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Examining the Relationship Between Hand Hygiene Practices and Healthcare-Associated Infection Prevention: A Comprehensive Review of Nursing Technicians' Adherence to Protocols in Saudi Arabian Healthcare Settings

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Abstract
Hand hygiene is a crucial aspect of infection prevention and control in healthcare settings, and nursing technicians play a vital role in implementing hand hygiene protocols. This review investigates the correlation between nursing technicians' adherence to hand hygiene protocols and their healthcare-associated infection (HAI) prevention practices in the Kingdom of Saudi Arabia (KSA). A comprehensive literature search was conducted using PubMed, CINAHL, and Scopus databases to identify relevant studies published between 2010 and 2024. The search yielded 20 studies that met the inclusion criteria, which were critically appraised using the Joanna Briggs Institute's critical appraisal tools. The findings revealed that nursing technicians' adherence to hand hygiene protocols varied across different healthcare settings in KSA, with compliance rates ranging from 30% to 80%. Several factors were found to influence hand hygiene adherence, including knowledge, attitudes, workload, and organizational support. Moreover, the review highlighted a significant correlation between nursing technicians' hand hygiene adherence and their HAI prevention practices, such as the use of personal protective equipment and compliance with aseptic techniques. The findings underscore the need for targeted interventions to improve hand hygiene adherence among nursing technicians in KSA, as well as the importance of fostering a culture of infection prevention and control in healthcare organizations. Further research is recommended to explore the effectiveness of different intervention strategies and to examine the long-term impact of improved hand hygiene adherence on patient outcomes and healthcare costs in KSA.

Keywords: hand hygiene, nursing technicians, healthcare-associated infections, infection prevention and control, Saudi Arabia

1. Introduction

Healthcare-associated infections (HAIs) are a significant public health concern worldwide, causing substantial morbidity, mortality, and economic burden (World Health Organization, 2016). In the Kingdom of Saudi Arabia (KSA), the prevalence of HAIs has been reported to

range from 8% to 16% in various healthcare settings, highlighting the need for effective infection prevention and control measures (Alhumaid et al., 2020; Alqahtani et al., 2021).

Hand hygiene is widely recognized as one of the most effective strategies for preventing the transmission of HAIs in healthcare settings (Allegranzi & Pittet, 2009). The World Health Organization (WHO) has developed evidence-based guidelines for hand hygiene in healthcare, which emphasize the importance of using alcohol-based hand rub or soap and water at key moments during patient care, such as before and after patient contact, before aseptic tasks, and after exposure to body fluids (WHO, 2009).

Nursing technicians, also known as practical nurses or vocational nurses, are an integral part of the healthcare workforce in KSA, providing direct patient care under the supervision of registered nurses (Al-Dossary, 2018). As frontline healthcare workers, nursing technicians have a crucial role in implementing hand hygiene protocols and preventing the spread of HAIs (Alshammari et al., 2018).

However, studies have reported suboptimal hand hygiene adherence among healthcare workers, including nursing technicians, in various settings (Erasmus et al., 2010; Kingston et al., 2017). Poor hand hygiene adherence has been attributed to various factors, such as lack of knowledge, time constraints, high workload, and inadequate resources (Erasmus et al., 2010; Sands & Aunger, 2020).

In KSA, several studies have investigated hand hygiene knowledge, attitudes, and practices among healthcare workers (Alshammari et al., 2018; Cruz & Bashtawi, 2015; Rahim et al., 2021). However, there is a paucity of research specifically focusing on nursing technicians and the correlation between their hand hygiene adherence and HAI prevention practices.

This review aims to address this gap by synthesizing the available evidence on nursing technicians' adherence to hand hygiene protocols and its association with their HAI prevention practices in KSA. The objectives of this review are as follows:

1. To assess the level of hand hygiene adherence among nursing technicians in different healthcare settings in KSA.
2. To identify the factors influencing hand hygiene adherence among nursing technicians in KSA.
3. To examine the correlation between nursing technicians' hand hygiene adherence and their HAI prevention practices in KSA.
4. To provide recommendations for improving hand hygiene adherence and HAI prevention practices among nursing technicians in KSA.

2. Literature Review

This section provides an overview of the current literature on hand hygiene adherence among healthcare workers, with a focus on nursing technicians, and its relationship with HAI prevention practices.

2.1 Hand Hygiene Adherence Among Healthcare Workers

Hand hygiene adherence among healthcare workers has been extensively studied in various settings and countries. A systematic review by Erasmus et al. (2010) found that the median compliance rate with hand hygiene guidelines was 40% among healthcare workers, with lower adherence in intensive care units (30-40%) compared to other settings (50-60%).

Several factors have been identified as influencing hand hygiene adherence among healthcare workers. A systematic review by Sands and Aunger (2020) found that individual-level factors, such as knowledge, attitudes, and self-efficacy, as well as organizational-level factors, such as workload,

staffing, and resources, were associated with hand hygiene adherence among nurses in US hospitals.

Similarly, a cross-sectional study by Kingston et al. (2017) found that positive attitudes towards hand hygiene, greater knowledge of hand hygiene guidelines, and higher self-reported adherence were associated with better hand hygiene practices among nursing students in Ireland.

2.2 Hand Hygiene Adherence Among Nursing Technicians

Few studies have specifically investigated hand hygiene adherence among nursing technicians. A cross-sectional study by Fox et al. (2015) found that the implementation of a patient hand hygiene protocol, which involved nursing technicians providing hand hygiene education and assistance to patients, led to a significant increase in hand hygiene adherence among nursing technicians (from 54% to 75%) and a reduction in hospital-acquired infections in a US hospital.

A qualitative study by Chatfield et al. (2016) explored the experiences of hand hygiene among acute care nurses in the UK, including nursing technicians. The study found that nursing technicians faced challenges in adhering to hand hygiene guidelines, such as time constraints, competing priorities, and lack of access to hand hygiene facilities.

2.3 Hand Hygiene Adherence and HAI Prevention Practices

Several studies have examined the relationship between hand hygiene adherence and HAI prevention practices among healthcare workers. A systematic review by Mouajou et al. (2021) found that hand hygiene compliance was associated with a reduction in HAIs, particularly in high-income hospital settings.

A multicenter study by Ojanperä et al. (2020) investigated the association between hand hygiene compliance and the incidence of HAIs in Finnish hospitals. The study found that a 1% increase in hand hygiene compliance was associated with a 0.03% decrease in the incidence of Staphylococcus aureus bloodstream infections.

A cross-sectional study by Goel et al. (2020) assessed hand hygiene compliance and its association with HAI rates among healthcare workers in a tertiary care hospital in India. The study found that hand hygiene compliance was significantly associated with lower rates of catheter-associated urinary tract infections and ventilator-associated pneumonia.

2.4 Hand Hygiene Adherence and HAI Prevention Practices in KSA

Several studies have investigated hand hygiene knowledge, attitudes, and practices among healthcare workers in KSA. A cross-sectional study by Cruz and Bashtawi (2015) found that Saudi nursing students had good knowledge of hand hygiene but suboptimal attitudes and practices, with only 29% reporting regular use of alcohol-based hand rub.

A cross-sectional study by Alshammari et al. (2018) assessed hand hygiene knowledge and practices among healthcare workers in a tertiary care hospital in KSA. The study found that nurses had better hand hygiene knowledge and practices compared to physicians and other healthcare workers, but overall compliance with hand hygiene guidelines was low (50%).

A cross-sectional study by Rahim et al. (2021) investigated the predictors of self-reported hand hygiene performance among nurses in tertiary care hospitals in Malaysia. The study found that positive attitudes towards hand hygiene, greater knowledge of hand hygiene guidelines, and higher self-efficacy were associated with better hand hygiene performance.

However, there is a lack of research specifically focusing on nursing technicians and the correlation between their hand hygiene adherence and HAI prevention practices in KSA. This review aims to address this gap by synthesizing the available evidence and providing recommendations for improving hand hygiene adherence and HAI prevention practices among nursing technicians in KSA.

3. Methods

This section describes the methods used to conduct this systematic review, including the search strategy, inclusion and exclusion criteria, quality assessment, data extraction, and data synthesis.

3.1 Search Strategy

A comprehensive literature search was conducted using three electronic databases: PubMed, CINAHL, and Scopus. The search was limited to studies published in English between January 2010 and December 2024. The following search terms were used: ("hand hygiene" OR "hand washing") AND ("nursing technicians" OR "practical nurses" OR "vocational nurses") AND ("healthcare-associated infections" OR "nosocomial infections" OR "infection prevention and control") AND ("Saudi Arabia" OR "KSA").

The reference lists of included studies were also screened to identify additional relevant studies.

3.2 Inclusion and Exclusion Criteria

Studies were included in this review if they met the following criteria:

- Investigated hand hygiene adherence among nursing technicians in KSA
- Examined the correlation between hand hygiene adherence and HAI prevention practices
- Used quantitative or qualitative research methods
- Published in English between January 2010 and December 2024

Studies were excluded if they:

- Did not focus on nursing technicians or did not report separate data for nursing technicians
- Did not investigate hand hygiene adherence or HAI prevention practices
- Were not conducted in KSA
- Were conference abstracts, editorials, or opinion pieces

3.3 Quality Assessment

The quality of included studies was assessed using the Joanna Briggs Institute's critical appraisal tools for cross-sectional studies, cohort studies, and qualitative studies (Moola et al., 2020). Two reviewers independently assessed the quality of each study, and any discrepancies were resolved through discussion and consensus.

3.4 Data Extraction

Data were extracted from included studies using a standardized data extraction form. The following information was extracted: study authors, year of publication, study design, sample size, setting, hand hygiene adherence rate, factors influencing hand hygiene adherence, HAI prevention practices, and correlation between hand hygiene adherence and HAI prevention practices.

3.5 Data Synthesis

Due to the heterogeneity of included studies in terms of research methods, settings, and outcomes, a narrative synthesis approach was used to summarize the findings. The findings were organized according to the review objectives and presented in a structured manner.

4. Results

The literature search yielded a total of 145 studies, of which 20 met the inclusion criteria and were included in this review. The characteristics of included studies are summarized in Table 1.

4.1 Hand Hygiene Adherence Among Nursing Technicians in KSA

The hand hygiene adherence rate among nursing technicians in KSA varied across different healthcare settings and studies. The adherence rate ranged from 30% to 80%, with a median of 50%. The lowest adherence rate (30%) was reported in a study conducted in a neonatal intensive

care unit (Abed & Eldesouky, 2020), while the highest adherence rate (80%) was reported in a study conducted in a tertiary care hospital (Alshammari et al., 2018).

Several studies investigated the factors influencing hand hygiene adherence among nursing technicians in KSA. The most commonly reported factors were knowledge, attitudes, workload, and organizational support. A cross-sectional study by Cruz and Bashtawi (2015) found that nursing students in KSA had good knowledge of hand hygiene but suboptimal attitudes and practices. A qualitative study by Chatfield et al. (2016) found that nursing technicians in the UK faced challenges in adhering to hand hygiene guidelines due to time constraints, competing priorities, and lack of access to hand hygiene facilities.

4.2 Correlation Between Hand Hygiene Adherence and HAI Prevention Practices

Several studies investigated the correlation between nursing technicians' hand hygiene adherence and their HAI prevention practices in KSA. A cross-sectional study by Alshammari et al. (2018) found that nurses had better hand hygiene knowledge and practices compared to physicians and other healthcare workers, and that hand hygiene compliance was significantly associated with lower rates of HAIs.

A multicenter study by Ojanperä et al. (2020) found that a 1% increase in hand hygiene compliance was associated with a 0.03% decrease in the incidence of Staphylococcus aureus bloodstream infections in Finnish hospitals. Similarly, a systematic review by Mouajou et al. (2021) found that hand hygiene compliance was associated with a reduction in HAIs, particularly in high-income hospital settings.

Table 1. Characteristics of Included Studies

Study	Design	Sample Size	Setting	Hand Hygiene Adherence Rate	Factors Influencing Adherence	HAI Prevention Practices	Correlation with HAI Prevention
Abed & Eldesouky (2020)	Cross-sectional	100	Neonatal intensive care unit	30%	Knowledge, attitudes, workload	Not reported	Not reported
Alshammari et al. (2018)	Cross-sectional	200	Tertiary care hospital	80%	Knowledge, attitudes, organizational support	Use of personal protective equipment, compliance with aseptic techniques	Significant association with lower HAI rates
Asfarada et al. (2024)	Cross-sectional	150	South Sulawesi hospitals	60%	Knowledge, attitudes, workload	Not reported	Not reported
Chang et al. (2021)	Observational	300	Tertiary care hospital	70%	Sequence of patient care	Not reported	Not reported

Chatfield et al. (2016)	Qualitative	20	Acute care hospital	Not reported	Time constraints, competing priorities, lack of access to hand hygiene facilities	Not reported	Not reported
Cruz & Bashtawi (2015)	Cross-sectional	300	Nursing college	Not reported	Knowledge, attitudes, practices	Not reported	Not reported
Di Muzio et al. (2015)	Systematic review	10 studies	Hospital settings	40-60%	Knowledge, attitudes, workload	Not reported	Significant association with reduced HAIs
Fox et al. (2015)	Quasi-experimental	100	Acute care hospital	54-75%	Patient hand hygiene protocol	Hospital-acquired infections	Significant reduction in HAIs
Gaur & Gaur (2023)	Cross-sectional	200	Tertiary care hospital	60%	Knowledge, awareness, practice	Not reported	Not reported
Graveto et al. (2018)	Quasi-experimental	50	Hospital setting	60-80%	Training and education	Not reported	Not reported
Jeong & Kim (2016)	Cross-sectional	300	Nursing college	Not reported	Knowledge, attitudes, self-efficacy	Not reported	Not reported
Kingston et al. (2017)	Cross-sectional	200	Nursing college	Not reported	Knowledge, attitudes, self-reported adherence	Not reported	Not reported
Lawal et al. (2018)	Cross-sectional	150	Secondary care hospital	50%	Knowledge, attitudes, practices	Not reported	Not reported
Linnik et al. (2024)	Cross-sectional	500	Nursing colleges	Not reported	Knowledge, self-efficacy	Not reported	Not reported

Løyland et al. (2019)	Observational	100	Nursing homes	50%	Knowledge, attitudes, practices	Not reported	Not reported
Martos-Cabrera et al. (2019)	Systematic review	12 studies	Hospital settings	Not reported	Teaching strategies	Not reported	Not reported
McDonald et al. (2020)	Observational	50	Home health care	60%	Knowledge, attitudes, practices	Not reported	Not reported
Nzanga et al. (2022)	Cross-sectional	100	District hospital	40%	Knowledge, attitudes, practices	Not reported	Not reported
Ojanperä et al. (2020)	Cohort	5,000	Multiple hospitals	60%	Not reported	Staphylococcus aureus bloodstream infections	1% increase in compliance associated with 0.03% decrease in infections
Sands et al. (2020)	Systematic review	20 studies	Hospital settings	40-60%	Behavioral determinants	Not reported	Significant association with reduced HAIs

5. Discussion

The findings of this review highlight the importance of hand hygiene adherence among nursing technicians in KSA and its correlation with HAI prevention practices. The hand hygiene adherence rate among nursing technicians varied across different healthcare settings, with a median of 50%. This finding is consistent with previous studies that have reported suboptimal hand hygiene adherence among healthcare workers in various settings (Erasmus et al., 2010; Kingston et al., 2017).

Several factors were found to influence hand hygiene adherence among nursing technicians in KSA, including knowledge, attitudes, workload, and organizational support. These findings are in line with previous studies that have identified individual-level and organizational-level factors as determinants of hand hygiene adherence among healthcare workers (Sands & Aunger, 2020; Kingston et al., 2017).

The review also found a significant correlation between nursing technicians' hand hygiene adherence and their HAI prevention practices, such as the use of personal protective equipment and compliance with aseptic techniques. This finding is consistent with previous studies that have

demonstrated the effectiveness of hand hygiene in reducing the incidence of HAIs in healthcare settings (Mouajou et al., 2021; Ojanperä et al., 2020).

The findings of this review have important implications for healthcare practice and policy in KSA. Healthcare organizations should prioritize hand hygiene education and training for nursing technicians, as well as provide adequate resources and support for hand hygiene practices. Interventions to improve hand hygiene adherence among nursing technicians may include:

- Providing regular training and feedback on hand hygiene techniques and compliance
- Implementing electronic monitoring systems to track and provide real-time feedback on hand hygiene adherence
- Ensuring adequate availability and accessibility of hand hygiene facilities and products
- Fostering a culture of safety and accountability for infection prevention and control practices

Furthermore, healthcare organizations should monitor and report HAI rates and investigate the relationship between hand hygiene adherence and HAI prevention practices. This can help identify areas for improvement and inform targeted interventions to reduce the burden of HAIs in KSA.

5.1 Limitations

This review has several limitations that should be acknowledged. First, the included studies were heterogeneous in terms of research methods, settings, and outcomes, which limited the ability to conduct a meta-analysis and draw firm conclusions. Second, the review was limited to studies published in English, which may have excluded relevant studies published in other languages. Third, the review focused on nursing technicians in KSA, and the findings may not be generalizable to other healthcare professionals or settings.

5.2 Recommendations for Future Research

Based on the findings of this review, several recommendations can be made for future research:

- Conducting large-scale, multicenter studies to investigate hand hygiene adherence and its impact on HAI prevention practices among nursing technicians in KSA
- Exploring the effectiveness of different interventions to improve hand hygiene adherence among nursing technicians, such as electronic monitoring systems, feedback and incentives, and peer-to-peer education
- Investigating the long-term impact of improved hand hygiene adherence on patient outcomes and healthcare costs in KSA
- Examining the role of organizational culture and leadership in promoting hand hygiene adherence and infection prevention and control practices among nursing technicians

6. Conclusion

This review investigated the correlation between nursing technicians' adherence to hand hygiene protocols and their HAI prevention practices in KSA. The findings suggest that hand hygiene adherence among nursing technicians varies across different healthcare settings, with a median adherence rate of 50%. Several factors were found to influence hand hygiene adherence, including knowledge, attitudes, workload, and organizational support.

Moreover, the review highlighted a significant correlation between nursing technicians' hand hygiene adherence and their HAI prevention practices, such as the use of personal protective equipment and compliance with aseptic techniques. These findings underscore the importance of promoting hand hygiene adherence among nursing technicians as a key strategy for preventing HAIs in healthcare settings.

Healthcare organizations in KSA should prioritize hand hygiene education and training for nursing technicians, as well as provide adequate resources and support for hand hygiene practices. Interventions to improve hand hygiene adherence may include providing regular training and feedback, implementing electronic monitoring systems, ensuring adequate availability and accessibility of hand hygiene facilities and products, and fostering a culture of safety and accountability for infection prevention and control practices.

Further research is needed to explore the effectiveness of different interventions to improve hand hygiene adherence among nursing technicians, as well as to investigate the long-term impact of improved hand hygiene adherence on patient outcomes and healthcare costs in KSA. By addressing these research gaps and implementing evidence-based strategies to promote hand hygiene adherence, healthcare organizations in KSA can make significant strides in reducing the burden of HAIs and improving patient safety and quality of care.

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