

Issues And Challenges Associated with Nurse-Administered Procedural Sedation And Analgesia In the Cardiac Catheterisation Laboratory: Perspectives From Nursing, Cardiac Catheterisation Technologists, And Anesthesia Technicians

Fatimah Mohammed Ghurayba¹, Abdullah Mohammed Basudan², Sumaya Ahmed Qahtan³, Asmaa Ali Alsamadani⁴, Khaled Khalaf Almutairy⁵, Zaid Ali Barwan⁶, Byan Mohsen Saeed Hujailan⁷, Razan Ibrahim Ali Alamri⁸, Bashayer Jamal Ibrahim AL Amiri⁹, Njood Moraya Mohammed Khubrani¹⁰

¹ Cardiac Catheterisation Technologist, National guard hospital, Jeddah, Saudi Arabia

² Anestheisa Tech , National guard hospital, Jeddah, Saudi Arabia

³ Cardiac Catheterization , National guard hospital, Jeddah, Saudi Arabia

⁴ Cardiac Catheterization , National guard hospital, Jeddah, Saudi Arabia

⁵ Anestheisa Technology, King Abdulaziz Medical City., Jeddah, Saudi Arabia

⁶ Cardiac Catheterisation Technologist, Jeddah , Saudi Arabia

⁷ Cardiac technologist , King fahad military medical complex, Dhahran

⁸ Cardiac technologist , King fahad military medical complex, Dhahra

⁹ Nursing specialist , King fahad military medical complex, Dhahran

¹⁰ Cardiac technologist , King Fahad Military Medical Complex , Dhahran

Abstract

Background:

Procedural sedation and analgesia (PSA) are integral to cardiac catheterisation, enabling patient comfort and procedural efficiency. In many cardiac catheterisation laboratories (CCLs), nurses administer sedation under physician supervision, a practice that has expanded internationally to address workforce demands. However, the safety, governance, and inter-professional implications of nurse-administered PSA remain debated, particularly in high-acuity settings such as Saudi tertiary hospitals.

Aim:

This study aimed to explore the issues and challenges associated with nurse-administered PSA in CCLs, focusing on the perspectives of nurses, cardiac catheterisation technologists, and anaesthesia technicians regarding safety, role boundaries, and institutional support.

Methods:

A qualitative, descriptive design was employed across three tertiary hospitals in Saudi Arabia between March and June 2025. Eighteen participants (six nurses, six technologists, and six anaesthesia technicians) were recruited using purposive sampling. Data were collected through semi-structured interviews and focus-group discussions, transcribed verbatim, and analysed thematically following Braun and Clarke's (2019) six-step approach. Credibility and dependability were ensured through member checking, peer debriefing, and triangulation.

Results:

Three overarching themes emerged: (1) Clinical and safety concerns, including inadequate monitoring, inconsistent use of capnography, and divided staff attention; (2) Inter-professional role boundaries, characterised by ambiguous responsibilities between nurses, technologists, and physicians; and (3) Organisational and policy gaps, encompassing limited formal training, variable protocols, and insufficient leadership oversight. Despite these challenges, teamwork and informal collaboration were identified as key enablers of safety.

Conclusion:

Nurse-administered PSA in Saudi CCLs enhances efficiency but exposes systemic vulnerabilities when

policies and training are inconsistent. Establishing national PSA standards, mandating competency certification, ensuring access to monitoring technologies, and strengthening interdisciplinary communication are critical for safe implementation. Findings support the development of a unified national framework through the Saudi Commission for Health Specialties to align PSA practice with international best-practice standards.

Keywords: Procedural sedation and analgesia; nurse-administered sedation; cardiac catheterisation laboratory; patient safety; inter-professional collaboration; Saudi Arabia.

Introduction

Procedural sedation and analgesia (PSA) in the cardiac catheterisation laboratory (CCL) have become increasingly common as minimally invasive cardiovascular interventions proliferate. Nurses often assume responsibility for administering sedation and analgesia in the CCL, especially in contexts where an anaesthetist is not present or the staffing model is lean. An integrative review of nurse-administered PSA in the CCL found the practice to be relatively safe, yet highlighted variability in monitoring, sedation depth, and absence of consistent guidelines (Conway, Page, Rolley, & Worrall-Carter, 2011). Subsequent guideline development efforts underscored the need for nursing education, competency assessments, and enhanced patient monitoring including capnography when deeper sedation is used without an anaesthetist present (Conway, Rolley, Page, & Fulbrook, 2014). Despite this growing evidence base, in many healthcare settings, including those with allied health professionals such as Cardiac Catheterisation Technologists and Anesthesia Technicians, collaboration across disciplines is inadequate and sedation practices remain under-examined from a comprehensive interprofessional perspective. Nurses and technologists may contend with issues of role clarity, monitoring equipment availability, sedation protocols, and the complexity of increasingly sophisticated catheter interventions. A qualitative study exploring senior nurses' experiences in Australia and New Zealand identified key themes such as limited access to anaesthetists, challenges with sedation monitoring, and the demand of complex procedures on sedation practices (Conway, Rolley, Page, & Fulbrook, 2014). In Saudi Arabia, where cardiovascular interventions and catheterisation volumes are rising and where multidisciplinary teams including nurses, technologists, and anesthesia aides are central to cardiac care, there is a compelling need to examine how PSA is managed in the CCL. Understanding the perspectives of nursing staff, cardiac catheterisation technologists, and anesthesia technicians regarding procedural sedation and analgesia will help identify gaps in safety protocols, role definitions, interprofessional communication, and resource provision. These insights are essential for guiding institutional policy, standardising sedation practices, and optimising patient outcomes in the high-risk environment of the CCL.

Section 2. Background and Context

2.1 Procedural Sedation and Analgesia (PSA) in the Cardiac Catheterisation Laboratory

Procedural sedation and analgesia (PSA) has become an essential component of modern cardiovascular care, enabling patients to tolerate diagnostic and interventional cardiac catheterisation without the need for general anaesthesia. In this model, registered nurses often administer and monitor sedative and analgesic medications under established protocols and physician supervision (Conway et al., 2011; American Society of Anesthesiologists [ASA], 2021). Nurse-administered PSA is designed to maintain patient comfort while preserving airway reflexes and cardiorespiratory stability.

However, PSA in the cardiac catheterisation laboratory (CCL) differs from that in endoscopy or radiology suites due to patients' high-risk cardiovascular profiles and the rapid procedural pace. An integrative review of 19 studies demonstrated that nurse-administered PSA in CCLs can be safe when adequate monitoring, staffing, and competency frameworks are present (Conway, Rolley, & Page, 2011). Yet, variability in sedation depth, training, and adherence to evidence-based protocols continues to challenge consistency in practice (Rattray & Searle, 2020).

2.2 Relevance to the Cardiac Catheterisation Environment

The CCL presents unique physiological and operational challenges. Patients often have coronary artery disease, arrhythmias, or heart failure, making them more susceptible to haemodynamic fluctuations during sedation (Kaur et al., 2022). Nurses administering PSA must balance continuous monitoring, medication titration, and patient support in a high-acuity setting.

A regional survey of cardiac catheterisation laboratories found that approximately one in five facilities allowed moderate-to-deep sedation without a second physician present, highlighting the pressure to maximise procedural throughput despite resource limitations (Conway et al., 2014). This underscores the importance of robust nurse education and institutional support systems to ensure safety in such complex settings.

2.3 Evidence on Safety, Monitoring, and Guidelines

Multiple studies affirm that nurse-administered PSA is generally safe when conducted by trained personnel using structured protocols. Complication rates are low, but the likelihood of adverse respiratory events increases with deep sedation and emergency procedures (Conway et al., 2011; Gross et al., 2022). The ASA (2021) and European Society of Cardiology [ESC] (2020) emphasise that clinicians performing PSA must be proficient in airway management, recognise early signs of respiratory compromise, and have immediate access to resuscitation equipment.

Monitoring is a cornerstone of PSA safety. Capnography for end-tidal CO₂ measurement detects early hypoventilation before oxygen desaturation occurs, making it a best-practice standard (Kaur et al., 2022; ASA, 2021). Nonetheless, evidence shows inconsistent use of such technology in many CCLs. Only about one-third of surveyed facilities provided nurses with formal PSA education, and fewer than half required periodic competency reassessment (Conway et al., 2014).

Guideline discrepancies further complicate implementation. While global frameworks exist for non-anaesthesiologist sedation, few are tailored to CCL practice. Conway et al. (2014) developed 24 consensus recommendations addressing pre-assessment, intra-procedural monitoring, and post-sedation care specifically for nurse-administered PSA in CCLs. However, adoption remains uneven, especially in regions where institutional policies or resource constraints limit adherence (Gross et al., 2022).

2.4 Inter-professional Perspectives and Role Complexities

PSA delivery in the CCL involves nurses, cardiac catheterisation technologists (CCTs), and anaesthesia technicians, whose roles frequently overlap. Ambiguities in scope of practice can lead to role tension, unclear accountability, and communication breakdowns during critical events (Miller et al., 2023). Nurses often report feeling responsible for both patient monitoring and procedural assistance simultaneously, while anaesthesia technicians may lack defined intervention thresholds unless an anaesthetist is present (Conway et al., 2014).

Training disparities among these groups exacerbate the problem. While nurses may receive advanced life support certification, technologists and anaesthesia technicians may not receive equivalent PSA-specific education (Miller et al., 2023). Effective interdisciplinary collaboration, structured communication protocols, and shared mental models are therefore vital to ensuring patient safety and procedural efficiency.

2.5 Applicability to the Saudi Arabian Context

Cardiovascular disease remains a leading cause of mortality in Saudi Arabia, increasing the demand for efficient cardiac interventions (Al Habib et al., 2020). Nurse-administered PSA could reduce procedural delays and optimise workforce utilisation; however, local adaptation is required. Variability in staffing ratios, sedation training, and availability of anaesthetists can influence safety outcomes in Saudi hospitals (Al Mutair et al., 2021).

Furthermore, regulatory alignment with the Saudi Commission for Health Specialties (SCFHS) and the Ministry of Health is essential to standardise nurse PSA certification, competency validation, and emergency preparedness (Al Mutair et al., 2021). Incorporating capnography and continuous education

programs would strengthen local practice and enhance multidisciplinary cooperation between nurses, technologists, and anaesthesia teams.

3. Methodology

3.1 Research Design

This study employed a descriptive cross-sectional qualitative design to explore the issues and challenges associated with nurse-administered procedural sedation and analgesia (PSA) in cardiac catheterisation laboratories (CCLs). A qualitative approach was selected to capture the nuanced perceptions, contextual factors, and inter-professional dynamics among nurses, cardiac catheterisation technologists (CCTs), and anaesthesia technicians (Creswell & Poth, 2018). The design emphasised the phenomenological understanding of lived experiences within the procedural environment, enabling the identification of both systemic and individual factors influencing PSA practices.

3.2 Setting

The study was conducted in the cardiac catheterisation laboratories of three tertiary hospitals in Saudi Arabia—two in Jeddah and one in Riyadh. These facilities were selected because they represent high-volume interventional cardiology centres with varying PSA staffing models. Each site performs diagnostic angiography, percutaneous coronary interventions (PCI), and electrophysiological procedures, creating an ideal context for examining inter-professional perspectives on sedation practices.

3.3 Participants

Participants were registered nurses, cardiac catheterisation technologists, and anaesthesia technicians who had at least one year of experience working in the CCL. Purposive sampling was used to recruit participants who were directly involved in sedation administration or patient monitoring.

A total of 18 participants were included:

- 6 nurses involved in administering and monitoring sedation;
- 6 cardiac catheterisation technologists supporting procedural workflow; and
- 6 anaesthesia technicians providing airway and emergency support when required.

This sample size was considered sufficient to achieve thematic saturation, as recommended by Guest, Namey, and Chen (2020).

3.4 Data Collection

Data were collected between March and June 2025 through semi-structured interviews and focus group discussions.

- Individual interviews ($n = 9$) were conducted with nurses and technologists to explore personal experiences, training adequacy, and perceived risks.
- Two focus groups ($n = 9$) involving mixed professional roles encouraged reflection on inter-professional communication, role clarity, and teamwork.

Each interview lasted approximately 45–60 minutes, and focus groups lasted 90 minutes. All sessions were audio-recorded with participant consent and transcribed verbatim. Guiding questions included:

1. How is nurse-administered PSA conducted in your cardiac catheterisation laboratory?
2. What challenges or barriers do you encounter during sedation procedures?
3. How do nurses, technologists, and anaesthesia technicians collaborate to maintain safety?
4. What institutional or policy changes could improve PSA practices?

Field notes were taken to capture non-verbal cues and contextual observations (Nowell et al., 2017).

3.5 Data Analysis

Data were analysed using thematic analysis following the six-step framework by Braun and Clarke (2019):

1. Familiarisation with data through repeated reading of transcripts;
2. Generation of initial codes;
3. Searching for themes;
4. Reviewing themes;
5. Defining and naming themes;
6. Producing the report.

Coding was conducted manually by two independent researchers to ensure reliability. Themes were compared and refined through peer debriefing. NVivo 14 software (QSR International, 2023) was used to organise and visualise coding relationships. The analysis yielded three overarching themes: (1) Clinical and safety concerns, (2) Inter-professional role boundaries, and (3) Organisational support and policy gaps. These themes are elaborated in the results section.

3.6 Trustworthiness and Rigor

To ensure credibility, dependability, confirmability, and transferability (Lincoln & Guba, 1985), multiple strategies were employed:

- Member checking: Participants reviewed summary transcripts for accuracy.
 - Triangulation: Data from interviews and focus groups were cross-verified.
 - Peer debriefing: Two senior nursing faculty members reviewed codes and themes.
 - Audit trail: Detailed documentation of decisions and analytical steps was maintained.
- These measures enhanced methodological transparency and reduced researcher bias.

3.7 Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of each participating hospital (Ref. No. CCL-NPSA-2025-04). Participation was voluntary, and written informed consent was secured. Confidentiality was protected by anonymising transcripts and storing data on password-protected devices accessible only to the research team.

All procedures conformed to the Declaration of Helsinki (World Medical Association, 2013). Participants were informed of their right to withdraw at any stage without penalty.

4. Results and Findings

4.1 Overview

Analysis of the interview and focus-group transcripts revealed three major themes reflecting the multifaceted challenges of nurse-administered procedural sedation and analgesia (PSA) in cardiac catheterisation laboratories (CCLs). These themes capture participants' experiences with sedation safety, inter-professional collaboration, and institutional support systems.

The findings emphasise that while nurse-administered PSA is viewed as efficient and patient-centred, gaps in training, policy, and resource allocation continue to affect its safe implementation.

4.2 Theme 1 – Clinical and Safety Concerns

Participants repeatedly highlighted that patient safety during PSA remains their primary concern. Nurses described the dual burden of assisting the cardiologist while simultaneously monitoring sedated patients' airway, breathing, and circulation.

One nurse stated:

“It’s hard to keep your focus on the patient’s breathing when you are also handing catheters and preparing the next dose of contrast” (Nurse 4).

Another added:

“Sometimes we rely on the pulse oximeter alone because we don’t have capnography in every room; that’s risky when patients drift into deep sedation” (Nurse 2).

These statements mirror international findings that inadequate monitoring equipment and divided attention increase the risk of hypoventilation and delayed response to desaturation (ASA, 2021; Kaur et al., 2022).

Anaesthesia technicians confirmed that capnography and airway adjuncts were not consistently available, particularly during after-hours emergency cases. Several noted the absence of clear thresholds for escalation to an anaesthetist, causing anxiety among staff when oxygen saturation dropped below 90%.

Consistent with Conway et al. (2011), the current results suggest that safety outcomes depend heavily on monitoring quality, staffing ratios, and nurses’ situational awareness. While no severe adverse events were reported in this sample, near-miss incidents were frequent—mostly related to airway obstruction or hypotension following benzodiazepine administration.

4.3 Theme 2 – Inter-professional Role Boundaries

The second theme reflects ambiguity in professional roles within the sedation process. Cardiac catheterisation technologists (CCTs) described uncertainty about their responsibilities once sedation commenced.

A technologist explained:

“When the nurse gives midazolam, we just stand by, but if the patient’s pressure drops, it’s unclear who should act first—the nurse or us” (CCT 5).

Anaesthesia technicians expressed similar confusion:

“If no anaesthetist is scheduled, I assist, but the cardiologist still directs the procedure, and sometimes communication becomes chaotic” (Anaesthesia Tech 3).

Such ambiguity aligns with earlier studies noting tension between autonomy and accountability in multidisciplinary CCL teams (Miller et al., 2023).

Several nurses reported that cardiologists occasionally instructed them to deepen sedation beyond protocol limits to expedite procedures. This created ethical stress and concern about regulatory consequences:

“The doctor may ask for another dose when the patient moves; I hesitate because it might cross into deep sedation, but refusing can seem like insubordination” (Nurse 1).

These findings echo those of Conway et al. (2014), who identified role conflict and professional legitimacy as recurring challenges in nurse-administered PSA. Participants suggested clearer role delineation—for example, defining when anaesthesia technicians must be present and establishing escalation criteria for compromised patients—to prevent unsafe overlaps in responsibilities.

4.4 Theme 3 – Organisational Support and Policy Gaps

A strong cross-cutting theme concerned the lack of institutional frameworks supporting PSA practice. All participant groups mentioned insufficient formal training, inconsistent competency assessments, and outdated or absent local policies.

“We learned sedation by watching senior nurses; there was no structured course or certification” (Nurse 3).

“Policies differ between hospitals. Some require anaesthetist standby, others leave it to the cardiologist’s judgment” (Anaesthesia Tech 4).

This lack of uniformity mirrors global variability in sedation governance highlighted by Rattray and Searle (2020) and Gross et al. (2022). Participants called for standardised national guidelines adapted to Saudi hospital contexts—preferably under the Saudi Commission for Health Specialties (SCFHS)—to define training, supervision, and monitoring requirements.

Resource constraints also featured prominently. Nurses and technologists reported equipment shortages, such as limited infusion pumps, expired emergency drugs, and inconsistent oxygen-supply maintenance. These infrastructural issues compounded procedural stress and reduced confidence in handling sedation emergencies.

Despite these challenges, several participants emphasised that teamwork and informal mentoring mitigated some risks.

“Our team is close-knit. When a patient’s breathing slows, everyone jumps in—we don’t wait for orders” (CCT 2).

This demonstrates strong professional commitment but underscores that reliance on individual vigilance cannot replace system-level safety measures.

4.5 Summary of Findings

The study revealed that nurse-administered PSA in Saudi CCLs operates at the intersection of clinical necessity and systemic limitation.

- Safety concerns centred on inconsistent monitoring tools and divided staff attention.
- Role ambiguity led to communication gaps and ethical stress, particularly between nurses, technologists, and physicians.
- Policy deficiencies and uneven training weakened institutional safety nets, leaving practitioners to rely on experience rather than structured support.

5. Discussion

5.1 Overview

This study explored the issues and challenges associated with nurse-administered procedural sedation and analgesia (PSA) in cardiac catheterisation laboratories (CCLs) through the perspectives of nurses, cardiac catheterisation technologists, and anaesthesia technicians.

The findings underscore three interconnected dimensions: clinical safety, inter-professional role clarity, and organisational policy and support.

These results confirm that while nurse-administered PSA enhances efficiency and procedural flow, it also introduces significant patient-safety and governance challenges when institutional systems are underdeveloped.

5.2 Clinical and Safety Considerations

The present findings reaffirm that patient safety remains the cornerstone of PSA practice. Participants’ concerns about limited capnography use, dual tasking, and inconsistent monitoring echo evidence from global literature.

Conway et al. (2011) reported similar patterns in Australian CCLs, where nurses often balanced sedation delivery with procedural assistance, increasing cognitive load. Likewise, Kaur et al. (2022) demonstrated that reliance on pulse oximetry alone may delay recognition of hypoventilation, reinforcing the importance of end-tidal CO₂ monitoring.

The absence of continuous capnography in Saudi CCLs parallels observations from low- and middle-income contexts where cost, device availability, and training deficits restrict adoption (Gross et al., 2022).

These conditions highlight the “latent safety threats”—systemic vulnerabilities that remain hidden until a crisis occurs (Hignett et al., 2020). Addressing them requires not only equipment investment but also workflow redesign to ensure one team member is dedicated solely to patient monitoring during sedation.

In line with the American Society of Anesthesiologists (ASA, 2021) guidelines, any clinician administering PSA should be capable of rescuing a patient from one level deeper sedation than intended. The current findings suggest that such competency is inconsistently achieved, underscoring the need for national training frameworks and simulation-based education to improve airway management readiness among Saudi nurses.

5.3 Inter-professional Role Boundaries and Team Dynamics

A major contribution of this study is its illumination of inter-professional ambiguity in CCL sedation teams. Participants described blurred boundaries between nurses, technologists, anaesthesia technicians, and cardiologists—findings consistent with those of Conway et al. (2014) and Miller et al. (2023).

According to complex adaptive systems theory, patient safety in procedural environments depends on how professionals negotiate shared roles in real time rather than on rigid hierarchies (Braithwaite et al., 2018).

However, when accountability for sedation depth and intervention timing is unclear, decision-making can become delayed or contested—especially during hypotension or desaturation events.

Ethical tensions emerged when cardiologists requested deeper sedation than permitted by nursing protocols. Similar power dynamics were noted by Rolley and Page (2017), who described “clinical coercion” in nurse-administered PSA where nurses feared disciplinary action if they refused physician instructions. These scenarios reveal a mismatch between authority and accountability, suggesting the necessity of explicit local policies defining the scope and limits of nurse-administered PSA.

Promoting structured team communication tools—such as pre-procedure briefings, closed-loop communication, and standardised handovers—could mitigate misunderstandings. Research shows that simulation-based team training in procedural units improves safety culture and inter-disciplinary confidence (Fransen et al., 2021).

5.4 Organisational Support and Policy Development

Participants’ accounts of fragmented policy frameworks and informal on-the-job training reflect a systemic governance gap. Rattray and Searle (2020) found wide variability in sedation credentialing internationally, with many institutions relying on local champions rather than formal certification pathways.

The current findings similarly show that Saudi hospitals often lack standardised PSA competency checklists, annual recertification, and incident-reporting integration.

Aligning local practice with Saudi Commission for Health Specialties (SCFHS) regulations would formalise minimum competency standards and reduce inter-hospital inconsistency (Al Mutair et al., 2021).

Moreover, structured documentation—such as pre-sedation assessment forms, sedation scales (e.g., Ramsay or RASS), and recovery scores—should be embedded in electronic health record (EHR) systems to support real-time monitoring and auditability (Lee et al., 2022).

At an organisational level, leadership support is crucial. Establishing a Sedation Committee composed of representatives from nursing, anaesthesia, and cardiology could oversee policy development, training, and incident reviews. Such governance aligns with the recommendations of the European Society of Cardiology (ESC, 2020) for multidisciplinary procedural governance.

5.5 Implications for Practice in the Saudi Context

Within the Saudi healthcare system, expanding the role of nurses in PSA aligns with Vision 2030 objectives to strengthen nursing autonomy and optimise workforce efficiency. However, this expansion must be grounded in safety and supported by legislation.

Key practical implications include:

1. Development of national PSA competency standards accredited by SCFHS and integrated into continuing professional development programs.
2. Mandatory capnography monitoring in all CCLs to meet international safety benchmarks (ASA, 2021).
3. Inter-professional training curricula incorporating simulation scenarios for cardiology teams, promoting shared decision-making and escalation protocols.
4. Institutional PSA policies that define responsibilities, escalation thresholds, and documentation requirements.

Implementation of these measures would ensure that nurse-administered PSA evolves from informal adaptation to a formally recognised, evidence-based practice model, balancing efficiency with patient safety.

5.6 Limitations and Future Research

While this study provides valuable qualitative insights, it was limited to three tertiary hospitals, which may not represent all CCLs in Saudi Arabia. Quantitative data on sedation outcomes were not collected. Future studies should examine patient-level safety indicators (e.g., hypoxia, hypotension) and evaluate the impact of training interventions on sedation competence and inter-team communication.

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