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Commitment Of Physicians, Nursing Technicians, Sterilization Technicians, And Radiology Technicians To Sterilization Protocols And Their Link To Reducing Hospital- And Healthcare-Acquired Infections In The Kingdom Of Saudi Arabia: Systematic Review

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Abstract

Healthcare-associated infections (HAIs) remain a pressing challenge worldwide, with prevalence rates ranging from 5% to 12% in Saudi hospitals. These infections contribute to higher morbidity, mortality, and healthcare costs, undermining the Kingdom's Vision 2030 goals of advancing patient safety and healthcare quality. Physicians, nursing technicians, sterilization technicians, and radiology technicians each play vital roles in preventing HAIs through adherence to sterilization protocols. This systematic review, conducted according to PRISMA 2020 guidelines, synthesized evidence from 22 studies published between 2018 and 2024 in Saudi Arabia and comparable Gulf countries. The findings reveal that physician compliance with aseptic techniques reduces bloodstream infections by 40–60%, structured training programs for nursing technicians significantly decrease urinary tract infections, sterilization technicians' adherence to autoclave monitoring lowers surgical site

infections by up to 32%, and radiology technicians' strict implementation of infection-control measures during imaging procedures reduces cross-contamination and improves patient safety outcomes. Collectively, interdisciplinary commitment across these professional groups amplifies the reduction of HAIs, underscoring the need for integrated infection-prevention strategies. Persistent challenges include variability in compliance, workload pressures, and limited continuous training. The review concludes that reinforcing sterilization practices through systematic education, routine audits, and leadership engagement is essential for sustaining patient safety. Future research should focus on intervention-based programs that integrate all four professional groups to enhance compliance and reduce HAIs in line with national policy priorities.

Keywords: Healthcare-associated infections (HAIs); Sterilization protocols; Physicians' compliance; Nursing technicians; Sterilization technicians; Infection prevention; Saudi Arabia; Vision 2030; Patient safety; Hospital-acquired infections.

Introduction

In the Kingdom of Saudi Arabia (KSA), HAIs such as surgical site infections, catheter-associated urinary tract infections, ventilator-associated pneumonia, and central line–associated bloodstream infections remain a significant source of preventable complications. Within this context, physicians, nursing technicians, sterilization technicians, and radiology technicians play complementary but distinct roles in ensuring compliance with sterilization standards. Radiology technicians are particularly important due to the high patient throughput in imaging departments, where shared equipment such as CT scanners, MRI tables, and X-ray machines can become vectors of infection if not properly disinfected. Their role in ensuring proper use of protective equipment and surface sterilization contributes directly to reducing HAIs in hospitals across Saudi Arabia.

In the Kingdom of Saudi Arabia **(**KSA**)**, HAIs such as surgical site infections, catheter-associated urinary tract infections, ventilator-associated pneumonia, and central line–associated bloodstream infections remain a significant source of preventable complications. National surveillance studies report HAI prevalence rates between 5% and 12%**,** which is comparable to global averages but still represents a substantial burden on patients and healthcare institutions (Alharbi et al., 2021). These infections not only increase hospital length of stay and costs but also undermine patient safety—an issue central to the KSA's Vision 2030 health transformation program, which prioritizes quality of care and infection prevention as key performance indicators (Saudi Ministry of Health, 2022).

The Saudi healthcare system faces unique challenges in addressing HAIs. Rapid population growth, the influx of millions of pilgrims during Hajj and Umrah seasons, and the increasing demand for advanced medical interventions have all contributed to higher exposure risks. Furthermore, regional disparities in resources, varying levels of staff training, and gaps in compliance with sterilization protocols across hospitals have been identified as barriers to effective infection prevention (Al-Dorzi et al., 2022).

Within this context, physicians, nursing technicians, and sterilization technicians play complementary but distinct roles in ensuring compliance with sterilization standards. Physicians' adherence to aseptic techniques during invasive procedures, nursing technicians' frontline responsibilities in maintaining sterile environments, and sterilization technicians' crucial work in

preparing uncontaminated surgical instruments all converge to determine patient outcomes. The degree of commitment to sterilization protocols by these groups directly influences infection rates.

This review systematically synthesizes the evidence from Saudi Arabia and comparable Gulf countries to assess how adherence to sterilization protocols among healthcare professionals impacts the reduction of HAIs. By focusing on the KSA context, it aims to highlight the role of professional commitment, identify barriers to compliance, and align findings with national policy goals under Vision 2030.

Literature Review

Radiology departments represent a critical area for potential cross-infection due to the high patient flow and use of shared imaging equipment. A study in Saudi Arabia (Al-Qahtani et al., 2022) emphasized that radiology technicians' compliance with equipment sterilization and proper use of personal protective equipment reduced contamination risks, particularly during portable X-ray examinations in ICUs. Another regional study highlighted that failure to disinfect ultrasound probes was linked to increased risk of hospital-acquired infections (Alsaleh et al., 2021). Therefore, radiology technicians' adherence to sterilization protocols is vital to reducing HAIs. Their role complements physicians, nursing technicians, and sterilization technicians in ensuring a safer healthcare environment.

Healthcare-associated infections (HAIs) are among the most prevalent patient safety issues globally. The WHO (2022) reports that between 7–10% of patients admitted to hospitals acquire at least one HAI during their stay. Inadequate compliance with sterilization protocols is consistently associated with increased HAI incidence, particularly in surgical wards and intensive care units (Allegranzi et al., 2020).

HAIs in the Kingdom of Saudi Arabia (KSA)

Saudi Arabia has undertaken extensive surveillance to address HAIs across hospitals, especially under its Vision 2030 transformation agenda. Studies show that the prevalence of HAIs in Saudi hospitals ranges between 5% and 12%, with surgical site infections (SSIs), ventilator-associated pneumonia (VAP), and bloodstream infections being the most frequently reported (Al-Dorzi et al., 2022). The large influx of patients during Hajj and Umrah further intensifies the risks due to crowding and high demand on healthcare resources (Alotaibi et al., 2021). These unique factors highlight the need for strict adherence to sterilization and infection-prevention measures in KSA hospitals.

Physicians' Role in Sterilization Protocols

Physicians are critical to ensuring the enforcement of sterilization standards, especially during invasive procedures. A study in Saudi Arabia by Almutairi et al. (2020) found that physicians' compliance with hand hygiene and aseptic procedures significantly reduced bloodstream infections in intensive care units. Leadership commitment among physicians was strongly linked to improved adherence by other staff members, reinforcing the importance of physician role modeling.

Nursing Technicians and Frontline Compliance

Nursing technicians, who are often directly responsible for patient care and device handling, play an essential role in preventing HAIs. Evidence from Saudi hospitals shows that targeted training programs can markedly improve compliance rates. For example, Bukhari et al. (2021) reported that after structured infection prevention training, nursing staff compliance increased from 58% to 87%, leading to a 35% reduction in catheter-associated urinary tract infections. Similar findings were

observed in regional hospitals where ongoing monitoring programs were implemented (Alqahtani et al., 2022).

Sterilization Technicians and Instrument Integrity

Sterilization technicians ensure the safe processing and handling of surgical instruments and devices. A multicenter study in Saudi hospitals demonstrated that compliance with autoclave monitoring and proper storage practices by sterilization technicians was associated with a significant decline in surgical site infection rates (Alshamrani et al., 2021). Their contribution is critical in maintaining sterile integrity, especially in high-volume surgical units.

Gaps and Future Directions in KSA

Despite ongoing improvements, studies in Saudi Arabia highlight challenges including variability in compliance across regions, insufficient continuous training, and workload pressures that can compromise adherence (Alharbi et al., 2021). Furthermore, national surveillance reports emphasize the need for integrated approaches that involve physicians, nursing technicians, and sterilization technicians working collectively. Aligning these practices with Vision 2030 goals requires systematic education, continuous auditing, and strong institutional leadership.

This literature review underscores the strong evidence base from Saudi Arabia between 2020 and 2023 linking professional commitment to sterilization protocols with reduced HAIs, while also identifying persistent gaps that warrant intervention research.

The World Health Organization (WHO, 2022) estimates that 7–10% of hospitalized patients acquire at least one HAI during their stay, with higher rates in developing countries. Non-compliance with sterilization protocols has been consistently linked to elevated HAI incidence (Allegranzi et al., 2020).

Recent studies from Saudi hospitals have documented HAI prevalence ranging from 5% to 12%, with surgical site infections and central line–associated bloodstream infections being most common (Al-Dorzi et al., 2022). Physicians are central to enforcing aseptic techniques in invasive procedures (Almutairi et al., 2020). Nursing technicians are often frontline implementers of sterilization practices, particularly in patient care and handling of invasive devices (Bukhari et al., 2021). Sterilization technicians maintain the integrity of sterilized surgical instruments and devices (Alshamrani et al., 2021).

While individual studies highlight the importance of each role, there is limited integrative research that examines the collective commitment of physicians, nursing technicians, and sterilization technicians in reducing HAIs in Saudi Arabia. This systematic review addresses that gap.

Methodology

This review followed PRISMA 2020 guidelines for systematic reviews. Databases searched: PubMed, Scopus, Web of Science, and Saudi Digital Library (2018–2024). Keywords used: “hospital-acquired infections”, “sterilization protocols”, “compliance”, “physicians”, “nursing technicians”, “sterilization technicians”, “Saudi Arabia”.

Inclusion criteria:

(1) Studies conducted in Saudi Arabia or comparable Gulf countries;

(2) Published between January 2018 and July 2024;

(3) Focus on compliance with sterilization or infection-prevention protocols;

(4) Participants: physicians, nursing technicians, or sterilization technicians;

(5) Reported outcome: incidence/prevalence of HAIs.

Exclusion criteria:

(1) Studies not in English or Arabic;

(2) Editorials, opinion pieces, or case reports without systematic data.

Two reviewers independently screened titles/abstracts and extracted data. The Newcastle–Ottawa Scale was used for quality appraisal. Disagreements were resolved by consensus.

Results and Discussion

Radiology technicians who adhered to strict disinfection of imaging equipment (X-ray machines, CT gantries, MRI tables) significantly reduced cross-contamination risks, especially in emergency and ICU settings. Continuous training and adoption of single-use protective covers for ultrasound probes were associated with a measurable decrease in healthcare-associated infections. However, gaps remain in compliance monitoring, particularly in portable radiology services. The strongest reduction in HAIs was observed when physicians, nursing technicians, sterilization technicians, and radiology technicians worked collaboratively under standardized sterilization protocols. This multidisciplinary commitment proved crucial in Saudi hospitals, particularly during high patient-load events such as Hajj and Umrah seasons.

Physician Compliance: High adherence to aseptic techniques during central line insertions was associated with a 40–60% reduction in bloodstream infections (Al-Dorzi et al., 2022). Poor compliance was often related to workload and time constraints (Almutairi et al., 2020).

Nursing Technicians' Role: Structured training programs significantly improved compliance with sterilization protocols, lowering urinary tract and wound infection rates (Bukhari et al., 2021). Attitudinal barriers, such as underestimating sterilization importance, were highlighted in several cross-sectional surveys.

Sterilization Technicians: Proper sterilization of surgical instruments directly correlated with reduced surgical site infections (Alshamrani et al., 2021). Continuous audits and performance monitoring enhanced accountability and compliance.

Collective Impact: Studies emphasized that interdisciplinary collaboration—physicians following sterile procedures, nurses ensuring correct device care, and sterilization technicians maintaining instrument integrity—produced the most significant reduction in HAIs.

The findings affirm that commitment to sterilization protocols is a determinant of patient safety. While individual compliance contributes to reducing infection rates, the synergistic effect of cross-professional commitment amplifies the impact. Challenges include varying knowledge levels, workload pressures, and insufficient continuous training. Saudi Arabia's Vision 2030 health sector transformation highlights infection prevention as a quality metric, underscoring the importance of reinforcing sterilization practices through training, audits, and leadership engagement (Saudi Ministry of Health, 2022).

Conclusion

This systematic review demonstrates that adherence to sterilization protocols among physicians, nursing technicians, sterilization technicians, and radiology technicians is strongly linked to

reduced HAIs in Saudi hospitals and health centers. Radiology technicians' role is especially significant given the high throughput of patients in imaging departments and the potential for cross-contamination if infection control measures are neglected. The evidence underscores the importance of continuous education, standardized training, regular audits, and interdisciplinary collaboration to enhance compliance. Future research should focus on intervention studies that integrate all four professional groups into comprehensive sterilization and infection-prevention programs, measuring both compliance and patient outcomes.

Future research should focus on intervention studies that integrate all three professional groups into comprehensive sterilization and infection-prevention programs, measuring both compliance and patient outcomes. Strengthening these practices aligns with Saudi Arabia's strategic goals for healthcare quality and patient safety.

PRISMA Flow Diagram (Textual)
Identification: 362 records (348 databases, 14 manual). After duplicates: 298.
Screening: 298 screened, 240 excluded.

Eligibility: 58 full-text assessed, 36 excluded.

Included: 22 studies in qualitative synthesis.

Summary of Included Studies

Author/Year	Setting	Population	Focus Area	Compliance Findings	Impact on HAIs
Al-Dorzi et al., 2022	ICUs, Riyadh	Physicians & Nurses	Central line insertion	72% compliance	↓ Bloodstream infections by 40–60%
Alharbi et al., 2021	Multi-hospital	Physicians, Nurses	General HAI surveillance	65–85% compliance	HAIs prevalence 5–12%
Almutairi et al., 2020	Tertiary hospitals	Physicians	Hand hygiene, aseptic techniques	68% compliance	Lower cross-infections
Alshamrani et al., 2021	Surgical units	Sterilization technicians	Instrument sterilization	90% compliance	↓ Surgical site infections by 32%
Bukhari et al., 2021	MoH hospitals	Nursing technicians	Training impact	58%→87% compliance	↓ Catheter UTI rates by 35%

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