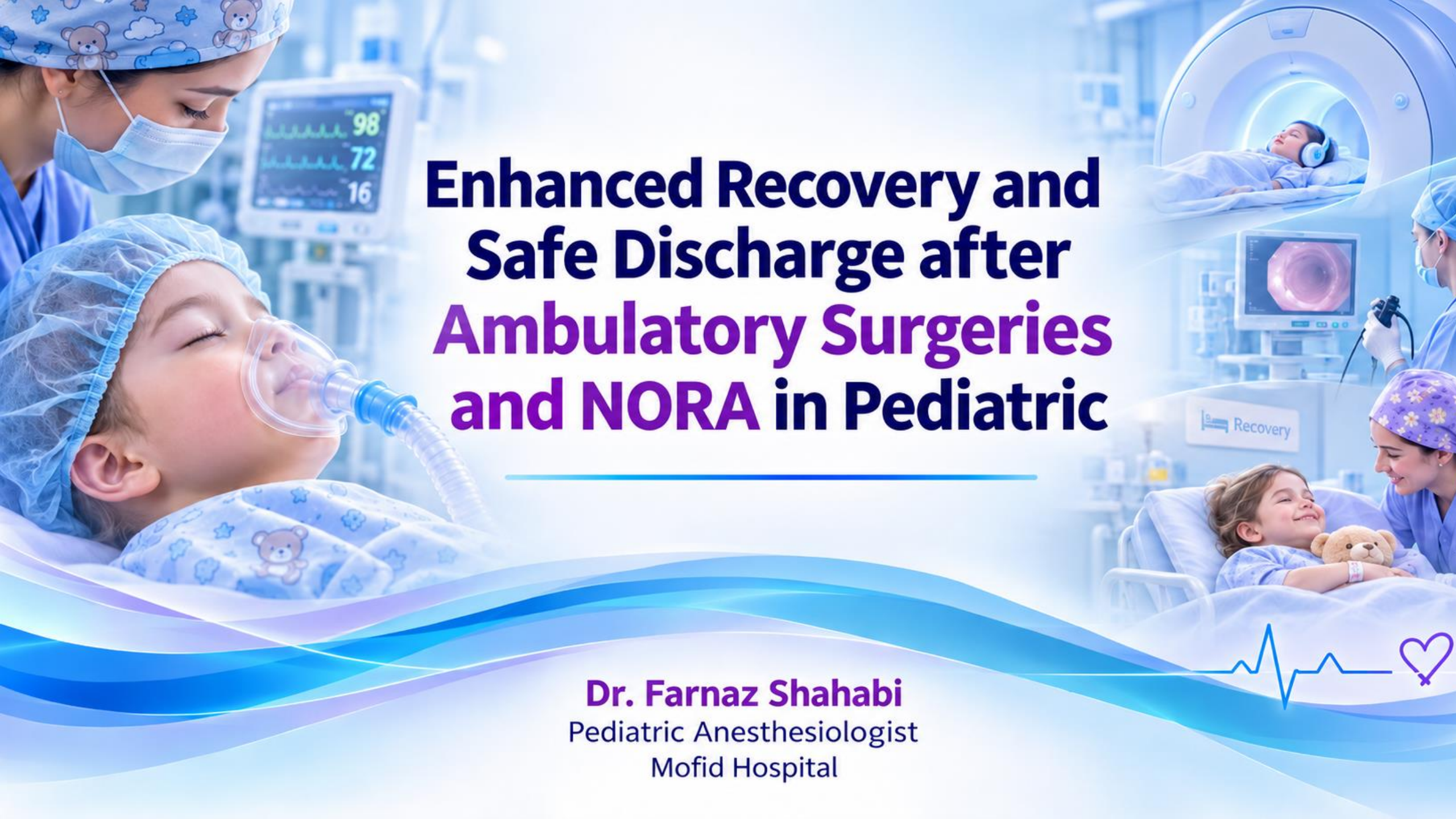

Enhanced Recovery and Safe Discharge after Ambulatory Surgeries and NORA in Pediatric

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Ambulatory Surgeries vs Non-Operating Room Anesthesia (NORA)

Key Differences in Pediatric Practice

Characteristic	Ambulatory Surgeries	Non-Operating Room Anesthesia (NORA)
Definition	Anesthesia for surgical procedures with planned **same-day discharge**.	Anesthesia or sedation performed **outside** a conventional operating room.
Main classification	Based on **patient disposition**.	Based on **procedural location**.
Typical procedures	Hernia repair, circumcision, minor ENT, ophthalmic, urologic, and orthopedic surgeries.	MRI, CT, gastrointesinal endoscopy, interventional radiology, cardiac catheterization, dental procedures, radiotherapy.
Patient population	**Selected** children (appropriate medical status and social support) for same-day discharge.	Includes healthy children **and** those with complex or critically ill conditions.
Anesthetic techniques	General anesthesia, regional anesthesia, or sedation (multimodal, opioid-sparing).	General anesthesia, deep sedation, or moderate sedation (tailored to procedure and risk).
Recovery	Usually in a dedicated **PACU** with ambulatory discharge pathways.	Recovery facilities **vary** by location (e.g., imaging suite, endoscopy unit, cath lab).
Discharge	Planned and expected on the same day (using standardized criteria).	May be **home discharge**, transfer to a ward, or **ICU admission**, depending on the procedure and patient.
Major challenge	Ensuring **rapid, safe, and comfortable** same-day discharge.	Providing **operating-room–equivalent safety** in a remote location (airway, monitoring, rescue, and recovery).









Key Take-Home

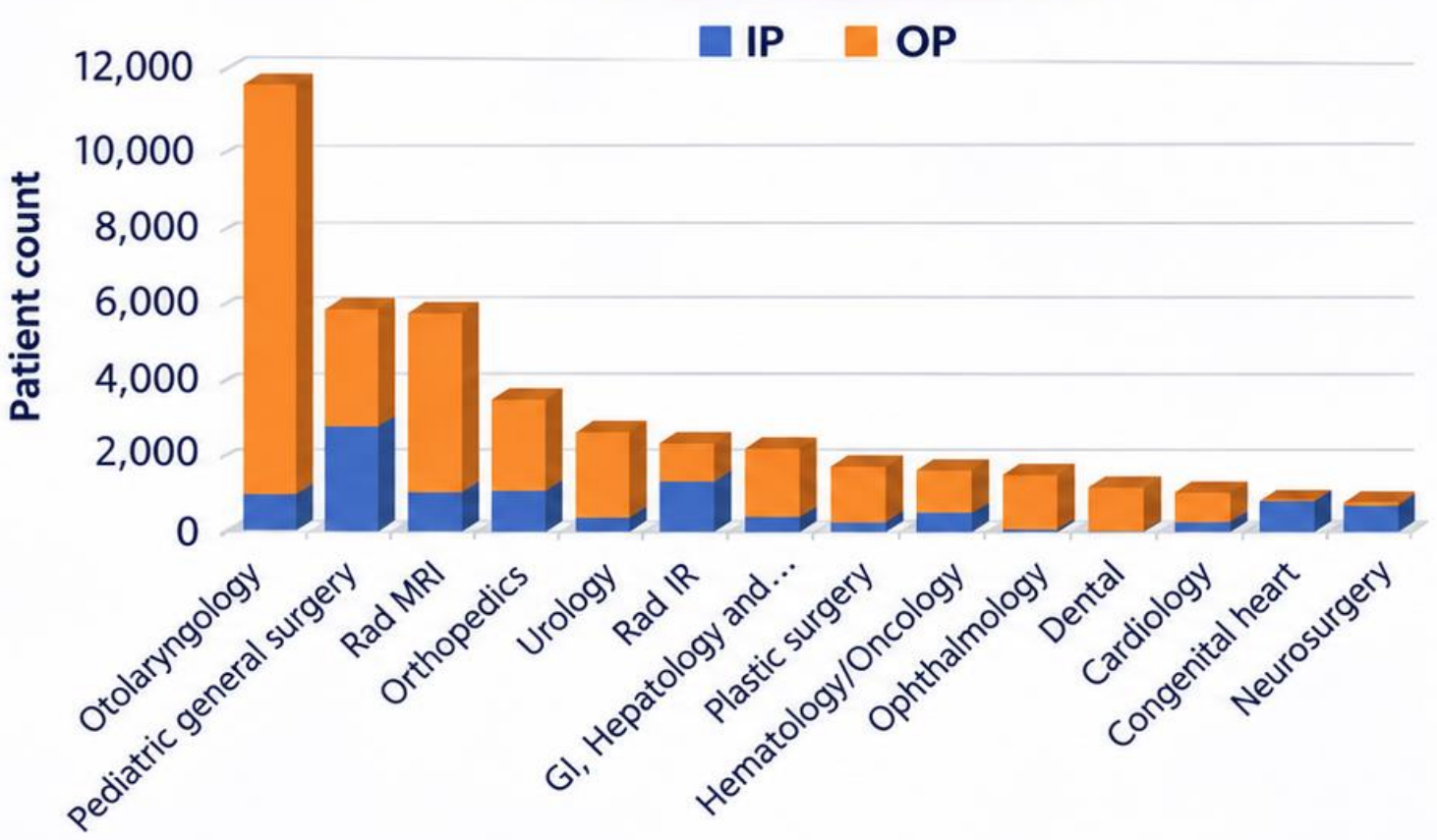
- Ambulatory anesthesia answers: **"When can the patient go home?"**
- NORA answers: **"Where is anesthesia being performed?"**



High-Volume Pediatric Ambulatory and NORA Services

Inpatient (IP) vs Outpatient (OP) Case Distribution

Service categories with total case count > 900







Interpretation

- Most high-volume pediatric anesthesia encounters are outpatient (OP).
- Otolaryngology shows the largest case volume, followed by pediatric general surgery and MRI-related services.
- These patterns highlight the importance of strong ambulatory pathways and safe discharge protocols for pediatric NORA and same-day surgery.

Essential Requirements for Pediatric Ambulatory Surgery



Facility & Operating Area

- Dedicated, safe, and age-appropriate surgical area
- Same anesthetic and recovery standards as the main hospital OR
- Pediatric-sized space, monitoring, and recovery (PACU)

Anesthesia Equipment

- Age-appropriate anesthesia workstation and monitors
- Full monitoring: ECG, NIBP, SpO_2, $EtCO_2$, ± temperature
- Ventilation and oxygen delivery for all pediatric ages

Airway & Resuscitation

- Pediatric difficult airway cart (video laryngoscope and/or fiberoptic)
- Resuscitation equipment and emergency drugs (PALS-compliant)
- Equipment for emergent front-of-neck access (e.g,, cricothyrotomy kit)

Support Services

- Basic laboratory capability
- Equipment processing, sterilization, and maintenance
- Electronic medical record and information system

Planning & Safety

- Clear protocols: patient selection, NPO, anesthesia, recovery, and discharge
- Defined escalation and transfer plan for unplanned admission or complication



Age-appropriate Anesthesia & Monitoring



Pediatric Difficult Airway Cart



Pediatric PACU / Recovery Area



Sterilization & Equipment Processing



Electronic Medical Record (EMR)

Pediatric ambulatory surgery requires hospital-level safety, age-appropriate equipment and expertise, and well-defined protocols for a safe and efficient same-day care.

Fast Awakening ≠ Fast Recovery ≠ Safe Discharge



A child who opens their eyes five minutes after anesthesia is **not necessarily ready to go home.**

Our goal is **not simply** to shorten PACU time; it is to achieve **rapid, high-quality recovery** without increasing complications, unplanned admissions, or readmissions.

The Goal in Pediatric Ambulatory Anesthesia

- Smooth emergence
- Effective pain control
- Minimal PONV
- Early function
- Safe same-day discharge

Key Points: Design, Setting, and Appropriate Procedures





- Ideally, facilities should be **dedicated solely** to pediatric patients and outpatient surgery.
- Appropriate procedures are generally **< 4 hours,** have a **low risk** of surgical or anesthetic complications, have **minimal blood loss** and physiological derangements, and have **easily managed pain**.
- ENT surgery comprises about **one-third** of outpatient surgical procedures.

Discharge Criteria in Pediatric Ambulatory & NORA

Postanesthesia Recovery Scoring Systems



Modified Aldrete Score (MAS)

Variable	Criteria	Score
Airway	Coughing on command or crying	2
	Maintaining good airway	1
	Airway requires maintenance	0
Vital signs	Stable and appropriate for age	2
	Stable but inappropriate for age	1
	Unstable	0
Motor activity	Moving limbs purposefully	2
	Non-purposeful movements	1
	Not moving	0
Consciousness	Awake	2
	Responding to stimuli	1
	Not responding	0
SpO_2 (room air)	> 95%	2
	90–94%	1
	< 90%	0

Total score ≥ 9 = suitable for discharge

Steward Postanesthetic Recovery Score (SPAR)

Patient sign	Criteria	Score
Consciousness	Awake	2
	Responding to stimuli	1
	Not responding	0
Airway	Coughing on command or crying	2
	Maintaining good airway	1
	Airway requiring maintenance	0
Movement	Moving limbs purposefully	2
	Moving limbs non-purposefully	1
	Not moving	0

Total score ≥ 6–7 = suitable for discharge

Objective, simple, and validated tools to assess recovery and readiness for safe discharge after pediatric ambulatory and NORA procedures.

Complications of Outpatient (Ambulatory) Anesthesia



Etiology (Multifactorial)

- Patient's comorbidities
- Anesthetic technique
- Surgical procedure

Major morbidity & mortality
Extremely rare

Reported death rate:
≈ 2 per 100,000 procedures

Common Minor Complications

- Drowsiness
- Uncontrolled PONV
- Unrelieved pain
- Bleeding complications
- Respiratory complications

These minor sequelae may lead to:

- Delayed discharge
- Unplanned hospital admission
- Readmission after discharge

Post-Discharge Symptoms After Pediatric Ambulatory Anesthesia



Unrelieved Pain

- Most common symptom after discharge
- Incidence: **25–91%**
- Tonsillectomy is a predictor for higher pain
- Pain lasting ≥7 days in **~33%**



PONV After Discharge

Incidence: **5.9–59%**

Other Symptoms

Drowsiness | Headache | Dizziness | Fever | Hoarseness / mild croup

Key Message: Individualized discharge education (pain control, PONV, and expected symptoms) reduces parental anxiety and increases satisfaction.



Should the success of pediatric ambulatory anesthesia be measured by PACU length of stay or by the child's recovery during the first 24 hours?

PACU Length of Stay

OR

Child's Recovery (First 24 Hours)

24 h





- **Enhanced recovery begins before induction**

- **Which anesthetic technique provides the best recovery?**

The September 2026 day-surgery consensus identifies **TIVA, alpha-2 agonists**, and **multimodal analgesia** as approaches that can help prevent emergence delirium.

TIVA (Propofol)

Alpha-2 Agonists

Multimodal Analgesia

• Dexmedetomidine: better emergence, but faster discharge?



Reduces emergence agitation and delirium

Sedative effects may delay awakening or discharge readiness

Ericksen et al., 2025

Systematic review & meta-analysis

12 studies
(1,133 children)

Emergence delirium:
RR 0.52 (95% CI 0.29–0.90)

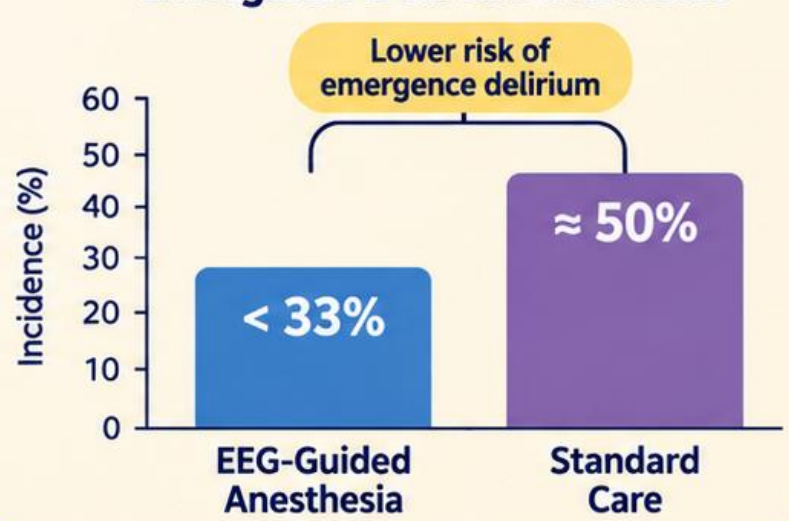
• EEG-Guided Pediatric Anesthesia: A New Tool for Enhanced Recovery?



Haidar et al., JAMA Pediatrics, 2026

Systematic review & meta-analysis

Nine randomized clinical trials
(1,052 children)





"The future of pediatric ambulatory anesthesia is **not faster awakening at any cost.** It is **individualized anesthesia, opioid-sparing analgesia, high-quality recovery**, and **safe discharge** with continued care at home."

- Individualized Anesthesia
- Opioid-Sparing Analgesia
- High-Quality Recovery
- Safe Discharge & Continued Home Care

Unplanned Admission

in Pediatric Ambulatory Surgery

Pediatric ambulatory surgery cases
n = 21,957

Hospital admission rate
0.97%



47% of the admissions were anesthesia related.



Factors Associated with Admission

Risk Factor	Association with Admission
Age < 2 years	Increased risk
ASA physical status 3	Increased risk
Surgery duration > 1 hour	Increased risk
Completion of surgery after 3 p.m.	Increased risk
Type of surgery: orthopedic, dental, or ENT	Increased risk
Obstructive sleep apnea (OSA)	Increased risk
Intraoperative events	Increased risk

Leading Anesthetic Causes for Admission



Inadequate pain control **24%**



Postoperative nausea and vomiting (PONV) **21%**

Which Pediatric Patient Should Not Be Discharged Rapidly?



Consider admission or prolonged observation in children with these risk factors.

Risk Factor	Concern
Young infants	Postanesthetic apnea and respiratory instability
Former preterm infants	Increased apnea risk related to postmenstrual age and other factors
Severe obstructive sleep apnea (OSA)	Postoperative obstruction and respiratory events
Significant congenital heart disease	Hemodynamic or oxygenation instability
Complex neurological disease	Airway protection, respiratory function, and baseline neurological status
Significant respiratory infection	Increased perioperative respiratory adverse events
Poorly controlled postoperative pain	Unsafe or ineffective recovery at home
Persistent vomiting	Dehydration and inability to tolerate oral medication
Inadequate caregiver support	Unsafe recovery outside the hospital

Enhanced Recovery in Pediatric NORA

NORA
(Non-Operating Room Anesthesia)



> *"Enhanced recovery in pediatric NORA is not "wake the child faster"; it is "avoid physiologic, pharmacologic, psychological and organizational causes of delayed discharge while preserving rescue capacity."*

An Integrated ERAS–NORA Pathway

- Optimized fasting
- Appropriate drug selection (opioid-sparing)
- Airway monitoring & safety
- PONV prevention
- Early feeding
- Discharge scoring (e.g., MAS/SPAR)
- Caregiver education
- Institutional quality systems

A comprehensive, evidence-based pathway that promotes safe, efficient, and timely discharge in pediatric NORA.



ERAS in pediatric NORA is not just "wake the child faster"; it aims to avoid physiologic, pharmacologic, psychological, and organizational causes of delayed discharge while preserving rescue capacity.

Key Contributors to Delayed Discharge

- Prolonged fasting
- Dehydration
- Anxiety
- Unnecessary opioids
- Excessive long-acting sedatives
- PONV
- Emergence agitation
- Inefficient recovery protocols

Updated Fasting Guidance (European Pediatric Guideline)

- **Clear fluids:** **1 hour** (in appropriate children)
- **Breast milk:** **3 hours**

Evolving Practice

- ✓ **UK practice:** moving toward **"sip until send"** pathways in selected low-risk children.

The Fastest Drug Is Not Always the Fastest Pathway



Propofol remains difficult to beat for rapid onset and rapid recovery, especially for short imaging and minimally painful procedures.

Dexmedetomidine: What Do We Know?

- Adding dexmedetomidine can reduce propofol requirement by **~60%** (Mason et al., 2025).
- A single bolus (with propofol) did not prolong recovery.
- Higher dose or infusion regimens can prolong recovery.

Evidence Update

A 2024 systematic review of pediatric RCTs:

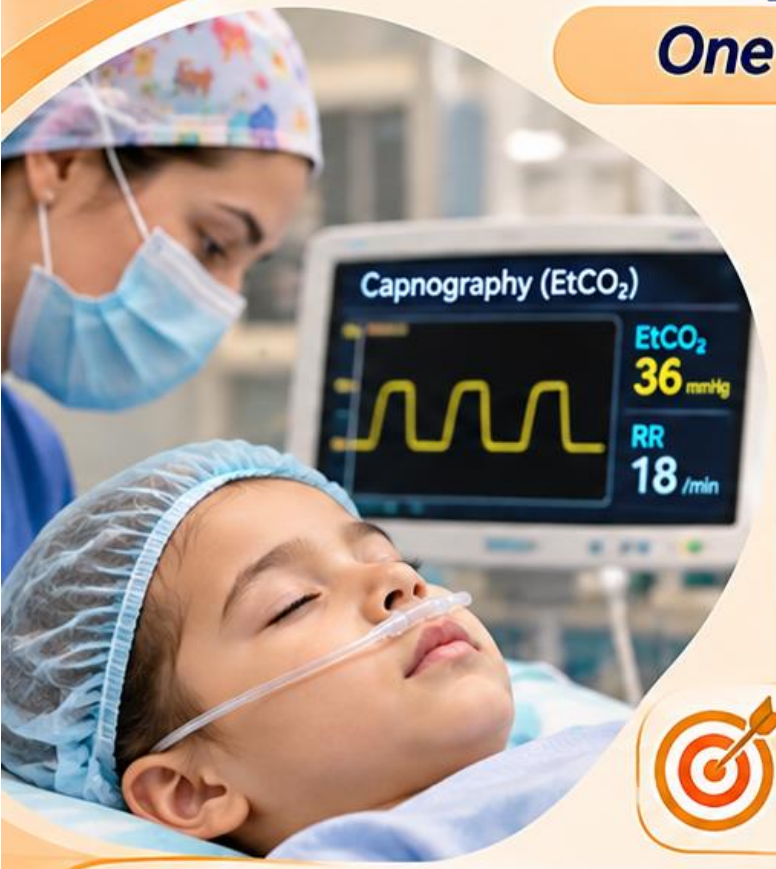
- Dexmedetomidine reduced emergence delirium.
- It tended to prolong recovery, particularly at higher doses.

Key Take-Home

- Dexmedetomidine is often "respiratory friendly," but it is not automatically an enhanced-recovery drug.
- The optimal drug choice should be individualized, balancing rapid recovery with respiratory safety, movement control, and total dose.

Respiratory Monitoring and Oxygen:

One of the Strongest Recent Changes in Pediatric NORA



Key Evidence (2025 RCT)

In children undergoning procedural sedation outside the OR:

Pulse oximetry alone		With capnography	Odds ratio
33% oxygen desaturation	vs	16% oxygen desaturation	0.38

AAP/AAPD Pediatric Sedation Guideline (Recent Update)

- ✓ Emphasizes continuous expired CO_2 (capnography) monitoring in appropriate sedation settings.
- ✓ Use alongside:
  - Pulse oximetry
  - Adequate staffing
  - Rescue competence
  - A properly equipped recovery area

Practical Message

Capnography is not just "more monitoring"; it allows earlier intervention, at higher SpO_2, before deterioration progresses.

Key Take-Home

- ✓ Enhanced recovery includes preventing respiratory events that may prolong observation or trigger escalation.
- ✓ Routine use of capnography improves safety in pediatric NORA.

Oxygen Strategies in Pediatric NORA

Low-Flow Oxygen



- Nasal cannula (1–4 L/min)
- Suitable for mild sedation
- Simple and widely used

High-Flow Oxygen (HFNC)



- Heated, humidified (≈ 2 L/kg/min, e.g., 10–30 L/min)
- Provides higher and more stable oxygenation
- Useful for deeper sedation or higher respiratory risk

PONV and Emergence Agitation:

Key Targets for a Smooth and Fast Recovery in Pediatric NORA



PONV
(Postoperative Nausea and Vomiting)

- Common after pediatric NORA.
- Can delay discharge, increase resource use, and reduce satisfaction.

Emergence Agitation (EA)

- A frequent and impactful event after anesthesia in children.
- Consumes nursing resources, interferes with monitoring/IV access, delays parent reunion and discharge.



Modifiable Risk Factors (for PONV and EA)

- 

Volatile anesthetics (e.g., sevoflurane)
- 

Nitrous oxide
- 
Opioid exposure

Evidence-Based Prevention Strategy



Propofol-based TIVA (in susceptible patients)



Dexamethasone (≥ 3 years): strong evidence to reduce PONV



5-HT3 antagonist (e.g., ondansetron): central prophylaxis for PONV

Key Take-Home

- **Prevent early, not treat later:** incorporate PONV prophylaxis and strategies to reduce EA at induction.
- This is especially important for NORA procedures (e.g., MRI, endoscopy) to ensure a smooth, rapid recovery and timely discharge.









“*Fast recovery* is a pharmacological outcome; *safe discharge* is a clinical decision.”