A SYSTEMATIC REVIEW OF THE KNOWLEDGE AND PRACTICE OF ICU NURSES IN SAUDI ARABIA REGARDING THE PREVENTION OF CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTIONS

Shuruq Mohammed Alruwaili[1], Nwair Mohali Alrowaliy[2], Tamani Rabea Alruwili[3], Nourah Mashni Alruwaili[4], Meead Mofak Alrowale[5], Ahoud Mohammed Alruwaili[6], Dalal Saleh Alkuwikbi[7]

[1]Nursing Specialist, Prince Mutaib Bin Abdulaziz Hospital
[2]Nursing Specialist, Prince Mutaib Bin Abdulaziz Hospital
[3]Nursing Specialist, Prince Mutaib Bin Abdulaziz Hospital
[4]Nursing specialist, Prince Mutaib Bin Abdulaziz Hospital
[5]Nursing specialist, Prince Mutaib Bin Abdulaziz Hospital
[6]Nursing Technician, Prince Mutaib Bin Abdulaziz Hospital
[7]Nursing technician, Prince Mutaib Bin Abdulaziz Hospital

Abstract - Central line-associated bloodstream infections (CLABSIs) were a serious concern in ICUs around the world, resulting in increased morbidity, mortality, and healthcare costs. This systematic review aimed to assess the knowledge and behaviors of ICU nurses in Saudi Arabia regarding CLABSI prevention, with an emphasis on identifying gaps in understanding, adherence to infection control recommendations, and barriers to successful practice. A thorough literature search revealed four studies published between 2021 and 2024 that met the inclusion criteria. The findings found that, while ICU nurses in Saudi Arabia were somewhat aware of CLABSI prevention, actual adherence to evidence-based procedures was critically low. The review revealed common difficulties such as heavy workloads, limited resources, and barriers to effective training that hampered adherence to CLABSI preventive strategies. In comparison, research from other countries had equivalent results, indicating that the obstacles associated with CLABSI prevention were not unique to Saudi Arabia. These findings highlighted the importance of targeted educational programs and institutional assistance in narrowing the knowledge-practice gap among ICU nurses, resulting in improved patient safety and care quality. Future research should look into contextual factors influencing compliance and provide standardized training procedures tailored to the unique challenges experienced in various healthcare settings.

Keywords: Knowledge, Practice, ICU Nurses in Saudi Arabia, Prevention, Central, Bloodstream, Infections

Introduction

Central line-related bloodstream infections (CLABSIs) are the most prevalent consequence of central venous catheters (CVCs), with an incidence of 4.1 per 1000 central line days (Rosenthal et al., 2016). CLABSIs are related with higher morbidity, death, and medical expenses. A meta-analysis found that individuals with CLABSI have a 2.75-fold higher risk of hospital death than those without. It has been demonstrated that CLABSI is associated with a large cost burden, accounting for around $46,000 per case (Chi et al., 2020).

Acta Biomed 2024; Vol. 95, N. 2: ISSN: 0392-4203 | eISSN: 2531-6745

Central line-associated bloodstream infections (CLABSI) have been a substantial burden in healthcare, raising expenditures and resulting to negative consequences, including mortality (Badparva et al., 2023). Numerous studies have found several risk factors for CLABSIs, these characteristics, as noted in both systematic review studies and meta-analyses, include total parenteral nutrition, chemotherapy, immunosuppression, and catheterization duration (Lafuente Cabrero et al., 2023).

However, it is critical to highlight the actions of health-care providers, particularly nurses, regarding CVCs. Given their importance in managing and maintaining CVCs, these practices have a major impact on CLABSIs. As a result, a lack of awareness and compliance with infection control protocols, combined with the presence of barriers to effective practice, can contribute to an elevated risk of CLABSIs (Sham et al., 2023). According to one study in Jordan, the CVC maintenance care package should be used more widely in hospital settings. Programs aimed at increasing nurses' understanding of CLABSI prevention and compliance with CVC care must take into account several elements, including nurses' age and employment circumstances (nurse-to-patient ratio) (Matlab et al., 2021).

Despite the fact that CLABSIs are essentially preventable, they are still often seen due to breaches in sterile procedure during catheter insertion, fluid administration, or catheter maintenance (Almahmoud et al., 2020). Physicians and nurses are the frontline workers in charge of inserting and caring for central lines. Additionally, nurses typically spend more time with patients than physicians (Bulter et al., 2018).

Nurses are responsible for monitoring IV devices and determining whether to cease central venous access, some low-resistance lines, such those used for dialysis, require anticoagulant flushes, while lines with valves for long-term access do not. To limit infection risk, it's important to utilize thorough sterile procedure during line placement and routine care, as well as remove unused lines (Ahmad et al., 2021). The understanding and behaviors of nurses about CLABSI vary greatly, particularly in underdeveloped countries. Nurses are frequently more knowledgeable about vascular catheters than physicians, however their knowledge may not always be sufficient or standardized (Shahbaz et al., 2024).

The Kingdom of Saudi Arabia (KSA) is classified as a high-income country by the World Bank, as are the majority of the Gulf Cooperation Council (GCC) countries (Al-Yateem et al., 2021). The healthcare system in Saudi Arabia is currently being improved and upgraded to meet the norms of modern countries. However, authoritative data on the rates of hospital-acquired infections are sparse. There are few relevant scientific articles, however accessible research revealed that the KSA had a higher than predicted rate of device-related hospital-acquired illnesses (Al-Yateem et al., 2021).

In the US, the ICU CLABSI rate is estimated to be 0.8 per 1,000 central line-days (Rosenthal et al., 2016). These findings highlight the importance of addressing CLABSI prevention efforts in Saudi Arabia and implementing effective measures that are consistent with international standards, including evidence-based guidelines for CVC placement and management (Almalki et al., 2023).

ICU nurses have an important role in providing quality care and ensuring patient safety in the ICU setting (Van et al., 2021). Studies from several countries have demonstrated a lack of awareness and adherence to best practices among ICU nurses, as outlined by bodies such as the US CDC (Aloush & Alsaraireh, 2018). Despite the significant burden of Central Line-Associated Bloodstream Infections (CLABSIs) in healthcare systems, particularly in critical care settings, Saudi ICU nurses continue to lack knowledge and practice in the prevention and management of these infections. Existing literature has identified several risk factors for CLABSIs, but disparities in nurses' understanding, adherence to infection control methods, and consistent use of evidence-based guidelines exist, particularly in impoverished regions. The critical role that ICU nurses play in the maintenance of central venous catheters (CVCs) highlights the need for additional training and educational programs. However, the evidence suggests that some demographic characteristics, such as nurse age and patient-to-nurse ratios, influence varying levels of compliance with recommended practices. Furthermore, while some statistics suggest that nurses have higher knowledge of vascular catheters than physicians, there are still variations in comprehending and applying standardized protocols. This highlights the critical need to examine the current knowledge base, procedures, and barriers that ICU nurses face in Saudi Arabia, in order to effectively decrease the risks of CLABSIs.

Objective of the Systematic Review

The purpose of this systematic review was to describe Saudi ICU nurses' knowledge and practices for preventing Central Line-Associated Bloodstream Infections (CLABSIs). The review sought to identify existing gaps in infection control protocol awareness and adherence, as well as barriers to effective practice, and to provide insights into demographic factors that may influence the implementation of best practices in CLABSI prevention among nursing staff in critical care environments.

Methods

Introduction

This systematic review sought to consolidate the current research on Saudi ICU nurses' knowledge and practices for preventing Central Line-Associated Bloodstream Infections (CLABSIs). A thorough search approach was used to uncover relevant papers, followed by a controlled selection procedure and data extraction to ensure rigorous analysis of the findings.

Search Strategy

A thorough literature search was undertaken across numerous databases, including PubMed, Scopus, Web of Science, and Google Scholar, to locate peer-reviewed articles published from 2022 to 2024. The search approach employed a combination of keywords and Medical Subject Headings (MeSH) terms, including "ICU nurses," "Central Line-Associated Bloodstream Infections," "CLABSI," "knowledge," "practices," and "Saudi Arabia." Boolean operators (AND, OR) were employed to narrow down search results, and language constraints were imposed to include only

Acta Biomed 2024; Vol. 95, N. 2: ISSN: 0392-4203 | eISSN: 2531-6745

publications published in English and Arabic. Reference lists for relevant studies were also examined to find other papers that satisfied the inclusion criteria.

Inclusion Criteria

This systematic review included studies that met particular criteria for ensuring the research's relevance and quality. Inclusion criteria included studies that focused on ICU nurses' knowledge and practices for preventing Central Line-Associated Bloodstream Infections (CLABSIs) in Saudi Arabian healthcare settings. Only peer-reviewed studies published between 2021 and 2024 were evaluated, and eligibility included quantitative, qualitative, or mixed-methods research designs that collected primary data via surveys, interviews, or observations.

Exclusion Criteria

Studies that focused on ICU nurses or were conducted outside of the ICU were excluded. Articles that did not explicitly address CLABSI prevention or infection control measures were eliminated, as were opinion pieces, editorials, and reviews that lacked original research data. The survey also excluded unpublished academic works like theses and dissertations. This wide set of criteria ensured that the systematic review focused on the specific context of ICU nursing in Saudi Arabia for CLABSI prevention.

Selection process

In 2024, the review search generated 100 results. After removing duplicate studies, 50 remained. After reviewing the titles and abstracts, 30 studies were excluded because they did not match the inclusion criteria. Thus, 10 research were thoroughly analyzed to determine eligibility; 6 studies were removed since they did not describe the original studies. As a result, 4 studies were included in this systematic review (Table 1 and Figure 1).

Data Extraction

A review search was carried out, with all titles and abstracts provided, inclusion and exclusion criteria applied, reasons for inclusion and removal explained, and duplicates removed. A PRISMA flowchart was used to depict the four stages of the systematic review approach. Figure 1 depicts the process for a systematic review. The features of the included studies (n = 4) were collected and presented in Table 1. The summarised data was then assessed. The author(s), study design, findings, and conclusions were all gathered and evaluated.

Results

According to AlMalki et al. (2023), central line-associated bloodstream infections (CLABSIs) have a significant impact on patient outcomes in intensive care units (ICUs), emphasizing the need of following evidence-based guidelines for prevention. A cross-sectional survey of adult ICU nurses in Ministry of Health (MOH) hospitals in Jeddah, Saudi Arabia, revealed important information on their knowledge, attitudes, and practices related CLABSI prevention. The study,

which included 203 nurses with at least one year of ICU experience, discovered an overall knowledge score of 71%, with only 20% correctly answering more than 90% of knowledge questions, indicating significant knowledge gaps. While 58% of nurses were enthusiastic about the use of recommendations in CLABSI prevention, actual adherence to evidence-based practices was disturbingly low, with just 5% reporting complete compliance. These findings highlight the critical need for focused training interventions to improve nurses' comprehension and adherence to CLABSI preventive practices, reducing infection risks and improving patient outcomes in Jeddah's MOH facilities. More research into the factors influencing nurses' adherence to evidence-based guidelines is required for the development of successful educational programs and treatments.

One study showed that participants had a sufficient level of knowledge and behavior regarding the evidence-based guidelines for CLABSI prevention, with knowledge levels being substantially related to years of experience. Nurses had very good sentiments toward the use of CLABSI prevention recommendations. Notably, nurses from critical care units had a higher degree of knowledge and behavioral patterns related to the guidelines, although nurses from non-critical care units had a more positive attitude toward their value. The study indicated that there is space for development through innovative teaching and training (Al-Yateem et al., 2021).

One study evaluated nurses' knowledge and practices regarding Healthcare-Associated Infections (HAIs) control measures at King Salman Armed Forces Hospital (KSAMC) in Madinah City, and discovered that the majority of participants were female (79.5%), married (60.2%), held bachelor's degrees (62.1%), and had 1 to 5 years of work experience (28%). The findings revealed that 58.4% of nurses were aware of infection control procedures, 94.1% were knowledgeable about hand hygiene, and 58.7% had a thorough understanding of personal protective equipment. Practices for HAI control measures were fair (63.7%), and there was a positive correlation ($r=0.336$) between knowledge and practice ratings. The study found that continual health education and regular supervision by nurse managers are necessary to increase nurses' adherence to infection control protocols, which leads to better patient safety outcomes (Alrefaee et al., 2023).

A prospective study was done at the King Faisal Specialist Hospital and Research Center in Saudi Arabia from January 2017 to December 2021 to evaluate the impact of deploying CL care packages on hospital-wide CLABSI incidence rates. The study was divided into two phases: pre-intervention (January 1, 2017-December 31, 2018) and post-intervention (January 2019-December 31, 2020), during which outcome variables such as CLABSI rates were assessed. A total of 439 CLABSIs were reported, with 266 occurring prior to intervention and 173 happening after intervention. The CLABSI rate reduced from 1.6 ± 0.05 in the pre-intervention phase to 0.9 ± 0.05 in the post-intervention phase, indicating a statistically significant decline ($p<0.0001$) across all hospital settings, including critical care units. This study stresses the importance of care package adoption in drastically lowering CLABSI rates across almost all participating units (Alhumaidan et al., 2024).

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Table (1): Summary of the related studies

Author	Aim	Study Design	Results
(Almalki et al., 2023)	To assess the knowledge, attitudes, and adherence to national guidelines for preventing Central Line-Associated Bloodstream Infections (CLABSIs) among adult ICU nurses in Ministry of Health (MOH) hospitals in Jeddah, Saudi Arabia.	Cross-sectional	Out of 203 nurses surveyed (response rate: 91.5%), the overall knowledge score was 71%, with just 20% correctly answering more than 90% of questions. 58% of respondents had a positive impression of recommendations, whereas 65% complied with evidence-based procedures, with only 5% claiming complete adherence.
(Al-Yateem et al., 2021)	The primary aim of the study was to evaluate the knowledge, behavior, and attitudes of nurses working in Adult Intensive Care and Hemodialysis Units regarding the prevention of Central Line-Associated Bloodstream Infections (CLABSIs).	Quantitative descriptive cross-sectional and comparative study	The findings showed that participants had a sufficient level of knowledge and behavior regarding the evidence-based guidelines for CLABSI prevention, with knowledge levels being substantially related to years of experience. Nurses had very good sentiments toward the use of CLABSI prevention recommendations. Notably, nurses from critical care units had a higher degree of knowledge and behavioral patterns related to the guidelines, although nurses from non-critical care units had a more positive attitude toward their value. The study indicated that there is space for development through

			innovative teaching and training, as well as regular practice audits.
(Alrefaee et al., 2023)	To assess the knowledge and practices of nurses regarding Healthcare-Associated Infections (HAIs) control measures at King Salman Armed Forces Hospital (KSAMC) in Madinah City.	A descriptive cross-sectional study	The survey discovered that the majority of participants were female (79.5%), married (60.2%), held bachelor's degrees (62.1%), and had work experience ranging from one to five years (28%). The majority of nurses (51.2%) worked at maternity and children's hospitals, with emergency departments being the most popular specialty (18%). It was discovered that 58.4% of nurses had a reasonable awareness of healthcare-associated infection control methods. Notably, 94.1% of nurses had high awareness of hand hygiene, and more than half (58.7%) had a solid comprehension of personal protective equipment. However, overall HAIs control measures were rated as fair (63.7%). A substantial positive connection was found between knowledge and practice scores (r=0.336).
(Alhumaidan et al., 2024).	To evaluate the impact of implementing central line (CL) care bundles on the incidence rates of	Prospective study	The study found a total of 439 CLABSIs, with 266 occurring before intervention and 173 occurring after intervention. The CLABSI rate reduced dramatically from 1.6±0.05 in

Acta Biomed 2024; Vol. 95, N. 2: ISSN: 0392-4203 | eISSN: 2531-6745

	central line-associated bloodstream infections (CLABSIs) at the King Faisal Specialist Hospital and Research Center in Saudi Arabia.		the pre-intervention phase to 0.9±0.05 in the post-intervention phase, with a statistically significant reduction ($p<0.0001$) across all hospital settings. These findings show that the deployment of CL care bundles effectively lowered CLABSI rates in nearly all participating units, emphasizing the necessity of following best practices for CL insertion and maintenance.

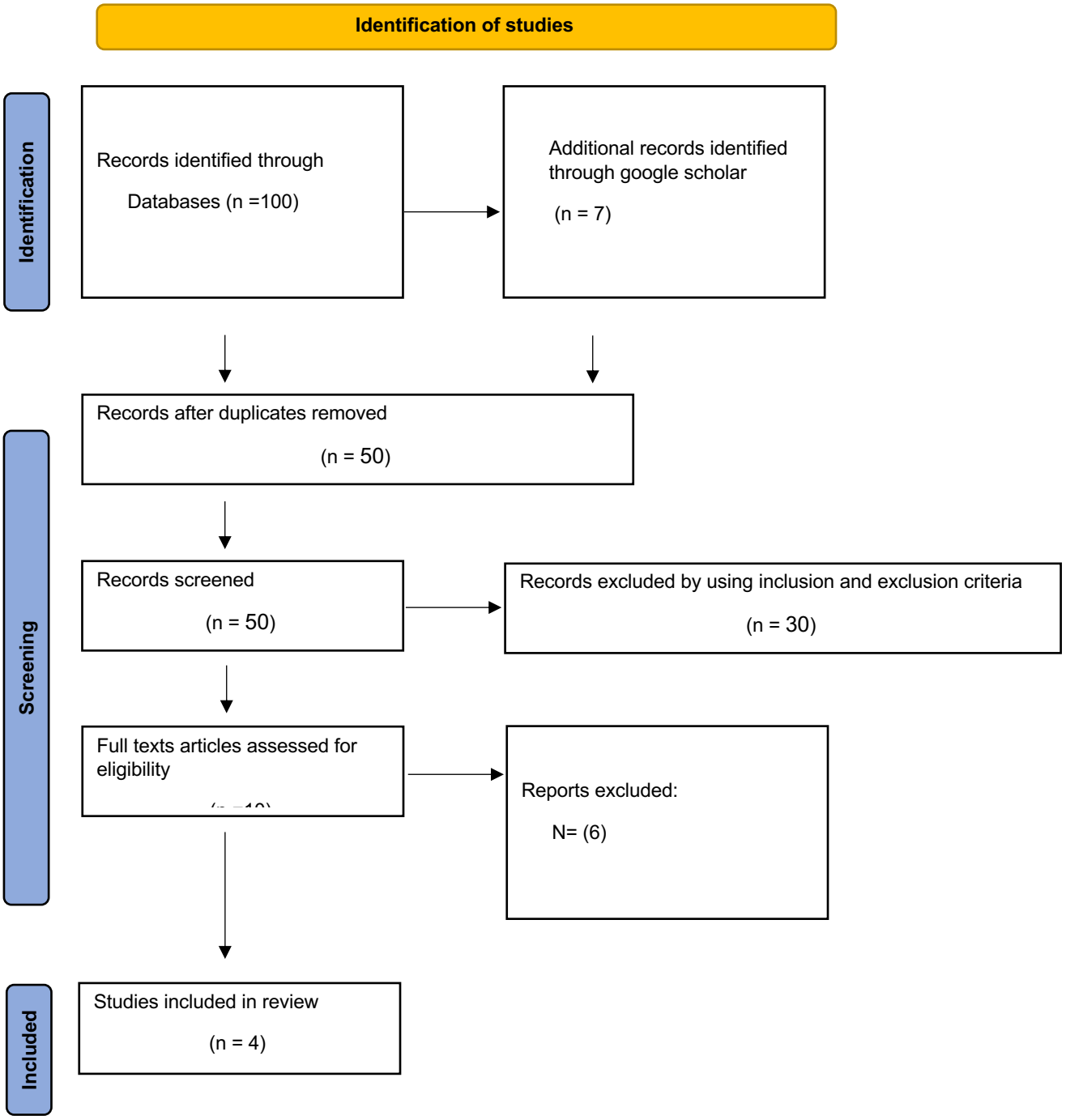

Fig. 1. PRISMA 2009 Flow Diagram

Acta Biomed 2024; Vol. 95, N. 2: ISSN: 0392-4203 | eISSN: 2531-6745

Discussion

Introduction

The management of central line-associated bloodstream infections (CLABSIs) is a major challenge in intensive care units (ICUs) around the world, especially in Saudi Arabia. This systematic review sought to compare the knowledge and practices of ICU nurses in Saudi Arabia to findings from worldwide research, detecting both similarities and variations in adherence to evidence-based guidelines for CLABSI prevention. Several studies shed light on the knowledge levels and behaviors of ICU nurses in Saudi Arabia, suggesting major areas for development despite some encouraging results.

Discussion

Saudi research, such as AlMalki et al. (2023), demonstrate severe knowledge gaps among ICU nurses in the Kingdom of Saudi Arabia, with an overall knowledge score of 71% and just 20% of nurses scoring above 90%. Despite a high proportion of nurses (85.9%) reporting prior training on CLABSI prevention guidelines, actual adherence to evidence-based treatments was alarmingly low, at only 5%. This mismatch highlights a crucial issue: knowledge does not translate into practice. In comparison, Al-Yateem et al. (2021) found that ICU nurses had a comparably appropriate level of expertise, indicating that instructional procedures or experience may vary across different ICU settings in Saudi Arabia.

In contrast, an international study conducted by Chi et al. (2020) on ICU nurses in China found a mean knowledge score of only 4.02 out of 11 items, indicating a concerning lack of adherence to established criteria. Similar to the findings in Saudi Arabia, a large percentage of Chinese nurses reported poor compliance with maximum barrier measures and antisepsis regimens. Such analogies highlight that low adherence to suggested measures is not limited to Saudi settings, but rather reflects a larger issue in global healthcare practices.

Both Saudi and foreign investigations have shown common hurdles to effective CLABSI prevention. The findings of the Saudi study reveal obstacles such as inadequate adherence to infection control methods and severe workloads, which are consistent with the challenges identified by Badparva et al. (2023) in Iran, where nurses mentioned limited resources and a lack of training as major difficulties. The Iranian study found that more than half of ICU nurses lacked appropriate knowledge on CLABSI prevention, which mirrors the knowledge gaps identified in KSA.

Furthermore, in a comprehensive study conducted at King Faisal Specialist Hospital and Research Center, Alhumaidan et al. (2024) found that standardized care packages lowered CLABSI rates after adoption. This successful intervention contrasts with findings by Chi et al. (2020) and Badparva et al. (2023), which found that nurses in other countries experienced major barriers to adhering to standards. The successful implementation in Saudi Arabia demonstrates that structured interventions can provide beneficial results, implying that, while knowledge is important, organizational support and methodical interventions are vital.

When nurses' perspectives about CLABSI prevention are compared across studies, an interesting contrast emerges. While nurses in Saudi Arabia were generally enthusiastic about CLABSI preventive guidelines (58% expressed willingness), actual adherence was dangerously low (5%). This contrasts with the findings of Al-Yateem et al. (2021), who found that ICU nurses had both sufficient knowledge and positive attitudes, implying that experience and education may play an important role in changing nurses' actions.

Internationally, Chi et al. (2020) found similar enthusiasm, but with considerable gaps in actual practice, demonstrating that good sentiments regarding guidelines do not necessarily translate into implementation. The statistics indicate a common feeling among nurses across geographies, highlighting the critical necessity for personalized educational programs that not only improve knowledge but also foster a culture of infection control adherence.

Conclusion

In conclusion, comparing ICU nurses' knowledge and actions in Saudi Arabia to those in foreign research gives vital insights into the major problems of successful CLABSI prevention. Addressing these difficulties through systematic training and organizational assistance is critical for closing the knowledge-practice gap and improving overall patient care in ICUs around the world.

Recommendations for Practice and Research

As a result, the findings emphasize the importance of multiple approaches to improving ICU nurses' knowledge, attitudes, and practice in Saudi Arabia and around the world. The findings demonstrate that, while knowledge levels may differ, the consistent obstacles faced by ICU nursing staff in adhering to CLABSI prevention protocols constitute a common thread across hospital systems. Future study should look at the particular elements that contribute to these knowledge-practice gaps, as well as contextual barriers in different hospital settings and the role of leadership and institutional culture on infection control protocol adherence. Furthermore, developing strong, standardized training programs based on successful interventions in KSA could improve knowledge application and, ultimately, patient safety results across a wide range of healthcare settings.

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