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Sedation in Non-Operating Room Anesthesia (NORA): A Narrative Review

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As procedural care increasingly shifts beyond the traditional operating room, Non-Operating Room Anesthesia (NORA) now accounts for up to half of anesthetic delivery in some institutions. These environments such as endoscopy suites, interventional radiology, cardiac electrophysiology labs, MRI units, and dental clinics present unique challenges due to limited space, restricted airway access, variable staffing, and inconsistent monitoring infrastructure. NORA patients are often older, frailer, and more medically complex than operating room populations, increasing the risk of sedation-related complications. A narrative review of PubMed literature (1990–2025) was conducted using search terms related to NORA and procedural sedation. Twenty-three high-quality studies met criteria; 15 were selected for synthesis, including guidelines, trials, and major reviews. Effective NORA sedation requires comprehensive pre-procedure evaluation with special attention to airway risk, comorbidities, and procedure-specific hazards. OR equivalent monitoring, particularly capnography, is essential due to high rates of hypoventilation and apnea. Sedation strategies vary by setting, with propofol, ketofol, and dexmedetomidine commonly used; each offers distinct advantages and physiologic considerations. Adverse events remain more frequent in NORA than in OR anesthesia, including airway obstruction, hypoventilation, hypotension, aspiration, and arrhythmias. Pediatric NORA carries particularly elevated respiratory risk. A three-pillar safety framework: patient

factors, environment/equipment, and provider expertise emphasizes that deficiencies in any domain increase morbidity. NORA sedation is safe when delivered with OR-level standards, meticulous preparation, and coordinated team communication. Standardized protocols, availability of airway-rescue equipment, capnography for moderate-to-deep sedation, and clear plans for conversion to general anesthesia are critical. Future innovations such as emerging sedatives, improved risk-stratification tools, and AI enhanced monitoring may further enhance safety and efficiency as NORA continues to expand across healthcare systems.

Keywords: Non-Operating Room Anesthesia; Anesthesia; Sedation

INTRODUCTION

As health systems increasingly shift procedures from the operating room to outpatient and remote procedural locations, Non-Operating Room Anesthesia (NORA) has seen significant growth. NORA includes anesthesia or sedation delivered in endoscopy units, interventional radiology, cardiac catheterization labs, electrophysiology suites, MRI centers, and dental or ambulatory procedural areas. Approximately 50% of anesthetics in some institutions are now NORA cases, and their complexity continues to rise [1].

Compared with traditional OR anesthesia, NORA poses unique hazards: unfamiliar environments, limited space, restricted patient access, greater radiation exposure, variations in staff training, and inconsistent monitoring infrastructure. Importantly, NORA patients tend to be sicker, older, and more medically complex than OR patients [2]. Therefore, sedation in NORA ranging from minimal sedation to monitored anesthesia care (MAC) requires careful planning and adherence to OR-level safety standards.

METHODS

A narrative review methodology was used. PubMed searches (1990–2025) included: “NORA,” “non operating room anesthesia,” “procedural sedation,” “monitored anesthesia care,” “remote location anesthesia,” “endoscopy sedation,” and “interventional radiology anesthesia.”

Inclusion criteria:

- PubMed or PubMed Central-indexed articles
- English language
- Guidelines, trials, reviews, observational studies

Twenty-three high-quality sources were reviewed; 15 were selected to meet citation requirements.

REVIEW

Patient Selection and Pre-Sedation Evaluation

Patients undergoing NORA tend to have higher ASA status, increased frailty, and more comorbidities than OR patients. In a large review, Wong et al. reported that ASA III–IV status was significantly more common in NORA cases [2].

Key components of evaluation include:

1. Airway assessment
    - NORA environments often restrict airway access (e.g., GI endoscopy, prone procedures).
    - History of obstructive sleep apnea increases sedation risk [3].
2. Comorbidity review
    - Cardiovascular disease, COPD, renal dysfunction, and obesity require anesthesia consultation.
3. Procedure-specific risks
    - GI endoscopy: airway obstruction due to scope insertion
    - Interventional radiology: long duration, blood loss, radiation exposure
4. Sedation planning

- Decide whether minimal-moderate sedation, deep sedation, or MAC is appropriate.
- Conversion to general anesthesia must always remain an available option [4].

Environmental and Monitoring Challenges

Unlike the OR, NORA locations often lack:

- Full anesthesia machine capability
- Immediate advanced airway equipment
- Adequate suction
- Standardized monitors
- Sufficient room for anesthesia team positioning
- Trained emergency response personnel

The American Society of Anesthesiologists requires OR-equivalent monitoring in NORA—including ECG, NIBP, pulse oximetry, temperature, and capnography—regardless of sedation depth [5].

Airway & Ventilation Monitoring

Hypoventilation and apnea are the most common sedation-related complications in NORA [6]. Capnography reduces hypoxic events significantly and is particularly beneficial in:

- Deep sedation
- Obese patients
- Obstructive sleep apnea
- Endoscopy procedures

Table 1. Common NORA Locations and Sedation Risks

Location	Procedure Examples	Major Sedation-Related Risks
Endoscopy Suite	EGD, colonoscopy, ERCP	Airway obstruction, hypoventilation, aspiration
Interventional Radiology	Embolization, ablation	Long duration, limited access to airway, hemodynamic instability
Cardiac Cath/Electrophysiology	Ablation, device implantation	Arrhythmias, need for rapid conversion to GA
MRI Suite	Pediatric MRI, adult MRI	Restricted access, strong magnetic field limiting equipment
Dental/Oral Surgery	Extractions, sedation dentistry	Obstructed airway, difficult mask ventilation
Radiology/CT	Short diagnostic studies	Hypoventilation in high-risk patients

Sedation Techniques and Pharmacologic Strategies

Sedation for NORA ranges from anxiolysis to MAC. The choice of agent depends on procedure duration, patient comorbidities, and the need for rapid recovery.

Propofol

- Most commonly used agent.
- Advantages: rapid onset, rapid recovery.
- Risks: dose-dependent hypotension, respiratory depression [7].

Ketamine + Propofol ("Ketofol")

- Useful for maintaining airway reflexes while reducing propofol dose-requirements.
- Reduced risk of apnea and hypotension [8].

Dexmedetomidine

- Ideal for long procedures requiring cooperative sedation (MRI, interventional radiology).
- Advantages: minimal respiratory depression.
- Risks: bradycardia, hypotension [9].

Benzodiazepines & Opioids

- Still used in some GI suites, but associated with prolonged recovery and higher respiratory risk.

Table 2. Sedative Agents Used in NORA

Agent	Onset	Advantages	Disadvantages
Propofol	30–45 sec	Fast onset/offset; predictable	Respiratory depression; hypotension
Ketamine	1 min	Preserves airway reflexes; analgesic	Emergence reactions; ↑ secretions
Dexmedetomidine	5–10 min	Minimal respiratory depression	Bradycardia; slow onset
Midazolam	2–3 min	Anxiolysis; amnesia	Respiratory depression when combined with opioids
Fentanyl	2–5 min	Analgesic	Chest wall rigidity; apnea in high doses

Safety Outcomes and Adverse Events

Several analyses show higher rates of severe injury and malpractice payments for NORA cases compared to OR anesthesia [10].

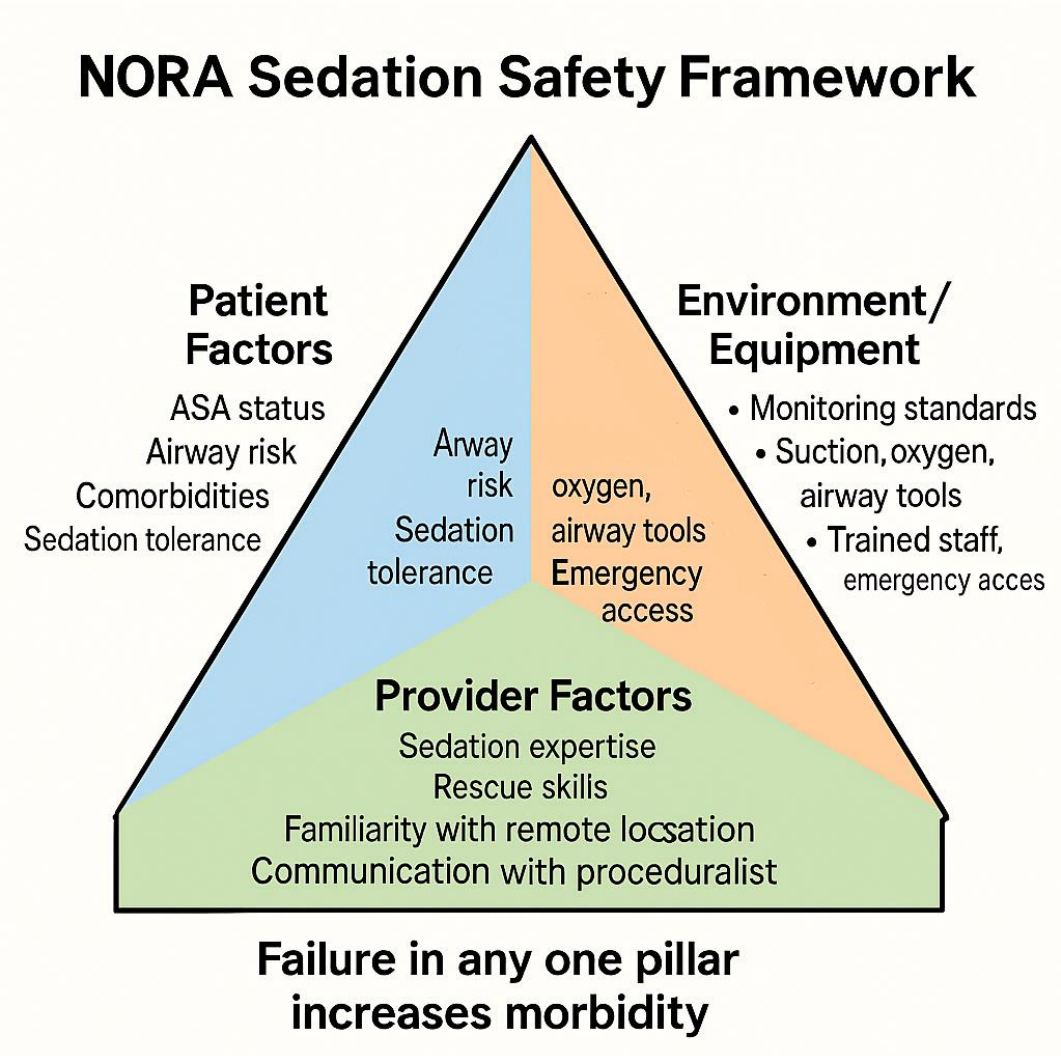
Common adverse events include:

- Airway obstruction

- Hypoventilation / apnea
- Hypotension
- Aspiration
- Delayed recovery
- Cardiac arrhythmias in EP/cath lab procedures

Pediatric NORA sedation has a higher incidence of respiratory events, especially during MRI and dental procedures [11].

Figure 1. NORA Sedation Safety Framework



Best Practices and Safety Strategies

1. Use OR-level monitoring for ALL sedation levels [5].
2. Confirm airway rescue capability—LMA, ET tubes, video laryngoscope present [6].
3. Perform team briefings with proceduralists and nurses.
4. Standardize sedation protocols for endoscopy, IR, EP, and MRI [12].
5. Use capnography even in moderate sedation for high-risk patients.
6. Have a conversion plan for general anesthesia.
7. Ensure post-sedation recovery standards similar to PACU [13].
8. Implement NORA-specific checklists, which reduce critical events [14].

Future Directions

Emerging sedatives—such as ciprofol, a propofol analogue—may reduce injection pain and respiratory depression in NORA settings, though long-term data are limited [15].

Further needs include:

- Better NORA-specific risk stratification scoring systems
- Increased training for non-OR staff
- Standardized national guidelines for procedural sedation
- Integration of artificial intelligence for real-time respiratory monitoring
- Prospective trials comparing sedation regimens in specific NORA environments

CONCLUSION

Sedation in NORA has become an essential component of modern procedural medicine. While clinically useful, it presents unique challenges compared with OR anesthesia, particularly regarding environment, monitoring, staffing, and airway management. The literature consistently demonstrates that NORA sedation requires OR-equivalent safety standards, meticulous planning, and team communication.

With appropriate patient selection, vigilant physiologic monitoring, and clear procedures for rescue and escalation, sedation in NORA can be performed safely and effectively. Ongoing research, technological advancements, and standardization of protocols will continue to improve outcomes and expand the safety margins for these increasingly common procedures.

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