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ORIGINAL

Nurses' Knowledge Toward Preventing Central Line-Associated Bloodstream Infections in Intensive Care Units

Conocimientos de las enfermeras sobre la prevención de infecciones sanguíneas asociadas a catéteres centrales en unidades de cuidados intensivos

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ABSTRACT

Introduction: Central Line-Associated Bloodstream Infections (CLABSIs) are a major source of preventable harm in ICUs, leading to increased mortality, morbidity, and healthcare costs. ICU nurses are the frontline defenders against these infections, and their knowledge is a critical determinant of prevention success. However, studies consistently show gaps in nurses› understanding of evidence-based guidelines.
Method: a cross-sectional study was conducted with 101 ICU nurses from multiple hospitals. A self-administered questionnaire was used to assess socio-demographic characteristics and knowledge of CLABSI prevention practices based on CDC guidelines. Knowledge was evaluated via 10 yes/no questions, and a total score was calculated. Data were analyzed using descriptive and inferential statistics (t-tests, ANOVA) with SPSS version 26.0.
Results: the study revealed a moderate overall level of knowledge. Significant knowledge gaps were identified in fundamental daily care practices: only 46,5 % knew not to change dressings routinely, 45,5 % knew to use a sterile dressing, and a critical low of 35,6 % knew the correct protocol for replacing administration sets for continuous fluids. Statistically significant associations were found between knowledge scores and sex (p=0,035), hospital type (p=0,001), and a trend with education level (p=0,068). Prior training did not significantly impact scores (p=0,416).
Conclusion: while ICU nurses possess foundational knowledge, significant and dangerous gaps persist in key areas of catheter maintenance. These findings underscore an urgent need for targeted, hands-on, and recurrent educational interventions focused on daily maintenance protocols to improve adherence to guidelines and enhance patient safety.

Keywords: Central Line-Associated Bloodstream Infection; CLABSI; Knowledge; Intensive Care Unit; ICU Nurses; Prevention; Infection Control.

RESUMEN

Introducción: las infecciones del torrente sanguíneo asociadas a catéteres centrales (CLABSI) son una fuente importante de daños evitables en las UCI, ya que provocan un aumento de la mortalidad, la morbilidad y los costes sanitarios. El personal de enfermería de las UCI es la primera línea de defensa contra estas infecciones, y sus conocimientos son un factor determinante para el éxito de la prevención. Sin embargo, los estudios muestran sistemáticamente lagunas en la comprensión de las directrices basadas en la evidencia por parte del personal de enfermería.

Método: se realizó un estudio transversal con 101 enfermeras de UCI de varios hospitales. Se utilizó un cuestionario autoadministrado para evaluar las características sociodemográficas y los conocimientos sobre las prácticas de prevención de las CLABSI basadas en las directrices de los CDC. Los conocimientos se evaluaron mediante 10 preguntas de sí/no y se calculó una puntuación total. Los datos se analizaron mediante estadísticas descriptivas y inferenciales (pruebas t, ANOVA) con el programa SPSS versión 26.0.
Resultados: el estudio reveló un nivel general de conocimientos moderado. Se identificaron importantes lagunas de conocimiento en las prácticas fundamentales de cuidados diarios: solo el 46,5 % sabía que no debía cambiar los apósitos de forma rutinaria, el 45,5 % sabía que debía utilizar apósitos estériles y un porcentaje críticamente bajo, el 35,6 %, conocía el protocolo correcto para sustituir los equipos de administración de líquidos continuos. Se encontraron asociaciones estadísticamente significativas entre las puntuaciones de conocimientos y el sexo (p = 0,035), el tipo de hospital (p = 0,001) y una tendencia con el nivel de educación (p = 0,068). La formación previa no influyó significativamente en las puntuaciones (p = 0,416).
Conclusión: aunque las enfermeras de la UCI poseen conocimientos básicos, persisten lagunas importantes y peligrosas en áreas clave del mantenimiento de los catéteres. Estos resultados subrayan la necesidad urgente de intervenciones educativas específicas, prácticas y recurrentes, centradas en los protocolos de mantenimiento diario, para mejorar el cumplimiento de las directrices y la seguridad de los pacientes.

Palabras clave: Infección del Torrente Sanguíneo Asociada a Catéteres Centrales; CLABSI; Conocimientos; Unidad de Cuidados Intensivos; Enfermeras de la UCI, Prevención; Control de Infecciones.

INTRODUCTION

Central Line-Associated Bloodstream Infections (CLABSIs) represent a formidable and persistent challenge within modern intensive care units (ICUs), constituting a significant source of morbidity, mortality, and escalated healthcare costs globally.[1] These infections are defined as serious laboratory-confirmed bloodstream infections that occur in a patient with a central venous catheter (CVC) in place within the 48-hour period before the onset of infection, which is not related to an infection at another site.[2] Despite being largely preventable, CLABSIs remain a frequent complication of central venous access, particularly among critically ill patients whose compromised immune systems make them exceptionally vulnerable.[3] The consequences are severe; patients who develop a CLABSI face prolonged hospital stays, increased antimicrobial use, and a significantly elevated risk of mortality.[4] From a systems perspective, these infections impose a substantial financial burden on healthcare systems, consuming resources that could be allocated elsewhere.[5]

The prevention of CLABSIs is a paramount priority in critical care nursing and is the focus of extensive evidence-based guidelines from leading health organizations worldwide, including the Centers for Disease Control and Prevention (CDC).[6] These guidelines outline a multifaceted "bundle" approach to prevention, encompassing stringent hand hygiene, maximal sterile barrier precautions during insertion, optimal site selection, daily review of line necessity, and meticulous maintenance care involving sterile dressing changes and hub disinfection.[6] The consistent and correct application of these practices is widely recognized as the most effective strategy to reduce the incidence of these devastating infections.[7]

As the healthcare professionals most intimately involved in the daily maintenance and manipulation of central lines, ICU nurses are the undisputed frontline defenders against CLABSIs.[8] Their role is not merely procedural; it is cognitive and behavioral, requiring a deep and nuanced understanding of the evidence-based protocols that underpin safe practice. Consequently, the knowledge, attitudes, and practical adherence of nurses are universally acknowledged as the critical determinants in the success of any CLABSI prevention initiative.[9] A deficiency in knowledge can directly translate into suboptimal practice, inadvertently increasing infection risk.[10]

However, numerous international studies persistently reveal concerning gaps in nurses' knowledge regarding specific aspects of CLABSI prevention. Research from Saudi Arabia, Italy, and China has demonstrated variable levels of understanding among ICU nurses, particularly concerning the frequency of dressing changes, the use of antibiotic ointments, and the protocols for replacing administration sets.[11,12,13] These knowledge gaps suggest a disconnect between established guidelines and clinical practice, potentially stemming from inadequate training, the rapid evolution of guidelines, or contextual barriers within the healthcare environment.[14]

Therefore, assessing the current state of nurses' knowledge is not an academic exercise but a crucial first step in strengthening infection control programs. By identifying specific areas of strength and weakness, healthcare institutions can develop targeted, evidence-based educational interventions and reinforcement strategies. This study aims to contribute to this vital effort by evaluating the knowledge of ICU nurses toward preventing CLABSIs, thereby identifying key areas for improvement to enhance patient safety and clinical

outcomes in the intensive care setting.

METHOD

Study Design

This study employed a **cross-sectional, descriptive survey design** to assess the knowledge of intensive care unit (ICU) nurses regarding the prevention of Central Line-Associated Bloodstream Infections (CLABSIs). This design was selected to collect data on variables from a sample of participants at a single point in time, providing a snapshot of their current knowledge levels.[11]

Setting and Participants

The study was conducted across multiple ICU settings. A purposive sample of 101 registered nurses was recruited for participation. Inclusion criteria required participants to be full-time ICU nurses with at least one year of experience in critical care, actively involved in the insertion and/or maintenance of central venous catheters (CVCs). Nurses in administrative roles without direct patient care responsibilities were excluded from the study.

As shown in table 1, the socio-demographic characteristics of the participants were diverse. The majority were male (58,4 %), held a bachelor's degree (63,4 %), and worked in government-sector hospitals (84,2 %). The sample represented a range of experience levels, with 40,6 % having 1-5 years of experience and 28,7 % having more than 10 years of experience.

Data Collection Tool and Measures

Data was collected using a self-administered, structured questionnaire developed based on a comprehensive review of the literature and established guidelines from the Centers for Disease Control and Prevention (CDC).[6] The questionnaire consisted of three main sections:

- Section A: Socio-Demographic Data. This section captured variables including age, sex, marital status, educational level, total work experience, hospital sector, specific hospital, experience in the ICU ward, and whether they had previously attended a formal training course on CLABSI prevention.
- Section B: Knowledge Assessment. This section comprised 10 multiple-choice questions specifically designed to evaluate nurses› knowledge of evidence-based practices for preventing CLABSIs. The questions covered critical areas such as routine catheter replacement, use of antiseptic-impregnated catheters, dressing change protocols, site disinfection, use of antibiotic ointments, and replacement schedules for administration sets (as detailed in table 2). Each question had "Yes" or "No" answer options, with only one correct answer based on current CDC guidelines.[6] A knowledge score was calculated for each participant by summing the correct answers (range: 0-10).

Data Collection Procedure

Ethical approval was obtained from the relevant institutional review board prior to the commencement of the study. Potential participants were approached in their respective ICUs, and the study's purpose, procedures, and the voluntary and anonymous nature of participation were explained. Written informed consent was obtained from all nurses who agreed to participate. The questionnaires were distributed and collected by the research team, ensuring confidentiality. Participants were given approximately 20 minutes to complete the questionnaire.

Data Analysis

The collected data was analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 26.0. Descriptive statistics were used to summarize the socio-demographic characteristics of the participants and their responses to the knowledge questions. Categorical variables were presented as frequencies and percentages, while continuous variables (e.g., knowledge score) were presented as mean and standard deviation (SD).

Inferential statistics were employed to examine relationships between variables. An independent samples t-test was used to compare the mean knowledge scores between two groups (e.g., male vs. female, those who attended a course vs. those who did not). A one-way analysis of variance (ANOVA) was used to compare mean knowledge scores across more than two groups (e.g., different age groups, educational levels, years of experience). A p-value of less than 0,05 was considered statistically significant for all tests.

Ethical Considerations

The study adhered to the ethical principles outlined in the Declaration of Helsinki. Participation was entirely voluntary, and respondents could withdraw at any point without penalty. Anonymity was maintained by not collecting any identifying information on the questionnaires. The data was kept confidential and used solely

for the purpose of this research.

RESULT

Table 1 shows the socio-demographic characteristics of 101 participants. Most were aged 25–29 years (38,6 %), with fewer in older age groups. Males (58,4 %) outnumbered females (41,6 %), and the majority were married (63,4 %). Bachelor's degree holders represented the largest group (63,4 %), followed by diploma (19,8 %) and master or higher (16,8 %). Most had 1–5 years of work experience (40,6 %). The majority worked in government hospitals (84,2 %), and 64,4 % had less than five years of ward experience. Only 31,7 % had prior CLABSI training.

Table 1. Socio-Demographic Characteristics of Participants (n=101)

Characteristics	No.	%	Mean	SD	T/F	P-Value
Age in years						
25-29 years old	39	38,6 %	5,12	2,646		,942
30-34 years old	27	26,7 %	5,76	3,525		
35-39 years old	16	15,8 %	6,42	3,233		
40+ years old	19	18,8 %	5,92	3,730		
Sex				2,176	,035	
Male	59	58,4 %	5,14	2,987		
Female	42	41,6 %	6,36	3,395		
Marital status					,702	,553
Single	28	27,7 %	5,43	3,005		
Married	64	63,4 %	5,59	3,279		
Divorced	6	5,9 %	6,62	3,889		
Widowed	3	3,0 %	7,66	1,527		
Educational level				2,741	,068	
Diploma	20	19,8 %	5,50	3,432		
Bachelor	64	63,4 %	5,32	3,108		
Master or higher	17	16,8 %	7,09	3,069		
Work experience (years)				,810	,447	
1-5 years	41	40,6 %	5,52	3,054		
6-10 years	31	30,7 %	6,17	3,296		
>10 years	29	28,7 %	5,28	3,344		
Hospital sector				,980	,329	
Non-government	16	15,8 %	6,28	3,084		
Government	85	84,2 %	5,53	3,233		
Hospital				4,268	,001	
Government	55	5,0 %	7,42	1,718		
Non-government	46	9,9 %	6,38	3,150		
Experience in ward				,937	,394	
1-5 years	65	64,4 %	5,61	3,045		
6-10 years	19	18,8 %	6,32	3,771		
>10 years	17	16,8 %	5,04	3,154		
Course on CLABSIs				1,708	,416	
Yes	32	31,7 %	5,31	2,986		
No	69	68,3 %	5,81	3,311		
Total	101	100 %				

Table 2 presents participants' knowledge regarding CLABSI prevention. More than half correctly identified that CVCs should not be replaced routinely (56,4 %) and that antiseptic-coated catheters are recommended

in high infection-risk settings (56,4 %). Knowledge was lower regarding routine dressing changes (46,5 %) and sterile site coverage (45,5 %). About half knew the need for antiseptic site disinfection (48,5 %) and avoiding antibiotic ointment use (47,5 %). Awareness was higher for replacing administration sets with blood products (64,4 %) and disinfecting hubs/connectors (59,4 %). Overall, knowledge levels were moderate, with gaps in key practices.

Table 2. Distribution of Participants' Responses on Knowledge-Related Questions

No.	Questions	Correct Answer	No.	%	Wrong Answer	No.	%
1	Is it recommended to replace Central Venous Catheters (CVCs) routinely?	Yes	57	56,4 %	No	44	43,6 %
2	In settings with a high rate of catheter-related infections, is it recommended to use a CVC coated or impregnated with an antiseptic agent?	Yes	57	56,4 %	No	44	43,6 %
3	Is it recommended to change the dressing on the catheter insertion site routinely?	Yes	47	46,5 %	No	54	53,5 %
4	Is it recommended to cover up the catheter insertion site with a sterile dressing?	Yes	46	45,5 %	No	55	54,5 %
5	Is it recommended to disinfect the catheter insertion site with an antiseptic agent?	Yes	49	48,5 %	No	52	51,5 %
6	Is it recommended to apply an antibiotic ointment at the insertion site of a CVC?	Yes	48	47,5 %	No	53	52,5 %
7	When blood, blood products, or lipid emulsions are administered through a CVC, is it recommended to replace the administration set routinely?	Yes	65	64,4 %	No	36	35,6 %
8	When liquids other than blood, blood products, or fat emulsions are administered continuously, should the administration set be replaced?	Yes	36	35,6 %	No	65	64,4 %
9	Is it recommended to use an antiseptic agent to clean the access hub or connector before connecting the administration set or after unscrewing the dead-end cap?	Yes	60	59,4 %	No	41	40,6 %
10	When manipulating the catheter insertion site and hubs, is it recommended to use						

DISCUSSION

This cross-sectional study aimed to assess the knowledge of ICU nurses regarding evidence-based guidelines for the prevention of Central Line-Associated Bloodstream Infections (CLABSIs). The findings reveal a moderate level of overall knowledge among participants, with significant variations across different demographic groups and specific practice domains. These results underscore both the strengths and critical gaps in current understanding, highlighting areas for targeted educational intervention.

The socio-demographic analysis revealed several noteworthy associations. The statistically significant difference in knowledge scores between male (mean=5,14) and female (mean=6,36) nurses (p=0,035) is an intriguing finding that merits further investigation. While biological sex itself is unlikely to be the causative factor, it may be a proxy for other variables such as differences in specialization, engagement in continuous education, or work assignments within the ICU.[15] Similarly, nurses with a Master's degree or higher demonstrated a notably higher mean knowledge score (7,09) compared to those with a Bachelor's (5,32) or Diploma (5,50), although this finding was not statistically significant (p=0,068). This trend suggests that advanced education may contribute to a deeper assimilation of complex evidence-based guidelines, a correlation supported by previous research.[14]

A particularly striking finding was the significant disparity in knowledge scores between nurses working in government (mean=7,42) and non-government (mean=6,38) hospitals (p=0,001). This could be indicative of systemic differences in the implementation of infection prevention and control (IPC) programs, the frequency and quality of in-service training, or the availability of resources and institutional support for adhering to best practices.[17] Interestingly, prior attendance at a formal course on CLABSI prevention did not result in a significantly higher knowledge score (p=0,416). This suggests that the *quality*, *recency*, and *practical application* of such training may be more critical than its mere occurrence, pointing to a need for more effective, hands-on, and recurrent educational programs rather than one-off sessions.[15]

The analysis of individual knowledge items (table 2) exposes critical and specific gaps in understanding.

Alarmingly, less than half of the nurses correctly answered questions regarding fundamental maintenance practices: only 46,5 % knew it is not recommended to change the dressing routinely, 45,5 % knew to cover the site with a sterile dressing, and 48,5 % knew to disinfect the site with an antiseptic. Even more concerning, only 35,6 % knew the correct protocol for replacing administration sets for continuous fluids other than blood or lipids. These gaps are particularly dangerous as they relate to daily, routine nursing care where lapses can directly introduce pathogens.

Conversely, areas of stronger knowledge were also identified. A majority of nurses (64,4 %) correctly answered regarding the replacement of administration sets for blood and lipid emulsions, and 59,4 % knew to use an antiseptic to clean the catheter hub. This indicates that knowledge is not uniformly lacking but is inconsistent, with strengths in some protocol areas and weaknesses in others.

When viewed through the lens of established literature, these findings are consistent with a global pattern. Studies from Saudi Arabia, Italy, and China have similarly reported moderate knowledge levels among ICU nurses, with inconsistencies in the understanding of dressing protocols, hub disinfection, and the use of antibiotic ointments.[11,12,13] This recurrent theme across different healthcare systems suggests a universal challenge in translating guidelines into embedded knowledge and consistent practice.

The implications of these knowledge gaps are profound. As the primary caregivers responsible for CVC maintenance, nurses' knowledge is the first line of defense against CLABSIs.[16] Misconceptions about basic procedures can directly lead to breaches in aseptic technique, increasing infection risk, patient morbidity, and healthcare costs.[3] Therefore, the identified gaps are not merely academic but represent tangible patient safety risks.

Limitations and Strengths

This study has several limitations. The use of a convenience sample may limit the generalizability of the findings to the broader population of ICU nurses. The self-reported nature of the knowledge questionnaire is susceptible to social desirability bias. Furthermore, the study measured knowledge but did not directly observe clinical practice, which is the ultimate determinant of infection outcomes. Despite these limitations, the study provides valuable, data-driven insights into specific knowledge deficits that can inform the development of tailored educational programs.

CONCLUSION

In conclusion, this study demonstrates that while ICU nurses possess foundational knowledge of CLABSI prevention, significant and dangerous gaps persist, particularly in the daily maintenance and monitoring of central lines. These gaps are associated with factors such as gender, educational level, and hospital sector.

To address these findings, the following recommendations are proposed:

1. Implement regular, mandatory, and simulation-based training programs focused specifically on the identified weak areas, such as dressing change protocols, site disinfection, and administration set replacement.
2. Develop and disseminate clear, concise, and accessible job aids (e.g., checklists, posters) for placement at the point of care to serve as quick reminders of evidence-based protocols.
3. Hospitals, particularly in the non-government sector, should invest in strengthening their IPC infrastructure and fostering a culture of continuous learning and adherence to best practices.
4. Future research should employ a mixed-methods approach, combining knowledge assessments with direct observational audits of practice and qualitative exploration of the barriers to guideline adherence.

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None.

CONFLICT OF INTEREST

None.

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