Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Jamshed et al., 2026

KNOWLEDGE AND PRACTICES REGARDING SURGICAL ATTIRE AMONG OPERATING THEATER STAFF: A CROSS-SECTIONAL STUDY FROM TWO PUBLIC HOSPITALS IN DERA ISMAIL KHAN, PAKISTAN

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Received on 25 May, 2026
Accepted on 21 June, 2026
Published on 23 June, 2026

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Abstract

Background: Surgical site infections (SSIs) are a major cause of healthcare-associated morbidity, prolonged hospital stay, and increased cost, and appropriate surgical attire is among the most important barriers against microbial transmission in the operating theater (OT). This study assessed the knowledge, practices, and attitudes of OT staff regarding surgical attire at two public-sector hospitals in Dera Ismail Khan, Pakistan. Methods: A cross-sectional, observational study was conducted using census sampling of all 140 OT staff (surgeons, anesthetists,

scrub nurses, circulating nurses, surgical technicians, and anesthesia technicians). A self-designed questionnaire covering demographics, knowledge, practice, and attitude was used. Data were analyzed in SPSS v23 using descriptive statistics and Pearson chi-square tests ($p \leqslant 0.05$). Results: Although 70.7% of staff correctly identified the prevention of microbial contamination as the primary purpose of surgical attire, 81% of circulating nurses believed it was for comfort. Practice gaps were substantial: 34.3% reported never wearing sterile gloves, 34.3% rarely changed contaminated attire, and 62.9% did not consistently follow proper hand-hygiene technique. Occupation was significantly associated with both knowledge and practice ($p < 0.05$). On a Likert-based compliance scale, surgeons and anesthetists achieved "Excellent" compliance (84.4–100%), scrub nurses and surgical technicians fell into "Good" to "Very Good" categories, and anesthesia technicians and circulating nurses recorded the lowest compliance ("Fair" to "Good"). Conclusion: Considerable knowledge and practice gaps regarding surgical attire exist among OT support staff. Targeted training, supervision, and regular audits are urgently needed, particularly for technician and nursing support cadres.

Keywords: Surgical Attire; Operating Theater Staff; Surgical Site Infections; Knowledge and Practice

INTRODUCTION

Surgical site infections (SSIs) are among the most common healthcare-associated infections, accounting for over 30% of such infections in many studies, with rates ranging from 3.5–12% in developed countries to 5.7–19.1% in developing countries, resulting in significant morbidity, prolonged hospitalization, and increased costs (Uzair et al., 2021; Shaheen & Hawash, 2021). Surgical attire—including gowns, gloves, masks, head coverings, and shoe covers—forms a critical barrier against microbial transmission in the operating theater (OT), and international guidelines such as those of the Association of periOperative Registered Nurses (AORN) recommend evidence-based attire protocols to minimize contamination from healthcare personnel to patients (Braswell & Spruce, 2012; Link, 2020). Non-compliance, particularly among support staff, has been associated with elevated intraoperative bacterial loads and increased SSI risk (Loftus et al., 2008; Alayemi et al., 2024).

Evidence from multiple settings underscores both the rationale for surgical attire and persistent gaps in its application. Reviews from Brazil, Ireland, and the United States have examined the evidence base for OT clothing, generally affirming that sterile gowns, gloves, and head coverings reduce bacterial contamination, although the link between specific attire components and SSI rates remains debated (Duarte & Leite, 2013; McHugh et al., 2014; Salassa & Swiontkowski, 2014; Bartek et al., 2017). Comparative

studies on gowns and gloves have found that disposable gowns and timely glove changes reduce contamination, particularly during implant surgery (Ward et al., 2014), while updated guidelines address scrub attire, jewelry, personal items, and laundering practices (Cowperthwaite & Holm, 2015; Ramos & Itani, 2020). Facemask use during implant surgery has likewise been associated with reduced infection risk, although the overall evidence remains limited (Marson et al., 2021).

Knowledge–practice gaps among healthcare workers, particularly support and paramedical staff, have been documented across South Asia, Africa, and the Middle East. Studies from Egypt, India, and South Africa report inadequate knowledge and inconsistent use of personal protective equipment among nurses, technicians, and support staff despite generally positive attitudes (SA et al., 2016; Lakshmi et al., 2018; Alayemi, 2020; Alayemi et al., 2024). Educational interventions have shown promise in improving both knowledge and practice in these groups (Alayemi et al., 2024; Zimmerman et al., 2023). In Pakistan specifically, infection-control practices remain suboptimal due to limited training and inconsistent protocol adherence (Batool et al., 2023; Mahboob et al., 2021; Tamoor et al., 2024), and a broader review of operating-room traffic, attire, and distractions reinforces the need to translate existing recommendations into consistent everyday practice (Christou et al., 2024).

Despite established attire guidelines, data on OT staff knowledge and practice in resource-constrained settings such as Dera Ismail Khan, Pakistan, remain scarce. Persistent knowledge gaps and inconsistent practice among OT personnel continue to compromise infection prevention and contribute to preventable SSIs, underscoring the need for locally relevant evidence to guide targeted training interventions. This study therefore aimed to (1) assess the level of knowledge among OT staff regarding proper surgical attire and its role in infection control, and (2) evaluate current practices of surgical attire use among surgeons, anesthetists, nurses, and technical support staff in the operating theater.

MATERIALS AND METHODS

Study Design and Setting

A cross-sectional, observational study was conducted at two public-sector hospitals in Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan: District Headquarters (DHQ) Hospital and Mufti Mehmood Memorial Teaching Hospital (MMMTH).

Sampling and Selection Criteria

A census sampling approach was used to enroll all 140 OT staff members across both facilities, including surgeons, anesthetists, scrub nurses, circulating nurses, surgical technicians, and anesthesia technicians. Staff aged 20 to 50+ years with a minimum of

six months of OT experience who provided written informed consent were included. Non-clinical or administrative personnel, trainees with less than six months of OT experience, staff on leave, and individuals working exclusively in non-sterile areas were excluded.

Data Collection Tool

Data were collected using a self-designed, structured questionnaire adapted from previously validated instruments (Mashal et al., 2025; Wahba, 2016) and validated through expert consultation with surgical department heads at both hospitals. The questionnaire comprised four sections: (1) demographic characteristics; (2) five knowledge items (four-option multiple choice); (3) five practice items (five-point Likert scale ranging from "Never" to "Always"); and (4) three attitude items (agree/disagree).

Ethical Considerations

Ethical approval was obtained from Times University, Multan, with administrative consent from both participating hospitals. Participation was voluntary, anonymous, and confidential, and written informed consent was obtained from all participants prior to data collection (August–September).

Statistical Analysis

Data were analyzed using IBM SPSS version 23. Descriptive statistics (frequencies and percentages) summarized all variables, and Pearson chi-square tests assessed associations between occupation and knowledge/practice domains, with significance set at $p \leqslant 0.05$. Overall practice compliance was graded using a Likert-based scale: Poor (<20%), Fair (21–40%), Good (41–60%), Very Good (61–80%), and Excellent (>80%) (Kassa et al., 2014).

RESULTS

Demographic Characteristics

Of the 140 OT staff, the largest age group was 20–30 years (33.6%, n = 47), followed by 31–40 years and 51+ years (22.9% each, n = 32), and 41–50 years (20.7%, n = 29). The sample was predominantly male (76.4%, n = 107). Most staff held diplomas in surgical or anesthesia technology or, for surgeons, bachelor's degrees (75.7%, n = 106), while 19.3% (n = 27) held diplomas in Nursing. By occupation, surgical technicians formed the largest group (30.0%, n = 42), followed by anesthesia technicians (20.7%, n = 29), scrub persons (16.4%, n = 23), circulating nurses (15.0%, n = 21), surgeons (13.6%, n = 19), and anesthetists (4.3%, n = 6). Most staff had 5–10 years of OT experience (38.6%, n = 54), and 92.1% (n = 129) had received infection-control training (Table 1).

Table 1: *Demographic characteristics of operating theater staff (N = 140)*

Variable	Category	n (%)
Age (years)	20–30	47 (33.6)
	31–40	32 (22.9)
	41–50	29 (20.7)
	51+	32 (22.9)
Gender	Male	107 (76.4)
	Female	33 (23.6)
Educational qualification	Diploma (surgical/anesthesia technology) / Bachelor's (surgeons)	106 (75.7)
	Diploma in Nursing	27 (19.3)
	Bachelor's in Nursing	3 (2.1)
	Technical institute award	4 (2.9)
Occupation	Surgical Technicians	42 (30.0)
	Anesthesia Technicians	29 (20.7)
	Scrub Persons	23 (16.4)
	Circulating Nurses	21 (15.0)
	Surgeons	19 (13.6)
	Anesthetists	6 (4.3)
OT experience	< 5 years	41 (29.3)
	5–10 years	54 (38.6)
	11–20 years	35 (25.0)
	> 20 years	10 (7.1)
Infection-control training	Yes	129 (92.1)
	No	11 (7.9)

Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about
Online ISSN 3007-2387
Print ISSN 3007-2379

Figure 1. Age distribution of operating theater staff (N = 140)

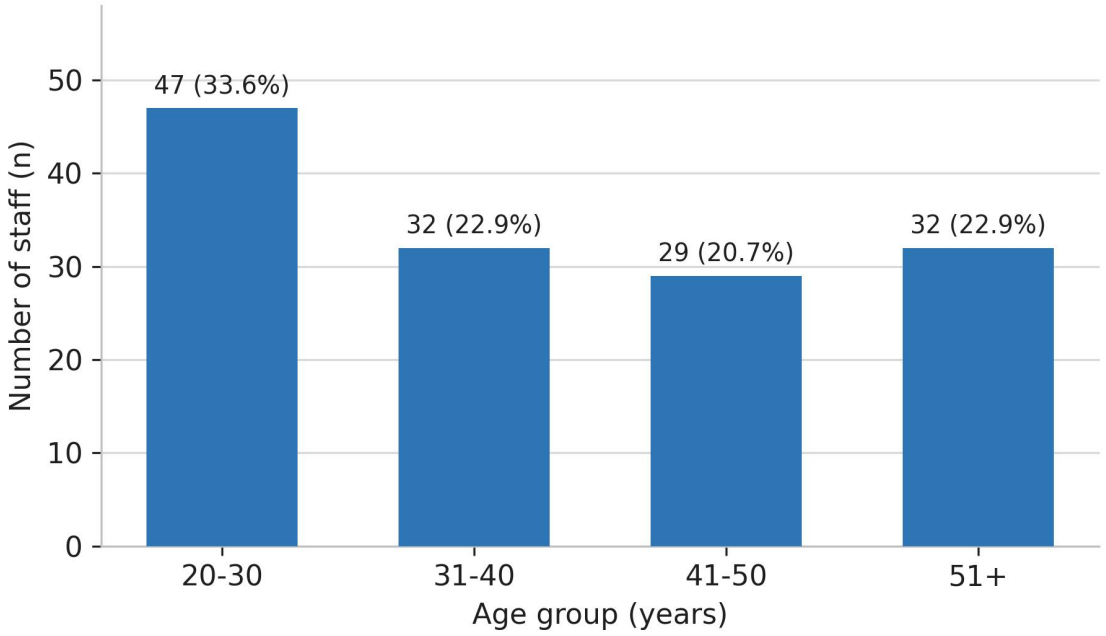
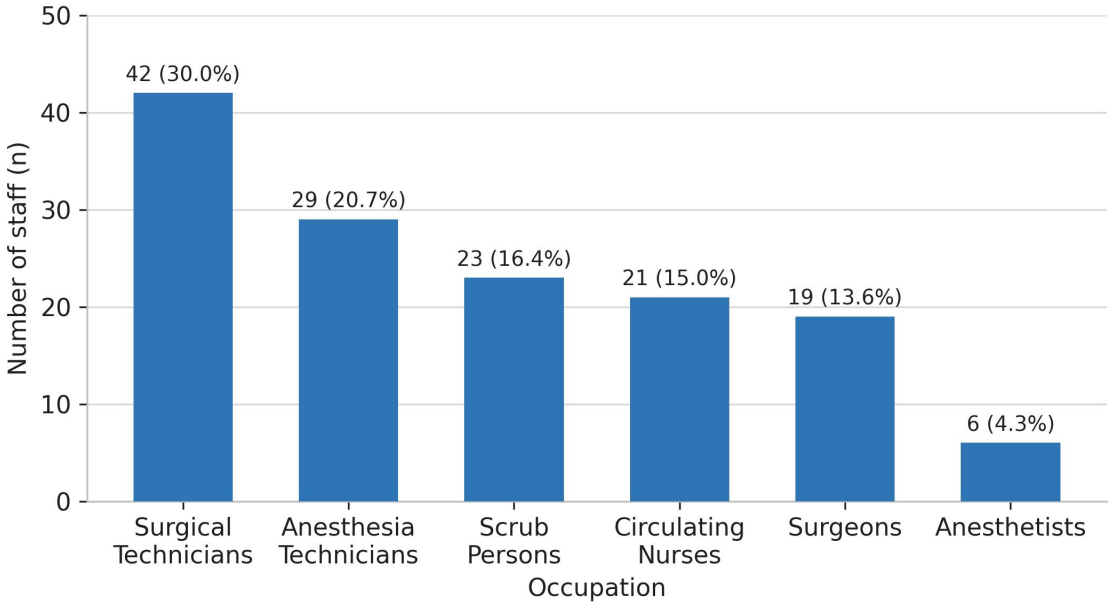


Figure 2. Distribution of operating theater staff by occupation (N = 140)



Knowledge of Surgical Attire and Infection Prevention

Most staff (70.7%, n = 99) correctly identified prevention of microbial contamination as the primary purpose of surgical attire, while 22.1% believed it was to increase comfort, 5.0% to enhance visibility, and 2.1% to shorten surgical time. For pre-operative skin preparation, 48.6% (n = 68) selected povidone-iodine and 31.4% (n = 44) selected alcohol-based chlorhexidine, whereas 15.7% (n = 22) incorrectly chose normal saline. Regarding prophylactic antibiotic timing, 59.3% (n = 83) correctly identified administration within one hour before incision, while 20.0% believed it should be given 24 hours pre-operatively. For hand-hygiene duration, 45.0% (n = 63) correctly identified two minutes as the recommended scrub time, while 30.0% selected the 20–30 second guideline appropriate for routine, non-surgical hand hygiene. Most staff (59.3%, n = 83) correctly identified that surgical masks should be changed after each procedure.

Occupation was significantly associated with knowledge on all five items (Table 2). Surgeons and anesthetists demonstrated 100% accuracy in identifying the purpose of surgical attire and the recommended hand-hygiene duration, whereas 81% (n = 17/21) of circulating nurses incorrectly believed surgical attire was primarily for comfort. Anesthesia technicians showed the largest knowledge gap regarding antibiotic timing, with 44.8% (n = 13/29) believing antibiotics should be given 24 hours before surgery, and surgical technicians most often selected the 20–30 second hand-hygiene duration (52.4%, n = 22/42) rather than the correct two-minute scrub.

Table 2: *Association between occupation and knowledge of surgical attire*

Knowledge item	χ^2	df	p-value	Key finding
Primary purpose of surgical attire	71.399	15	<.001	Surgeons and anesthetists 100% correct; 81% of circulating nurses believed attire was for comfort
Pre-operative skin-preparation agent	26.861	15	.030	Surgeons favored povidone-iodine (89.5%); technicians showed varied, often incorrect, responses
Timing of prophylactic antibiotics	37.257	15	.001	Surgeons 89.5% correct; 44.8% of anesthesia technicians believed antibiotics should be given 24 h pre-op

Knowledge item	χ^2	df	p-value	Key finding
Duration of surgical hand hygiene	50.666	15	<.001	Surgeons/anesthetists 100% correct (2 min); 52.4% of surgical technicians chose 20–30 sec
Timing of surgical mask change	26.053	15	.037	Surgeons 100% correct (after each procedure); technicians often believed "once per shift" acceptable

Practice and Attitudes Regarding Surgical Attire

Practice assessment revealed substantial gaps. Only 32.1% (n = 45) of staff reported "Always" wearing sterile gloves during all procedures, while 34.3% (n = 48) reported "Never" doing so. For changing contaminated attire, 30.7% (n = 43) reported "Always," while 34.3% (n = 48) reported "Rarely." Regarding hand-hygiene technique before and after procedures, only 34.3% (n = 48) reported "Always" adhering, while a combined 62.9% reported doing so only "Sometimes," "Rarely," or "Never." For ensuring the operating room was cleaned and disinfected between surgeries, 35.7% (n = 50) reported "Always," while 25.7% (n = 36) reported "Never." For following hospital protocols for surgical attire, 42.1% (n = 59) reported "Always," while 20.0% (n = 28) reported "Never." On attitude items, 89.3% (n = 125) agreed that infection-control training is essential for all OT staff, and 82.1% (n = 115) agreed that compliance with attire protocols reduces infection rates. However, 67.1% (n = 94) agreed that shortcuts in attire protocols are acceptable during emergencies.

Occupation was significantly associated with practice across all five items (Table 3). Anesthetists (100%) and most surgeons (73.7%, n = 14/19) reported "Always" complying with sterile glove use, contaminated-attire changes, hand hygiene, OR cleaning, and protocol adherence. In contrast, "Never" or "Rarely" responses predominated among anesthesia technicians, surgical technicians, and circulating nurses for most items—for example, 41.4% (n = 12/29) of anesthesia technicians and 38.1% (n = 16/42) of surgical technicians reported never wearing sterile gloves, and 52.4% (n = 11/21) of circulating nurses reported rarely changing contaminated attire.

Table 3: *Association between occupation and practice of surgical attire*

Practice item	χ^2	df	p-value	Key finding
Wearing sterile gloves during all procedures	41.822	20	.003	Anesthetists/surgeons mostly "Always"; 38–44% of technicians and scrub persons "Never"
Changing contaminated attire immediately	47.435	20	.001	Anesthetists/surgeons mostly "Always"; circulating nurses (52.4%) and surgical technicians (35.7%) mostly "Rarely"
Adherence to proper hand-washing technique	40.184	20	.005	Anesthetists/surgeons mostly "Always"; 90.5% of circulating nurses "Sometimes" or less
Ensuring OR cleaning/disinfection between surgeries	44.436	20	.001	Anesthetists/surgeons mostly "Always"; ~30% of technicians "Never"
Following hospital attire protocols	36.327	20	.014	Anesthetists/surgeons mostly "Always"; 16–29% of support staff "Never"

Overall Practice Compliance by Occupation

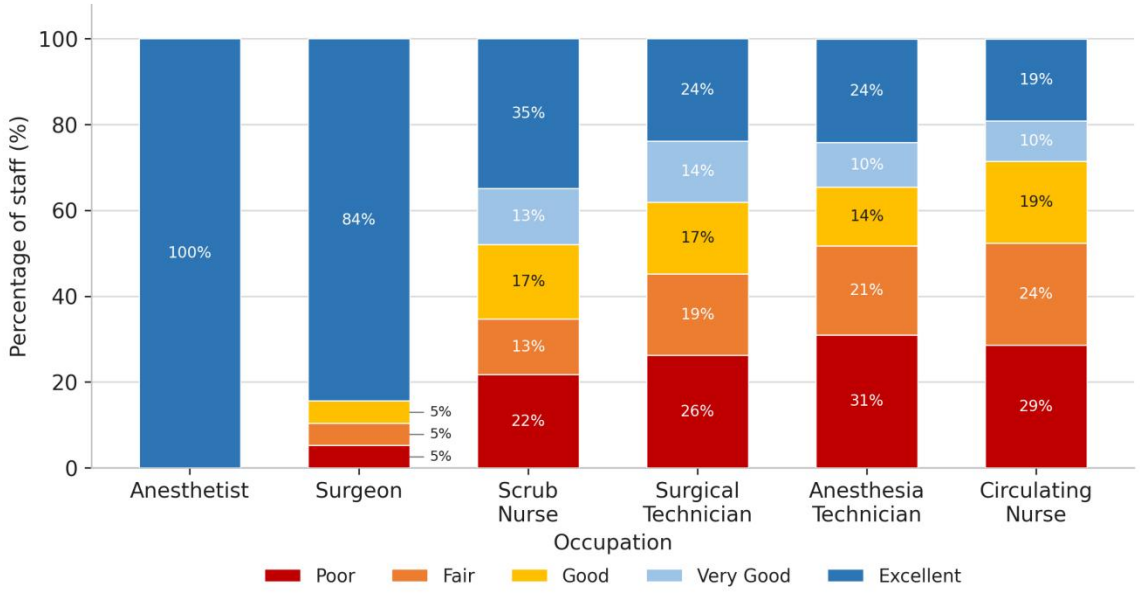
When the five practice items were combined on the Likert-based compliance scale (Table 4), surgeons (84.4% "Excellent") and anesthetists (100% "Excellent") demonstrated the highest overall compliance. Scrub nurses and surgical technicians showed more variable compliance spanning "Poor" to "Excellent" categories, with notable deviations in glove changing, hand hygiene, and attire cleanliness. Anesthesia technicians and circulating nurses showed the lowest overall compliance, with the largest proportions falling into the "Poor" and "Fair" categories. Across all staff, 36.4% (n = 51) achieved "Excellent" compliance, while 39.3% (n = 55) fell into the "Poor" or "Fair" categories combined, indicating an urgent need for targeted training among support staff.

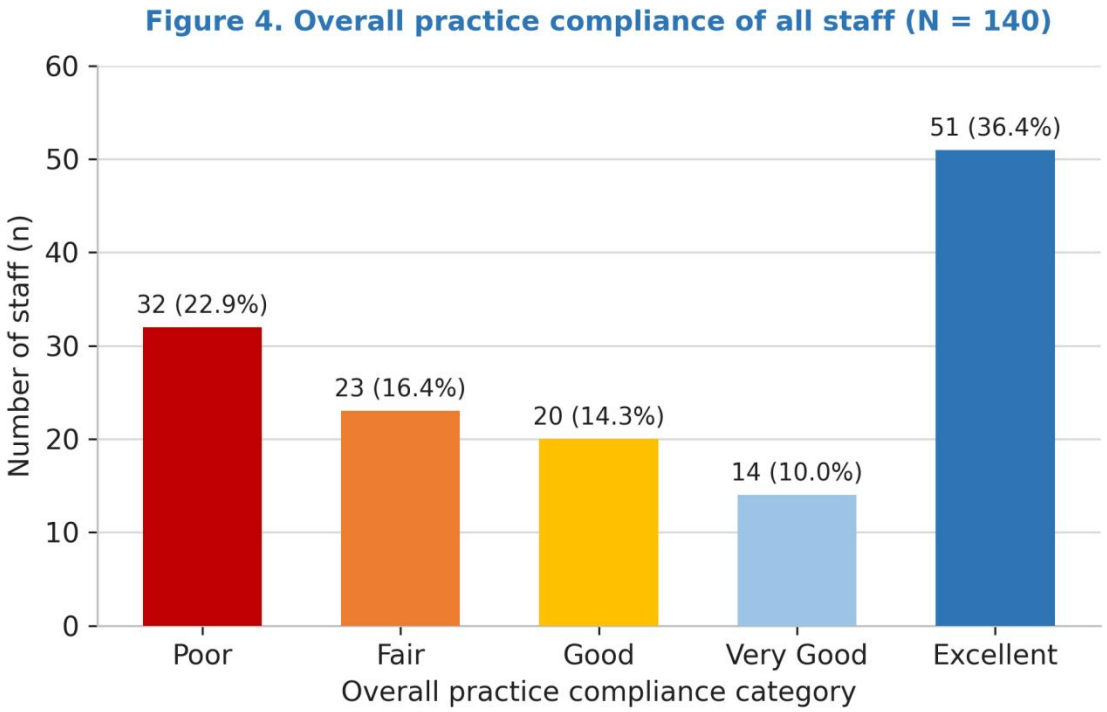
Table 4: *Overall practice compliance by occupation (Likert-based scale)*

Occupation	n	Poor	Fair	Good	Very Good	Excellent
Anesthetist	6	0 (0%)	0 (0%)	0 (0%)	0 (0%)	6 (100%)
Surgeon	19	1 (5.2%)	1 (5.2%)	1 (5.2%)	0 (0%)	16 (84.4%)
Scrub Nurse	23	5	3	4	3 (13.0%)	8 (34.9%)

Occupation	n	Poor	Fair	Good	Very Good	Excellent
		(21.7%)	(13.0%)	(17.4%)		
Surgical Technician	42	11 (26.2%)	8 (19.0%)	7 (16.7%)	6 (14.3%)	10 (23.8%)
Anesthesia Technician	29	9 (31.0%)	6 (20.7%)	4 (13.8%)	3 (10.3%)	7 (24.1%)
Circulating Nurse	21	6 (28.6%)	5 (23.8%)	4 (19.0%)	2 (9.5%)	4 (19.0%)
Overall (All Staff)	140	32 (22.9%)	23 (16.4%)	20 (14.3%)	14 (10.0%)	51 (36.4%)

Figure 3. Overall practice compliance by occupation (Likert-based scale)





DISCUSSION

This study found that, although most OT staff in Dera Ismail Khan recognized the basic purpose of surgical attire, significant knowledge and practice gaps persisted among support staff, consistent with patterns reported regionally and internationally.

Surgeons and anesthetists consistently demonstrated superior knowledge, correctly identifying the purpose of surgical attire and the recommended hand-hygiene duration with 100% accuracy. In contrast, 81% of circulating nurses believed surgical attire was primarily for comfort, echoing earlier findings that irregular hand hygiene and attire practices substantially increase SSI risk (Loftus et al., 2008). Similarly, technicians' selection of non-antiseptic skin-preparation agents mirrors prior reports that support staff display variable infection-control compliance attributable to insufficient training and oversight (Allegranzi et al., 2011). Nearly half of anesthesia technicians believed prophylactic antibiotics should be given 24 hours pre-operatively, contrary to the recommended administration within one hour of incision (Bratzler et al., 2013), and many technicians favored a 20–30 second hand-hygiene duration suited to alcohol-based rubs rather than the traditional two-minute surgical scrub, again reflecting standardization and training gaps documented elsewhere (Loftus et al., 2008; Cowperthwaite & Holm, 2015).

Practice gaps were even more pronounced. While nearly all anesthetists and most surgeons reported consistently wearing sterile gloves, changing contaminated attire, performing proper hand hygiene, ensuring OR cleanliness, and following attire protocols, substantial proportions of anesthesia technicians, surgical technicians, scrub persons, and circulating nurses reported "Never" or "Rarely" doing so. This pattern is consistent with previous Pakistani studies reporting inadequate infection-control practices attributable to limited awareness or insufficient institutional support (Sarfraz, 2019; Tamoor et al., 2024), and aligns with evidence that variable glove and attire practices among anesthesia providers contribute to bacterial transmission in the operating room (Loftus et al., 2012).

When practice was assessed on the Likert-based compliance scale, surgeons and anesthetists achieved "Excellent" compliance (84.4–100%), while scrub nurses and surgical technicians fell into "Good" to "Very Good" categories with specific deviations in glove changing, hand hygiene, and attire cleanliness. Anesthesia technicians and circulating nurses recorded the lowest compliance, categorized as "Fair" to "Good." These findings parallel an Egyptian study reporting that nurses with good knowledge nonetheless demonstrated poor practice, underscoring the urgent need for workshops and training to translate knowledge into consistent behavior (Shaheen & Hawash, 2021). Overall, the gap between knowledge and practice observed among support staff suggests that awareness alone is insufficient and that sustained training, supervision, and accountability mechanisms are required (Loftus et al., 2008; Sarfraz, 2019).

Limitations

This study has several limitations. The cross-sectional design permits identification of associations but not causal inference. Findings reflect two public-sector hospitals in Dera Ismail Khan and may not generalize to institutions with different infection-control systems or training programs. Practice data were self-reported and may be subject to recall or social-desirability bias, as staff may have overstated adherence; observational verification was not performed.

CONCLUSION

This study identified considerable disparities in knowledge and practice regarding surgical attire among OT staff at two public-sector hospitals in Dera Ismail Khan. Surgeons and anesthetists consistently demonstrated high knowledge and "Excellent" practice compliance, whereas anesthesia technicians, surgical technicians, scrub nurses, and circulating nurses exhibited considerable gaps, with 39.3% of all staff falling into the "Poor" or "Fair" practice categories. Although attitudes toward infection control were generally positive, knowledge did not consistently translate into safe practice,

particularly regarding glove use, attire changes, and hand hygiene. Based on these findings, the following are recommended:

1. Develop and implement targeted, occupation-specific training programs on infection prevention for anesthesia technicians, surgical technicians, scrub nurses, and circulating nurses.
2. Conduct regular audits of infection-control practices in the operating theater, supported by direct observation rather than self-report alone.
3. Place visible reminders (posters, checklists) in operating theaters to reinforce mask replacement, hand hygiene, and attire requirements.

Source of Funding

No external funding was received for this study.

Conflict of Interest

The authors declare no conflict of interest related to this study.

Authors Contribution

Authors' Contributions

Muhammad Jamshed: Conceived and designed the study, supervised data collection, contributed to manuscript drafting, and critically reviewed the final manuscript.

Muhammad Abrar: Assisted in study design, data collection, data interpretation, and manuscript preparation.

Khalid Jamil: Served as corresponding author, coordinated the research activities, supervised data analysis, finalized the manuscript, and approved the final version for publication.

Saif Ullah/Inam Ullah: Contributed to literature review, data entry, statistical analysis, and manuscript drafting.

Dr. Aatrah Azhar Khan: Provided methodological guidance, assisted in data interpretation, and critically revised the manuscript for important intellectual content.

Muhammad Ihtisham Ul Haq: Assisted in study design, statistical analysis, manuscript editing, and interpretation of findings.

Shakir Ullah: Participated in data collection, questionnaire administration, and data management.

Khalid Jamil: Served as corresponding author, coordinated the research activities, supervised data analysis, finalized the manuscript, and approved the final version for publication.

All authors contributed substantially to the study, reviewed and approved the final manuscript, and agree to be accountable for all aspects of the work.

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