World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Compliance with hand disinfection practices in the operating rooms: An observational study

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World Journal of Advanced Research and Reviews, 2025, 28(01), 502-508

Publication history: Received on 30 August 2025; revised on 05 October 2025; accepted on 07 October 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.28.1.3445

Abstract

Background: Hand hygiene (HH) using alcohol-based hand rub is critical for preventing surgical site infections. Despite multiple HH opportunities during perioperative care, compliance among operation room staff remains unclear.

Objectives: This study aimed to observe HH compliance among surgical and anesthesia and nursing staff in operating theatres at a governmental hospital in Jordan offering general and speciality surgeries.

Methods: A trained observers assessed HH compliance based on the WHO's "My 5 Moments for Hand Hygiene" (WHO-5) model. A total of 930 HH opportunities were recorded. Chi-square test and cross-tabulations were used to comparing occupational groups and medical specialties.

Results: Of the 930 observed opportunities, 46.2% were compliant. HH compliance was highest after body fluid exposure (55.9%) and lowest after contact with patient surroundings (33.0%). Most observations (72.8%) occurred inside the operating room. Significant differences in compliance were observed between males and females.

Conclusion: Although healthcare professionals understand the importance of HH, high workload and overlapping procedures hinder compliance. Hospital management should implement targeted interventions and stricter monitoring to improve HH adherence in surgical settings.

Nursing implication: Nurses should prioritize hand hygiene compliance by integrating it into workflow routines despite high workloads, thereby reducing surgical site infections and enhancing patient safety.

Keywords: Hand hygiene; Compliance; Observational Study; Operation Rooms; Operation Rooms Staff

1. Introduction

The recent prevalence of healthcare-associated infections (HCAIs) is a major public health concern (1). Hand hygiene (HH) is considered the cornerstone in reducing infection rates in the operating room, preventing HCAIs, and mitigating microorganism resistance (2). Despite its proven benefits, HH compliance in healthcare settings—including operating rooms—has historically been poor (3). Alcohol-based hand rub (ABHR) solutions were introduced as effective and convenient alternatives to traditional hand washing, offering rapid sanitization to eliminate pathogens (4).

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Although healthcare settings deliver complex services to large patient populations, HH compliance remains suboptimal and requires improvement (5,6) .The intraoperative environment particularly poses a high risk for the development of hospital-acquired infections, with failure to adhere to infection prevention protocols often leading to cross-infection (7). In this context, the WHO's "My 5 Moments for Hand Hygiene" model offers a structured approach to minimize contamination and prevent surgical site infections (8).

Despite reports indicating that surgical site infections (SSIs) affect between 0.5% and 3% of surgical patients (3) . Many of these cases are preventable with better HH practices. However, in low- and middle-income countries, reliable data on HH compliance is limited (9) and variations in SSI rates are often linked to policy implementation, staff workload, training, and adopted guidelines (10). Therefore, this study aims to assess HH compliance in the perioperative setting of a Jordanian clinic, comparing occupational groups (nurses vs. physicians) and medical specialties (surgery vs. anesthesia). To our knowledge, this is the first local study to explore the interaction between HH and work-related factors in the operating room environment.

Hand Hygiene (HH) using Alcohol-based hand rub (ABHR) is regarded as the most cost-effective intervention to prevent surgical site infections and ensure aseptic practice (11). In an observational study covering 1145 HH opportunities during 16 surgeries, reported a low compliance rate of 40.8%, emphasizing the urgent need for improvement in operating rooms (5). This underlines the essential role of hand disinfection practices in achieving low-cost, infection-free surgical services and better patient outcomes (12).

The WHO-5 model specifically recommends HH during critical perioperative phases—such as anesthesia induction, patient transport, and immediate postoperative care—to prevent contamination of hands and instruments (8) . However, studies have shown that compliance with this model is generally poor in surgical settings (13 ,14). Contributing factors include high workload, overlapping responsibilities, and inefficient workflow systems that hinder adherence to HH protocols.

In Jordan, no published studies were found assessing HH compliance using the WHO-5 model in perioperative contexts. Thus, there is a pressing need to gather baseline data and investigate how occupational roles and work environments affect HH practices in local surgical settings. This gap in knowledge limits the development of effective infection control interventions tailored to the specific challenges of Jordan's healthcare infrastructure. Consequently, this observational study aimed to evaluate the adherence of surgical teams to hand hygiene using alcoholic hand rub solutions as recommended by WHO- 5 in the operation rooms. This study also aimed to identify the differences among surgical team adherence with WHO-5 recommendations for hand hygiene based on certain demographic variables (i.e. gender and specialty).

2. Methods

2.1. Study Design

A prospective observational study was conducted using a covert approach to assess hand hygiene compliance among surgical staff in a governmental hospital in (XXXXX). The hospital offers a variety of surgical specialties, including general surgery, urology, pediatric surgery, and neurosurgery. A total of 11 operating rooms, located in a restricted area, were included in the study. Elective surgeries were conducted during official working hours. A convenience sampling technique was employed to recruit study participants.

2.2. Measurements

Hand hygiene compliance was assessed using the World Health Organization's Five Moments for Hand Hygiene (WHO-5), which include: (1) before patient contact, (2) before an aseptic task, (3) after body fluid exposure risk, (4) after patient contact, and (5) after contact with patient surroundings. Compliance observations targeted multiple healthcare worker categories: surgeons (n = 38), anesthesiologists (n = 23), operating room nurses (n = 49), and anesthesia nurses (n = 21).

2.3. Data Collection

Two trained observers conducted covert observations of hand hygiene practices. Observations were recorded using handwritten notes to ensure discretion and minimize observer effect. According to the hospital's internal guidelines, surgical hand washing is primarily recommended for removing visible contamination prior to the initiation of surgical procedures. Alcohol-based hand rub solutions were readily available throughout all operating rooms.

2.4. Ethical Considerations

Ethical approval was obtained from the ethical committee at Jerash University and from the Ministry of Health in Jordan. All participants were informed in advance about the observational nature of the study focusing on hand hygiene compliance. Data collection was anonymous, and participant confidentiality was strictly maintained throughout the study.

2.5. Data Analysis

Data were analyzed using IBM SPSS Statistics, version 26 (IBM Corp., Armonk, NY, USA). Hand hygiene compliance rates were calculated as overall and subgroup-specific percentages. Associations between categorical variables were assessed using cross-tabulations and Chi-square (χ^2) tests. A p-value of <0.05 was considered statistically significant.

3. Results

A total number of 930 HH opportunities were observed, of these 164 (17.6%) occurred before patient contact, 202 (21.7%) before an aseptic task, 170 (18.3%) after body fluid exposure risk, 191 (20.5%) after patient contact and 203 (21.8%) after contact with patient surroundings. The majority of observations 677 (72.8%) occurred inside the operation room. The overall compliance with HH was 46.2% (Table 1).

Table 1 Results of hygienic hand disinfection overall compliance observation according to gender, occupational groups and location of observations (n = 930 opportunities observed)

Parameter	**Overall Compliance**
Observed	
	Opportunities (Compliance in %)
All opportunities (O.)	430/930 (46.2%)
O. Females	202/390 (51.8%)
O. Males	228/540 (42.2.6%)
O. Surgeons	89/260 (34.2.5%)
O. Anesthetists	98/185 (53.0%)
O. Surgical Nurses	179/345 (51.9%)
O. Anesthesia Technicians	64/140 (45.7%)
O. Inside Operation Room	366/677(54.1%)
O. Outside Operation Room	179/253 (25.3%)

Across the WHO-5 categories, the highest compliance observed after body fluid exposure risk was 55.9%, while compliance was lowest after contact with patient surroundings (33.0%). Results showed that there were statistically significant differences between males and females.

Chi-Square analysis showed that females' overall compliance was higher than men's (51.8% vs. 42.2%); this difference was statistically significant (Chi Square= 8.34, p= 0.0042). Although women showed higher compliance on the WHO-5 moment of hand hygiene; chi square 25.33 (p< 0.001). Pairwise comparisons were done between males and females. The results showed that women compliance was statistically significant higher before patient contact (54.4% vs. 34.4) chi square = 6.53, p= 0.011 (Table 2).

Table 2 Results of hygienic hand disinfection compliance observation according to gender by WHO-5 moments (n = 930)

Parameter	**Compliant**	**By WHO-5**				
Observed		Before Patient	Before Aseptic Task	After Body Fluid	After Patient	After Contact
	Opportunities (Compliance in %)*	Contact*		Exposure Risk	Contact	with Patient Surroundings
O. Females	202/390 (51.8%)*	37/68 (54.4%)*	49/82 (59.8%)	42/70 (60.0%)	42/76 (55.3%)	32/94 (34.0%)
O. Males	228/540 (42.2.6%)*	33/96 (34.4%)*	58/120 (48.3%)	53/100 (53.0%)	49/115 (42.6%)	35/109 (32.1 %)

*< 0.05

As well, anesthetists and surgical nurses showed higher HH compliance (53.0% anesthetists, surgical nurses 51.9%) than surgeons (34.2%) and anesthesia technicians (45.7%). Chi square analysis showed statistically significant differences in overall compliance on hand hygiene with a value of chi square= 22.9 ($p< 0.001$. Pairwise comparisons were done to explore the difference in compliance among occupational groups by the WHO-5 moments of hand hygiene. Table 3 shows that anesthetists and surgical nurses have statistically higher compliance (nurses 53%, anesthetists 51.9%) than surgeons (34.2%) and anesthesia technicians (45.7%) with chi square= 11.9 ($p= 0.008$).

Table 3 Results of hygienic hand disinfection compliance observation according to occupational groups by WHO-5 moments (n = 930 opportunities observed)

Parameter	**Compliant**	**By WHO-5**				
Observed		**Before Patient**	**Before Aseptic Task**	**After Body Fluid**	**After Patient**	**After Contact**
	Opportunities (Compliance in %)*	**Contact***		**Exposure Risk***	**Contact***	**With Patient Surroundings**
O. by Surgeons	89/260 (34.2%)	9/43 (20.9%)	20/63 (47.6%)	15/42 (35.7%)	18/56 (32.1%)	17/56 (30.4%)
O. by Anesthetists	98/185 (53.0%)	17/34 (50.0%)	21/39 (53.8%)	18/34 (52.9%)	27/39 (69.2%)	15/39 (38.5%)
O. by Surgical Nurses	179/345 (51.9%)	33/62 (53.2%)	40/72 (55.6%)	46/66 (69.7%)	36/71 (50.7%)	24/74 (32.4%)
O. by Anesthesia Technicians	64/140 (45.7%)	11/25 (44.0%)	16/28 (57.1%)	16/28 (57.1%)	10/25 (40.0%)	11/34 (32.4%)

The results indicated that the overall hand hygiene compliance was statistically significant higher inside the operation room areas (54.1%) compared to outside operation room areas (25.3%), chi square = 61.3 ($P< 0.001$). Pairwise comparisons revealed that compliance inside operation room areas was higher in all WHO-5 hand hygiene moments (Table 4).

Table 4 Results of hygienic hand disinfection compliance observation according to place of observation by WHO-5 moments (n = 930 opportunities observed)

Parameter	**Compliant**	**By WHO-5**				
Observed		**Before Patient**	**Before Aseptic Task**	**After Body Fluid**	**After Patient**	**After Contact**
	Opportunities (Compliance in %)	**Contact**		**Exposure Risk**	**Contact**	**with Patient Surrounding**
O. Inside operation room	366/677 (54.1%)	9/42 (21.4%)	19/52 (36.5%)	10/43 (23.3%)	17/51 (33.3%)	9/65 (13.8%)
O. Outside operation room	64/253 (25.3%)	61/122 (50.0%)	88/150 (58.7%)	85/127 (66.9%)	74/140 (52.9%)	58/138 (42.0%)

4. Discussion

This study investigated HH compliance among healthcare professionals working the operation rooms as recommended by WHO-5. Overall, compliance of approximately 46.2% was observed in all opportunities. There have been differences in the opportunities observed among participants based on gender, profession and place in the surgical sites. Compared with the reported literature, clearly the study sample has reported a relatively better compliance in almost all opportunities (15,16). However, there are still missing opportunities to improve adherence to HH disinfection further in surgical sites. Even though research studies' results and recommendations have significantly increased compliance in different healthcare areas of specialization (5), there are still missing components of the HH and infection control puzzle. By far, most studies reported missed HH adherence in approximately 50% of the opportunities in different healthcare settings (17,18). There might be different explanations for such a less than required rate of compliance. First, the workload in the operation rooms and the surgical suite where the turnover of patients is based on the listed patients scheduled for surgery (5,19). This long list is often very tight and there could also be a window for emergency operations that is an added effort. Healthcare professionals might have an overestimation of their own practice of HH leading to a negative influence of adherence to the proper guidelines of infection control (20). Therefore, emphasis should be made on how to properly be performed HH and this could become, if not already, a yearly relicensing to continue working in the operating rooms (21).

Looking at different specializations within the operation room, inside and outside, we could find variations. In the present study, compliance was higher in the operation room among female staff, nurses and anesthetists. Female participants showed more adherence to HH disinfection when compared with their male counterparts. A possible explanation might be that nurses, who are mostly females, undergo extensive training and follow-up to emphasize adherence to infection prevention and control guidelines (5). Anesthetists also undergo training, but they are not meticulously engaged in patient management like, for instance, surgeons, surgeons associate or other healthcare staff in the operating rooms.

In addition, adherence to HH disinfection in the operating room is relatively low because of staff engagement in patient maintaining patient safety and wellbeing, including heart rate, arterial blood pressure, airway clearance and observable bleeding. Therefore, the surgical staff might view these biological marks of significant importance when compared with disinfection and thus could receive less emphasis. Although almost half of the staff at best practices adopted HH disinfection, there is still a considerable percentage of staff who did not. The HH disinfection compliance should be addressed at a multilayered level to improve compliance from all staff (22).

Perhaps the current wide uses of artificial intelligence could present a solution to improve HH compliance by setting up alarming system that would remind healthcare professionals in the operating room, inside and outside, with HH guidelines. The current analytical systems adopted by AI could improve observation and compliance by, for instance, not allowing the staff to move from room to another and getting in or out of the room and so on.

Despite having results that reflect close number to the literature, there are still limitations that this study could not manage. Sample size and settings were limited in the number of settings. As healthcare professionals were observed,

they might have not reflected their true practices. This in turn could increase the rates of compliance among them. Perhaps a single-blind study would reflect the true rates of compliance. HH hygiene technique was not addressed for accuracy and appropriateness as in some cases where hands are not clean, hand washing with water and soap is better be adopted.

Finally, HH when adopted is expected to improve rates of cross-infections in surgical settings and operation rooms. The healthcare professionals are all aware of the importance of HH; however, factors, such high workload, overlapped surgical procedures, turnout rates, are all important factors influencing compliance to HH guidelines. Hospital management could improve HH compliance rate by addressing these factors and by adopting stricter follow-up and observation policies among their staff.

Based on the findings of this study, the nursing implications emphasize the critical role of nurses in promoting and maintaining effective hand hygiene (HH) practices within the operating room. Given the observed higher compliance among nurses and female staff, nursing professionals are well-positioned to lead by example in adhering to WHO-5 HH guidelines. Nurses should be actively involved in continuous education and training programs to reinforce proper HH techniques and foster a culture of accountability. Furthermore, integrating HH compliance into annual competency assessments and professional relicensing can serve as an effective strategy to ensure sustained adherence. Nursing leadership should advocate for system-level changes, including workload management, staffing adequacy, and the use of technological innovations like AI-based reminders, to support HH practices without compromising patient safety. By addressing these organizational and behavioral barriers, nurses can significantly reduce the risk of surgical site infections and improve overall patient outcomes in perioperative care.

Compliance with ethical standards

Acknowledgment

The authors would like to thank the staff in the operating rooms who facilitated the observational data collection. The authors also acknowledge any individuals not listed as co-authors who contributed technical or administrative support.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of Ethical approval

Ethical approval was obtained from the ethical committee at Jerash University and from the Ministry of Health in Jordan.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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