

KNOWLEDGE ASSESSMENT OF SURGICAL HAND SCRUBBING PRACTICES
AMONG OPERATING ROOM PERSONNEL IN A DHQ HOSPITAL, DERA
ISMAIL KHAN

Mahwish Bibi

Faculty of Allied Health Sciences, Surgical Technology, Gomal University Dera Ismail Khan.

Afaq Ali*

Faculty of Allied Health Sciences, Surgical Technology, Gomal University Dera Ismail Khan.

Aurad Ahmad

Faculty of Allied Health Sciences, Surgical Technology, Gomal University Dera Ismail Khan.

Amara Saeed

Faculty of Allied Health Sciences, Surgical Technology, Gomal University Dera Ismail Khan.

Maryam Rasool

Faculty of Allied Health Sciences, Surgical Technology, Gomal University Dera Ismail Khan.

Muhammad Naeem

Faculty of Allied Health Sciences, Surgical Technology, Gomal University Dera Ismail Khan.

Ella Ud din

Faculty of Allied Health Sciences, Surgical Technology, Gomal University Dera Ismail Khan.

Muhammad Junaid

Faculty of Allied Health Sciences, Surgical Technology, Gomal University Dera Ismail Khan.

Abstract

Author Details

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Corresponding E-mails & Authors*:

Afaq Ali

afaqali06699@gmail.com

Introduction: Surgical hand scrubbing is a fundamental infection prevention practice performed before every surgical procedure. SHS is vital to prevent the spread of SSIs and ensuring patient safety in operating room. **Aim:** This study aims to assess the knowledge of SHS practices among operating room personnel in DHQ Hospital, Dera Ismail Khan. **Methodology:** A descriptive cross sectional study conducted in DHQ Hospital DERA ISMAIL KHAN, with

a sample size 109 participants. Data was gathered via a structured questionnaire .The data was analyzed using SPSS software. **Results:** The results revealed that 73.4% of the personnel were men and 26.6% were female. Most of the participants indicated a satisfactory level of knowledge with correct answers ranging from 70.6% to 97.2%. The highest level of knowledge was observed, necessity of scrubbing before every surgery (97.2%), although a significant gap in knowledge was observed regarding the misunderstanding that sterile gloves can replace hand scrubbing (29.4%). Adherence to

protocol regarding the recommended scrubbing duration was low. The major barriers identified were lack of training (84.4%), time pressure (68.8%), heavy workload (66.1%), and supply shortages (61.5%). In conclusion, while operating room personnel demonstrate satisfactory knowledge and positive attitudes toward surgical hand scrubbing, the gap between knowledge and clinical practice remains a concern. Managing barriers such as the deficiency of formal training, heavy workload and shortage of crucial instruments and equipment is essential. The study emphasizes the need for interventions consisting of regular formal training and enhanced supply management to improve compliance and ultimately reduce the risk of SSIs.

2. INTRODUCTION

Surgical hand scrubbing (SHS) is a fundamental infection-prevention practice performed before surgical procedures to reduce microorganisms on the hands and arms through mechanical washing and chemical antisepsis (1). It plays an important role in preventing surgical site infections (SSIs), which can cause delayed wound healing, prolonged hospital stay, increased healthcare costs, patient discomfort, morbidity, and compromised patient safety (2,3). SSIs are among the most common healthcare-associated infections, with an estimated incidence of 2.5% globally and up to 11% in developing countries (4). Although sterile gloves provide an important barrier, contamination may still occur because of glove perforation or inadequate hand hygiene (5). Proper hand hygiene therefore remains essential for protecting patients and healthcare workers from microbial transmission (6).

Surgical hand preparation has been recommended since the nineteenth century, and organizations including the World Health Organization (WHO), Association of periOperative Registered Nurses (AORN), and National Institute for Health and Care Excellence (NICE) recommend standardized hand-hygiene practices before surgical procedures to reduce SSIs (7). The WHO and AORN emphasize hand hygiene at critical points of care, including before patient contact, before aseptic procedures, after exposure to body fluids, after patient contact, and after contact with the patient's surroundings (8). Hand hygiene is a simple and cost-effective component of infection prevention and control. However, healthcare workers' hands can become contaminated with transient microorganisms, while compliance remains low in many developing countries (9). Effective hand hygiene also contributes to reducing cross-infection, healthcare-associated infections, and antimicrobial resistance (10,11).

Healthcare-associated infections contribute substantially to morbidity, mortality, and healthcare costs. Proper hand hygiene can reduce infection transmission, and strict adherence has been associated with a potential 15–30% reduction in hospital-acquired

infections (12–14). Common surgical hand-preparation methods include antimicrobial soap and water and alcohol-based hand preparations, both of which reduce microbial contamination (15,16). Alcohol-based preparations, particularly ethanol- and isopropanol-based formulations, provide broad antimicrobial activity, while antimicrobial agents such as povidone-iodine and chlorhexidine are also used in healthcare settings (17). WHO-recommended surgical hand preparation involves appropriate cleaning of the hands, fingers, and forearms using an antimicrobial preparation with correct technique and duration. Adherence to recommended procedures may substantially reduce SSIs (18).

Despite established guidelines, non-compliance with hand hygiene remains a major concern and is influenced by inadequate knowledge, limited training, time constraints, poor accessibility to hand-rub facilities, and concerns about skin irritation (19,20,24). The effectiveness of hand hygiene depends on the appropriate technique, duration, and adherence to standardized procedures (21). The WHO's "Five Moments for Hand Hygiene" provides a global framework for improving hand hygiene practices in healthcare settings (22).

Knowledge of surgical hand-scrubbing procedures among operating room personnel is essential for effective infection prevention. However, studies have often focused on compliance rather than assessing healthcare workers' actual knowledge and technique (23). In developing countries, inadequate training and limited educational opportunities may further contribute to poor adherence (24). Reported compliance with recommended surgical hand-scrubbing procedures has frequently remained below 50% (25). Standardized, evidence-based assessment tools focusing specifically on the sequence and essential steps of surgical hand scrubbing are also limited (26).

Therefore, this study aimed to assess the knowledge of surgical hand-scrubbing practices among operating room personnel at DHQ Hospital, Dera Ismail Khan. The findings may identify knowledge gaps and provide evidence for targeted training and improved infection-prevention practices, ultimately contributing to safer surgical care and reduced SSI risk.

3. METHODOLOGY

A descriptive cross-sectional study was conducted at DHQ Teaching Hospital, Dera Ismail Khan, to assess knowledge of surgical hand-scrubbing practices among operating room personnel. The target population consisted of approximately 150 operating room personnel, and a sample size of 109 was calculated using the Raosoft online sample size calculator at a 95% confidence level and 5% margin of error. Data were collected over approximately six months following approval of the synopsis and ethical clearance.

A non-probability convenience sampling technique was used, and participants were selected based on their availability and willingness to participate. The study included surgeons, surgical assistants, surgical technologists, scrub nurses, OT technicians, and anesthesiologists. Staff on long leave, new or trainee staff, non-practicing or administrative staff, and those unwilling to provide consent were excluded. Data were collected using a structured, self-administered questionnaire developed according to the study objectives and relevant literature. The questionnaire covered demographic characteristics, including age, gender, professional role, educational level, and years of experience, as well as knowledge regarding causes, risk factors, prevention, and management of surgical site infections and infection-control practices.

Ethical approval was obtained from DHQ Hospital, Dera Ismail Khan, and the Research Committee of Gomal University, Dera Ismail Khan. Data were analyzed using SPSS, with descriptive statistics including frequencies, percentages, and mean scores used to summarize the findings.

4. RESULTS AND DISCUSSION

The results of the study done to evaluate the surgical hand scrubbing knowledge, attitudes, and practices of operating room staff at DHQ Hospital, Dera Ismail Khan, are presented in this chapter. Participant demographics, answers to knowledge, attitude, and practice questions, variables influencing surgical hand washing, and summary statistics of the research variables are examples of descriptive statistics. The correlations between knowledge, attitude, and practice scores, as well as the relationships between demographic variables and knowledge and practice levels, were investigated by inferential methods.

4.1. Demographic characteristics of participants

The study participants' age group, gender, job title, operating room experience, and prior surgical hand cleaning training are displayed. The study involved 109 individuals working in operating rooms.

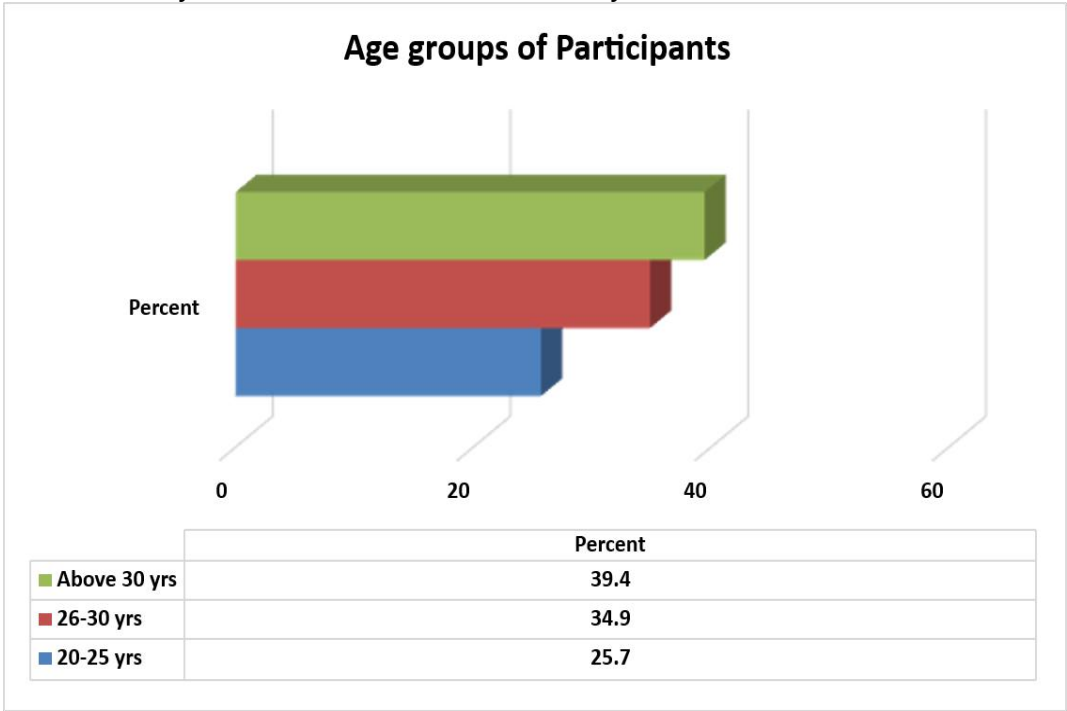
Table 4.1: *Demographic characteristics of patients*

Variable		Frequency	Percent
Age Groups	20-25 yrs	28	25.7
	26-30 yrs	38	34.9
	Above 30 yrs	43	39.4
Gender	Male	80	73.4
	Female	29	26.6
Job Title	OT Nurse	13	11.9
	Surgical Technologist	31	28.4

OR Experience	Surgeon/Resident	40	36.7
	Other	25	22.9
	Less than 1 year	42	38.5
	1-5 Yrs	33	30.3
	More than 5 Yrs	34	31.2
Received Training	Yes	70	64.2
	No	39	35.8

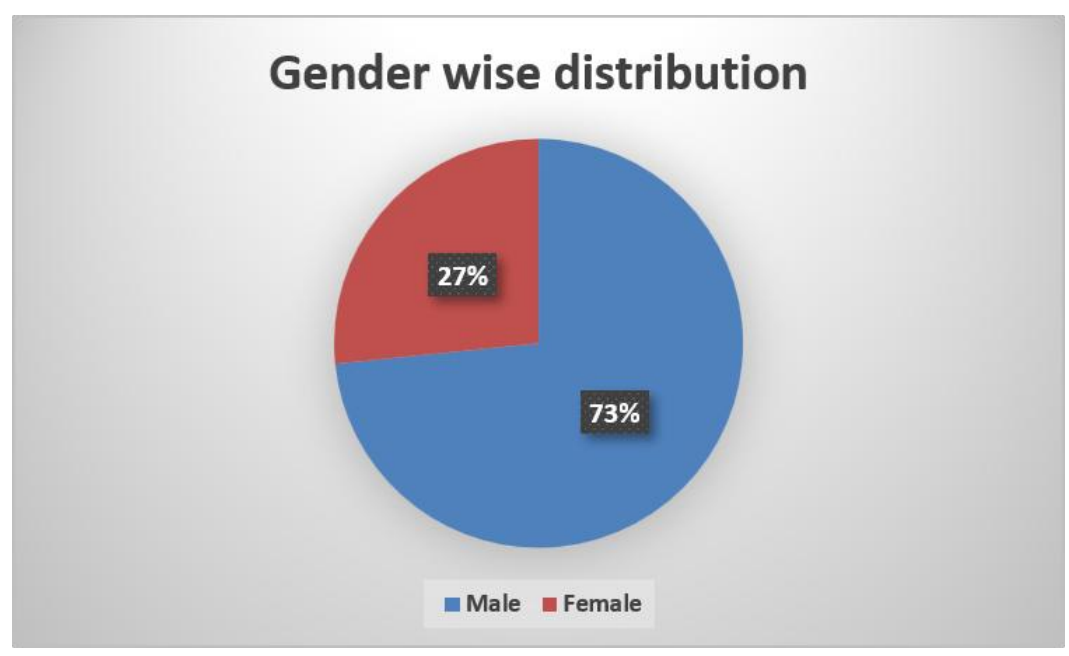
4.1.1. Age Group

The participants' age distribution is shown in Table 4.1. Those over 30 years represented the largest proportion of participants (43; 39.4%), followed by those between the ages of 20 years and 25 years (28; 25.7%) and 26 to 30 years (38; 34.9%).



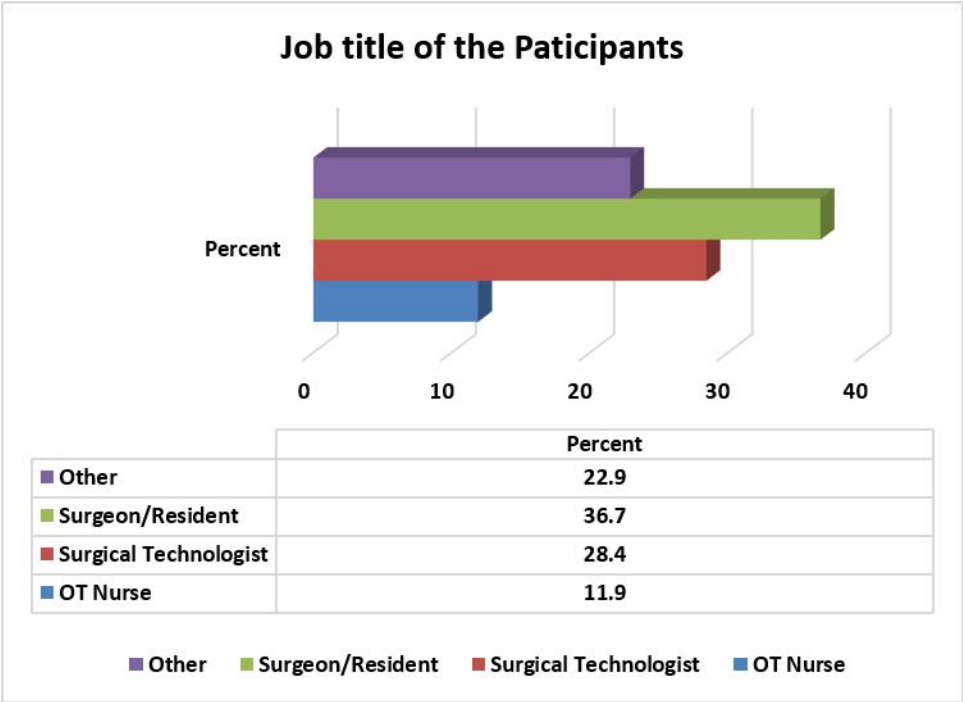
4.1.2 Gender

The gender distribution of the participants is shown in Table 4.1. The majority of the participants were male (80; 73.4%), whereas 29 (26.6%) were female.



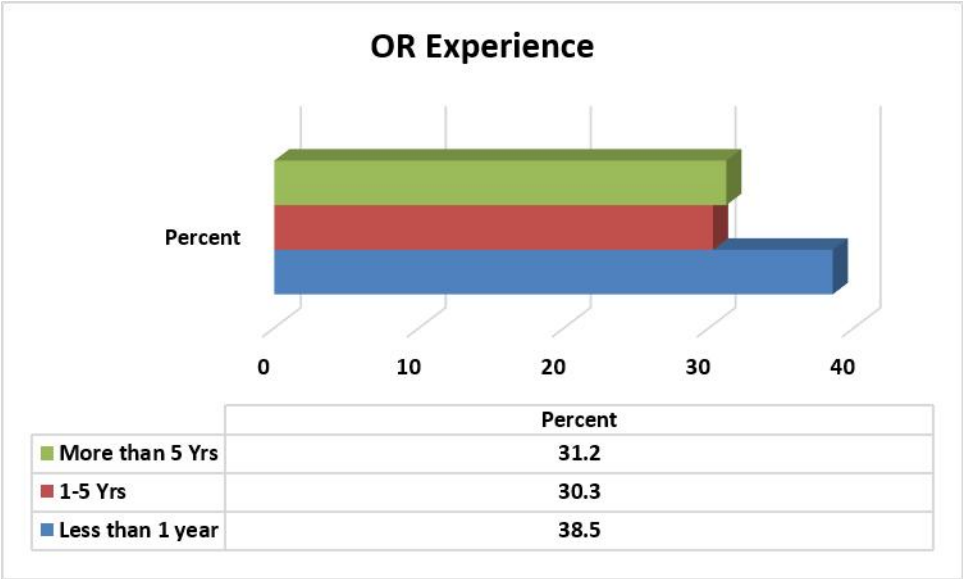
4.1.3 Job Title

The distribution of participants according to job title is presented in Table 4.1. Surgeons/Residents constituted the largest professional group (40; 36.7%), followed by Surgical Technologists (31; 28.4%), other operating room personnel (25; 22.9%), and OT Nurses (13; 11.9%).



4.1.4 Operating Room Experience

The participants' experience of operating room is summarized in Table 4.1. The highest proportion of participants had less than one year of operating room experience (42; 38.5%), while 34 (31.2%) had more than five years of experience and 33 (30.3%) had 1–5 years of experience.



4.1.5 Previous Training on Surgical Hand Scrubbing

The distribution of participants according to previous training on surgical hand scrubbing is presented in Table 4.1. The majority of the participants (70; 64.2%) reported having received training on surgical hand scrubbing, whereas 39 (35.8%) indicated that they had not received any formal training.

4.2 Responses of Participants Regarding Knowledge, Attitude, and Practice of Surgical Hand Scrubbing

This section presents the participants' responses to the questionnaire items related to knowledge, attitude, and self-reported practices regarding surgical hand scrubbing. The responses are summarized using frequencies and percentages to provide an overview of participants' understanding, perceptions, and adherence to recommended surgical hand scrubbing practices.

4.2.1 Knowledge Regarding Surgical Hand Scrubbing

This subsection presents the participants' responses to the eight knowledge-related questions assessing their understanding of the principles and recommended practices of surgical hand scrubbing. The responses are summarized using frequencies and percentages.

Table 4.2. *Participants' Responses to Knowledge Regarding Surgical Hand Scrubbing (n = 109)*

S. No.	Knowledge Item	Correct n (%)	Incorrect n (%)
1	Purpose of surgical hand scrubbing is to reduce microorganisms	104 (95.4)	5 (4.6)
2	Recommended surgical hand scrubbing time	96 (88.1)	13 (11.9)
3	Jewelry should be removed before scrubbing	101 (92.7)	8 (7.3)
4	Surgical hand scrubbing helps prevent surgical site infections	105 (96.3)	4 (3.7)
5	Sterile gloves replace surgical hand scrubbing	77 (70.6)	32 (29.4)
6	Fingernails should be cleaned during scrubbing	100 (91.7)	9 (8.3)
7	Antiseptic solutions are used for surgical hand scrubbing	104 (95.4)	5 (4.6)
8	Surgical hand scrubbing should be performed before every surgery	106 (97.2)	3 (2.8)

The responses to the knowledge-related questions about surgical hand scrubbing by the participants are reported in Table 4.2. Most participants had a good knowledge of all the items. A high percentage of participants correctly identified that surgical hand scrubbing is to reduce the number of microorganisms (95.4%), to prevent surgical site infections (96.3%) and should be performed before all types of surgeries (97.2%). Likewise, 95.4% identified the use of antiseptic solutions in surgical hand scrubbing, 92.7% identified the removal of jewelry before surgical hand scrubbing and 91.7% identified the need to clean fingernails. In addition, 88.1% correctly answered the recommended surgical hand scrubbing time. The proportion of correct responses was, however, comparatively low for sterile gloves (70.6%), the least correct of the items. In general, the results showed that the respondents had a good knowledge of the recommended surgical hand washing practices.

4.2.2 Attitude Toward Surgical Hand Scrubbing

This subsection summarizes the participants' responses to the five attitude-related statements regarding the importance of surgical hand scrubbing. The findings are presented as frequencies and percentages for each response category (Agree, Neutral, and Disagree).

Table 4.3. *Participants' Responses to Attitude toward Surgical Hand Scrubbing (n = 109)*

S. No.	Attitude Statement	Agree n (%)	Neutral n (%)	Disagree n (%)
1	Surgical hand scrubbing is essential for patient safety.	106 (97.2)	3 (2.8)	0 (0.0)
2	Proper surgical hand scrubbing reduces the risk of infection.	101 (92.7)	8 (7.3)	0 (0.0)
3	Operating room staff should strictly follow surgical hand scrubbing guidelines.	81 (74.3)	26 (23.9)	2 (1.8)
4	Regular training on hand hygiene is important.	100 (91.7)	6 (5.5)	3 (2.8)
5	Poor hand hygiene can harm patients.	101 (92.7)	6 (5.5)	2 (1.8)

This subsection briefly outlines the responses of the participants to the five statements about hand scrubbing and the importance of it in connection with surgery. The results are reported in terms of frequency and percentage for every response option (Agree, Neutral, Disagree). The responses of the participants to the statements related to attitude towards surgical hand scrubbing are presented in the Table 4.3 below. The participants had a very positive attitude towards surgical hand scrubbing and infection prevention overall. Patient safety was the statement with the highest level of agreement; 106 (97.2%) participants agreed that surgical hand scrubbing is necessary for patient safety. Likewise, 101 (92.7%) participants agreed that proper surgical hand scrubbing would decrease the risk of infection and 101 (92.7%) agreed that hand hygiene poor practices will be detrimental to patients. In addition, all 100 (91.7%) agreed that hand hygiene training is important. Operating room staff should strictly follow guidelines for surgical hand scrubbing was the item with the most neutral responses accepted (23.9%) and the lowest level of agreement (81; 74.3%) of all attitude items. Overall, the results suggest that the respondents had positive attitude towards the importance of surgical hand scrubbing.

4.2.3 Self-Reported Practices Regarding Surgical Hand Scrubbing

Table 4.8 shows the self-reported practices of the participants when it comes to surgical hand scrubbing prior to surgical procedures. The answers were grouped into three categories: **Always, Sometimes, and Never.**

Table 4.4. *Participants' Self-Reported Practices Regarding Surgical Hand Scrubbing (n = 109)*

S. No.	Practice Item	Always (%)	n	Sometimes (%)	n	Never (%)	n
1	Perform surgical hand scrubbing before procedures	103 (94.5)		3 (2.8)		3 (2.8)	
2	Follow the recommended scrubbing time	44 (40.4)		56 (51.4)		9 (8.3)	
3	Remove jewelry before scrubbing	92 (84.4)		11 (10.1)		6 (5.5)	
4	Clean fingernails before surgery	92 (84.4)		12 (11.0)		5 (4.6)	
5	Follow hospital infection control guidelines	60 (55.0)		42 (38.5)		7 (6.4)	

The participants' self-reported practice related to surgical hand scrubbing is shown in Table 4.4. Surgical hand scrubbing prior to operative procedures was a high rate of compliance among the majority of participants (103; 94.5% said they always scrub their hands in surgery). Likewise, 92 (84.4%) participants said they always take off jewelry before scrubbing and 84.4% said they always clean their fingernails before surgery. As for the recommended surgical hand scrubbing time, 44 (40.4%) participants reported that they always followed the recommended scrubbing time, while 56 (51.4%) indicated that they sometimes followed the recommended scrubbing time. Additionally, 60 (55.0%) participants reported always following the hospital infection control guidelines and 42 (38.5%) indicated that they sometimes followed the hospital infection control guidelines. Overall, the results indicate that most of those who participated were consistently performing key components of surgical hand scrubbing, but there was generally less compliance with the suggested scrubbing time and hospital infection control guidelines than other practice-related behaviors.

4.3 Factors Affecting Proper Surgical Hand Scrubbing

Table 4.9 presents the participants' responses regarding the factors affecting proper surgical hand scrubbing practices in the operating room. The responses were categorized as **Yes** and **No**.

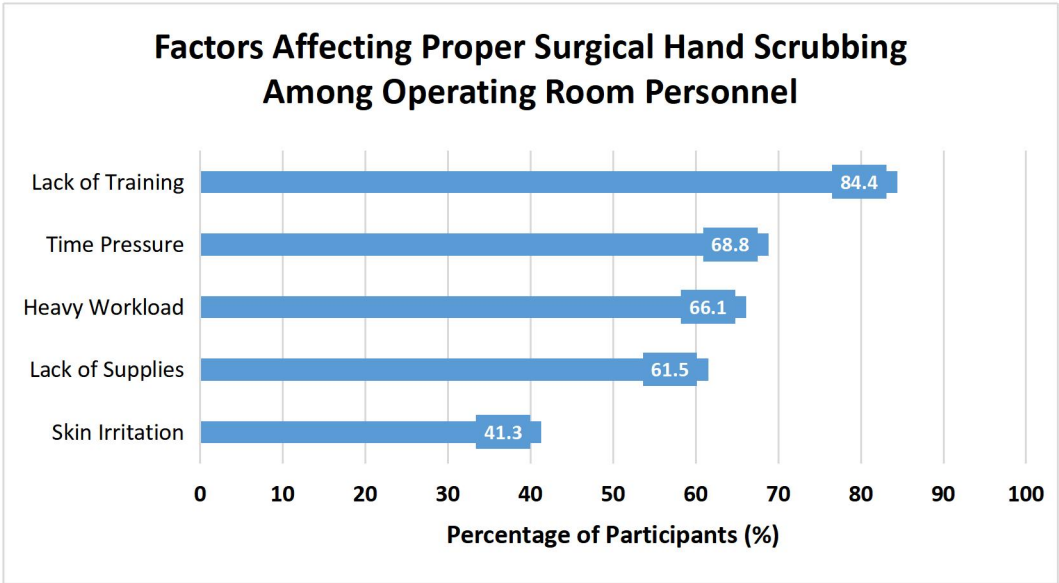


Figure 4.5.1 Factors Affecting Proper Surgical Hand Scrubbing Among Operating Room Personnel

Table 4.5. Factors Affecting Proper Surgical Hand Scrubbing Among Operating Room Personnel (n = 109)

S. No.	Factor	Yes n (%)	No n (%)
1	Lack of supplies	67 (61.5)	42 (38.5)
2	Heavy workload	72 (66.1)	37 (33.9)
3	Time pressure	75 (68.8)	34 (31.2)
4	Lack of training	92 (84.4)	17 (15.6)
5	Skin irritation from antiseptics	45 (41.3)	64 (58.7)

Table 4.5 shows responses by the participants to the question on what factors influence good surgical hand hygiene. Lack of training was the most common factor reported by 92 (84.4%) participants. Time pressure was reported by 75 (68.8%) participants followed by heavy workload reported by 72 (66.1%) participants. Moreover, 67 (61.5%) participants felt that lack of supplies was a challenge to good surgical hand scrubbing. In contrast, skin irritation (antiseptic solutions) was the least common barrier listed, with 45 (41.3%) participants stating that it was a barrier, and 64 (58.7%) participants saying it is not a barrier. The study results indicated that the overall factors hindering the compliance of proper surgical hand scrubbing practices among operating room personnel included organizational and resource-related factors, such as lack of proper training, shortage of time and heavy workload.

4.2 Distribution of Participants According to Knowledge, Attitude, and Practice Levels

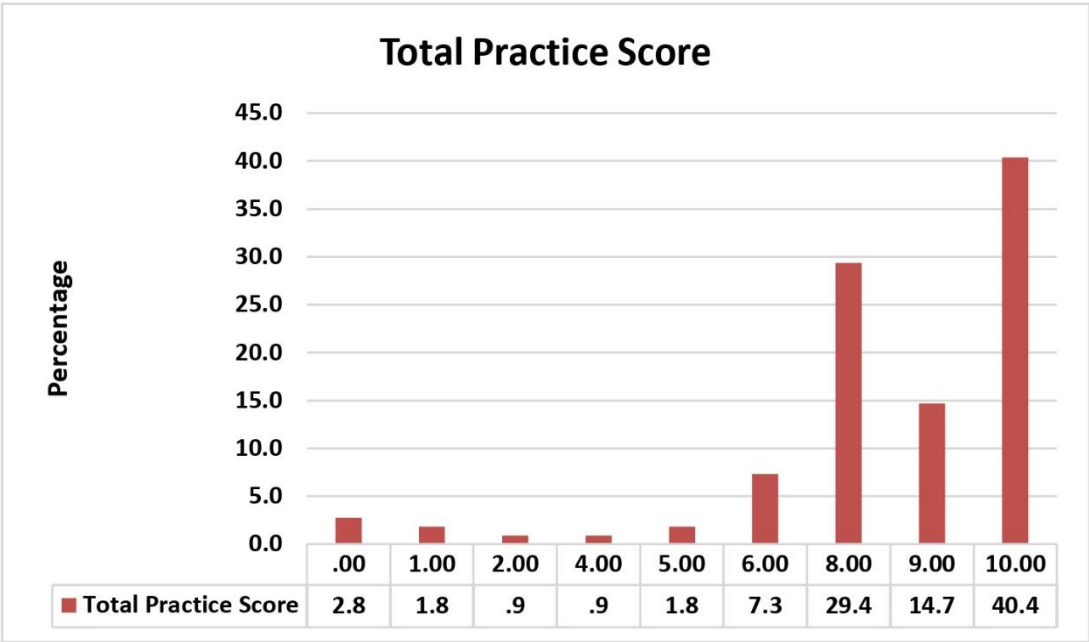
Surgical hand scrubbing knowledge, attitude and practice of OR staff members were measured by the sum of the scores of each section of the questionnaire. The participants were divided into predetermined categories and the overall knowledge, attitude and reported practices were assessed.

4.2.1 Knowledge Level

The distribution of participants by their level of knowledge about surgical hand scrubbing is shown in Table 4.6. Most of the participants (96; 88.1%) showed good knowledge, eight (7.3%) showed poor knowledge and five (4.6%) showed moderate knowledge. The results showed that a majority of the operating room staffs had adequate knowledge of the recommended surgical hand scrubbing practices.

Table 4.6: *Distribution of Participants According to Knowledge Level (n = 109)*

Knowledge Level	Frequency (n)	Percentage (%)
Poor Knowledge	8	7.3
Moderate Knowledge	5	4.6
Good Knowledge	96	88.1



4.3 Mean ± Standard Deviation of Knowledge, Attitude, and Practice Scores

The descriptive statistics of the study participants' TOTAL knowledge, attitude and practice scores are shown in Table 4.9. The average knowledge score was 7.28 ± 1.70

with a range from 0 to 8. The mean attitude score was 14.42 ± 1.46 , ranging from a high score of 15 to a low score of 7. Likewise, the average score of the practice was 8.31 ± 2.30 (range 0–10). The overall results show that the mean was fairly high.

Table 4.7: *Mean ± Standard Deviation of Knowledge, Attitude, and Practice Scores*

Variable	Mean ± SD	Minimum	Maximum
Knowledge Score	7.28 ± 1.70	0	8
Attitude Score	14.42 ± 1.46	7	15
Practice Score	8.31 ± 2.30	0	10

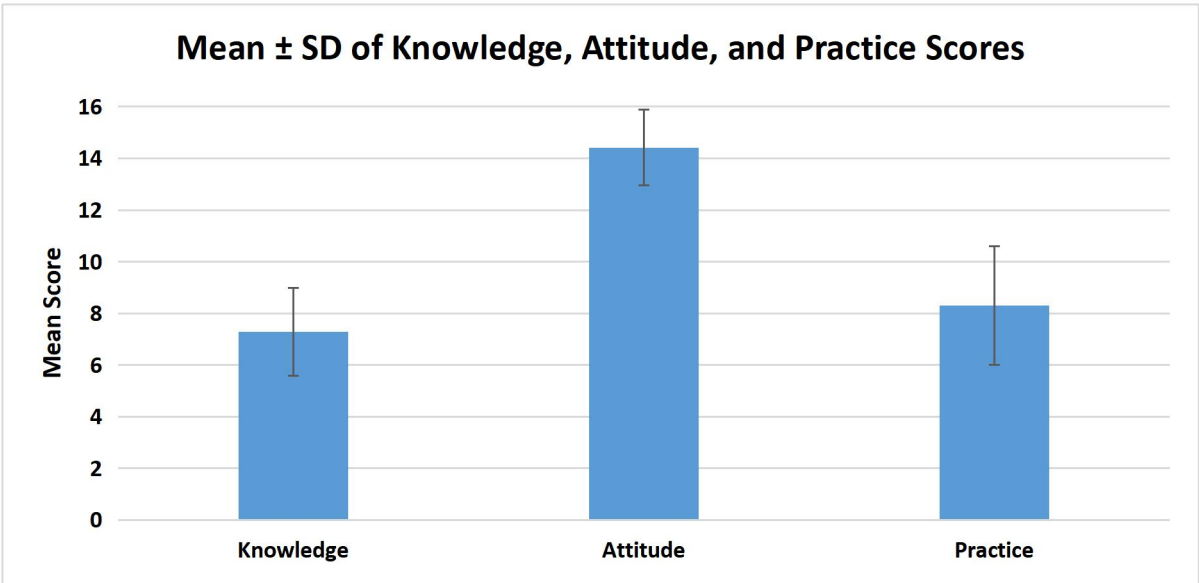


Figure 4.5: *Mean scores of knowledges, attitude, and practice regarding surgical hand scrubbing among operating room personnel.*

4.4 Reliability Analysis of the Study Instrument

Cronbach's alpha coefficient was used to check the internal consistency of the questionnaire. Reliability analysis was conducted on each dimension separately (knowledge, attitude and practice). The results showed very good internal consistency for the three domains, and thus the questionnaire was a reliable instrument for measuring knowledge, attitude and self-reported practices regarding surgical hand scrubbing.

Table 4.8. *Reliability Analysis of the Study Instrument*

Domain	Number of Items	Cronbach's Alpha	Interpretation
Knowledge	8	0.901	Excellent Reliability
Attitude	5	0.893	Good Reliability

Practice	5	0.912	Excellent Reliability
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The reliability of the study instrument was discussed in Table 4.10. The reliability analysis of the study instrument is presented in Table 4.10. The knowledge domain showed an excellent internal consistency (Cronbach's alpha = 0.901) for eight items. The same degree of internal consistency was also found for the attitude domain with a Cronbach's alpha of 0.893 for 5 items. The reliability of the practice domain was the highest with the Cronbach's alpha coefficient of 0.912 on 5 items, which is excellent internal consistency. At the end, the results indicate that all three areas from the questionnaire showed satisfactory to excellent reliability and were suitable for further statistical analysis.

Interpretation of Cronbach's Alpha (For reference)

No	Coefficient of Cronbach's Alpha	Reliability Level
1	More than 0.90	Excellent
2	0.80-0.89	Good
3	0.70-0.79	Acceptable
4	0.6-.69	Questionable
5	0.5-0.59	Poor
6	Less than 0.59	Unacceptable

4.5 Association Between Demographic Variables and Knowledge Level

Pearson's Chi-square test was used to determine whether there was any association between the demographic characteristics of the participants with their level of knowledge on surgical hand scrubbing. The results of the study are tabulated in Table 4.11.

Table 4.9. Association Between Demographic Variables and Knowledge Level

Demographic Variable	χ^2	df	p-value	Interpretation
Gender	3.046	2	0.218	Not Significant
OR Experience	13.922	4	0.008	Significant

Note: A p-value < 0.05 was considered statistically significant.

Table 4.11 presents the association between selected demographic variables and knowledge level regarding surgical hand scrubbing. There was no statistically significant association between gender and knowledge level ($\chi^2 = 3.046$, $df = 2$, $p = 0.218$), indicating that the level of knowledge did not differ significantly between male and female participants.

In contrast, a statistically significant association was observed between operating room experience and knowledge level ($\chi^2 = 13.922$, $df = 4$, $p = 0.008$). This finding suggests that participants with different levels of operating room experience demonstrated significantly different levels of knowledge regarding surgical hand scrubbing.

4.6 Association between Demographic Variables and Practice Level

Pearson's Chi-square test was also performed to examine the association between demographic characteristics and self-reported practice level regarding surgical hand scrubbing. The findings are summarized in Table 4.12.

Table 4.10. Association between Demographic Variables and Practice Level

Demographic Variable	χ^2	df	p-value	Interpretation
Gender	2.207	2	0.332	Not Significant

Note: A p-value < 0.05 was considered statistically significant.

Table 4.12 shows the association between gender and practice level regarding surgical hand scrubbing. The Chi-square analysis showed no statistically significant relationship existed between gender and practice level ($\chi^2 = 2.207$, $df = 2$, $p = 0.332$). This suggests that there were no significant differences in the self-reported surgical hand scrubbing habits of men and women.

4.7 Correlation among Knowledge, Attitude, and Practice Levels

Pearson's correlation analysis was performed to examine the relationships among knowledge, attitude, and practice levels regarding surgical hand scrubbing among operating room personnel. The results are presented in Table 4.13.

Table 4.11. Pearson Correlation Among Knowledge, Attitude, and Practice Levels

Variables	Pearson's r	p-value	Interpretation
Knowledge Level vs. Attitude Level	0.870	<0.001	Strong Positive Correlation
Knowledge Level vs. Practice Level	0.925	<0.001	Very Strong Positive Correlation
Attitude Level vs. Practice Level	0.812	<0.001	Strong Positive Correlation

Note: Correlation is significant at the 0.01 level (2-tailed).

Table 4.13 presents the Pearson correlation analysis among knowledge, attitude, and practice levels regarding surgical hand scrubbing. A strong positive correlation was observed between knowledge level and attitude level ($r = 0.870$, $p < 0.001$), indicating that participants with higher knowledge levels tended to have more positive attitudes toward surgical hand scrubbing.

Similarly, a very strong positive correlation was found between knowledge level and practice level ($r = 0.925$, $p < 0.001$), suggesting that better knowledge was associated with better self-reported surgical hand scrubbing practices.

Furthermore, a strong positive correlation was identified between attitude level and practice level ($r = 0.812$, $p < 0.001$), indicating that participants with more positive attitudes were more likely to report good surgical hand scrubbing practices.

At the end, the findings demonstrate significant positive relationships among knowledge, attitude, and practice levels, suggesting that improvements in knowledge are associated with more positive attitudes and better surgical hand scrubbing practices

4.12 Discussion

Surgical hand scrubbing is an infection prevention objective that is a key element in reducing microbial contamination of the hands of the members of the operating room, and in decreasing the incidence of surgical site infections. Healthcare professionals knowledge, attitude, and practices, institution and organization factors are the influencing factors for the compliance with the surgical hand scrubbing guidelines. This study aimed to evaluate the knowledge, attitude, practices and factors contributing to the proper surgical hand scrubbing among the operating room (OR) staff of a District Headquarters Hospital (DHQ) in Dera Ismail Khan.

The demographic characteristics of the respondents revealed that the highest number of respondents (39.4%) were above 30 years of age, followed by 34.9% between the ages of 26 and 30, 25.7% between 20 and 25. The majorities of the participants were over the age of 30, suggesting that most respondents were in a relatively late stage of their professional careers, and were likely to have significant experience in OR practices. A similar demographic distribution has been reported in studies among operating room personnel where the majority of the study population was experienced healthcare professionals.

The study also indicated that 73.4% of the respondents were males while 26.6% were females. The higher proportion of males than females in the study samples might be due to the staffing pattern in the study context and not due to the gender difference in professional competence. In other studies conducted among operating room personnel in Pakistan and other developing countries, the majority of the population were males and similar gender distribution figures have been reported.

As far as the professionals were concerned, surgeons and resident professionals made up the largest group (36.7%), followed by surgical technologists (28.4%), other operating room personnel (22.9%), and operating room nurses (11.9%). The variation in the professional categories was advantageous for the study as it was necessary for

surgical hand scrubbing to be performed with the collaboration of all professionals in the surgical team. Prior studies assessing OR personnel have also included surgeons, nurses, technologists, and other members of the OR staff to get a broad picture of infection prevention practices.

Surgical hand scrubbing training had been received by nearly two-thirds (64.2%) of the respondents, while 35.8% had not had any formal training. While the percentage of trained participants was good, over one-third of operating room workers were not formally trained, so there is room for additional professional development. The World Health Organization (WHO) has also underscored the importance of regular education and ongoing competency-based training to ensure high standards of surgical hand preparation and to minimize the risk of surgical site infections.

The results of the present study showed that the respondents had a good knowledge about surgical hand scrubbing. The mean knowledge score was 7.28 ± 1.70 out of a maximum possible score of eight. Moreover, the good knowledge was displayed by 88.1% of the participants while poor knowledge was displayed by 7.3% and moderate knowledge was displayed by 4.6% of the participants. The results suggest that most of the OR staff members had a good knowledge of recommended surgical hand scrubbing. The present results are similar to the findings of Gul et al. (2024) who reported that over 90% of the operating room staff had good knowledge of the WHO Surgical Safety Checklist and infection prevention in a tertiary care hospital in Peshawar. Similarly, Shaheen et al. (2023) found appropriate knowledge on sterile procedure among OR staff in Khyber Teaching Hospital, Pakistan.

Analysis of individual knowledge items also indicated that nearly all respondents correctly identified the main purpose of surgical hand scrubbing, the necessity to remove jewelry before surgical hand scrubbing, surgical hand scrubbing of fingernails, usage of antiseptic solutions and the need for surgical hand scrubbing before each operation. Over 95% of respondents also correctly identified surgical scrubbing as a way to prevent surgical site infections. The results indicate that the knowledge of infection prevention concepts is widely shared among most of the operating room staff.

One aspect of the knowledge assessment that stood out, however, was that the responses were related to the local context. About 29.4% of the respondents mistakenly thought that sterile gloves could substitute surgical hand scrubbing. This misconception shows that although general knowledge is good, certain healthcare professionals have some misconceptions about the complementary use of surgical hand antisepsis and sterile gloves. International guidelines make it clear that sterile gloves are not an excuse for inadequate surgical hand preparation as it is possible for the gloves to tear or

develop microscopic holes during the operation. So, suitable surgical prepping is still a crucial part of infection prevention regardless of whether or not gloves are worn.

The results of the present study revealed a very positive attitude of operating room staff towards surgical hand scrubbing. The average attitude score obtained was 14.42 ± 1.46 out of 15, with 92.7% having a positive attitude, 5.5% a neutral attitude and 1.8% a negative attitude. The results showed that most of the healthcare professionals understood the value of scrubbing the surgical hand to prevent HAIs and patient safety. As in previous research when operating room staff demonstrated positive attitudes and followed hand hygiene recommendations. Since positive attitudes are deemed to be a key factor associated with compliance to infection preventative measures, health care workers who have a positive attitude about hand hygiene are more likely to comply with the recommended practices.

These findings were further supported by the answers given for each of the attitude statements. Nearly all participants agreed that scrubbing of surgical hands is a critical hygiene measure for patient safety and helps to lower the risk of surgical site infection. Over 90% also agreed strict adherence to surgical hand scrubbing guidelines should be enforced and that regular training programs were needed for competency. The results indicate a high level of understanding among OR staff about the importance of infection prevention. World Health Organisation highlights the need for ongoing education, support from institutions and positive safety culture to increase compliance with hand hygiene guidelines and decrease HAIs.

Although the overwhelmingly positive attitude that was observed in the current study, there were a few negative responses and a few neutral responses to some of the statements. This can be a reflection of personal perception, past training experiences or institutional practices. Similarly, previous studies have shown that the overall attitude of health workers towards hand hygiene is positive, though it is essential to keep them compliant in the practice of HH, by continuing to educate, supervise and monitor them regularly.

Assessment of self-reported practices showed generally satisfactory practices with regard to the recommended surgical hand scrubbing procedures. The mean practice score was 8.31 ± 2.30 out of a maximum possible score of 10. In addition, 9.2% of the participants had fair practice and only 6.4% had poor practice. The results have shown that most of the operating room staff members reported that they perform adequate surgical hand scrubbing during routine surgeries. The same has been observed in previous studies, where compliance with surgical hand hygiene practices

was correlated to good knowledge, positive attitudes, and infection control policies of the institution.

Results of the individual practice items showed that almost all participants (94.5%) always do surgical hand scrubbing before surgical procedures. Similarly a high percentage indicated that they always took their rings, bracelets, and rings off before scrubbing and cleaning fingernails before surgery. These practices are entirely aligned with international guidelines as jewelry and long fingernails provide more opportunities for microbial colonization and less efficient surgical hand antisepsis. WHO guidelines state that no jewelry should be worn on hands and wrists before hand preparation for surgery, and fingernails should be short, clean and free of bacteria.

Another interesting discovery from the present study was that a mere 40.4% said that they always scrub their hands for the recommended amount of time after surgery, while over half (51.4%) indicated that they scrub their hands after surgery only sometimes for the recommended amount of time. This implies that despite the awareness of the participants regarding the significance of surgical hand scrubbing, keeping up the recommended contact time in regular clinical practice was a challenge. This is in line with previous research that found that compliance with scrub duration ranged widely by type of healthcare professional. Although people are well aware of the recommended amount of time to scrub, the time is frequently limited due to time constraints, workload, and the growing number of surgeries.

Likewise, 55.0% reported compliance with hospital infection control guidelines at all times and over third of respondents said they complied with guidelines only occasionally. The discovery implies that the compliance in institutions is still a subject for continuous monitoring and quality improvement programs. Previous research has focused on the need to ensure implementation of infection prevention rules in addition to frequent supervision, auditing and ongoing professional education. Surgical hand hygiene practices tend to be more compliant in healthcare institutions that have active infection prevention programs as opposed to those that do not have structured systems to monitor hand hygiene practices.

The present study also investigated the factors that influence the proper surgical hand scrubbing. Lack of training (84.4%), time pressure (68.8%), heavy workload (66.1%) and lack of supplies (61.5%) were the most commonly reported barriers. The results suggest the major challenges to surgical hand scrubbing compliance are not individual but organizational factors. In past studies, healthcare workers have also consistently cited lack of education, lack of staff, too much work, and not enough resources for infection prevention as major challenges in achieving good hand hygiene compliance.

WHO guidelines also note that hand hygiene programmes must be implemented with the support of the institution, regular education and training, sufficient hygiene supplies and institutional support to ensure success.

It was the notable reading that, only 41.3% of the participants reported that antiseptic agents caused skin irritation, which was the least common barrier in the present study. This discovery indicates that whilst adverse skin reactions might deter some healthcare practitioners to follow the necessary steps to maintain compliance, organisational factors like inadequate training and a heavier workload have a significantly more impact on practices of surgical hand scrubbing. WHO suggests using antiseptic formulations that are good for the skin, as well as using the correct hand-care products, to reduce skin damage and still fight germs.

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infection prevention as major challenges in achieving good hand hygiene compliance. WHO guidelines also note that hand hygiene programmes must be implemented with the support of the institution, regular education and training, sufficient hygiene supplies and institutional support to ensure success.

Interestingly, only 41.3% of the participants reported that antiseptic agents caused skin irritation, which was the least common barrier in the present study. This discovery indicates that whilst adverse skin reactions might deter some healthcare practitioners to follow the necessary steps to maintain compliance, organisational factors like inadequate training and a heavier workload have a significantly more impact on practices of surgical hand scrubbing. WHO suggests using antiseptic formulations that are good for the skin, as well as using the correct hand-care products, to reduce skin damage and still fight germs.

The internal consistency of the study questionnaire was tested and the results of the reliability analysis were good. The Cronbach's alpha coefficients of the knowledge, attitude and practice sections were 0.901, 0.893 and 0.912, respectively. These values are higher than the minimum of 0.70 that is recommended for high reliability of the questionnaire, and the items within each section of the questionnaire all measured the constructs intended. The higher Cronbach's alpha value is, the more reliable the scores are, with values >0.80 considered good and >0.90 considered excellent (Tavakol and Dennick, 2011). Based on the high reliability found in the present study, thus, it is believed that the data that has been collected is valid and reliable, and the findings of the study is credible.

There were interesting relationships revealed between the demographic characteristics and the knowledge level. There was no statistically significant difference between the gender and the level of knowledge ($\chi^2 = 3.046$, $p = 0.218$), meaning that there was no difference between the knowledge of the male and female operating room personnel about surgical hand scrubbing. Likewise, there was no statistically significant relationship between gender and the compliance to surgical hand scrubbing practices ($\chi^2 = 2.207$, $p = 0.332$) and thus compliance to surgical hand scrubbing practices did not differ significantly between male and female participants. These results suggest that gender was not a significant factor in the present study in terms of knowledge and practice. Previous researchers have reported similar findings and stated that infection prevention practices were more likely to be followed due to professional training and institutional support than gender differences.

On the other hand, there was a statistically significant relationship between experience in the operating room and knowledge level ($\chi^2 = 13.922$, $p = 0.008$).

Participants had more years of experience showed more knowledge than those participants with a fewer year of experience. The results align with previous studies that have shown that more clinical exposure and professional experience lead to better understanding of infection control and standard operating procedures. Healthcare professionals with more experience are more aware of the evidence-based guidelines and often use recommended surgical hand preparation procedures in clinical practice.

The correlation analysis also showed that there were strong positive correlation among the knowledge, attitude and practice score. There was a very high positive correlation between knowledge and practice ($r = 0.925$, $p < 0.001$) which means that those who have high knowledge have high surgical hand scrubbing practice. Similarly, the correlation between knowledge and attitude was high ($r = 0.870$, $p < 0.001$); and attitude with practice had a high positive correlation ($r = 0.812$, $p < 0.001$). This indicates that as knowledge increases, attitudes become more positive and there is greater acceptance of the recommended practices of surgical hand scrubbing.

The relationships observed are in line with those identified by behavioural theories and previous studies in the healthcare field, which suggest that knowledge is the basis for positive attitudes, and that positive attitudes will support professional attitudes and clinical practice. Education on increasing knowledge of healthcare workers has been proven to increase compliance with infection prevention guidelines and decrease HAI. These high relationship levels are therefore important for the continuous professional education and competency based training for operating room staff in the present study.

Lastly, the results of the present study revealed that the surgical hand scrubbing knowledge, attitudes and practices of operating room staff were adequate. However, there are still a number of organizational issues that continue to impact compliance with recommended surgical hand scrubbing procedures such as lack of training, time pressure, heavy workload, and inadequate supplies. Continuous education, regular monitoring, adequate resource allocation and supportive policies for the hospitals may address these institutional challenges further and enhance compliance with international surgical site infection prevention guidelines, hopefully leading to the prevention of surgical site infections in patients undergoing surgery.

CONCLUSION

The current study evaluated knowledge, attitudes, practices and factors influencing surgical hand scrubbing among the surgical staff at District Headquarters Hospital, Dera Ismail Khan. The results indicated that the participants generally had good knowledge, positive attitudes and good self-reported practices for surgical hand scrubbing. The

obtained mean scores were good, suggesting that the study participants had satisfactory knowledge, attitude, and practices regarding infection prevention measures. Although these results were promising, there were some challenges encountered with regards to optimal surgical hand scrubbing compliance. The most common challenges were training, time pressure, workload and lack of supplies. Moreover, the operating room experience had a significant association with the knowledge level and there were strong positive correlations between the knowledge, attitude, and practice scores, reflecting the inter-relatedness of these.

The questionnaire was also highly reliable, enabling consistency and validity of the research results. The overall findings of this study indicate that the knowledge and attitudes of operating room personnel are generally adequate, but ongoing professional development, support from the institution, and effective infection prevention practices are needed to ensure compliance with recommended surgical hand scrubbing practices. Increasing these measures could play an important role in reducing the incidence of surgical site infections and patient safety.

RECOMMENDATIONS

Based on the findings of the present study,

- It is recommended that hospitals conduct regular training and refresher programs on surgical hand scrubbing for all operating room personnel.
- Hospital administrations should ensure the continuous availability of hand hygiene supplies and adequate staffing to minimize workload and time constraints.
- Regular monitoring, supervision, and compliance audits should be implemented to reinforce adherence to established infection prevention guidelines.
- Future studies should include larger multicentre samples and incorporate direct observational methods to provide a more comprehensive assessment of surgical hand scrubbing practices.

5.2 Study Limitations

- This study was conducted in only one hospital (DHQ Teaching Hospital D.I. Khan), which may limit the applicability of the findings to other hospitals or healthcare institutions.
- A cross-sectional research design was employed. Therefore, it was not possible to identify the casual link between training, knowledge, attitude, and practice.
- The information was gathered using a self-completed questionnaire, which exposed the results to the risk of memory bias and social desirability bias.
- This study included a limited sample of 109 participants, which may not properly reflect all categories of staff.

- The study based on participants' self-reported practices rather than real time monitoring of surgical hand hygiene procedures. As a result, the actual level of adherence may contrast from that reported by participants.

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