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Assessment of Knowledge and Performance of Operating Room Staff and Students in Preventing Surgical Site Infections

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Abstract

Surgical site infection (SSI) is one of the most common postoperative complications, leading to prolonged hospitalization, increased healthcare costs, and reduced quality of life. The knowledge and performance of surgical teams in adhering to preventive protocols play a crucial role in reducing the incidence of these infections. This study aimed to assess the knowledge and performance of operating room staff and surgical technology students regarding the prevention of SSIs.

This descriptive–analytical cross-sectional study was conducted in 2024 with 80 participants (65 staff members and 15 students) working in the operating rooms of hospitals affiliated with Torbat Heydariyeh University of Medical Sciences, Iran. Data were collected using a validated standard questionnaire comprising demographic information, 25 multiple-choice items on knowledge, and 18 self-reported items on performance rated on a Likert scale. Data were analyzed using descriptive statistics, independent t-test, chi-square, and Pearson correlation tests in SPSS version 26.

The overall mean knowledge score was 55.60 ± 12.10, and the mean performance score was 63.90 ± 8.70, indicating a moderate level of knowledge and a moderately high level of performance. Staff demonstrated better performance in technical procedures such as sterile dressing and skin preparation. In contrast, students excelled in fundamental skills like proper hand disinfection and mask/glove replacement. Knowledge and performance were significantly correlated across the entire sample ($r = 0.45$, $p < 0.001$), particularly among staff members.

The findings highlight the need for targeted educational initiatives to strengthen theoretical knowledge among students and update advanced technical skills among staff. Incorporating simulation-based learning, immediate feedback, and blended assessment strategies may enhance the integration of knowledge and practice, ultimately contributing to a reduction in SSI incidence.

Keywords: Surgical site infection; Infection prevention; Operating room staff; Knowledge and performance

Introduction

Surgical site infection (SSI) remains one of the major challenges in surgery and postoperative care, significantly contributing to increased morbidity, prolonged hospitalization, and higher healthcare costs worldwide (1, 2). Despite remarkable advances in surgical techniques and infection control protocols in recent years, the incidence of SSI in inpatient surgeries still ranges between 2% and 10 percent. Low and middle-income countries bear the greatest burden of these infections (3, 4).

Effective prevention of SSIs requires the precise implementation of evidence-based interventions such as hand hygiene, timely administration of prophylactic antibiotics, maintenance of sterile technique, and adherence to aseptic protocols in the operating room (1, 5). The knowledge and performance of operating room personnel and surgical technology students are crucial for implementing these protocols and minimizing infection-related risks (2, 6).

However, recent studies continue to report noticeable gaps between theoretical knowledge and actual compliance with SSI prevention guidelines among perioperative nurses and surgical staff, particularly in teaching hospitals (2, 4). Targeted education and structured, evidence-based training programs have repeatedly been emphasized in the literature as essential strategies to enhance compliance with infection prevention standards (1, 4). Assessing both the knowledge and practical competence of operating room personnel and students helps identify existing educational needs. It also supports the design of effective interventions aimed at strengthening the culture of infection control in surgical settings (2,5).

Knowledge refers to an informed understanding of evidence-based principles, concepts, and guidelines. In contrast, performance represents the practical application of this knowledge in clinical settings to achieve desired outcomes (1). Consequently, the knowledge and performance of operating room staff in SSI prevention reflect not only individual professional competence but also directly influence patient safety and care quality (7,8).

Evidence from a 2025 systematic review revealed that despite general awareness of SSI prevention, there remains a substantial gap between existing knowledge and the actual implementation of standard protocols. Many nurses still lack sufficient understanding of key preventive measures, leading to reduced effectiveness of infection control efforts (7). Recent research also shows that even after formal education, a significant discrepancy persists between theoretical awareness and actual preventive practices, potentially increasing the risk of SSIs (2, 7).

For instance, Woldegioris et al. (2019) reported that although over 70% of nurses were familiar with hand hygiene principles, only 52% consistently practiced them (2). Similarly, Shaheen et al. (2021) showed that poor adherence to sterile techniques was directly associated with insufficient procedural knowledge (4). These findings highlight the importance of concurrently assessing knowledge and performance. This helps identify competency gaps and to design targeted interventions such as simulation-based training, feedback systems, and continuing professional development programs (3,5).

Finally, the integration of validated evaluation tools within educational cycles and clinical quality improvement initiatives may strengthen compliance with SSI prevention guidelines. This integration may reduce postoperative complications and foster a sustainable culture of safety in the operating room (6, 9). Therefore, future research should focus on developing and testing such educational interventions and longitudinally evaluating their effectiveness (10, 11). This study aimed to evaluate the knowledge and performance of operating room staff and surgical technology students in preventing surgical site infections (SSI).

Materials and Methods

This descriptive, analytical cross-sectional study was conducted in 2024. It aimed to assess the knowledge and performance of operating room personnel and surgical technology

students in preventing SSIs. This study was conducted in the operating rooms of hospitals affiliated with Torbat Heydariyeh University of Medical Sciences in Iran. This setting represents the actual working environment of surgical teams. Based on previous studies and power analysis considerations, the sample size was determined to be 80 participants. Proportional stratified sampling was used, dividing participants into two predefined strata: operating room staff and surgical technology students. The proportion of participants in each stratum reflected their actual distribution in the study setting. Accordingly, 65 operating room staff and 15 seventh- and eighth-semester surgical technology students were recruited.

Within each stratum, eligible participants were selected using convenience sampling from available staff and students who met the inclusion criteria during the data collection period. To reduce potential selection bias, all eligible individuals present during the study were invited to participate, and recruitment was conducted across different work shifts and surgical specialties. Uniform inclusion and exclusion criteria were applied to all participants. Data collection was performed by the same trained researcher using standardized instructions.

Data Collection Tool

Data were collected using a validated questionnaire adapted from a previously published study investigating nurses' knowledge and practices regarding the prevention of surgical site infections (12). The original instrument was developed and psychometrically evaluated in its initial context, and was subsequently adapted for use in the present study.

The adapted version was reviewed by subject-matter experts to ensure cultural relevance and content appropriateness. The instrument demonstrated acceptable psychometric properties in the current study, with a content validity index (CVI) greater than 0.85. Internal consistency reliability was confirmed using Cronbach's alpha, yielding values of 0.82 for the knowledge section and 0.79 for the performance section. The questionnaire consisted of three main sections:

(a) Demographic information, including age, gender, education level, work or study experience, and field of practice;

(b) 25 multiple-choice questions assessing knowledge regarding SSI prevention; and

(c) 18 self-reported performance items related to SSI preventive measures, rated on a four-point Likert scale (never = 1, rarely = 2, sometimes = 3, always = 4).

Scoring Method

Each knowledge item was scored as 1 for a correct answer and 0 for an incorrect or "don't know" response. This resulted in a total knowledge score ranging from 0 to 25, with higher scores indicating greater knowledge of SSI prevention. Knowledge scores were categorized as poor (0–8), moderate (9–17), and good (18–25) based on tertile distribution.

Performance items were summed to obtain a total performance score ranging from 18 to 72. Higher scores reflected better self-reported adherence to SSI preventive practices. Performance levels were classified as low (18–36), moderate (37–54), and high (55-72).

The average time required to complete the questionnaire was approximately 15–20 minutes. Prior to the main study, a pilot test with 10 participants from a similar population was conducted to assess clarity, feasibility, and completion time.

Data Collection Procedure

Data collection was conducted over a one-month period following approval by the university ethics committee (Ethics Code: IR.THUMS.REC.1401.017) and coordination with hospital authorities. All questionnaires were distributed and collected by the principal researcher, who had received standardized training regarding the study protocol to ensure consistent administration across participants.

Prior to questionnaire distribution, the researcher explained the study objectives and provided uniform instructions to all participants using a predefined script. Written informed consent was obtained from each participant before enrollment. Questionnaires were completed independently by participants

without the researcher's presence to minimize response bias.

Upon collection, questionnaires were immediately reviewed for completeness. Forms with missing or partially completed responses in the knowledge or performance sections were excluded from the final analysis, in accordance with the predefined exclusion criteria. All complete questionnaires were coded anonymously and prepared for statistical analysis.

Data Analysis

Data were entered and analyzed using SPSS version 26. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to summarize demographic characteristics and score distributions for knowledge and performance. Inferential statistics, including the independent t-test, chi-square test, and Pearson correlation coefficient, were employed to examine relationships between variables. All analyses were reviewed by the principal investigator and a statistical consultant. Throughout all stages, confidentiality and participant anonymity were strictly maintained, and all questionnaires were securely archived.

Results

In this descriptive–analytical cross-sectional study, a total of 80 participants were evaluated, including 65 operating room staff (81.25%) and 15 surgical technology students (18.75%). The overall mean age of participants was 27.10 ± 6.80 years. The mean age of operating room staff was 29.04 ± 7.23 years, whereas that of students was 22.35 ± 0.86 years. The Mann-Whitney U test indicated no statistically significant difference in mean age between the two groups ($p > 0.05$). Overall, 29 participants (36.2%) were male and 51 (63.8%) female. Detailed demographic distributions are presented in Table 1.

The mean work experience of the operating room staff was 9.4 ± 7.8 years, indicating a wide range of professional experience within this group. Among the staff, the most common surgical specialties were orthopedic surgery (35.7%), general surgery (35.7%), urology (10.7%), and obstetrics and gynecology (17.9%). This diversity reflects a relatively comprehensive representation of different surgical departments (Table 1).

Knowledge and Performance Scores

The overall mean score of knowledge regarding the prevention of SSI among all participants was 55.60 ± 12.10. The mean performance score was 63.90 ± 8.70. Operating room staff achieved higher mean knowledge scores (58.43 ± 10.23) compared to surgical technology students (52.31 ± 13.01), with the difference reaching statistical significance ($P < 0.05$). Among the staff, 64.3% were categorized as having a low level of knowledge, and no participant attained a very high level. Among students, 76.9% were classified as having a very low level of knowledge, while 23.1% showed a moderate level.

Domain-specific analysis showed that both groups obtained their highest knowledge scores in basic aseptic principles. In contrast, the lowest scores were observed in postoperative wound surveillance (Table 2).

Performance Scores and Domain-Specific Findings

The mean overall performance score among operating room staff was 64.20 ± 9.40, while surgical technology students achieved 62.80 ± 7.10. The difference between the two groups was not statistically significant ($p > 0.35$).

However, a domain-specific analysis revealed differing performance strengths. Staff members performed better in sterile dressing techniques (82% adherence) and skin preparation procedures (82%) compared to students (76% and 78%, respectively). In contrast, students showed superior performance in hand disinfection before wearing sterile gloves (85% vs. 78% among staff) and proper mask and glove replacement (85% vs. 81% among staff) (Table 3).

Correlation and Regression Analysis

The relationship between theoretical knowledge and practical performance was the core focus of this study. A significant positive correlation was observed between knowledge

and performance across the total sample ($r = 0.45$, $p < 0.001$). When analyzed by subgroup, the correlation was stronger among operating room staff ($r = 0.51$, $p = 0.002$) than among surgical technology students ($r = 0.39$, $p = 0.018$).

Multiple regression analysis controlling for age, gender, work experience, and marital status revealed that knowledge score independently predicted performance ($\beta = 0.40$, $p < 0.001$). These findings indicate that scientific awareness remains a key determinant of compliance with SSI prevention protocols, even after accounting for environmental or supervisory factors. Subgroup analyses further showed that operating room staff with more than five years of experience achieved significantly higher scores in both knowledge ($p = 0.038$) and performance ($p = 0.024$). Among students, attendance at infection-control workshops was associated with improved knowledge ($p = 0.044$) and performance ($p = 0.047$). No significant gender differences were found. Domain-specific correlations were strongest in aseptic technique ($r = 0.59$) and dressing and skin preparation ($r = 0.55$), both recognized as critical elements in the prevention of surgical site infections.

Table 1. Demographic Characteristics of the Participants

Variable		Total (n = 80)	Operating Room Staff (n = 65)	Surgical Technology Students (n = 15)
Age (years)		27.10 ± 6.80	29.04 ± 7.23	22.35 ± 0.86
Gender	Male	29 (36.2%)	25 (38.5%)	4 (26.7%)
	Female	51 (63.8%)	40 (61.5%)	11 (73.3%)
Work Experience (years)		—	9.4 ± 7.8	—
Field of Work		—	Orthopedic Surgery: %35.7 General Surgery: %35.7 Urology: %10.7 Obstetrics & Gynecology: %17.9	—

Table 2. Mean Knowledge Scores on Prevention of Surgical Site Infections (SSI)

Group	Mean ± SD	Interpretation of Knowledge Level
Total sample (n = 80)	55.60 ± 12.10	Moderate
Operating room staff (n = 65)	58.43 ± 10.23	Slightly above moderate
Surgical technology students (n = 15)	52.31 ± 13.01	Slightly below moderate

Table 3. Self-Reported Performance by Group and Domain

Performance Domain	Operating Room Staff (n = 65)	Surgical Technology Students (n = 15)	p-value
Overall performance score (Mean ± SD)	64.20 ± 9.40	62.80 ± 7.10	0.35
Sterile dressing	82%	76%	—

Skin preparation	82%	78%	—
Hand disinfection before wearing gloves	78%	85%	—
Mask and glove replacement	81%	85%	—

Discussion

This study showed that, although the self-reported performance of operating room staff and surgical technology students in preventing SSI was moderate to high. Overall knowledge particularly among students remained below the optimal level. Staff demonstrated superior performance in technically complex procedures such as sterile dressing and skin preparation. In contrast, students performed better in basic hygienic practices including hand disinfection before glove use and mask or glove replacement. These findings support the main hypothesis of the study and indicate distinct performance patterns associated with differing knowledge levels. The stronger correlation between knowledge and performance among staff highlights the critical role of experience-based learning and accumulated clinical exposure in effective SSI prevention.

Consistent with previous studies, the findings reflect a persistent gap between theoretical knowledge and actual adherence to infection-control protocols. Woldegioris et al. (2019) reported high awareness but limited consistent practice of hand hygiene (2). While Sham et al. (2021) found higher technical performance among experienced personnel (6). In contrast, Calderwood et al. (2019) observed minimal differences between staff and trainees, possibly due to variations in educational approaches and clinical supervision (5). Our results also align with Munoz-Price et al. (2019), who emphasized that procedural adherence without updated theoretical knowledge remains unstable (1).

The domain-specific findings further clarify these patterns. Staff showed greater proficiency in experience-dependent technical skills, likely resulting from repeated exposure to real operating-room conditions. Conversely, students performed better in simpler, repetitive tasks, reflecting the effects of structured instruction and close supervision within academic settings. This observation is consistent with Habtie et al. (2025), who identified repetitive practice and immediate feedback as key factors in improving basic infection-control behaviors among novice personnel (13). Given the limited duration of clinical rotations, these results highlight the need for targeted educational strategies.

Importantly, this study extends existing literature by separately analyzing the knowledge–performance relationship. Multiple regression analysis confirmed that knowledge independently predicted performance after controlling for demographic variables, a finding rarely reported in domestic studies. This supports behavioral theories such as the Theory of Reasoned Action, which conceptualize knowledge as a prerequisite for sustained behavioral change (9). These insights may help prioritize educational content in resource-limited settings by focusing on domains most strongly associated with performance.

Several limitations should be considered. Self-reported data may be subject to social desirability bias, and the cross-sectional design limits causal inference between knowledge and performance. Additionally, restricting the study to a single province may affect generalizability. Future research employing objective assessment methods and longitudinal interventional designs is recommended to clarify causal pathways. Advanced, skill-focused training for students and regular scientific retraining for staff may further strengthen the integration of knowledge and practice.

Overall, the findings highlight the need for group-specific, evidence-based educational programs aligned with actual clinical demands. Integrating theoretical instruction with simulation-based training can help bridge the gap between knowledge and performance. Continuous feedback and periodic evaluation also support this process. Together, these approaches reinforce a culture of patient safety and contribute to sustained reductions in SSI rates. Study Strengths

This study benefits from the inclusion of two distinct yet complementary participant groups—operating room staff and surgical technology students—which allowed for detailed comparative analysis of knowledge and performance patterns. The use of a validated and psychometrically assessed questionnaire strengthened the reliability of measurements. Furthermore, conducting domain-specific analyses and applying multiple regression modeling provided deeper insights into the mechanisms linking knowledge to performance beyond simple group differences.

Limitations

Despite these strengths, certain limitations should be acknowledged. The reliance on self-reported performance may introduce social desirability bias. The cross-sectional design limits causal inference regarding the directionality of the knowledge–performance relationship. The study was conducted in a single province, which may affect the generalizability of the findings to other clinical or educational contexts. Additionally, the relatively small number of students may have reduced statistical power for subgroup comparisons.

Future Directions

Future studies should employ objective performance-assessment tools such as direct observation, behavioral checklists, and digital monitoring systems to enhance accuracy. Longitudinal and interventional studies are recommended to examine causal pathways and evaluate the long-term impact of educational strategies on both knowledge and practice. Targeted educational interventions—like simulation training, skill-focused workshops for students, and regular scientific retraining for staff—may reduce knowledge gaps and improve adherence to SSI prevention protocols across groups.

Conclusion

This study revealed that the overall knowledge of operating room staff and surgical technology students regarding the prevention of SSI was at a moderate level. But, their self-reported performance was moderately high. Staff members demonstrated superior proficiency in technical procedures such as sterile dressing and skin preparation. In contrast, students performed better in basic tasks such as hand disinfection and mask/glove replacement. The stronger association between knowledge and performance among staff highlights the critical influence of professional experience and theoretical foundation in the accurate implementation of SSI prevention protocols. While the relatively high performance of students may stem from structured educational supervision.

The findings highlight the importance of targeted and group-specific educational strategies, with priority given to strengthening theoretical understanding for students and updating advanced practical skills for staff. Utilizing simulation-based learning, real-time feedback, and integrated evaluation approaches can effectively narrow the gap between knowledge and performance. It is recommended that future research examine the real impact of such interventions on reducing surgical site infection incidence through objective measurement tools and longitudinal designs.

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