PICU SEDATION AND ANALGESIA

SEDATION

Drug	Dose	Timing	Mechanism/ Clearance	Pros	Cons	Special considerations
Dexmedetomidine (Precedex)	Infusion: -Start at 0.3 mcg/kg/hr -Increase by 0.2 mcg/kg/hr (max dose 1.5 mcg/kg/hr) PRN dose: 0.5-1 mcg/kg/dose over 15 mins	For bolus dose: Onset: 5-10 mins Duration: 1-2 hrs	Alpha-2 agonist Hepatic	-critically ill pt can be comfortable but interactive/easily awakened -no respiratory suppression -less likely to cause delirium	-bradycardia -hypotension -don't use in patients with heart block, preexisting bradycardia spells, on certain antiarrhythmic meds	Great option for patients on NIPPV (CPAP, BIPAP) In addition to opioid infusion for intubated patients
Midazolam (Versed)	Infusion: -Start at 0.05-0.1 mg/kg/hr (max start dose 1-2 mg/hr) -Increase by 0.02 mcg/kg/hr (max dose 0.3 mg/kg/hr or 6 mg/hr) PRN dose: 0.05-0.1 mg/kg (max starting dose 2 mg IV)	For bolus dose: Onset: 2-5 mins Duration: 2-6 hrs	GABA agonist Hepatic/Renal	-potent amnestic and anxiolytic with immediate onset of action	-respiratory depression -hypotension -active metabolites can accumulate → prolonged sedation -Risk of delirium	For patients who are not candidates for dexmedetomidine due to above cardiac issues or certain patients with high risk seizures (underlying sz disorder, ingestion)
Lorazepam (Ativan)	Infusion- NA PRN dose: -0.05-0.1 mg/kg (max starting dose 2 mg)	Onset: 10-15 mins Duration: 10-20 hrs	GABA agonist Hepatic	-Sedative + amnestic + potent anxiolytic -Anticonvulsant properties	-Respiratory depression -Hypotension -Risk of delirium	PRN sedation in addition to dexmedetomidine and/or opioids. Longer duration of action c/w midazolam
Ketamine	Infusion: -start at 5 mcg/kg/min -increase by 5 mCg/kg/min (max 20 mCg/kg/min) Initial bolus dosing: -0.2-1 mg/kg IV	Onset: <30 sec Duration: 5-10 mins	NMDA receptor antagonist Hepatic	-Dissociative sedative AND (some) analgesic Effect -Maintains CO and MAP -No respiratory inhibition	-Sympathetic stimulation (tachycardia, HTN) -Vomiting (can premedicate with Zofran) -Sialorrhea -Laryngospasm/apnea occur rarely.	-Status asthmaticus - sedation + bronchodilation Patients who have developed tolerance to other sedatives Adjuvant sedative for patients on NIPPV (at low doses)

				Bronchodilator	Risk of Delirium.	
Propofol	Infusion: -start at 20 mcg/kg/min Max 100mcg/kg/min Bolus dose: -0.5-1 mg/kg IVP	Onset: 30 secs Duration: 3-10 mins	GABA agonist, NMDA antagonist Hepatic	-Good neurologic recovery -Reduced ICP -Quick on/off	-NO analgesia -Lipophilic-may produce longer effects in larger bodies -Not for long term use-risk propofol infusion syndrome -Can cause severe hemodynamic instability and respiratory depression	-TBI/Neuro patients who need frequent sedation interruptions for neuro exams- great option for adolescent patients at lower risk of infusion syndrome.
Clonidine*	Scheduled dose: 2 mcg/kg PO q6-8hr to start Or patch see weaning guideline*	PO Onset: 30-60 mins Duration: 6-12 hrs	Alpha-2 adrenoceptor agonists Hepatic	-prevent/TX withdrawal for dexmedetomidine infusion	-Bradycardia -Orthostatic hypotension -Rebound hypertension with abrupt drug withdrawal	TX dexmedetomidine withdrawal. Enteral tx is preferred over patch for small infants.

ANALGESIA

Drug	**Dose**	**Timing**	**Mechanism/ Clearance**	**Pros**	**Cons**	**Special considerations**
Fentanyl	Infusion: -start at 1 mcg/kg/hr (max starting dose 50 mCg/hr) -increase by 0.5-1 mCg/kg/hr (max dose 5 mCg/kg/hr or 250 mcg/hr) PRN dose: - 1 mcg/kg (max starting dose 50 mcg) Titrate to match hourly	Onset: <3-5 mins Duration: 30-60 mins	Opioid receptor Hepatic	-potent analgesic and sedative -less hypotension than other opioids due to lack of histamine release -more potent than morphine or dilaudid	-highly lipophilic - can accumulate with prolonged administration -rigid chest Tachyphylaxis Drug adsorption to circuits (ECMO/CKRT)	Most commonly used opioid for analgesia/ algo sedation in intubated PICU patients

	infusion rate					
Hydromorphone (Dilaudid)	Infusion: -start at 0.003 mg/kg/hr (max starting dose 0.5mg/hr) (max 2mg/hr) PRN dose: -0.005-0.01 mg/kg/dose or 0.5 mg IV q2 hr (max starting dose 1 mg)	Onset: 20-30 mins Duration: 3-5 hrs	Opioid receptor Hepatic/Renal	-alternative to fentanyl or morphine more potent than morphine More sedating than fentanyl	-potential neurotoxic metabolites can accumulate in hepatic or renal dysfunction	PRN for patients with SE from morphine. Infusion: for patients who have tolerance to other opioids. Useful in ECMO (decreased circuit binding)a
Morphine	Infusion: -start 0.02 mg/kg/hr (max start dose 1 mg/hr (max 4mg/hr) PRN dose: -0.05 mg/kg or 2mg IV/IM q2-4hr (max dose 4 mg)	Onset: 5 mins Duration: 2-4 hrs	Opioid receptor Hepatic/Renal	-longer acting than fentanyl and more sedating	-histamine release and vagally mediated - venodilation, hypotension and bradycardia -peak effect longer than fentanyl (5 mins vs 2 mins)	Useful in ECMO (decreased circuit binding)
Methadone*	Scheduled dose: -0.05 mg/kg/dose (max 10mg/dose)	Onset: 30-60 mins Duration: 6-8 hrs	Opioid receptor Hepatic	-beneficial to control narcotic withdrawal -duration of action increases to 24-48 hrs with repeated doses	-can increased QTc -histamine release -very sedating	For treatment opioid withdrawal For long term TX chronic pain

Max doses above are recommended maximum doses. Some patients may require higher doses- please discuss this with PICU Attending.

Resources: Pharmacy website on Intranet - see Neuro/pain/sedation tab
Power plan: use Sedation, Pain, and Paralysis ICU Pedi

WEANING/WITHDRAWAL
Precedex → Clonidine
Versed → Ativan
Fentanyl/Hydromorphone/morphine → Methadone

*See **Pediatric Opioid, Benzodiazepine, and Alpha Agonist Weaning Guideline** on the intranet for detailed conversions (under Pharmacy - DCMC, subcategory Neuro/Pain/Sedation or EBOC site)

Targeted Sedation

When assessing if your sedation infusions need adjustment, you should determine objectively how sedated your patient needs to use the RASS - set your RASS goal. Then look at what the RASS scores have been documented under sedation monitoring by RN. If the patient is more sedated than your target, you should reduce your drips. If the patient is less sedated than your target, you should increase your drips. Additionally, you should reassess your target sedation level every day - sometimes multiple times per day - as the needs of critically ill patients change frequently. In general, working your way to the patient safely tolerating RASS 0 is the best case, as deeper levels of sedation are associated with longer ICU stay and ICU delirium.

SEDATION SCORE RASS

TABLE 1. RICHMOND AGITATION–SEDATION SCALE

Score	Term	Description
+4	Combative	Overtly combative or violent; immediate danger to staff
+3	Very agitation	Pulls on or removes tube(s) or catheter(s) or has aggressive behavior toward staff
+2	Agitated	Frequent nonpurposeful movement or patient–ventilator dyssynchrony
+1	Restless	Anxious or apprehensive but movements not aggressive or vigorous
0	Alert and calm	
−1	Drowsy	Not fully alert, but has sustained (more than 10 seconds) awakening, with eye contact, to voice
−2	Light sedation	Briefly (less than 10 seconds) awakens with eye contact to voice
−3	Moderate sedation	Any movement (but no eye contact) to voice
−4	Deep sedation	No response to voice, but any movement to physical stimulation
−5	Unarousable	No response to voice or physical stimulation

Procedure

1. Observe patient. Is patient alert and calm (score 0)?
   Does patient have behavior that is consistent with restlessness or agitation (score +1 to +4 using the criteria listed above, under DESCRIPTION)?
2. If patient is not alert, in a loud speaking voice state patient's name and direct patient to open eyes and look at speaker. Repeat once if necessary. Can prompt patient to continue looking at speaker.
   Patient has eye opening and eye contact, which is sustained for more than 10 seconds (score −1).
   Patient has eye opening and eye contact, but this is not sustained for 10 seconds (score −2).
   Patient has any movement in response to voice, excluding eye contact (score −3).
3. If patient does not respond to voice, physically stimulate patient by shaking shoulder and then rubbing sternum if there is no response to shaking shoulder.
   Patient has any movement to physical stimulation (score −4).
   Patient has no response to voice or physical stimulation (score −5).

References:

1. Sessler CN, Gosnell MS, Jo Grap M, et al. The richmond agitation–sedation scale. Am J Respir Crit Care Med. 2002;166(10):1338–1344
2. Ragsdale C. Pediatric dosing for commonly used medications in the PICU. DCMC Pharmacy 2013

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