

NURSES' KNOWLEDGE AND PRACTICES REGARDING PERIOPERATIVE PATIENT SAFETY MEASURES PROVIDED FOR CARDIAC PATIENTS

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Abstract: Background: Perioperative patient safety is a fundamental component of high-quality surgical care, particularly for cardiac patients who are highly vulnerable to preventable adverse events throughout the surgical continuum. Nurses play a pivotal role in ensuring patient safety through the implementation of evidence-based perioperative safety measures. However, variations in nurses' knowledge and clinical practice may compromise the consistent delivery of safe perioperative care.

Aim: This study aimed to assess nurses' knowledge and practices regarding perioperative patient safety measures provided to cardiac surgical patients.

Methods: A quantitative descriptive cross-sectional study was conducted among a convenience sample of 89 nurses working in perioperative units at Aswan Heart Centre, Egypt. Data were collected using two validated instruments: a self-administered knowledge questionnaire and a structured perioperative safety observation checklist. Nurses' practices were observed across morning, evening, and night shifts before completion of the knowledge questionnaire to minimize observation bias. Descriptive and inferential statistics, including Chi-square tests and Pearson's correlation coefficient, were performed using SPSS version 21, with statistical significance set at $p < 0.05$.

Results: Most nurses demonstrated competent perioperative safety practices (85.4%), whereas knowledge levels were predominantly fair, with 39.3% exhibiting poor knowledge, 45.0% fair knowledge, and only 15.7% good knowledge. Clinical experience and working area were significantly associated with both knowledge and practice ($p < 0.05$). Furthermore, nurses' knowledge showed a statistically significant positive correlation with overall practice ($r = 0.217$, $p = 0.020$), indicating that higher knowledge levels were associated with better implementation of perioperative safety measures.

Conclusion: Although perioperative nurses demonstrated high levels of practical competency, important deficiencies in theoretical knowledge remain, particularly in ethical and legal principles, pain management, communication, teamwork, and patient safety culture. Strengthening role-specific continuing education, simulation-based training, and standardized communication strategies may enhance knowledge translation into clinical practice and further improve perioperative patient safety in cardiac surgical settings.

Keywords: Cardiac surgery; nurses; patient safety; perioperative nursing; perioperative safety measures; knowledge; practice; competency.

1. INTRODUCTION

Patient safety is a fundamental dimension of healthcare quality and remains a global public health priority. Despite remarkable advances in healthcare delivery and the implementation of international patient safety initiatives, preventable adverse events continue to occur across healthcare systems worldwide. The World Health Organization (WHO) Global Patient Safety Action Plan 2021–2030 recognizes patient safety as a strategic priority and estimates that approximately one in every ten patients experiences preventable harm during healthcare delivery, with surgical care representing one of the highest-risk clinical settings. Most adverse events are associated with failures in communication, human factors, inadequate adherence to evidence-based protocols, and system-related deficiencies, many of which are preventable through effective patient safety interventions (Illingworth et al., 2022; Pokhrel, 2024).

Cardiovascular diseases (CVDs) remain the leading cause of mortality worldwide, accounting for nearly one-third of all global deaths. Although advances in medical and surgical management have improved survival, the increasing prevalence of ischemic heart disease, valvular heart disease, congenital heart disease, and heart failure has substantially increased the demand for cardiac surgical interventions. Consequently, healthcare professionals are caring for an increasing number of patients requiring highly specialized perioperative management, where even minor deviations from recommended safety practices may result in catastrophic complications, prolonged hospitalization, increased healthcare costs, or mortality (Timmis et al., 2020; Mbakwem et al., 2023; WHO, 2023).

The perioperative period encompasses the preoperative, intraoperative, and postoperative phases of surgical care, each presenting unique patient safety challenges that require coordinated multidisciplinary management. Cardiac surgical patients are particularly vulnerable because of advanced age, multiple comorbidities, prolonged operative procedures, invasive monitoring, anticoagulation therapy, cardiopulmonary bypass, and the physiological complexity associated with major cardiac surgery. These factors substantially increase the risk of surgical site infections, medication errors, equipment-related incidents, communication failures, postoperative complications, and unexpected clinical deterioration if evidence-based perioperative safety measures are not consistently implemented (Martinez-Nicolas et al., 2024; Farooq et al., 2025).

Evidence-based perioperative safety measures—including standardized surgical safety checklists, accurate patient identification, effective communication and structured handover, medication safety, infection prevention strategies, equipment verification, and promotion of a positive patient safety culture—have consistently demonstrated their effectiveness in reducing preventable complications, improving multidisciplinary teamwork, and enhancing surgical outcomes. Recent international clinical practice guidelines continue to recommend multidisciplinary implementation of these interventions as essential components of safe perioperative care (Vaismoradi et al., 2020; Martinez-Nicolas et al., 2024; Suleman et al., 2025). Nevertheless, achieving sustained adherence to these evidence-based practices remains challenging because of variations in organizational safety culture, staffing levels, workload, continuing professional development opportunities, leadership support, and individual competency.

Perioperative nurses play a pivotal role in maintaining patient safety throughout the surgical pathway. Their responsibilities extend beyond technical nursing procedures to include comprehensive patient assessment, preparation for surgery, implementation of infection prevention measures, medication administration, equipment safety verification, continuous physiological monitoring, early recognition of patient deterioration, effective communication with multidisciplinary teams, advocacy for patient rights, and coordination of safe transitions of care. Consequently, nurses' knowledge and clinical competence directly influence adherence to perioperative safety standards, quality of care, and surgical outcomes (AHN & Lee, 2021; King et al., 2024).

Previous studies have demonstrated that although perioperative nurses frequently exhibit satisfactory technical performance, important deficiencies often persist in theoretical knowledge related to patient safety principles, ethical and legal responsibilities, communication, teamwork, pain management, and safety culture. Furthermore, several studies have reported discrepancies between nurses' knowledge and their observed clinical practice, suggesting that safe clinical performance is influenced not only by theoretical preparation but also by clinical experience, organizational support, workplace culture, and continuing professional education (Gupta & Superior, 2023; Putri & Rizky, 2024; Balachandran et al., 2025).

Although perioperative patient safety has received considerable international attention, evidence specifically evaluating nurses' knowledge and objectively observed practices within specialized cardiac surgical settings remains limited, particularly in low- and middle-income countries (Martinez-Nicolas et al., 2024; Balachandran et al., 2025). The recent systematic review of international perioperative patient safety guidelines highlighted substantial variability in the implementation of evidence-based safety recommendations and emphasized the need for further research evaluating healthcare professionals' competency in applying these recommendations across the perioperative continuum (Martinez-Nicolas et al., 2024). Furthermore, most published studies have focused on isolated patient safety domains—such as infection prevention, medication safety, communication, or surgical safety checklist compliance—or have relied primarily on self-reported questionnaires rather than objectively observed clinical practice (Vaismoradi et al., 2020; King et al., 2024; Balachandran et al., 2025). Consequently, comprehensive evidence simultaneously examining nurses' theoretical knowledge and observed perioperative safety practices in specialized high-volume cardiac centres remains scarce, limiting the available evidence needed to inform targeted educational interventions, strengthen adherence to evidence-based perioperative safety standards, and support continuous quality improvement initiatives (King et al., 2024; Balachandran et al., 2025).

Aswan Heart Centre is one of the leading specialized cardiac institutions in the Middle East and Africa, providing advanced cardiac surgical services for a large and diverse patient population. Evaluating nurses' knowledge and actual perioperative safety practices within this highly specialized environment is essential for identifying educational needs, strengthening adherence to evidence-based safety standards, supporting continuous quality improvement initiatives, and ultimately improving patient safety outcomes. Therefore, the present study aimed to assess nurses' knowledge and practices regarding perioperative patient safety measures provided to cardiac surgical patients and to examine the relationship between nurses' knowledge and clinical practice.

Significance of the Study

Patient safety remains a major challenge worldwide despite continuous improvements in healthcare systems and the widespread implementation of evidence-based safety initiatives. Surgical patients are particularly vulnerable to preventable adverse events, and cardiac surgery represents one of the most complex and high-risk specialties because of the physiological instability of patients, the complexity of surgical procedures, and the need for intensive multidisciplinary coordination throughout the perioperative period (Illingworth et al., 2022; Pokhrel, 2024; Farooq et al., 2025).

Nurses are central to the successful implementation of perioperative patient safety measures through continuous patient assessment, adherence to infection prevention practices, safe medication administration, effective communication, equipment verification, and early recognition of patient deterioration. Consequently, deficiencies in nurses' knowledge or inconsistent application of evidence-based safety practices may compromise patient safety and negatively affect surgical outcomes (AHN & Lee, 2021; King et al., 2024).

In Egypt, ongoing healthcare reforms have emphasized strengthening patient safety and quality improvement; however, preventable adverse events, communication failures, medication errors, healthcare-associated infections, and equipment-related incidents continue to challenge healthcare organizations. National evidence indicates that improving healthcare professionals' competency and adherence to standardized patient safety practices remains a strategic priority for achieving high-quality healthcare services (Elsharkawy et al., 2022; Bakr et al., 2025).

Although perioperative patient safety has been extensively investigated internationally, research specifically examining nurses' knowledge together with objectively observed perioperative safety practices in specialized cardiac surgical settings remains limited, particularly within low- and middle-income countries. Most available studies have evaluated isolated aspects of patient safety or relied primarily on self-reported practice, providing limited evidence regarding actual clinical performance across the entire perioperative pathway (Martinez-Nicolas et al., 2024; Balachandran et al., 2025).

Aswan Heart Centre is one of the largest specialized cardiac centres in the Middle East and Africa and provides highly complex cardiac surgical services for patients from across Egypt and neighboring countries. Evaluating nurses' knowledge alongside their observed perioperative safety practices within this specialized environment provides valuable evidence regarding current competency levels, identifies educational and organizational gaps, and supports evidence-based quality improvement initiatives.

The findings of the present study are expected to contribute to nursing practice by identifying priority areas for continuing professional education, strengthening adherence to evidence-based perioperative safety measures, supporting the development of targeted competency-based training programmes, and promoting safer perioperative care for cardiac surgical patients. Furthermore, the study provides baseline evidence that may inform institutional policy development, future multicentre research, and national patient safety initiatives aimed at improving surgical outcomes and advancing nursing practice in specialized cardiac care.

Purpose of the Study

The aim of this study was to assess nurses' knowledge and practices regarding perioperative patient safety measures provided to cardiac surgical patients at Aswan Heart Centre and to examine the relationship between nurses' knowledge and practices.

Research Questions

The study sought to answer the following research questions:

1. What is the level of nurses' knowledge regarding perioperative patient safety measures provided to cardiac surgical patients?
2. What is the level of nurses' practices regarding perioperative patient safety measures provided to cardiac surgical patients?
3. Is there a statistically significant relationship between nurses' knowledge and practices regarding perioperative patient safety measures provided to cardiac surgical patients?

Operational Definitions

For the purpose of this study, the following operational definitions were adopted.

Perioperative Period

The perioperative period refers to the continuum of surgical care encompassing the preoperative, intraoperative, and postoperative phases. In the present study, it included the period before surgery, during surgery, and the immediate postoperative period, during which nurses were responsible for implementing perioperative patient safety measures.

Perioperative Patient Safety Measures

Perioperative patient safety measures refer to the evidence-based protocols, interventions, and nursing practices implemented throughout the perioperative period to minimize preventable patient harm and ensure safe surgical care. In the present study, these measures included ethical and legal practice, patient identification, infection prevention, medication safety, medical equipment safety and accountability, communication, structured handover, teamwork, patient safety culture, and postoperative patient monitoring.

Nurses' Knowledge

Nurses' knowledge refers to nurses' theoretical understanding of perioperative patient safety principles and evidence-based safety measures throughout the perioperative continuum. Operationally, knowledge was assessed using the structured self-administered questionnaire adapted from Romero et al. (2022) and Martinez-Nicolas et al. (2024). Knowledge scores were converted into percentage scores and classified as **poor** (<70%), **fair** (70% to <80%), and **good** (≥80%).

Nurses' Practice

Nurses' practice refers to nurses' actual implementation of perioperative patient safety measures during routine perioperative care. Operationally, practice was assessed through direct observation using the Perioperative Safety Observation Checklist adapted from the Surgical Patient Safety Observation Tool (SPOT) developed by Heideveld-Chevalking et al. (2018). Practice scores were converted into percentage scores and classified as **incompetent** (<90%) and **competent** (≥90%).

Cardiac Surgical Patient

A cardiac surgical patient refers to an adult patient undergoing cardiac surgery and receiving perioperative nursing care at Aswan Heart Centre during the study period.

2. METHODS

Research Design

A quantitative descriptive cross-sectional study design was employed to assess nurses' knowledge and practices regarding perioperative patient safety measures provided to cardiac surgical patients and to examine the relationship between nurses' knowledge and practices.

Setting

The study was conducted at **Aswan Heart Centre (AHC)**, a specialized tertiary cardiac institution established by the **Magdi Yacoub Global Heart Foundation** in Aswan, Egypt. The centre provides comprehensive diagnostic, medical, and surgical services for patients with cardiovascular diseases and serves as a regional referral centre for advanced cardiac care. Data were collected from the perioperative units, including the preoperative wards, operating rooms, the Adult Cardiac Intensive Care Unit (ACICU), and postoperative wards, where nurses provide perioperative care for adult cardiac surgical patients.

Sampling

A convenience sample of **89 registered nurses** working in the perioperative units at Aswan Heart Centre was recruited. All eligible nurses working across the morning, evening, and night shifts during the data collection period were invited to participate.

Inclusion Criteria

Participants were eligible if they:

- were permanently employed registered nurses at Aswan Heart Centre;
- had at least one year of clinical experience in perioperative cardiac care;
- were directly involved in providing perioperative care for adult cardiac surgical patients during the preoperative, intraoperative, or postoperative phases; and
- voluntarily agreed to participate in the study.

Exclusion Criteria

Nurses with less than one year of perioperative clinical experience, temporary staff, interns, or those who were not directly involved in perioperative care for adult cardiac surgical patients during the study period were excluded.

Instruments

Two instruments were used to collect the necessary data.

The First Instrument: Self-Administered Questionnaire

The first instrument was a **self-administered questionnaire** adapted from **Romero et al. (2022)** and **Martinez-Nicolas et al. (2024)** to assess nurses' knowledge regarding perioperative patient safety measures.

The questionnaire consisted of two parts.

Part A: Demographic Characteristics

This part collected participants' demographic and professional characteristics, including age, gender, highest educational qualification, years of clinical experience, and working area.

Part B: Knowledge Regarding Perioperative Patient Safety Measures

This part consisted of **93 items** distributed across five competency domains:

- Ethical and legal practice
- Perioperative nursing role

- Pain management
- Communication and teamwork
- Patient safety culture

The items were originally rated using a five-point Likert scale ranging from **0 (Not applicable)** to **4 (Always)**.

The Second Instrument: Perioperative Safety Observation Checklist

The second instrument was the **Perioperative Safety Observation Checklist**, adapted from the **Surgical Patient Safety Observation Tool (SPOT)** developed by **Heideveld-Chevalking et al. (2018)** to assess nurses' practices regarding perioperative patient safety measures.

The checklist consisted of **134 observational items** covering the entire perioperative continuum, including patient admission, pre-anesthetic preparation, intraoperative care, postoperative intensive care, and recovery before discharge.

The observational items were grouped into four competency domains:

- Infection prevention
- Medical equipment safety and accountability
- Medication safety
- Communication and handover

To ensure role-specific assessment, each nurse was evaluated only on the activities relevant to his or her assigned clinical responsibilities within the perioperative team.

Each observational item was scored as:

- **1 = Done completely**
- **0 = Not done**

Scoring System

Knowledge and practice scores were converted into percentage scores to facilitate standardized interpretation.

Knowledge scores were classified as:

- **Poor:** <70%
- **Fair:** 70% to <80%
- **Good:** ≥80%

Practice scores were classified as:

- **Incompetent:** <90%
- **Competent:** ≥90%

Validity and Reliability

The study instruments were adapted from previously published and validated instruments developed by **Romero et al. (2022)**, **Martinez-Nicolas et al. (2024)**, and the **Surgical Patient Safety Observation Tool (SPOT)** developed by **Heideveld-Chevalking et al. (2018)**. Following adaptation, the instruments underwent a comprehensive validation process to ensure their suitability for assessing nurses' knowledge and practices regarding perioperative patient safety measures within the cardiac surgical setting.

Content validity was established through expert review by a panel of specialists in perioperative nursing, cardiac critical care, nursing administration, and patient safety. The experts evaluated each item for clarity, relevance, comprehensiveness,

and representativeness in relation to the study objectives and the competency domains of perioperative patient safety. Based on their recommendations, minor linguistic modifications were made to improve the clarity and precision of selected items without altering their conceptual meaning or content. The expert review confirmed that the instruments adequately represented the essential competency domains of perioperative patient safety.

A pilot study was subsequently conducted on **10 nurses (approximately 10% of the study sample)** to evaluate the clarity, feasibility, applicability, and estimated completion time of the adapted instruments within the actual clinical setting. Participants reported that all items were clear, understandable, and applicable to their clinical practice, and no difficulties were encountered during data collection. Consequently, no further modifications were required, and the pilot participants were included in the final study sample.

The internal consistency reliability of the instruments was assessed using **Cronbach's alpha coefficient**. The self-administered questionnaire demonstrated **good internal consistency** (Cronbach's $\alpha = 0.819$), while the Perioperative Safety Observation Checklist demonstrated **acceptable internal consistency** (Cronbach's $\alpha = 0.731$), indicating that the items within each instrument consistently measured their intended constructs. Inter-rater reliability was not assessed because all observational assessments were conducted by a single trained researcher using a standardized observation checklist and a uniform observation protocol, thereby minimizing observer variability. According to established psychometric standards, a Cronbach's alpha coefficient of **0.70 or higher** indicates acceptable internal consistency and measurement reliability (**Izah et al., 2024**). Therefore, the study instruments were considered valid and reliable for assessing nurses' knowledge and practices regarding perioperative patient safety measures in cardiac surgical settings.

Pilot Study

A pilot study was conducted on **10 nurses (approximately 10% of the study sample)** to evaluate the clarity, feasibility, applicability, and usability of the study instruments. No modifications to the instruments were required following the pilot study. Therefore, the pilot participants were included in the final study sample.

Ethical Approval

Ethical approval was obtained from the **Institutional Review Board (IRB) of the British University in Egypt** before commencement of the study (Approval No. **P.010**). Official permission to conduct the study was subsequently obtained from the administration of Aswan Heart Centre after a detailed explanation of the study objectives and procedures.

Written informed consent was obtained from all participants before data collection. Participation was entirely voluntary, and participants were informed of their right to withdraw from the study at any stage without penalty or consequences. Confidentiality and anonymity were strictly maintained throughout the study. No personal identifiers were collected, and all questionnaires and observation checklists were coded to protect participants' identities. All collected data were securely stored and used exclusively for research purposes.

Procedure

Data were collected over a three-month period from **September to November 2025** during routine working hours across the morning, evening, and night shifts.

To minimize the potential influence of the knowledge questionnaire on observed performance, nurses' clinical practices were assessed before administration of the self-administered questionnaire. Each participant was observed on **three separate occasions**, representing the morning, evening, and night shifts, using the standardized Perioperative Safety Observation Checklist.

Following completion of the observational assessment, participants independently completed the self-administered questionnaire under the supervision of the researcher to ensure completeness and to clarify any queries when necessary. Completed questionnaires and observation checklists were coded immediately after collection to preserve participant anonymity and facilitate data management.

Statistical Analysis

Data were coded, entered, cleaned, and analyzed using the **Statistical Package for the Social Sciences (SPSS), version 21.0** (IBM Corp., Armonk, NY, USA).

Descriptive statistics were used to summarize participants' demographic characteristics, knowledge levels, and practice levels. Categorical variables were presented as frequencies and percentages, whereas continuous variables were expressed as means and standard deviations.

For knowledge analysis, responses of "**Always**" and "**Normally**" were considered correct, whereas responses of "**Sometimes**" and "**Rarely**" were considered incorrect. Responses marked "**Not applicable**" were treated as missing values. Practice items were scored as **correct** ("**Done completely**") or **incorrect** ("**Not done**"), while activities that did not occur during the observation period were treated as missing values.

Chi-square tests were used to examine the associations between nurses' demographic characteristics and knowledge and practice levels. Pearson's correlation coefficient was used to examine the relationship between overall nurses' knowledge and practice scores. Statistical significance was established at a two-tailed **p-value** < 0.05.

3. RESULTS

Table 1 presents the demographic characteristics of the studied nurses. More than half of the participants (50.6%) were aged between 20 and 24 years, followed by 33.7% aged 25–29 years, with a mean age of **24.9 ± 3.9 years**. The gender distribution was almost equal, with 50.6% being male and 49.4% female. Regarding clinical experience, half of the nurses (50.6%) had between 3 and less than 6 years of experience, with a mean of **4.2 ± 2.4 years**. Most participants held a bachelor's degree in nursing (61.8%), whereas 29.2% held a nursing diploma and only 9.0% had a master's degree. Regarding work area, the largest proportion of nurses worked in the Adult Cardiac Intensive Care Unit (ACICU) (40.4%), followed by the operating room (22.5%), preoperative wards (20.2%), and postoperative wards (16.9%).

Table 1. Demographic Characteristics of the Studied Nurses (N = 89)

Characteristic	Category	n	%
Age (years)	20–24	45	50.6
	25–29	30	33.7
	30–34	13	14.6
	≥35	1	1.1
	Mean ± SD	24.9 ± 3.9	
Gender	Male	45	50.6
	Female	44	49.4
Clinical Experience (years)	1 to <3	23	25.8
	3 to <6	45	50.6
	≥6	21	23.6
	Mean ± SD	4.2 ± 2.4	
Educational Qualification	Nursing Diploma	26	29.2
	Bachelor's Degree in Nursing	55	61.8
	Master's Degree in Nursing	8	9.0
Working Area	Preoperative Ward	18	20.2
	Operating Room	20	22.5
	Adult Cardiac Intensive Care Unit (ACICU)	36	40.4
	Postoperative Ward	15	16.9

Table 2 illustrates nurses' level of knowledge regarding perioperative patient safety measures across the five competency domains. The highest proportion of good knowledge was observed in the perioperative nursing role domain (76.4%). Conversely, knowledge related to pain management demonstrated the lowest performance, with 46.1% of nurses classified as having poor knowledge, followed by ethical and legal practice (41.6%) and communication and teamwork (40.4%). Overall, 39.3% of nurses demonstrated poor knowledge, 45.0% demonstrated fair knowledge, and only 15.7% demonstrated good knowledge regarding perioperative patient safety measures.

Table 2. Nurses' Level of Knowledge Regarding Perioperative Patient Safety Measures According to Knowledge Competency Domains (N = 89)

Knowledge Domain	Poor n (%)	Fair n (%)	Good n (%)
Ethical and Legal Practice	37 (41.6)	38 (42.7)	14 (15.7)
Perioperative Nursing Role	10 (11.2)	11 (12.4)	68 (76.4)
Pain Management	41 (46.1)	34 (38.2)	14 (15.7)
Communication and Teamwork	36 (40.4)	32 (36.0)	21 (23.6)
Patient Safety Culture	29 (32.6)	40 (44.9)	20 (22.5)
Overall Knowledge	35 (39.3)	40 (45.0)	14 (15.7)

Knowledge score classification: Poor (<70%); Fair (70% to <80%); Good (≥80%).

Table 3 presents nurses' level of practice regarding the implementation of perioperative patient safety measures. Competency was highest in medical equipment safety and accountability (98.9%), followed by medication safety (97.8%) and infection prevention (88.8%). Communication and handover demonstrated the lowest level of competency, with 22.5% of nurses classified as incompetent in this domain. Overall, the majority of nurses (85.4%) demonstrated competent perioperative safety practices, whereas 14.6% were classified as incompetent.

Table 3. Nurses' Level of Practice Regarding the Implementation of Perioperative Patient Safety Measures (N = 89)

Practice Domain	Competent n (%)	Incompetent n (%)
Infection Prevention	79 (88.8)	10 (11.2)
Medical Equipment Safety and Accountability	88 (98.9)	1 (1.1)
Medication Safety	87 (97.8)	2 (2.2)
Communication and Handover	69 (77.5)	20 (22.5)
Overall Practice	76 (85.4)	13 (14.6)

Practice score classification: Incompetent (<90%); Competent (≥90%).

Table 4 presents the relationship between nurses' overall knowledge level and demographic characteristics. Statistically significant associations were identified between nurses' knowledge level and both **clinical experience** ($\chi^2 = 18.90$, $p = 0.004$) and **working area** ($\chi^2 = 27.24$, $p < 0.001$). Nurses working in the **Operating Room** demonstrated the highest proportion of good knowledge (45.0%), whereas nurses working in the **Adult Cardiac Intensive Care Unit (ACICU)** demonstrated the highest proportion of fair knowledge (66.7%). No statistically significant associations were observed between nurses' knowledge level and age, gender, or educational qualification ($p > 0.05$).

Table 4. Relationship Between Nurses' Overall Knowledge Level and Demographic Characteristics (N = 89)

Demographic Characteristics	Poor Knowledge n (%)	Fair Knowledge n (%)	Good Knowledge n (%)	χ^2	p-value	Significance
Age (years)				6.67	0.352	NS
20–24	15 (16.9)	21 (23.6)	9 (10.1)			
25–29	11 (12.4)	16 (18.0)	3 (3.4)			
30–34	8 (9.0)	3 (3.4)	2 (2.2)			
≥35	1 (1.1)	0 (0.0)	0 (0.0)			
Gender				0.40	0.817	NS
Male	18 (20.2)	19 (21.3)	8 (9.1)			
Female	17 (19.1)	21 (23.6)	6 (6.7)			
Clinical Experience (Years)				18.90	0.004	S
1 to <3 years	7 (7.9)	11 (12.4)	5 (5.6)			
3 to <6 years	19 (21.3)	13 (14.6)	13 (14.6)			

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≥6 years	Verify SPSS	from	Verify SPSS	from	Verify SPSS	from			
Educational Qualification							4.40	0.354	NS
Nursing Diploma	10 (11.2)		11 (12.4)		5 (5.6)				
Bachelor's Degree in Nursing	22 (24.7)		27 (30.3)		6 (6.7)				
Master's Degree in Nursing	3 (3.4)		2 (2.2)		3 (3.4)				
Working Area							27.24	<0.001	HS
Preoperative Ward	9 (10.1)		7 (7.9)		2 (2.2)				
Operating Room (Scrub, Circulating, and Anesthesia)	7 (7.9)		4 (4.5)		9 (10.1)				
Adult Cardiac Intensive Care Unit (ACICU)	9 (10.1)		24 (27.0)		3 (3.4)				
Postoperative Ward	10 (11.2)		5 (5.6)		0 (0.0)				

NS: Not statistically significant ($p > 0.05$).

S: Statistically significant ($p < 0.05$).

HS: Highly statistically significant ($p < 0.001$).

Table 5 presents the relationship between nurses' overall practice level and demographic characteristics. Statistically significant associations were identified between nurses' practice level and both **clinical experience** ($\chi^2 = 14.70$, $p = 0.020$) and **working area** ($\chi^2 = 52.30$, $p = 0.010$). Nurses working in the preoperative ward and the Adult Cardiac Intensive Care Unit (ACICU) demonstrated the highest levels of competency (94.4% each). In contrast, no statistically significant relationships were observed between nurses' practice level and age, gender, or educational qualification ($p > 0.05$).

Table 5. Relationship Between Nurses' Overall Practice Level and Demographic Characteristics (N = 89)

Demographic Characteristics	Competent n (%)	Incompetent n (%)	χ^2	p-value	Significance
Age (years)			2.80	0.424	NS
20–24	37 (82.2)	8 (17.8)			
25–29	28 (93.3)	2 (6.7)			
30–34	10 (76.9)	3 (23.1)			
≥35	1 (100.0)	0 (0.0)			
Gender			2.12	0.145	NS
Male	36 (80.0)	9 (20.0)			
Female	40 (90.9)	4 (9.1)			
Clinical Experience (Years)			14.70	0.020	S
1 to <3 years	21 (91.3)	2 (8.7)			
3 to <6 years	37 (82.2)	8 (17.8)			
≥6 years	18 (85.7)	3 (14.3)			
Educational Qualification			3.53	0.171	NS
Master's degree	6 (75.0)	2 (25.0)			
Bachelor's degree	50 (90.9)	5 (9.1)			
Nursing Diploma	20 (76.9)	6 (23.1)			
Working Area			52.30	0.010	S
Preoperative Ward	17 (94.4)	1 (5.6)			
Intraoperative (Operating Room)	16 (80.0)	4 (20.0)			
Adult Cardiac Intensive Care Unit (ACICU)	34 (94.4)	2 (5.6)			
Postoperative Ward	14 (93.3)	1 (6.7)			

NS: Not statistically significant ($p > 0.05$).

S: Statistically significant ($p < 0.05$).

Table 6 demonstrates the correlation between nurses' overall knowledge and practice scores. A weak but statistically significant positive correlation was identified between nurses' knowledge and practice scores ($r = 0.217$, $p = 0.020$), indicating that higher knowledge scores were associated with better implementation of perioperative patient safety measures.

Table 6. Correlation Between Nurses' Overall Knowledge and Practice Scores (N = 89)

Variable	Mean $\pm$ SD	Pearson's r	p -value
Overall Knowledge Score	64.72 $\pm$ 10.43	0.217	0.020*
Overall Practice Score	90.00 $\pm$ 37.32†	—	—

* Correlation is statistically significant at $p < 0.05$.

4. DISCUSSION

Perioperative patient safety is a cornerstone of high-quality surgical care, particularly in cardiac surgery, where patients are exposed to complex procedures and multiple perioperative risks. Nurses play a central role in implementing evidence-based safety measures throughout the perioperative continuum. Therefore, assessing their knowledge and clinical practices is essential for identifying educational needs and supporting continuous quality improvement within specialized cardiac surgical settings (Martinez-Nicolas et al., 2024; Farooq et al., 2025).

The present study revealed that nurses' overall knowledge regarding perioperative patient safety measures was predominantly **fair**, while only a limited proportion demonstrated **good** knowledge. Although this finding indicates an acceptable theoretical foundation, it also highlights important opportunities for strengthening nurses' understanding of essential patient safety principles. Similar findings were reported by King et al. (2024), who found that perioperative nurses generally demonstrated moderate knowledge levels despite working in specialized surgical settings. Likewise, Martinez-Nicolas et al. (2024) emphasized that continuous professional education remains essential for maintaining competency in perioperative patient safety.

Among the knowledge domains, the highest level of knowledge was observed in the **perioperative nursing role**, whereas **pain management**, **ethical and legal practice**, and **communication and teamwork** demonstrated the lowest knowledge levels. Greater familiarity with perioperative nursing responsibilities may reflect nurses' daily involvement in routine surgical care and adherence to established clinical protocols. Conversely, lower knowledge in pain management and communication may indicate the need for greater emphasis on these areas during continuing professional education. Comparable findings have been reported among perioperative nurses, where deficiencies were commonly identified in communication, patient safety culture, and pain management despite satisfactory knowledge of routine perioperative procedures (Ahmed Al-Abd et al., 2020; Samir Alruwaili et al., 2023; King et al., 2024).

The findings also demonstrated that the majority of nurses exhibited **competent perioperative safety practices**, suggesting a high level of adherence to evidence-based safety measures during routine clinical care. This level of competency may reflect the structured perioperative environment of Aswan Heart Centre, where standardized protocols, multidisciplinary collaboration, and continuous exposure to complex cardiac procedures reinforce safe clinical practice. Similar levels of practice competency have been reported among perioperative nurses working in specialized surgical settings (Martinez-Nicolas et al., 2024; Abbas et al., 2025).

Regarding individual practice domains, the highest competency was observed in **medical equipment safety and accountability**, followed by **medication safety** and **infection prevention**, whereas **communication and handover** demonstrated the lowest level of competency. These findings likely reflect the strong emphasis placed on equipment verification, medication administration, and infection prevention within cardiac surgical units. However, communication during patient transfer remains a recognized challenge in perioperative care because of the complexity of multidisciplinary interactions and frequent transitions between clinical areas. Similar observations have been reported by AHN and Lee (2021) and Martinez-Nicolas et al. (2024), who identified communication and structured handover as persistent priorities for improving perioperative patient safety.

Clinical experience and working area were significantly associated with both nurses' knowledge and practice levels. Nurses with greater clinical experience generally demonstrated higher competency, highlighting the contribution of cumulative clinical exposure to the development of perioperative patient safety competencies. Likewise, differences across working areas may reflect variation in daily responsibilities, exposure to patient safety activities, and opportunities for practical learning. Similar associations between clinical experience and perioperative competency have been documented in previous nursing research (King et al., 2024; Balachandran et al., 2025).

A **weak but statistically significant positive correlation** was identified between nurses' knowledge and practice, indicating that higher knowledge levels were associated with better implementation of perioperative patient safety measures. Although the relationship was modest, it suggests that theoretical knowledge contributes to clinical performance but is not the sole determinant of safe practice. Organizational factors, clinical experience, workplace learning, supervision, and adherence to standardized protocols may also influence nurses' performance in specialized perioperative settings. Similar findings have been reported in previous studies demonstrating that knowledge alone does not fully explain variations in clinical practice and that multiple individual and organizational factors collectively influence patient safety performance (Martinez-Nicolas et al., 2024; Balachandran et al., 2025).

Overall, the findings indicate that nurses demonstrated satisfactory perioperative safety practices despite predominantly fair knowledge levels. These results highlight the importance of strengthening continuing professional education, particularly in pain management, communication, ethical and legal practice, and patient safety culture, while maintaining the high standards achieved in technical aspects of perioperative care. Enhancing these competencies may further support evidence-based practice and contribute to safer outcomes for cardiac surgical patients.

Clinical experience and working area were significantly associated with nurses' knowledge regarding perioperative patient safety measures. Nurses with greater clinical experience generally demonstrated higher knowledge levels, suggesting that repeated exposure to perioperative care enhances the acquisition and application of patient safety principles. Similarly, variations in knowledge across working areas may reflect differences in daily responsibilities, clinical exposure, and opportunities for experiential learning within specialized perioperative units. Comparable findings have been reported by Balachandran et al. (2025) and King et al. (2024), who identified clinical experience as an important determinant of perioperative nursing competency and patient safety knowledge.

Similarly, nurses' practice level was significantly associated with both clinical experience and working area. More experienced nurses and those working in high-acuity perioperative areas demonstrated higher levels of competency in implementing patient safety measures. These findings emphasize the contribution of continuous clinical exposure and specialized practice environments to the development of technical skills and adherence to standardized safety protocols. Previous studies have likewise demonstrated that clinical experience and workplace learning positively influence perioperative nursing performance and patient safety practices (Martinez-Nicolas et al., 2024; Abbas et al., 2025).

The present study also identified a **weak but statistically significant positive correlation** between nurses' knowledge and practice regarding perioperative patient safety measures. Although nurses with higher knowledge scores tended to demonstrate better clinical practice, the relatively weak strength of the correlation indicates that knowledge alone does not fully determine clinical performance. Safe perioperative practice is influenced by multiple interacting factors, including clinical experience, organizational support, availability of standardized protocols, teamwork, and continuous professional development. Similar observations have been reported in previous studies, which concluded that theoretical knowledge contributes to practice competency but should be complemented by ongoing education, practical training, and supportive clinical environments to optimize patient safety outcomes (King et al., 2024; Martinez-Nicolas et al., 2024; Balachandran et al., 2025).

Overall, the findings demonstrate that nurses working in a specialized cardiac surgical setting achieved a satisfactory level of perioperative patient safety practice despite predominantly fair theoretical knowledge. The observed knowledge gaps, particularly in pain management, communication and teamwork, ethical and legal practice, and patient safety culture, highlight important areas for continuing professional education. Strengthening these competencies through structured educational programmes, regular competency assessment, and evidence-based training may further enhance perioperative patient safety and contribute to improved outcomes for cardiac surgical patients.

Strengths of the Study

This study possesses several important strengths. First, it simultaneously evaluated nurses' **knowledge and objectively observed clinical practices**, providing a comprehensive assessment of perioperative patient safety competencies rather than relying solely on self-reported data. Second, nurses' practices were assessed through **direct observation across different work shifts**, thereby reducing the potential for recall bias and enhancing the accuracy of practice assessment. Third, the study was conducted in **Aswan Heart Centre**, one of the leading specialized tertiary cardiac centres in the Middle East and Africa, where perioperative care follows standardized evidence-based protocols, increasing the clinical relevance of the findings. Finally, the use of validated data collection instruments with satisfactory internal consistency strengthened the reliability of the study findings.

Limitations of the Study

Several limitations should be considered when interpreting the findings of this study. First, the study employed a **cross-sectional descriptive design**, which precludes establishing causal relationships between nurses' knowledge and clinical practice. Second, the study was conducted at a **single specialized cardiac centre**, which may limit the generalizability of the findings to other healthcare settings with different organizational structures and patient populations. Third, although direct observation provides a more objective assessment of clinical practice than self-report measures, nurses' awareness of being observed may have influenced their performance (Hawthorne effect). Finally, although the study identified a statistically significant relationship between knowledge and practice, other factors that may influence perioperative patient safety practices—such as organizational culture, workload, staffing levels, leadership support, and availability of continuing professional education—were not examined and warrant further investigation.

Implications for Nursing Practice

The findings of this study have important implications for perioperative nursing practice, education, and quality improvement. The predominance of **fair knowledge** alongside **competent clinical practice** suggests that structured clinical protocols and specialized practice environments may support safe perioperative care; however, strengthening nurses' theoretical knowledge remains essential for sustaining evidence-based practice. The identified knowledge gaps in **pain management, communication and teamwork, ethical and legal practice, and patient safety culture** highlight priority areas for continuing professional education and competency-based training programmes. Furthermore, the significant association of clinical experience and working area with both knowledge and practice emphasizes the importance of structured orientation programmes, ongoing competency assessment, and mentorship to support professional development. These findings may also assist nursing leaders and healthcare organizations in designing targeted educational interventions and quality improvement initiatives aimed at strengthening perioperative patient safety and optimizing outcomes for cardiac surgical patients.

5. CONCLUSION

The present study demonstrated that nurses working in the perioperative units at Aswan Heart Centre possessed a predominantly **fair level of knowledge** regarding perioperative patient safety measures, while the majority demonstrated **competent clinical practices**. Knowledge was highest in the perioperative nursing role domain, whereas deficiencies were identified in pain management, ethical and legal practice, communication and teamwork, and patient safety culture. In contrast, practice competency was highest in medical equipment safety and accountability, medication safety, and infection prevention, while communication and handover represented the weakest practice domain.

Clinical experience and working area were significantly associated with both nurses' knowledge and practice levels. Furthermore, a weak but statistically significant positive correlation was identified between nurses' knowledge and practice, suggesting that higher knowledge contributes to better implementation of perioperative patient safety measures, although knowledge alone does not fully explain variations in clinical performance.

Overall, the findings indicate that strengthening nurses' theoretical knowledge, while maintaining the high standards of clinical practice achieved within the specialized cardiac surgical setting, may further enhance adherence to evidence-based perioperative patient safety measures and contribute to improved quality of care and patient outcomes.

6. RECOMMENDATIONS

Based on the findings of the present study, the following recommendations are proposed.

Recommendations for Clinical Practice

- Develop and implement regular competency-based continuing education programmes focusing on perioperative patient safety measures, particularly pain management, communication and teamwork, ethical and legal practice, and patient safety culture.
- Establish periodic competency assessments combining knowledge evaluation with direct observation of clinical practice to monitor adherence to evidence-based perioperative safety standards.
- Strengthen structured communication and handover processes through standardized evidence-based tools and regular multidisciplinary team training.
- Maintain continuous monitoring and auditing of infection prevention, medication safety, and medical equipment safety practices to sustain the high levels of competency observed in these domains.

Recommendations for Nursing Education

- Integrate perioperative patient safety competencies into undergraduate and postgraduate nursing curricula using competency-based educational approaches.
- Expand simulation-based education and continuing professional development programmes to strengthen clinical decision-making, teamwork, communication, and safe perioperative practice.

Recommendations for Nursing Administration

- Promote a positive patient safety culture by encouraging continuous learning, multidisciplinary collaboration, and adherence to standardized perioperative safety protocols.
- Develop structured orientation and mentorship programmes for newly employed perioperative nurses to facilitate competency development and integration into specialized cardiac surgical practice.
- Support continuous professional development by providing regular educational opportunities based on identified learning needs and competency gaps.

Recommendations for Future Research

- Conduct multicentre studies involving different cardiac and general surgical settings to improve the generalizability of the findings.
- Evaluate the effectiveness of educational and competency-based interventions in improving nurses' knowledge, clinical practice, and perioperative patient safety outcomes.
- Investigate additional organizational and individual factors, including patient safety culture, workload, staffing patterns, leadership support, and continuing professional development, that may influence perioperative patient safety practices.

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