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General Pediatric Approach to Sedation in a Community Hospital

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Preface

Over the past three decades, the practice of pediatric procedural sedation has evolved dramatically. It is a field of continual refinements and is of utmost interest to physicians belonging to different subspecialties like anesthesiologists, intensivists, ER physicians, radiologists, and dentists. In the past decade, the number of invasive diagnostic and therapeutic procedures on pediatric patients in non-traditional settings (i.e., Emergency Department, Radiology, dental offices, etc.) has increased substantially. Several organizations have generated guidelines and definitions pertaining to pediatric sedation. Most commonly used and agreed upon are those provided by the American Academy of Pediatrics (AAP), the American Society of Anesthesiologists (ASA), and the Joint Commission. The first guidelines for pediatric sedation were published in 1985 from the Committee on Drugs, American Academy of Pediatrics.¹ Since then, several sets of guidelines have been released, the most recent being the CMS guidelines.²

Key Points

- The levels of sedation include minimal sedation, moderate sedation and deep sedation.
- These stages are not discrete but rather represent a continuum and a child can easily progress from one level of sedation to another.
- Respiratory complications account for the majority of the adverse events related to sedation.
- Inadequate monitoring and a lack of emergency backup system are important causes of sedation related adverse events.
- Adherence to a systematic and standardized approach is pivotal for the safe and efficient delivery of pediatric procedural sedation.

Definitions of Levels of Sedation

Minimal Sedation

(Formerly anxiolysis)

- A drug-induced state during which patients respond normally to verbal commands
- Although cognitive function and coordination may be impaired, ventilatory and cardiovascular functions are unaffected.

Moderate Sedation

(Formerly conscious sedation)

- A drug induced depression of consciousness during which patients respond purposefully to verbal commands or light tactile stimulation.
- No intervention is required to maintain a patent airway and spontaneous ventilation is adequate.
- Cardiovascular function is usually maintained.

Deep Sedation

- A drug induced depression of consciousness during which patients cannot be easily aroused but respond purposefully after repeated or painful stimulation.
- Spontaneous ventilation maybe inadequate and patients may require assistance in maintaining a patent airway.
- Cardiovascular function is usually maintained.
- Next stage is general anesthesia.

The Continuum of Sedation

- These stages are not discrete.
- A child can easily progress from one level of sedation to another so the practitioner should be ready to rescue from a deeper state of sedation than intended. For example, a practitioner administering deep sedation to a child must be prepared to rescue the child if they unintentionally slip into general anesthesia, where the patient may require positive pressure ventilation, intubation, and cardiovascular stabilization.

Goals of Sedation

- Safety of the child
- Anxiolysis
- Analgesia
- Immobility
- Return to pre-sedation state prior to discharge³

Procedures Requiring Sedation

- Painful Procedures
 - Bone marrow aspiration
 - Lumbar puncture

- PICC line placement
- Intravenous and arterial line placement
- Repair of minor wounds/ lacerations
- Fracture reductions
- Burn dressing changes
- Non-painful Procedures
 - Radiology procedures like CT scans, MRIs, bone scans
 - EEGs
 - Auditory evoked responses
 - Echocardiograms

Adverse Events

- Respiratory
 - Airway obstruction
 - Hypoventilation
 - Desaturation
 - Apnea
 - Laryngospasm
 - Bronchospasm
- Cardiovascular
 - Hypotension
 - Bradycardia
 - Cardiac arrest
- Emesis leading to aspiration
- Unanticipated hospital admission
- Prolonged sedation
- Failed sedation

Causes of Adverse Events

Multiple studies show that the following factors are most frequently associated with sedation mishaps:^{4,5}

- Age <6 years
- Use of >2 drugs (drug combinations and interactions)
- Dosage errors leading to overdose
- Inadequate monitoring
- Lack of emergency backup system

Guidelines

Patient Evaluation

- Patient must be re-evaluated immediately before the procedure.^{3,6-8}
- History
 - Age of the child
 - American Society of Anesthesiologists (ASA) Physical Status classification (Table 1)
 - Presence of comorbidities
 - Previous sedation record and complications
 - Allergies

- Medication list
- Patient weight
- Nothing-by-mouth (NPO) status (Table 2)
- Is the patient acutely ill, i.e., upper respiratory infection, asthma exacerbation?
- Syndromes associated with difficult airway
 - Pierre Robin
 - Treacher-Collins
 - Goldenhar
 - Mucopolysaccharidosis
 - Down
 - Klippel-Feil
 - Choanal atresia (CHARGE syndrome)
- For teenagers illicit history of alcohol intake, substance abuse
- Nature/urgency of procedure (Table 3)

Table 1. Physical Status Classification

American Society of Anesthesiologists

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Table 1. American Society of Anesthesiologist Physical Status Classification⁸

CLASS	STATE	CASES
I	Healthy, normal child	
II	Child with mild systemic disease	Controlled asthma, controlled diabetes
III*	Child with severe systemic disease	Active wheezing, diabetes mellitus w/ complications, heart disease that limits activity
IV*	Child with severe systemic disease that is a constant threat to life	Status asthmatics, severe bronchopulmonary dysplasia (BPD), sepsis
V*	Child who is moribund and not expected to survive without the procedure	Cerebral trauma, pulmonary embolus, septic shock

* For Class III and above, consult anesthesia or critical care

American Society of Anesthesiologist Physical Status Classification is reprinted with permission of the American Society of Anesthesiologists, 520 N. Northwest Highway, Park Ridge, Illinois 60068-2573.

Table 2. Nothing-by-Mouth (NPO) Status

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Table 2. Nothing-by-Mouth (NPO) Status¹

INGESTED	TIME
Clear liquids (water, fruit juices w/o pulp, carbonated beverages, clear tea, black coffee)	2 hours
Breast milk	4 hours
Infant formula	6 hours
Solids	8 hours

Table 3. Red Flags for Sedation

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Table 3. Red Flags for Sedation

Respiratory	<ul style="list-style-type: none">• History of difficult airway• Airway obstruction: obstructive sleep apnea (OSA), <u>adenotonsillar hypertrophy (ATH)</u>• Acute/recent respiratory infection• Severe asthma
Cardiovascular	<ul style="list-style-type: none">• Congenital heart disease• Hemodynamic instability• Trauma patients• Hypovolemia
Neurologic	<ul style="list-style-type: none">• Central apnea• Uncontrolled seizures• Increased intracranial pressure (ICP)• Head trauma
Gastrointestinal	<ul style="list-style-type: none">• Severe gastroesophageal reflux disease (GERD)• Nausea/vomiting• Full stomach
Patient Factors	<ul style="list-style-type: none">• ASA physical status classification ≥ 3• Preterm neonates• Morbidly obese patients

Informed Consent

- Patients /parents should be informed about the plan for sedation including risks, benefits, limitations, and alternatives.
- Moderate and deep sedation require informed consent; informed consent is not required for minimal sedation.

Physical Examination

- Focused Airway Examination
 - Mallampati
 - Mouth opening
 - Neck mobility
 - Thyromental distance
 - Loose/missing teeth
 - Size and configuration of mandible
 - Global appearance (congenital anomalies)
 - Body habitus
 - Presence of microtia
- Auscultation of Heart and Lungs
- Baseline Vital Signs

Personnel Required

- A licensed *practitioner* skilled in airway management and cardiopulmonary resuscitation.
 - Deep sedation requires Pediatric Advanced Life Support (PALS) training.
 - The person administering sedation should have in depth understanding of the pharmacodynamics and pharmacokinetics of sedative and analgesic medications.
- Availability of an individual to monitor the patient
 - During deep sedation this should be their sole responsibility.
 - Usually an RN, who should have training in Basic Life Support (BLS) and PALS
- Usually a physician and nurse team, a minimum of two trained personnel, with the child at all times.

Equipment Required

- Airway
 - Positive pressure oxygen delivery system
 - Masks
 - ETTs and laryngoscope blades (appropriately sized)
 - Supplemental oxygen supply
- Suction
- Appropriate sized IV catheters
 - Children undergoing deep sedation should have an intravenous catheter in place.
- Monitor
- Infusion pumps
- Drugs for emergency resuscitation and reversal agents
- Crash cart, defibrillator

Time Out

- A time out should be performed before sedation identifying the correct patient, procedure, site, any known allergies and any anticipated issues.
- All members of the team should participate.

Monitoring

- Vigilant provider: Continuous monitoring of level of consciousness and the patient's cardiorespiratory status
- Monitor of oxygenation: Pulse oximeter; all patients undergoing sedation/analgesia should be monitored by pulse oximetry.
- Monitor of ventilation:
 - Direct observation and auscultation
 - End-tidal carbon dioxide (ETCO₂)
 - Recommended for all patients undergoing deep sedation
 - Also recommended for patients undergoing moderate sedation who cannot be observed directly (magnetic resonance imaging [MRI] scanner)
- Blood Pressure Monitoring
- Electrocardiographic Monitoring (ECG)
 - Should be used in all patients undergoing deep sedation
 - Should be used for patients undergoing moderate sedation if they have underlying cardiovascular disease or the procedure is such that arrhythmias are anticipated

- Recording of Monitored Parameters
 - Before the beginning of the procedure
 - After administration of sedative/analgesic agents
 - At regular intervals during the procedure
 - During initial recovery
 - Prior to discharge

Documentation

- Before the Procedure
 - Pre-sedation evaluation
 - Informed consent
 - Time out
- During the Procedure
 - Vital signs
 - Drugs
 - Name
 - Dose
 - Route of administration
 - Times
 - Fraction of inspired oxygen (FIO₂)
 - Adequacy of ventilation
 - Level of consciousness
- After the Procedure
 - Vital signs
 - Level of consciousness
 - Return to pre-sedation state

Sedatives/Analgesics

- Choice of pharmacologic agent is based on type of procedure (painful vs. non painful, need for immobility, etc.) and the individual patient.
- There are five main drug classes
 - Benzodiazepines
 - Anesthetics
 - Analgesics (opioids)
 - Local anesthetics
 - Miscellaneous (chloral hydrate, dexmedetomidine)
- A few of the most commonly used drugs for pediatric procedural sedation are shown in Tables 4-7.

Table 4. Midazolam

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Table 4. Midazolam

USES	ROUTES & DOSES*	ONSET OF ACTION & DURATION
<ul style="list-style-type: none">• Anxiolytic• Sedative• Amnestic• Anticonvulsant• <i>No analgesia</i>	<ul style="list-style-type: none">• PO - 0.5 mg/Kg• IV - 0.1 mg/Kg• SC - 0.15 mg/Kg• Nasal - 0.2 mg/Kg• PR	<ul style="list-style-type: none">• 15 minutes• 1-3 minutes - Lasts 45 – 60 minutes• 10-15 minutes• Unreliable
ADVERSE EFFECTS & CONTRAINDICATIONS		
<ul style="list-style-type: none">• Respiratory depression• Airway obstruction• Paradoxical reaction (~ 15% children) combativeness, disorientation, agitation• Caution: Avoid in patients who are predisposed to airway obstruction, eg, patients with <u>adenotonsillar hypertrophy (ATH)</u>, obstructive sleep apnea (OSA)<ul style="list-style-type: none">• Contraindicated in patients with ↑ intracranial pressure (ICP)		
COMMENTS		
<ul style="list-style-type: none">• Intranasal route very irritating• Prolonged duration with cytochrome P 450 inhibitors• Antagonist: flumazenil• In obese patients, dose based on ideal body weight		
<small>*PO – by mouth; IV – intravenous; SC – subcutaneous; PR – per rectum</small>		

Table 5. Ketamine

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Table 5. Ketamine

USES	ROUTES & DOSES*	ONSET OF ACTION & DURATION
<ul style="list-style-type: none"> • Amnesia • Analgesia • Maintains hemodynamic stability • Maintains spontaneous ventilation 	<ul style="list-style-type: none"> • IV (0.5-1 mg/Kg) • IM (1-2 mg/Kg) • PO (4-6 mg/Kg) 	<ul style="list-style-type: none"> • 1 min, peak effect in several minutes-lasts 15 minutes • 2-5 minutes, lasts 30-120 minutes • 20 minutes, lasts up to 120 minutes
ADVERSE EFFECTS & CONTRAINDICATIONS		
<ul style="list-style-type: none"> • Produces copious secretions, can cause laryngospasm • Increases cerebral blood flow • Increases intraocular pressure • Contraindicated in patients with: <ul style="list-style-type: none"> – Increased intracranial pressure – Open globe injury – Hypertension 		
COMMENTS		
<ul style="list-style-type: none"> • Pre-treat with anticholinergics • Ideal for burn dressing change and trauma patients 		

Table 6. Propofol

To view a larger image on your device, please click or touch the image.

Table 6. Propofol

USES	ROUTES & DOSES	ONSET OF ACTION & DURATION
<ul style="list-style-type: none"> • Sedative • Amnestic • Hypnotic • Antiemetic • <i>No analgesia</i> 	<ul style="list-style-type: none"> • IV (50-250 µg/Kg/min) 	<ul style="list-style-type: none"> • Onset 30 seconds
ADVERSE EFFECTS & CONTRAINDICATIONS		
<ul style="list-style-type: none"> • Respiratory depression • Apnea • Hypotension • Anaphylactic reaction • Bacterial contamination • Avoid in patients with <ul style="list-style-type: none"> – Hemodynamic instability – Hypovolemia – Trauma 		
COMMENTS		
<ul style="list-style-type: none"> • Advanced airway management skills required with appropriate credentialing 		

Table 7. Fentanyl

To view a larger image on your device, please click or touch the image.

Table 7. Fentanyl

USES	ROUTES & DOSES	ONSET OF ACTION & DURATION
<ul style="list-style-type: none">• Analgesic• <i>No amnesia</i>	<ul style="list-style-type: none">• IV (0.5 – 1 µg/kg)• Oral• Transmucosal	<ul style="list-style-type: none">• 30 seconds, peak effect 2-3 minutes, lasts ~ 30 minutes
ADVERSE EFFECTS & CONTRAINDICATIONS		
<ul style="list-style-type: none">• Pruritus• Nausea/vomiting• Bradycardia• Respiratory depression• Chest wall rigidity (idiosyncratic reaction associated with large doses & ↑ speed of injection)		
COMMENTS		
<ul style="list-style-type: none">• No active metabolites• Good in combination with Midazolam for painful procedures• Antagonist : Naloxone• Chest wall rigidity can be reversed with naloxone or muscle relaxants		

Recovery and Discharge

- A properly staffed and equipped recovery area is essential.
- Monitor until the child meets discharge criteria
 - Stable vital signs and returns to age-appropriate baseline
 - Stable cardiovascular and respiratory status
 - Easily arousable with intact protective reflexes
 - Adequate hydration
- The child should be discharged home with a responsible adult who should be provided with appropriate instructions and emergency contact information

Continuous Quality Improvement Indicators

- Desaturation, SpO₂ <90%
- Airway obstruction
- Laryngospasm
- Aspiration
- Unplanned hospital admission
- Failed sedation
- Medication errors³

Guidelines Implementation

- Hospital sedation policies should be compliant with Joint Commission standards.
- In order to provide safe and efficient patient care, a highly standardized institution-wide protocol should be developed.

- Joint Commission recommends that the Department of Anesthesia oversee all sedation protocols.
- A sedation committee comprising of physicians, nursing staff, representatives from the administrative staff, code committee, and risk management should be responsible for
 - Creation of policies
 - Training and education of personnel
 - Credentialing
 - Determination of equipment needs
 - Review of adverse events
 - Identification of problems
 - Continuous quality improvement measures

Conclusion

- Safe and efficient delivery of procedural sedation relies upon
 - Adherence to current sedation guidelines
 - Training and education of personnel
 - Checklists
 - Availability of consultant
 - Backup emergency system
 - Data collection and review
 - Continuous quality improvement measures
 - Uniformity of care

This guideline was developed to improve health care access in Arkansas and to aid health care providers in making decisions about appropriate patient care. The needs of the individual patient, resources available, and limitations unique to the institution or type of practice may warrant variations.

References

References

1. Pruitt AW, Anyan Jr. WR, Kauffman RE, Mofenson HC, et al. [Guidelines for the elective use of conscious sedation, deep sedation, and general anesthesia in pediatric patients](#). Pediatrics 1985;76(2):317-21.
2. CMS Memo; Revised Hospital Anesthesia Services Interpretive Guidelines - State Operations Manual Appendix Retrieved from <http://www.cms.gov/surveycertificationgeninfo/pmsr/itemdetail.asp?itemid=CMS1243344> Accessed August 27, 2011.
3. Coté CJ, Lerman J, Todres DI. A Practice of Anesthesia for Infants and Children, 4th ed. New York: Elsevier Saunders; 2008.
4. Coté CJ, Notterman DA, Karl HW, Weinberg MD, et al. Adverse sedation events in pediatrics: a critical incident analysis of contributing factors. Pediatrics 2000;105(4):805-14.
5. Leroy PLJM, Schipper DM, Knape, HJ. Professional skills and competence for safe and effective procedural sedation in children: recommendations based on a systematic review of the literature. Int J Pediatr 2010;2010:934298.
6. Coté CJ, Wilson S, Work Group on Sedation. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: an update. Pediatrics 2006;118(6):2587-2602.

7. Poe SS, Nolan MT, Dang D, Schauble J. et al. Ensuring Safety of Patients Receiving Sedation for Procedures: Evaluation of Clinical Practice Guidelines. *Jt Comm J Qual Patient Saf* 2001;27(1):28-41.
8. American Society of Anesthesiologist, Task Force on Sedation and Analgesia by Non-Anesthesiologist. Practice guidelines for sedation and analgesia by non-anesthesiologist. *Anesthesiology* 2002;96:1004-1

Additional Selected References

1. Goodson JM, Moore PA. Life-threatening reactions after pedodontic sedation: an assessment of narcotic, local anesthetic, and antiemetic drug interaction *J Am Dent Assoc* 1983;107(2):239-45.
2. Krauss B, Green SM. Sedation and analgesia for procedures in children. *N Engl J Med* 2000;342:938-945.
3. Coté CJ. Discharge criteria for children sedated by nonanesthesiologists: is "safe" really safe enough? *Anesthesiology* 2004;100:207-9.
4. Pitetti R, Davis PJ, Redlinger R, White J, et al. Effect on hospital-wide sedation practices after implementation of the 2011 JCAHO procedural sedation and analgesia guidelines. *Arch Pediatr Adolesc Med* 2006;160:211-6.
5. Lowrie A, Weiss AH, Lacombe C. The pediatric sedation unit: a mechanism for pediatric sedation. *Pediatrics* 1998;102(3):e30.
6. Motoyama EK, Davis PJ. *Smith's Anesthesia for Infants and Children*, 7th ed. Philadelphia, PA: Mosby, 2005.