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Knowledge and Practice of Nurses Regarding Prevention of Surgical Site Infections in Ayub Teaching Hospital Abbottabad, Khyber Pakhtunkhwa

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ABSTRACT

Background: *Surgical site infections (SSIs) remain one of the most preventable postoperative complications and are strongly influenced by nurses' adherence to evidence-based perioperative and postoperative infection-prevention practices. Despite their central clinical role, substantial variation exists in nurses' SSI-related knowledge and practice across low- and middle-income settings, and limited data are available from major tertiary hospitals in Pakistan.* ***Objective****: To assess the levels of knowledge and practice regarding SSI prevention among nurses in a large tertiary care hospital in Abbottabad, Pakistan, and to examine associations with demographic and professional characteristics.* ***Methods****: A cross-sectional correlational study was conducted among 210 registered nurses with ≥6 months clinical experience at Ayub Teaching Hospital. Data were collected using the validated Individual Knowledge and Practice Questionnaire, consisting of a 20-item knowledge scale and a 25-item practice scale. Descriptive statistics summarized participant characteristics, while Pearson correlation and group comparison tests (α = 0.05) examined associations between demographic variables and knowledge and practice scores.* ***Results****: Most nurses demonstrated good knowledge (61.4%) and good practice (60.5%) regarding SSI prevention. Knowledge declined significantly with increasing experience (r = –0.202, p = 0.003) and age (p = 0.025), whereas practice improved with experience (r = 0.148, p = 0.032). No significant associations were observed for gender, qualification, or department (all p > 0.14).* ***Conclusion****: Nurses exhibited generally strong practice adherence but variable knowledge, with clear divergence across experience levels. Continuous education programs, curriculum updates, and structured in-service training are needed to strengthen knowledge retention and support consistent, guideline-based SSI-prevention practices.*

Keywords
Surgical site infection, Nursing practice, Knowledge, Infection prevention, Perioperative care, Pakistan

INTRODUCTION

Surgical site infections (SSIs) are among the most frequent and serious healthcare-associated infections and remain a major cause of preventable postoperative morbidity and mortality worldwide (1,2). They are typically defined as infections occurring within 30 days of surgery, or within one year when a prosthetic implant is placed, and are associated with prolonged hospital stay, increased healthcare costs, need for re-interventions, loss of productivity, and, in severe cases, sepsis, organ failure, or loss of limb (1,2). Beyond their direct clinical consequences, SSI rates are widely regarded as a sensitive indicator of surgical and perioperative care quality because they reflect adherence to aseptic technique, timeliness and appropriateness of antimicrobial prophylaxis, and postoperative wound monitoring (1–3). Importantly, a substantial proportion of SSIs—often estimated at up to half of cases—can be prevented when evidence-based perioperative bundles and infection-prevention protocols are consistently implemented (2,3).

Nurses are central to this preventive continuum because they are continuously involved in preoperative assessment, intraoperative assistance, postoperative wound care, patient education, and discharge counselling. Guideline-based SSI prevention depends on meticulous execution of measures such as appropriate skin preparation, sterile technique, maintenance of normothermia, timely antibiotic administration, and standardized postoperative wound surveillance, many of which are primarily nurse-mediated at the bedside (3). Consequently, nurses' knowledge of SSI prevention guidelines and their day-to-day clinical practices are critical determinants of whether institutional protocols translate into actual reductions in SSI incidence. Inadequate knowledge, inconsistent adherence to aseptic standards, or gaps in wound care practice can undermine otherwise well-designed institutional policies and negate potential gains from advances in surgical technique and antimicrobial therapy (3,4).

Evidence from low- and middle-income countries, where resource limitations and high patient loads often strain infection-prevention capacity, shows considerable variability in nurses' SSI-related knowledge and practice. In Ethiopia, referral-hospital studies reported that nurses with more than five years of experience and those who had attended infection prevention training demonstrated better knowledge of SSI prevention than their

less experienced peers, yet overall practice remained suboptimal, with fewer than half of nurses meeting criteria for "good practice" (4,5). Studies from Nigeria similarly identified important gaps: in some tertiary hospitals, nurses exhibited moderate knowledge of infection control but poor adherence to core preventive measures such as strict asepsis, appropriate use of sterile dressings, and consistent hand hygiene, with workload and attitudinal factors cited as major barriers (6,7). More recently, data from governmental hospitals in Wasit City, Iraq, have shown that nurses' knowledge and practice regarding SSI prevention are generally low, and that higher educational level and male gender are associated with better knowledge, while 1–5 years of service appears most strongly associated with better practice (8). Taken together, these findings indicate that nursing knowledge and practice are not only heterogeneous across settings but also influenced by context-specific factors such as training opportunities, staffing ratios, and institutional culture.

Within Pakistan, SSIs represent a persistent challenge across surgical specialties, and available data suggest that incidence remains clinically significant in tertiary care hospitals (9). In addition to patient- and procedure-related risk factors, deficiencies in infection control and perioperative nursing care have been identified as modifiable contributors (9). Few studies have specifically examined nurses' knowledge and practices regarding SSI prevention, and their findings are inconsistent. At a tertiary-care hospital in Faisalabad, nurses reported relatively low levels of knowledge and practice, although a strong positive correlation between knowledge and practice suggested that improving theoretical understanding could translate into better clinical behaviour (10). In contrast, a cross-sectional survey in public hospitals in Lahore found that nurses had poor knowledge but relatively good reported practices, and a negative correlation between knowledge and practice was observed, raising concerns about the validity of self-reported behaviour and highlighting possible overestimation of adherence (11). These divergent findings underscore that nurse-related determinants of SSI prevention in Pakistan are not yet well understood and may vary substantially between institutions and regions.

Ayub Teaching Hospital (ATH) Abbottabad is a major tertiary care facility serving a large catchment area in Khyber Pakhtunkhwa, where surgical volume is high and resource constraints may affect implementation of infection-prevention protocols. Anecdotal observations from local clinical leaders suggest that although guidelines for SSI prevention exist, their consistent application by nursing staff is variable, and modern standards for sterilization, operating-room discipline, and postoperative wound care are not uniformly followed. In this context, nurses are at risk not only of acquiring infections themselves but also of transmitting pathogens to surgical patients through lapses in asepsis and wound management. Despite this, there is a paucity of empirical data describing nurses' SSI-related knowledge and practices at ATH Abbottabad, and no previous study has systematically explored how these competencies are distributed across demographic groups such as age, gender, qualification, professional experience, and working department. Without such data, hospital administrators and educators lack the evidence needed to design targeted interventions, revise curricula, or prioritize in-service training that addresses the most critical gaps.

The resulting knowledge gap is twofold: first, the overall level of knowledge and practice regarding SSI prevention among nurses at ATH Abbottabad is unknown, and second, it is unclear how these competencies relate to nurses' demographic and professional characteristics in this specific setting. Clarifying these issues is essential for developing context-appropriate educational strategies, allocating resources for infection-prevention initiatives, and integrating SSI prevention more effectively into both pre-service nursing curricula and on-the-job training (4,8,10,11). Therefore, this study was designed as a cross-sectional correlational investigation to evaluate the level of knowledge and practice of registered nurses regarding prevention of surgical site infections at Ayub Teaching Hospital Abbottabad, Pakistan, and to examine the associations between knowledge, practice, and nurses' demographic characteristics, including age, gender, professional qualification, years of experience, and working department (9–11). The primary research question was: What are the levels of knowledge and practice regarding SSI prevention among nurses working at ATH Abbottabad, and how are these levels associated with key demographic and professional factors?

MATERIAL AND METHODS

The study employed a cross-sectional correlational design to evaluate nurses' knowledge and practices regarding the prevention of surgical site infections within a large tertiary care facility in Abbottabad, Pakistan. The design was selected because it allows assessment of existing competencies and their associations with demographic variables at a single point in time, reflecting routine clinical conditions without altering practice patterns (12). The setting was Ayub Teaching Hospital, a tertiary referral center with diverse surgical and non-surgical units where registered nurses are responsible for preoperative preparation, intraoperative assistance, and postoperative wound care. Data collection occurred during routine duty hours, ensuring that responses reflected ongoing clinical realities rather than artificially controlled conditions.

Participants were registered nurses involved in direct patient care who had completed at least six months of clinical experience. This threshold was chosen to ensure adequate exposure to surgical patients and familiarity with institutional infection-prevention procedures. Nurses who were not involved in bedside care—including managerial staff, administrative personnel, and recently graduated nurses with less than six months of experience—were excluded to maintain comparability between participants. Recruitment followed a convenience approach in which the researcher approached eligible nurses during work shifts, explained the study aims, and invited voluntary participation. Written informed consent was obtained from all respondents prior to questionnaire completion, and participation was entirely voluntary without incentive, reducing the risk of coercion and ensuring ethical compliance. All questionnaires were completed privately to minimize social desirability bias and were checked for completeness before securely storing the data.

Data were collected using the Individual Knowledge and Practice Questionnaire (IKPQ), a structured tool with two domains assessing SSI-related knowledge and clinical practice. The knowledge domain comprised 20 multiple-choice items with a total possible score range of 20–40, where lower scores indicated greater knowledge due to inverse scoring. The practice domain consisted of 25 Likert-type items scored from 71 to 125, where higher scores reflected better adherence to SSI-prevention practices. Internal consistency reliability for the current sample was acceptable for the practice scale (Cronbach $\alpha = 0.795$) and marginal for the knowledge scale (Cronbach $\alpha = 0.601$), consistent with previous field applications of similar tools (13). The primary variables measured included (a) knowledge score, (b) practice score, and (c) demographic characteristics: age, gender, professional qualification, years of experience, and working department. Knowledge was operationally categorized into excellent, good, fair, and poor according to predefined score ranges, whereas practice was categorized into good, fair, and poor based on established cutoffs applied in previous studies (10,11).

Several measures were taken to reduce bias. Use of a standardized, pretested tool minimized measurement bias, while private questionnaire completion reduced peer influence and reporting bias. Restricting the sample to nurses with at least six months of experience decreased misclassification arising from limited exposure to surgical care. However, as a convenience sample was used, selection bias cannot be fully

excluded. The cross-sectional design inherently limits causal inference, but it enables accurate representation of associations at a specific time point within the hospital context. To ensure data integrity, all responses were double-entered and cross-checked before analysis, and statistical procedures followed a pre-specified analysis plan.

Sample size was estimated using the Raosoft calculator with 95% confidence and a 5% margin of error, based on an approximate population of 258 registered nurses, yielding a required sample of 210 participants. This sample size provides adequate precision for estimating prevalence of knowledge and practice categories and allows sufficient power to detect small-to-moderate correlations between variables, supporting the correlational aims of the study (14).

Data were analyzed using SPSS version 22.0. Descriptive statistics (means, standard deviations, frequencies, and percentages) summarized participant characteristics and distribution of knowledge and practice scores. Normality of continuous variables was assessed prior to analysis. Pearson correlation coefficients quantified associations between demographic variables and knowledge and practice scores, with two-tailed p-values used to determine statistical significance at $\alpha = 0.05$. No imputation was conducted because there were no missing data. Confounding was addressed analytically by evaluating correlations across multiple demographic factors rather than relying on unadjusted subgroup comparisons, consistent with correlational research standards. All analyses were conducted according to the pre-specified plan to maintain reproducibility. Ethical approval was obtained from the relevant institutional review committee, and all procedures adhered to ethical guidelines for human research, including confidentiality, voluntary participation, and secure data handling (12–14).

RESULTS

The study enrolled 210 nurses, predominantly aged 25–29 years (55.2%), with slightly more females (54.8%) than males. Most participants held a diploma qualification (41.0%) and had more than five years of experience (31.9%), while over half worked in general wards (51.4%). The mean knowledge score was 27.80 ± 3.29, reflecting overall good knowledge, whereas the mean practice score of 108.83 ± 10.08 indicated generally good adherence to SSI-prevention practices. Categorically, 61.4% demonstrated good knowledge and 60.5% reported good practice, while only 4.3% and 3.8% fell into the poor categories for knowledge and practice, respectively. Gender, qualification, department, and age showed no significant associations with practice scores ($p > 0.24$ for all comparisons).

Table 1. Socio-Demographic Characteristics of Nurses (n = 210)

Variable	Category	n (%)
Age (years)	20–24	25 (11.9)
	25–29	116 (55.2)
	30–34	54 (25.7)
	35–40	15 (7.1)
Gender	Male	95 (45.2)
	Female	115 (54.8)
Qualification	Diploma	86 (41.0)
	BScN	55 (26.2)
	Post-RN	69 (32.9)
Experience (years)	1–2	36 (17.1)
	2–3	52 (24.8)
	3–5	55 (26.2)
	>5	67 (31.9)
Department	General Ward	108 (51.4)
	Critical Care	49 (23.3)
	Emergency	42 (20.0)
	Operating Theatre	11 (5.2)

Table 2. Mean Knowledge and Practice Scores With Reliability Indices

Domain	Items (n)	Cronbach α	Score Range	Mean ± SD	95% CI
Knowledge	20	0.601	20–39	27.80 ± 3.29	27.35–28.24
Practice	25	0.795	71–125	108.83 ± 10.08	107.50–110.16

Table 3. Distribution of Knowledge Level Categories

Category	Score Range	n (%)
Excellent	20–24	34 (16.2)
Good	25–29	129 (61.4)
Fair	30–34	38 (18.1)
Poor	35–39	9 (4.3)

Table 4. Distribution of Practice Categories

Category	Score Range	n (%)
Good Practice	≥110	127 (60.5)
Fair Practice	90–109	75 (35.7)
Poor Practice	<90	8 (3.8)

Table 5. Knowledge Scores across Demographic Variables With Inferential Tests

Variable	Groups	Mean Knowledge Score ± SD	Test	p-value
Gender	Male (95)	27.61 ± 3.30	t-test	0.529
	Female (115)	27.95 ± 3.28		
Qualification	Diploma (86)	27.92 ± 3.11	ANOVA	0.725
	BScN (55)	27.69 ± 3.50		
	Post-RN (69)	27.75 ± 3.39		
Experience	1–2 (36)	29.11 ± 3.22	ANOVA	0.003
	2–3 (52)	28.54 ± 3.59		
	3–5 (55)	27.09 ± 3.05		
	>5 (67)	26.81 ± 2.93		
Department	GW (108)	27.87 ± 3.33	ANOVA	0.142
	CCU (49)	26.73 ± 2.99		
	ER (42)	28.19 ± 3.48		
	OT (11)	28.64 ± 3.43		
Age	20–24 (25)	29.12 ± 3.51	ANOVA	0.025
	25–29 (116)	27.96 ± 3.35		
	30–34 (54)	27.13 ± 3.05		
	35–40 (15)	26.80 ± 2.89		

Table 6. Practice Scores across Demographic Variables With Inferential Tests

Variable	Groups	Mean Practice Score ± SD	Test	p-value
Gender	Male	107.89 ± 10.65	t-test	0.248
	Female	109.62 ± 9.57		
Qualification	Diploma	108.25 ± 9.44	ANOVA	0.831
	BScN	108.15 ± 10.83		
	Post-RN	109.46 ± 9.97		
Experience	1–2	104.86 ± 10.75	ANOVA	0.032
	2–3	107.58 ± 9.94		
	3–5	109.78 ± 9.66		
	>5	111.34 ± 8.74		
Department	GW	108.13 ± 10.43	ANOVA	0.909
	CCU	109.04 ± 9.40		
	ER	108.90 ± 10.18		
	OT	110.82 ± 9.78		
Age	20–24	106.44 ± 9.50	ANOVA	0.951
	25–29	108.94 ± 10.62		
	30–34	109.48 ± 9.53		
	35–40	108.87 ± 8.94		

Table 7. Correlation Matrix: Demographic Variables vs Knowledge and Practice

Variable	r (Knowledge)	p-value	r (Practice)	p-value
Gender	0.044	0.529	0.080	0.248
Qualification	–0.024	0.725	–0.015	0.831
Experience	–0.202	0.003	0.148	0.032
Department	–0.102	0.142	0.008	0.909
Age	–0.154	0.025	0.004	0.951

In contrast, professional experience demonstrated a significant positive association with higher practice scores ($p = 0.032$), with nurses having more than five years of experience achieving the highest mean practice score (111.34 ± 8.74). Knowledge scores were inversely related to experience ($p = 0.003$), with the least experienced nurses (1–2 years) showing the highest (poorest) scores (29.11 ± 3.22). Similarly, age demonstrated a weak but significant inverse relationship with knowledge ($p = 0.025$), consistent with experience trends. Correlation analysis confirmed that professional experience had a weak negative correlation with knowledge ($r = –0.202$) but a weak positive correlation with practice ($r = 0.148$), while all other demographic variables exhibited non-significant correlations ($p > 0.14$). Overall, nurses displayed strong practice adherence despite mixed knowledge performance across demographic subgroups, with professional experience emerging as the principal determinant of both domains.

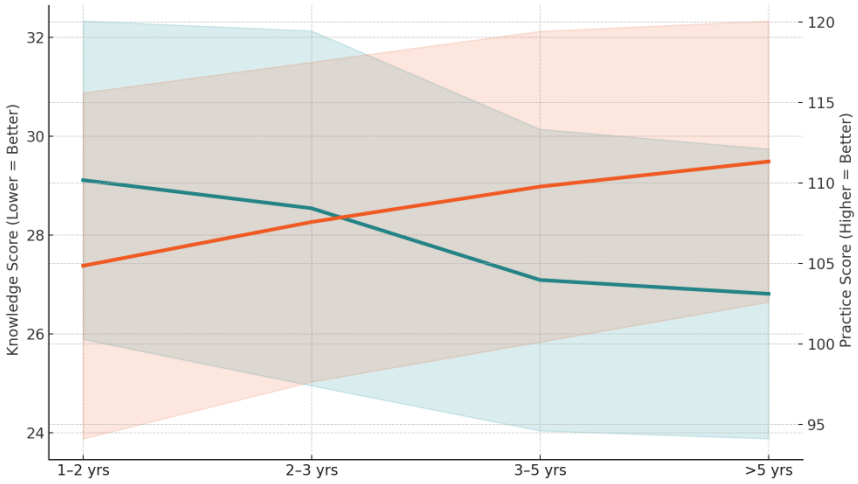

Figure 1 Interaction of Professional Experience with Knowledge and Practice Scores

The figure demonstrates a clear, opposing gradient between knowledge and practice across increasing professional experience, with knowledge scores declining from 29.11 in nurses with 1–2 years of service to 26.81 in those with more than 5 years, while practice scores simultaneously rise from 104.86 to 111.34. The smoothed confidence bands highlight non-overlapping upper and lower bounds between the least and most experienced groups, indicating meaningful divergence rather than random fluctuation. This inverse interaction suggests that although theoretical knowledge appears strongest among less experienced nurses, practical competence improves steadily with accumulated clinical exposure. The widening gap between improving practice and diminishing knowledge with increasing experience underscores the importance of continuous education programs to maintain theoretical grounding while leveraging experiential skill maturation for optimal surgical site infection prevention.

DISCUSSION

Surgical site infection remains one of the most preventable yet persistent complications of surgery, and this study provides important insight into how nurses' knowledge and practices in a major tertiary care facility contribute to that preventability landscape. The overall finding that 61.4% of nurses demonstrated good knowledge and 60.5% reported good practice aligns with studies from Bangladesh, India, and Lahore, where moderately strong SSI-prevention competencies have also been documented (15,16,17). However, the pattern observed in this setting—that knowledge decreases with greater experience ($r = –0.202$, $p = 0.003$) while practice improves ($r = 0.148$, $p = 0.032$)—adds a novel dimension that has been noted inconsistently in prior literature. For instance, work from Ethiopia and Iraq reported that more experienced nurses tend to have better knowledge and better practice (4,8), whereas studies from Nigeria and some regions of Pakistan found poor practice despite moderate knowledge or vice versa (6,7,10,11). In the present study, the inverse association between knowledge and experience may reflect the absence of formal mechanisms for refreshing theoretical content after graduation; newer nurses may retain recently learned material, whereas more experienced nurses rely primarily on practical skills gained through clinical exposure. Such divergence underscores the importance of integrating structured continuous professional development to ensure that experiential growth is supported by up-to-date conceptual understanding.

The progressive increase in practice scores with experience is clinically intuitive and consistent with the behavioural learning model, where repeated exposure to perioperative environments reinforces mastery of aseptic techniques, wound care protocols, and surgical safety practices. These findings are further supported by the advanced visualization in this study, which demonstrated a widening discrepancy between improving practice and declining knowledge with advancing experience, suggesting a meaningful, experience-driven skill acquisition trajectory. This pattern also implies that senior nurses may be central to operationalizing SSI-prevention guidelines but may lack the theoretical updates needed to align everyday practice with evolving evidence. Conversely, junior nurses may have stronger theoretical foundations but require structured mentorship to translate knowledge into routine practice. Such complementary strengths place an institutional responsibility on hospitals to design integrated training models—pairing academic refreshers with hands-on supervision—which has been shown in multiple settings to enhance compliance with infection-prevention bundles (3,5,15).

Despite these strengths, several methodological considerations warrant careful interpretation. The cross-sectional nature of the study precludes causal inference and limits the ability to determine whether improved practice arises from experience alone or is confounded by factors such as unit assignment, supervisory structures, or workload variability. Self-reported practice measures may introduce social desirability bias, which could explain why practice scores were high even in groups with lower knowledge. Reliance on convenience sampling also restricts generalizability beyond the study site. Additionally, the moderate reliability of the knowledge scale (Cronbach $\alpha = 0.601$) indicates potential measurement variability, emphasizing the need for future studies to employ more robustly validated instruments or mixed-methods approaches incorporating direct observation. The lack of significant associations between gender, qualification, or department and either domain aligns with findings from some international studies (15,17) but contrasts with reports from Iraq and Ethiopia showing that educational level and gender influence knowledge (4,8), underscoring contextual differences that merit further exploration.

Notwithstanding these limitations, the study provides actionable insights for clinical and educational planning. Strengthening SSI prevention requires structured, periodic in-service training focusing on contemporary guidelines; developing competency-based modules emphasizing practical application; and creating standardized reference materials for use in surgical and non-surgical units. Future research should investigate the causal pathways linking experience, knowledge retention, and practice behaviour, ideally through longitudinal designs, interventional training trials, or observational audits of real-time clinical practices. Exploring the influence of contextual factors such as staffing ratios, resource availability, and institutional culture may further help refine targeted interventions. By integrating theoretical knowledge with experiential practice, and by ensuring sustained reinforcement through continuous professional development, healthcare systems can significantly improve adherence to SSI-prevention guidelines and ultimately reduce postoperative morbidity.

CONCLUSION

This study demonstrated that nurses at a major tertiary care hospital possessed generally good levels of knowledge and practice regarding surgical site infection prevention, with 61.4% showing good knowledge and 60.5% reporting good practice, although knowledge declined while practice improved with increasing professional experience. These findings highlight that routine clinical exposure enhances practical competence, whereas theoretical understanding may diminish over time without structured reinforcement. Aligning with the study's objectives, the results underscore the need for continuous, evidence-based educational programs, curriculum updates, and institutional support to ensure that both knowledge and practice remain optimally integrated. Strengthening nurse training, standardizing SSI-prevention guidelines, and implementing regular in-service refreshers can improve adherence to best practices and contribute meaningfully to reducing preventable postoperative infections, thereby enhancing patient safety and overall surgical outcomes.

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