerations : The researcher fully ensured the confidentiality of the data. All identifying characteristics and marks of the participants were strictly concealed. Only pertinent information was gathered. The Institutional Review Board of the University of Hail gave clearance and approval of this study (H-2022-012), dated 2 July 2022.

Data Treatment/Analysis: The Statistical Package for the Social Sciences version 25 was used to process the collected data. Descriptive, frequency and percentage were used to calculate the participants' demographic characteristics. The distribution of the data was examined using the Kolmogorov-Smirnov test, under the assumption that they were normally distributed. The high Kolmogorov-Smirnov result score (0.90; p = 0.05) showed that the data had a normal distribution. A one-way analysis of variance (ANOVA) and a t-test were applied to investigate the difference in participant demographics, knowledge and compliance. The researcher made sure that the conditions for Pearson's correlations were met before estimating the strength of the connections in the population from which the data were sampled.

RESULTS

The demographic characteristics of the participants are presented in Table 1. Of the 209 participants in the study, most were 30 years old and below (34.4%), female (55%), married (53%) and had a bachelor's degree (54%). At least 36% of them had 6–10 years of work experience.

Table 1: Demographic characteristics of the participants. N = 209

	Frequency	Valid Percent
Age		
30 years old and below	72	34.4
31–40 years old	70	33.5
41 years old and above	67	32.1
Gender		
Male	94	45
Female	115	55
Civil Status		
Single	98	47
Married	111	53
Educational Background		

BSN	113	54
Master's	96	46
Years of Experience		
5 years and below	65	31
6–10 years of experience	76	36
11 years and above	68	33

The differences between the demographic variables and knowledge and compliance are presented in Table 2. It is noteworthy that gender had a significant difference with knowledge (t = -2.701; p = 0.007) and compliance (t = -3.118; P = .002), with females more knowledgeable (9.31 ± 1.625) and more compliant (11.71 ± 1.429) than their male counterparts. In addition, the civil status was found to have a significant difference with knowledge (t = 7.03; P <0.000) and compliance (t = 2.450; P = 0.015) having single are more knowledgeable (9.97 ± 1.690) and compliant (11.83 ± 1.673) than the married. On the educational background, it was found to have a significant difference with knowledge (t = 10.938; P <0.000) and compliance (t = 11.890; P <0.000), with the bachelor's having more knowledge (10.50 ± 1.513) and compliance (12.96 ± .971) than the masters. Regarding age, it was found to have a significant difference with knowledge (F = 63.376; P <0.000) and compliance (F = 21.178; P <0.000), with the 31 to 40-year-olds (9.97 ± 1.525) more knowledgeable and the 30-year-olds and below (12.85 ± .803) more compliant than the other age brackets. In addition, the years of working experience was found to have a significant difference with knowledge (F = 101.390; P <0.000) and compliance (F = 82.452; P <0.000), with five working years and below (10.50 ± 1.513) being more knowledgeable and those 11 years and above (12.96 ± .971) more compliant than the other years of working experience.

Table 2: Differences between demographic variables, knowledge and compliance

Gender		Mean	SD	t	df	Sig. (2-tailed)
Knowledge	Male	8.78	.411	-2.701	207	.007
	Female	9.31	1.625			
Compliance	Male	11.09	1.208	-3.118	207	.002
	Female	11.71	1.429			
Civil Status						
Knowledge	Single	9.97	1.690	7.033	207	.000
	Married	8.71	.905			
Compliance	Single	11.83	1.673	2.450	207	.015
	Married	11.34	1.186			
Educational Background						
Knowledge	BSN	10.50	1.513	10.938	207	.000
	Master's	8.64	.885			
Compliance	BSN	12.96	.971	11.890	207	.000
	Master's	10.97	1.105			
Age		Mean	SD	F	df	Sig.
Knowledge	30 years old and below	9.00	.000	63.376	2	.000
	31–40 years old	9.97	1.525		206	
	41 years old and above	8.17	.378			
Compliance	30 years old and below	12.85	.803	21.178	2	.000
	31–40 years old	11.50	1.380		206	
	41 years old and above	11.04	1.256			

Years of Experience		Mean	SD	F	df	Sig.
Knowledge	5 years and below	10.50	1.513	101.390	2	.000
	6–10 years of experience	9.15	.906		206	
	11 years and above	8.00	.000			
Compliance	5 years and below	10.61	.846	82.452	2	.000
	6–10 years of experience	11.25	1.206		206	
	11 years and above	12.96	.971			

The correlations between knowledge and compliance are presented in Table 3. It is noteworthy that there was a correlation between the knowledge and compliance of nurses on CLABSI (r = .552; P <0.000).

Table 3: Correlations between knowledge and compliance

		Knowledge	Compliance
Knowledge	Pearson's Correlation	1	.552**
	Sig. (2-tailed)		.000
Compliance	Pearson's Correlation	.552**	1
	Sig. (2-tailed)	.000	

**Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

This study aimed to determine the knowledge and compliance of paediatric nurses in preventing central line-associated bloodstream infections. It is noteworthy that gender had a significant difference with knowledge and compliance, with females having both more knowledge and compliance than their male counterparts. This means that female nurses have a greater awareness of CLABSI preventative measures, and they are more likely to adhere to them. This has been widely established[15]. It is possible that this has a connection with the way hospitals approach patient safety. Females have been shown to be more open to safety instructions, more likely to improve safety practices at work and more likely to have a more positive opinion of the safety culture at their place of employment. In a cross-sectional study in Ghana, Ahadzi et al.[16] found that female nurses had a more optimistic view of the workplace's safety culture than their male colleagues. Further, female nurses were more inclined to take measures to improve workplace safety procedures[17]. The research has broad implications for nursing worldwide. Since shifting societal beliefs about gender is a slow process, encouraging younger nurses to choose the profession would benefit immensely from efforts to combat stereotypes and increase public knowledge about the importance of nurses, regardless of gender[18]. It is the responsibility of nurses themselves to begin the process of altering public perception and, by extension, to lead the charge against prejudice and discrimination. The results additionally point to the need for action to both curb bias and to ensure gender diversity on nursing teams.

Further, civil status was found to have a significant difference, with knowledge and compliance having single nurses more knowledgeable and compliant than the married ones. This indicates that it is likely that single nurses are more compliant because they fear authority. Nurses experience fear because they want to protect themselves from potentially dangerous events[19]. This finding is similar to those of other

investigations in both Saudi Arabia and abroad[18], where the authors indicated that single nurses were more aware and more compliant, and they had a more positive safety culture than their married counterparts. However, this research outcome runs counter to the findings of several other studies, in which the authors indicated that respondents who were married or cohabited had better levels of knowledge and compliance[20]. Nevertheless, the study by Asadollahi et al.[21] indicated that, when comparing the knowledge scores of married and single nurses, there was no discernible trend. This gap can be explained by the fact that married nurses have additional obligations as wives, mothers and homemakers. Therefore, it is essential for them to be able to combine the requirements of their employment with those of their family life to fulfil all their obligations[22]. It can be assumed that conflicts may arise for married nurses due to the demands of their various roles. Additional study is required to clarify the complexity of this connection. Compared to married people, singles tend to be younger, less experienced and less self-aware, all of which can influence their decision-making.

On educational background, it was found to have a significant difference with knowledge and compliance, with those with a bachelor's degree having more knowledge and compliance than those with a masters. This means that bachelor's degree holders are the ones who provide continual care to patients and who play a crucial part in the management and treatment of vascular catheters, which is why they demonstrated significantly more expertise in this field than the master's degree holders. This result might be indicative of the fact that obtaining a master's degree allows an individual to specialise in a specific field of study and, consequently, they are specialised in that area[23]. Several studies indicate that a bachelor's or master's degree is inadequate and must be standardised to be compatible with CLABSI prevention[24-26]. A study on ICU nurses[25] revealed that quick, systematic training of nursing personnel boosts their knowledge and reduces the prevalence of CLABSI by as much as 41.7%[27]. Almahmoud et al.[28] noted that, even though compliance with the guidelines is high, education that emphasises individual suggestions that are less adhered to might be beneficial. Esposito et al.[13] recognised the necessity of incorporating the latest evidence-based practice guidelines into the teaching programs for healthcare professionals. Such a result contributes to the understanding that complementing knowledge with training in fundamental skills may be advantageous for nurses, regardless of their qualifications or degree.

Regarding age, it was found to have a significant difference with knowledge and compliance, with the 31 to 40-year-olds more knowledgeable, which means that knowledge and compliance of evidence-based guidelines for the prevention of CLABSIs can be improved with additional years spent working as a nurse, which results in increased experience and proper education. As stated in various studies, adult nurses are more safety conscious then both their novice and their senior counterparts[13,14,29]. According to reports[16], novice nurses are more likely to engage in hazardous and risky deviant work behaviours than their more experienced colleagues. Cognitive abilities, especially those pertaining to the ability to think critically and creatively and to take responsibility for one's own actions when making decisions, tend to improve with adult years[30]. Other similar studies have demonstrated a positive association between the age and amount of experience of nurses[31,32]. It is also noted that 30-year-olds and below are more compliant than the other age brackets, which means that compliance declines steadily thereafter (with those 30 years old and above). This finding is similar to those of previous studies[33,34] in which the authors revealed that younger nurses were compliant in terms of universal precautions. It appears vital to conduct additional staff training for these nurses on the prevention of CLABSIs. Positive attitudes, high employee morale and the avoidance of CLABSI all

necessitate a collaborative effort, and these can be beneficial for nurses to receive training in essential skills, which is in addition to their existing knowledge.

Years of working experience were found to have a significant difference with knowledge, with those with five working years and below being more knowledgeable than the other years of experience brackets. This means that these nurses benefit from their university experience, more to possess current information and intact memories. This result is consistent with literature. The study by Said et al.[29] reported that nurses with experience ranging from one to five years in nursing and less than one year in the intensive care unit, respectively, had higher mean knowledge scores than nurses in any other category. In comparison, the knowledge of more seasoned nurses demonstrated that they relied on opinions and tradition rather than evidence-based principles[29]. It is noteworthy that those who had 11 years and above were more compliant than the other years of working experience, which means that the use of evidence-based guidelines for the prevention of CLABSIs can be improved both with professional education and additional years spent working as a nurse. Comparatively, this data is consistent with that of Ikwueme's[35] study, which found that CLABSI prevention peaked among nurses with at least 20 years of experience. Scheier and associates'[36] study found that, after working at the same hospital for an extended period, the risk of CLABSI could be reduced through increased familiarity with infection prevention practices and centre-specific central line products. The length of a nurse's employment may be correlated with an increase in infection control competence[37]. These results indicate that, to increase nurses' level of knowledge and compliance, it is necessary for healthcare facilities to organise training sessions on the prevention of CLABSIs for all nurses, regardless of how long they have been in the profession.

There is a correlation between the knowledge and compliance of nurses on CLABSI, which means that, utilising this information would benefit nurses in their compliance, and vice versa, through educational management and training measures for its prevention. It will, consequently, contribute to the reduction in the number of cases. Knowledge and compliance with CLABSI preventative measures were also found to be related in past investigations[38-40]. Likewise, an observation-based cohort study that was carried out in Turkey found that sustaining a zero rate of CLABSI in ICUs was consistent with adhering to all the bundles related to its prevention[41]. This highlights the positive correlation between compliance with the CLABSI bundles and preventions. Moreover, a study conducted in Lahore, Pakistan, additionally confirmed that nurses with less awareness concerning the prevention of CLABSI had a lower rate of compliance with and adherence to guidelines addressing central line associated infections[40]. Hospital administrations would do well to encourage their nurses to participate in continuous professional development[42] as this is a major factor in the preservation of desired behaviour and a major source of change in the cognitive and psychomotor domains. This research drew attention to the problem of nurses lacking access to formal, ongoing education so that policymakers might address the issue.

LIMITATIONS OF THE STUDY

There are a few limitations to be considered with this investigation. Because only government-funded hospitals were included in the research, it is important to be cautious when extrapolating the study's findings. Additionally, the participants were limited to nurses who could read, write and understand English. Another consideration for future investigations would be to take these restrictions into account by considering private hospitals and translating the questionnaires into Arabic.

CONCLUSION

Gender, civil status, educational background, age and working experience were all significant to knowledge and compliance. Moreover, there was a significant correlation between the knowledge and compliance of nurses on CLABSI. Therefore, programs that aim to increase nurses' knowledge and compliance with CLABSI preventive protocols need to take a number of criteria, including the nurses' gender, civil status, educational background, age and amount of previous professional experience into consideration. Given the wide range in both CLABSI rates and compliance rates across the participating hospitals, opportunity likely remains for improvement in nurses' knowledge and compliance.

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