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Assessment of nurses' knowledge and practices for the prevention of nosocomial infections in surgery services in Southern Lebanon

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ABSTRACT

Background: Nosocomial infections remain a significant challenge in healthcare settings, particularly in surgical services where patients are vulnerable. Nurses play a pivotal role in preventing these infections through their knowledge and compliance to infection control practices. This study investigates nurses' knowledge and practices regarding the prevention of nosocomial infections in operating rooms. **Methods:** A cross-sectional survey was conducted in September 2023, among 140 nurses working in surgical services across six hospitals in South Lebanon. Data was gathered using a self-administered structured questionnaire consisting of both multiple-choice and open-ended questions and analyzed with SPSS to assess nurses' knowledge and compliance with infection prevention and control protocols and associated factors. **Results:** Surgical site infections were the most common nosocomial infections, followed by urinary tract infections and pneumonia. The predisposing factors included prolonged hospitalization, reduced immunity, older age, and comorbidities. While 68.5% of nurses reported a moderate risk of infection, 12% indicated a very high risk. Poor compliance to hand hygiene was attributed to workload, skin irritation, lack of awareness, and poor facilities. 18.5% of the nurses applied the clothing rules only sometimes while 8% never applied them. For waste disposal, 31% reported occasional use of specific bags for contaminated waste, and 3% stated this practice was never followed. Moreover, 34% of nurses were unaware of infection reporting protocols, and 9% indicated a lack of reporting. **Conclusion:** The findings highlight the need for continued efforts to promote compliance with infection control practices in surgical services to enhance patient outcomes and reduce nosocomial infections.

Introduction

Nosocomial infections, also known as healthcare-associated infections (HAIs), represent a major challenge to healthcare systems globally. They can lead to prolonged hospital stays, increased healthcare costs, and, most importantly, significant morbidity and mortality among affected patients

[1,2]. In high-income economies, approximately 7% of hospitalized patients develop HAIs. In contrast, in developing economies, the prevalence of HAIs tends to be higher, with about 10% of hospitalized patients experiencing such infections [3,4]. According to estimates from the Centers for Disease Control and Prevention (CDC), HAIs annually account for 99000 deaths in the United States of

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America [5]. Within the European Union, over 4 million patients acquire HAIs annually, leading to approximately 37000 deaths [6].

The most common types of HAIs include catheter-associated urinary tract infections (CAUTI), central line-associated bloodstream infections (CLABSI), surgical site infections (SSI), ventilator-associated pneumonia (VAP), hospital acquired pneumonia (HAP), and *Clostridioides difficile* colitis (CDI), with bacteria causing about 90% of HAI [6,7].

Surgical site infections (SSIs) are infections that occur at or near the surgical incision site following a surgical procedure. They account for approximately 20% of all HAIs and are associated to a 2-to 11-fold increase in the risk of mortality [8,9]. Complications attributed to SSIs may include delayed and non-healing of the wound, abscess formation, osteomyelitis, systemic infection (e.g., sepsis), and the need for additional surgical interventions or extended antibiotic therapy. SSIs can also result in long-term sequelae, such as chronic pain, impaired wound healing, and functional limitations, impacting patient recovery and quality of life. Several factors can predispose individuals to developing SSIs. These include patient-related factors such as advanced age, underlying medical conditions (e.g., diabetes mellitus, obesity), immunosuppression, and malnutrition [9]. Surgical factors such as the duration of surgery, type of procedure (e.g., clean, clean-contaminated, contaminated, or dirty), and the presence of foreign bodies (e.g., surgical implants) also influence SSI risk. Additionally, environmental factors, including the cleanliness of the operating room, air quality and ventilation, hand hygiene, and proper attire, are crucial in preventing SSIs [9,10,11].

Thus, in surgery services, where patients are particularly vulnerable due to invasive procedures, nurses play a critical role in avoiding nosocomial infections. They provide hands-on care, including wound dressing, administering medications, and assisting with hygiene, making their adherence to infection control protocols vital in minimizing infection risks. High compliance can significantly reduce infection rates, while lapses can lead to serious outbreaks.

Improving the practices of nursing staff is indeed strongly linked to acquiring solid knowledge in hygiene and asepsis. This knowledge forms the

foundation for effective infection control and prevention strategies. In recent studies conducted in Pakistan and Iran, nurses scored only 43% on knowledge and practices relating to the prevention of HAIs [12,13]. India reported a score of 57.5% [14], while two Nigerian tertiary care hospitals reported a score of 50.8% for healthcare workers' practice in preventing nosocomial infections [15].

Several risk factors contribute to the increased rate of inadequate practices and knowledge regarding the prevention of nosocomial infections among healthcare workers. These may include years of experience, gender distribution among health care workers, their level of education, as well as lack of training and compliance with guidelines [16].

In Lebanon, there is a lack of studies focusing on the situation of nosocomial infections in operating theaters. The economic crisis in the country since 2019, exacerbated by the COVID-19 pandemic, has had a profound impact on the healthcare sector. The resulting exodus of healthcare professionals, including doctors and nurses, has created significant challenges in maintaining healthcare quality and preventing nosocomial infections. Thus, this study aims to assess the current state of knowledge and level of compliance of nursing staff with infection prevention and control practices within surgery services in Southern Lebanon.

Materials and Methods

Study design and setting

This research is a descriptive cross-sectional study involving 140 Lebanese nurses working in surgical departments across six hospitals in Saida-Lebanon. The study was conducted in September 2023, after receiving the Institutional Review Board (IRB) approval, at the Branch 5 of the Faculty of Public Health in the Lebanese University.

Screening process

- **Population identification:** The study population comprised nurses working in the surgical units of selected hospitals in Southern Lebanon. All registered nurses in these units were considered for inclusion.
- **Inclusion criteria:** Nurses who had working in any of the study sites for a period longer than 3 months.

- **Exclusion criteria:** Student nurses and those who declined to participate were excluded from the study.
- **Screening:** Eligible participants were identified using hospital records and verified through consultation with department heads.

Ethical considerations and consent

- **Information dissemination:** Potential participants were invited to a briefing session where the study's objectives, procedures, and significance were explained in detail.
- **Informed consent:** Participants were provided with a consent form that detailed the study's aims, the voluntary nature of their participation, the confidentiality of their responses, and their right to withdraw at any time [17].
- **Consent collection:** Only nurses who signed the informed consent form were enrolled in the study. The confidentiality of their responses was assured, and data was anonymized to protect participant identity.

Questionnaire development and validation

- **Literature review:** The questionnaire was developed based on an extensive review of existing literature and guidelines on nosocomial infections and infection control practices.
- **Item selection:** 32 questions were selected and adapted to ensure they accurately reflected the study objectives.
- **Pilot testing:** The questionnaire was pilot tested on a small sample of nurses (not included in the main study) to assess its reliability and comprehensibility. Participants in the pilot study were asked to provide feedback on the clarity of the questions and the time required to complete the questionnaire. Based on the pilot test results, minor revisions were made to enhance the clarity and flow of the questionnaire [18].

Structure of the questionnaire

The questionnaire was divided into three main sections, consisting of both multiple-choice and open-ended questions.

- **Socio-demographic information:** This section gathered data on participants' background, including age group, gender, years of experience and level of education.
- **Knowledge assessment:** Knowledge was assessed based on the understanding of transmission and sources of nosocomial

infections. Topics covered include modes of transmission, pathogen types, risk factors, prevalence and specific examples of nosocomial infections.

- **Practice assessment:** This section contains questions related to the actual practices followed by nurses in the surgical department, including adherence to infection control guidelines, hand washing, glove-wearing, compliance with clothing rules and waste disposal.

Data analysis

The collected data were analyzed using SPSS statistical software version 25. Frequencies and percentages were calculated for categorical variables, and these results were presented in tables and graphs [19].

- **Demographic variables:** Basic demographic information such as age, gender, education level, and years of experience were summarized using descriptive statistics including frequencies and percentages.
- **Knowledge and practice assessment:** The participants' responses to the knowledge and practice-related questions were treated as categorical variables. The frequencies and percentages of each response category were calculated to summarize the data.
- **Relationship analysis:** Pearson's Chi square test was done to investigate the correlation between education level, professional experience, and certain operating room practices. A p-value < 0.05 was considered statistically significant.

Scoring approach

This study did not utilize a formal scoring system to assess the knowledge or practices of the nursing staff. Instead, the analysis focused on descriptive statistics to explore the frequency and distribution of responses for each item on the questionnaire.

Results

Socio-Demographic Characteristics

A total of 140 nurses had completed the questionnaire. The majority of participants were females representing 83.6% (n = 117) of the sample, while 16.4% (n = 23) were males. 21.4% (n = 30) of nurses were under 25 years old, 57.1% (n = 80) were between age 25 and 35 years old, 16% (n = 23) were between age 36 and 45 years old and 5.5% (n = 7) were above 45 years old. 7.1% (n = 10) were TS

educated nurses, 10 % (n = 14) were LT educated, whereas 68.6% (n = 96) and 14.3% (n = 20) were BS and master's degree holders respectively. Regarding their work experience at the surgical ward, 57.1% (n = 80) had work experience ranging from 1 to 10 years (table 1). Q4

Knowledge of nurses about nosocomial infections

Regarding sources of contamination in the operating room, a significant majority of nurses (85%) identified direct contact, particularly through the hands of healthcare personnel, as the main route of transmission for nosocomial infections.

The survey results highlight the types of nosocomial infections that nurses encounter most frequently in the operating room. A total of 226 choices were recorded, analyzed and presented in a pie chart to illustrate the distribution of different infection types (figure 1). With 90 choices (40%), surgical site infections were the most frequently observed nosocomial infections in the operating room. Urinary tract infections were mentioned 63 times (28%), making them the second most common nosocomial infection. Pneumonia was identified 50 times (22.1%), and bacteremia was mentioned 20 times (8.8%).

To provide a comprehensive overview of the germs most frequently identified in the surgery services, the survey recorded 274 responses, identifying six key germs: *Staphylococcus aureus* (90 responses; 32%), *E. coli* (83 responses; 30%), *Pseudomonas aeruginosa* (66 responses; 24%), *Enterococcus* (16 responses; 6%), *Candida* (14 responses; 5%), and *Acinetobacter* (8 responses; 3%).

Moreover, participants were asked to identify risk factors associated with the development of nosocomial infections. Most nurses opted for more than 3 factors, thus totaling 459 responses. The most frequently chosen risk factor was the length of hospital stay, cited by 116 nurses, accounting for 25% of the total responses (figure 2).

The survey also included an assessment of the perceived level of risk for the occurrence of nosocomial infections among nurses. 27 nurses (19.2%) estimated that the risk was low, 96 nurses (68.5%) indicated a medium risk, and 17 nurses (12%) reported a very high risk.

Additionally, knowledge regarding monitoring and reporting protocols of nosocomial infections was evaluated. The key findings from the survey responses are:

- 80 nurses (57%) confirmed that nosocomial infections are regularly reported throughout the year.
- 13 nurses (9%) indicated that these infections are not reported.
- 47 nurses (34%) stated that they do not know whether these infections are reported or not.

Concerning the presence of an Infection Control Committee, 123 nurses (88%) confirmed the existence of such a committee, while 17 nurses (12%) denied its presence.

Practices of nurses regarding the prevention of nosocomial infections

When asked about the application of hygiene and asepsis measures, the majority of nurses (65%) affirmed that these measures are always systematically applied in the surgical department, while the remaining 34% indicated that the measures are applied only irregularly.

In a more detailed inquiry regarding the ‘‘5 Moments for Hand Hygiene’’, a total of 163 responses were obtained. The responses are displayed in figure 3.

Additionally, nurses were assessed on their practical knowledge and attitudes regarding the use of disposable gloves. The vast majority of nurses (92 %) reported wearing disposable gloves during procedures, and 8 % of respondents said that they do not. Surprisingly, 80% of nurses believed that wearing gloves replaces the need for good hand hygiene, while 20% disagreed with this practice.

The investigation into the adherence of nurses to proper glove donning and removal methods revealed the following key findings:

- An overwhelming 95% of nurses reported that they adhere to the correct methods for donning gloves.
- Conversely, 5% of nurses admitted that they do not follow the correct methods for removing gloves.

The assessment of nurses' last training on hand hygiene reveals varied recency in their training experiences:

- 35% of nurses (n = 50) reported having received hand hygiene training a month ago.

- 23.5% of nurses (n = 33) indicated that they received training a year ago.
- Another 23.5% of nurses (n = 33) reported that they received hand hygiene training more than a year ago.
- 17% of nurses (n = 24) mentioned that they have not received any recent training.

The investigation into barriers to hand hygiene compliance among nurses identified several key factors that hinder proper hand hygiene practices. The responses accumulated to 281, with the following obstacles most frequently mentioned:

- The most frequently cited barrier, mentioned by 37% (103 nurses), is an increased workload.
- The second most common barrier, selected by 23.4% (66 nurses), is the perceived risk of skin irritation caused by hygiene products.
- Limited access to hygiene products was identified by 16% (46 nurses) as a barrier.
- A lack of knowledge was mentioned by 13% (36 nurses).
- Time constraints were identified by 10.6% (30 nurses) as a barrier.

The survey also identified areas of concern regarding the compliance with clothing regulations and waste disposal management in the operating room. Notably, a significant fraction of nurses (18.5%) said that clothes codes were only sometimes enforced. The 8% of respondents who

said that clothes codes were never followed are especially concerning. A mere 31% of the nurses polled said that special bags meant for contaminated waste were only occasionally used, and only 3% said that this procedure was never observed.

Impact of educational status and level of experience on practices of nurses

Pearson's Chi square was done to investigate the correlation between education level, professional experience, and certain operating room practices. Three questions were only considered:

- Single-use gloves are required for nurses.
- Wearing gloves replaces the need for hand hygiene.
- Clothes worn in the operating room need to be changed daily.

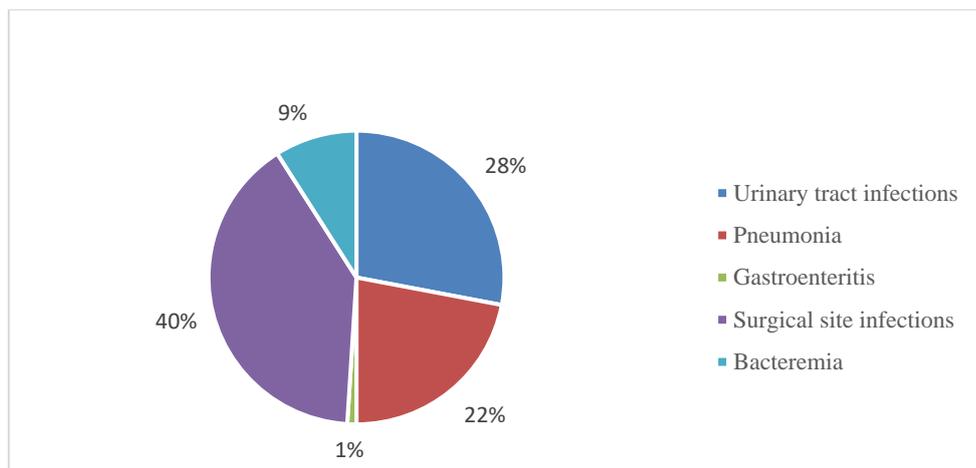
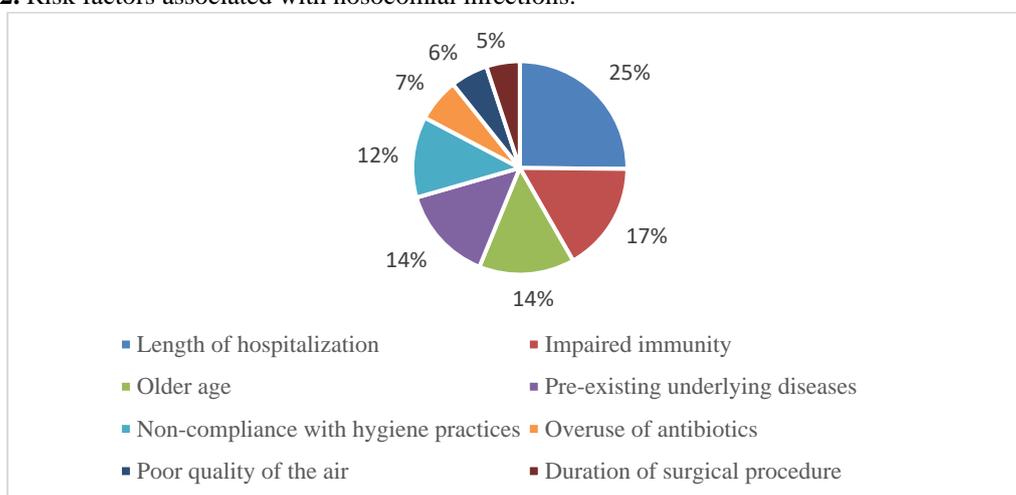
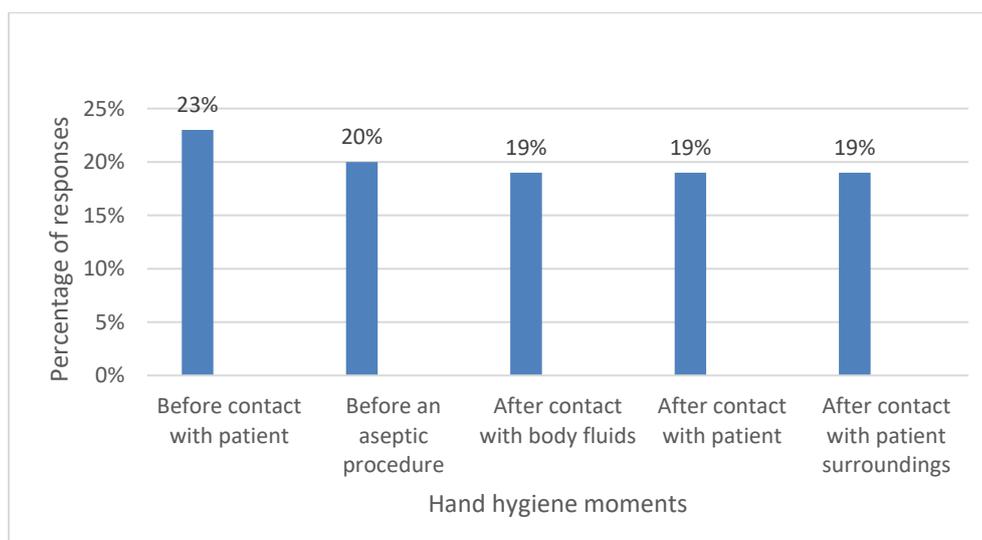
The analysis indicates that experience level significantly affects perceptions about whether glove use can replace effective hand hygiene (P-value < 0.001). Nurses with more than 10 years of experience believe the substitution is not acceptable. Similarly, the use of disposable gloves and the perception of the necessity for daily changes of operating room attire are significantly associated with both experience and education level (P-value < 0.001).

These findings outline that the investments in continuous education and professional development of nurses maintain and upgrade hygiene standards for patient safety and quality of care within surgical environments.

Table 1. Socio-demographic characteristics of participants

Variables	Category	Frequency	Percentage
Gender	Male	23	16.4
	Female	117	83.6
Age (years)	Less than 25	30	21.4
	25 – 35	80	57.1
	36 – 45	23	16
	46 – 55	4	3
	> 55	3	2.5
Education level	TS	10	7.1
	LT	14	10
	BS	96	68.6
	Master	20	14.3
Experience in years	< 1	39	27.9
	1 – 5	56	40
	6 – 10	24	17.1
	> 10	21	15

TS: Superior Technician Diploma. LT: Technical License Diploma. BS: Bachelor of Science

Figure 1. Distribution of nosocomial infections in surgery services.**Figure 2.** Risk factors associated with nosocomial infections.**Figure 3:** Attitude towards 5 moments for hand hygiene.

Discussion

Preventing nosocomial infections in operating rooms is a top priority for healthcare facilities. These infections can cause substantial morbidity, mortality, and healthcare costs [1]. Nurses' knowledge of nosocomial infections preventative measures is critical for the successful implementation and adherence to infection control strategies. Furthermore, having sufficient knowledge enables nurses to identify potential hazards, efficiently implement preventative measures, and respond quickly to infection control issues. This study provides a thorough examination of the sociodemographic traits, nosocomial infection awareness, and hygiene practices of nurses. It presents a comprehensive overview of the challenges and offers recommendations for lowering the risk of nosocomial infections in the surgical departments of six hospitals in southern Lebanon.

The influence of nurses' age and experience on the prevention of nosocomial infections in the operating room is an important topic. Experienced nurses have extensive knowledge and practical competence, while younger nurses can offer new viewpoints and are more likely to adopt new practices and technologies. Our study found that the majority of surveyed nurses are young, between the ages of 25 and 30, indicating a demographic shift in the healthcare sector. As a result, mentoring programs and continuing education are critical for maximizing the capabilities of all age and experience groups within the nursing team.

A significant majority of participants in the study are college graduates with extensive knowledge of hospital-acquired diseases. This frequently suggests a favorable relationship between higher education levels and increased awareness of infection prevention, emphasizing the good impact of education on health awareness and practices. Bayleyegn *et al.* reported that educational level and work experience of healthcare workers are significantly associated with practice and attitude towards hospital-acquired infection prevention [20]. In the Arabian context, similar findings have been observed. For instance, studies conducted in Egypt, Saudi Arabia and Jordan consistently found that continuous professional education and extensive experience significantly improve knowledge, compliance, and infection prevention measures among healthcare workers [21,22,23].

Our findings have shown that direct contact through the hands of healthcare personnel is the main route by which pathogenic organisms are transmitted in the operating room and is evident in 85% of respondents. Ensuring awareness and consistent adherence to hygiene protocols, such as thorough hand washing and surface disinfection, is critical to reduce the risk of spreading pathogens. A study conducted in secondary healthcare hospitals in Kuwait backs with our findings, with 73.6 % of nursing staff identifying contaminated hands as the main route of transmission of harmful germs [24].

Investigating the most common types of nosocomial infections encountered by nurses indicated that surgical site infections account for a large fraction (40 %). The key to preventing these infections is to follow aseptic procedures, sterilize instruments and surfaces, and use antibiotics as prescribed. Urinary tract infections account for 28 % and are commonly seen in individuals who are catheterized or undergoing urologic procedures. To limit the risk of infection, UTIs must be prevented through correct catheter usage, hygienic handling, and removal as soon as possible [25]. In accordance with our results, Spagnolo *et al.* indicated that surgical site infections account for 38 % of nosocomial infections in surgical patients [11]. Regarding the incidence of post-surgical UTIs, the review of literature studies shows that the rate of these infections can range from 2% to 10%, but this can be higher in certain types of surgeries, especially those involving the urinary tract, gynecological surgeries, and colorectal surgeries [26,27,28,29].

Our results on the length of hospitalization, being the commonest factor associated with nosocomial infection risk, agree with many previous research studies. Generally, a prolonged hospital stay exposes patients to a growing risk of nosocomial infections due to various reasons: prolonged exposure to the hospital environment, immunosuppression and weakening, repeated invasive procedures, and the use of antibiotics for a long period [1,30]. Accordingly, in those patients hospitalized longer, targeted preventive measures should be taken by strengthening hygiene protocols, closely monitoring possible infections, and minimizing invasive procedures or treatments for long periods to minimize the consequences of nosocomial infections.

The study reveals a complex pattern regarding the reporting of nosocomial infections among nurses in the operating room. It is of concern

that 34% of the nurses, a considerable percentage, were not sure whether the infections were reported or not. This may indicate flaws in the communication or follow-up mechanism of infection reporting. Several factors might have contributed to this lack of awareness or uncertainty: lack of clarity regarding the mechanism and procedures of reporting, miscommunication or misdocumentation, and inadequate training or awareness. This can be improved upon by developing transparent and easily followed reporting systems, continuous staff education in relation to reporting, development of an organizational culture that includes supporting open and fit-for-purpose communications systems, all of which will guarantee the accurate reporting and handling of all nosocomial infections.

It is encouraging to note that the greatest percentage of nurses, 88%, confirmed the presence of a specific committee for fighting nosocomial infections. The presence of such a committee is very fundamental in a healthcare facility in terms of overseeing, implementing, and evaluating prevention and control measures concerning nosocomial infections [31,32]. The worrying point, however, is that 12% of the nurses denied the presence of such a committee within a facility. This might mean a lack of clarity or perhaps just poor communication about structures existing within a facility for infection prevention.

It is concerning to note that high nursing workload is identified as the main factor preventing good hand hygiene. Such situation may lead to a number of negative consequences: hygiene practices being neglected, fatigue and stress, and an increased risk of making errors [33,34,35,36,37]. To mitigate these risks, healthcare facilities have to reduce workload, provide adequate staff to meet demand, offer regular breaks for handwashing, and implement policies that prioritize hand hygiene, even during busy periods.

It is positive that a clear majority, 65%, confirmed the systematic application of hygiene and asepsis measures. This will mean a high level of commitment to hygiene protocols. However, it is of concern that 34% responded that these measures were applied only sometimes. This might indicate some irregularity in the application of hygiene and asepsis protocols, increasing in this way the risk of nosocomial infection transmission.

The analysis of attitudes towards the "5 Moments for Hand Hygiene" shows a slight emphasis on hygiene before patient contact (23%). The more consistent responses to other moments 19-20% suggest that further reinforcement in the importance of hand hygiene at all moments, and equally so, is needed for overall infection control [24].

The finding that 20% of nurses disagreed with the statement that glove use replaced hand hygiene is encouraging. Such responses testify to the fact that healthcare staff understand that wearing gloves does not replace good hand hygiene. However, the responses of the 80% who agreed to this statement are concerning, reflecting a significant gap in knowledge. This contrasts sharply with findings from studies in Kuwait and Saudi Arabia, where 74.6% and 73.7% of nurses, respectively, correctly disagreed with the notion that 'wearing gloves reduces the need for hand washing' [24].

The assessment of nurses' last training on hand hygiene has shown varied recency of training experiences, which would show differences in how updated knowledge and practice may be. 17% of nurses have not had any recent training. This is concerning and implies that some good numbers of nursing staff could miss the current knowledge and practice at the heart of effective hand hygiene. This gap presents a huge risk to patient safety and infection control efforts. Structured training programs, continuous education, and monitoring systems shall be implemented to standardize practices on hand hygiene and maintain a high level of care.

The results of the survey about compliance with the dressing code in the operating room show that 8% indicated it is never followed—a major concern for hygiene protocol compliance. Compared to other studies, the wearing of jewelry or rings on fingers represents a reservoir for the pathogens, especially *Staphylococcus aureus* and Gram-negative bacilli; the lack of adherence to dress codes by caregivers increased the frequency of cross-nosocomial infections [38,39,40]. About the disposal of single-use equipment, 3% reported never following it in specific bags for contaminated waste, which is a worrisome response, as it may mean bad management of the contaminated waste and enhance the nosocomial infection risk. The results evidenced strengths and weaknesses in compliance regarding

dress code and waste disposal protocols in the operating room.

Conclusion

This study offered significant insights into nosocomial infection prevention in the surgical departments of hospitals in Southern Lebanon, based on a detailed assessment of 140 nurses' knowledge, practices, and attitudes. Our analysis revealed that, while the overall knowledge among nurses regarding the sources and risk factors of nosocomial infections is satisfactory, there are notable challenges in adherence to preventive procedures.

The findings highlight critical issues such as suboptimal hand hygiene practices, inconsistent use of appropriate clothing, and inadequate disposal of waste. These gaps underscore the importance of continuous re-education and training for nurses, as our study found that experience and educational levels are strongly associated with better infection control practices.

To improve compliance with infection control measures, targeted interventions should address identified barriers like high workloads and limited access to hygiene products. Additionally, enhancing the monitoring and reporting systems for nosocomial infections is crucial to strengthen infection control efforts. Recommendations include regular and comprehensive training, strict adherence to international infection control protocols, periodic evaluations of compliance, investment in improved hygiene facilities, and fostering a culture of safety and hygiene. By implementing these measures, healthcare facilities can ensure better patient outcomes and a higher quality of care in surgical environments.

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