PICU Pathway for Sedation/Analgesia in the Mechanically Ventilated Patient

Goals and Metrics

PICU Sedation/Analgesia in the Mechanically Ventilated Patient

Intubated Patient in PICU

Start SBS and Age Appropriate Pain Scale Assessment

Expected Length of Intubation < 48 hours

Short Term- All Ages

Expected Length of Intubation ≥ 48 hours

Patients < 50 kg

Patients ≥ 50 kg

Weight Based Dosing Guidelines for Patients > 50 kg

Ready for Extubation
Weaning

Pain Scales

FLACC	**Term NB – 7 yrs**
FACES	**≥ 3 yrs, able to self-report**
Numeric Rating Scale	**>5 years**

SBS

Pediatric patients on mechanical ventilation
Response to stimuli, 6 point scale

Non- Pharmacologic Soothing Interventions
Opioid Rotation, Alternative Agents
Delirium

Assessing Risk of Withdrawal Associated Adverse Outcomes
Titrating IV Sedation to Extubation Ready Level of Sedation
Patient Readiness for Extubation defined by Critical Care Team
IV Conversion Thresholds to Initiate Duration-Specific Wean Plan
Wean IV Sedation
Wean PO Sedation
Converting IV to Enteral Sedation-Calculating the Dose
Opioid
Benzodiazepine
Steps in Transitioning from Continuous IV Sedation to Intermittent enteral regimen
Guidance for Weaning
Duration 5-9 days or High Risk < 5 days -PO
Duration 10-21 days or High Risk 5-9 days -PO
Duration > 21 days or High Risk 10-21 days –POO
Withdrawal Symptoms
Managing
Pain
Withdrawal
Over-Sedation

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Authors:

Goals and Metrics

Goals

To develop a standard PICU algorithm to manage sedation in mechanically ventilated patients resulting in:

- Decreased population exposure to opioids and benzodiazepines,
- Decreased length of intubation
- Improved interdisciplinary communication at all stages of sedation.

Metrics

Population: Sedated, Mechanically ventilated patients

Decrease:
- PICU LOS
- # Days intubated
- # Sedation medications/day
- % of intubated time at goal SBS

Balancing Measure:
- # unplanned extubations

Measurement Data

Link to the QV application

Intubated Patient in PICU

Inclusion Criteria

This pathway can guide the use of sedation / analgesia for all intubated patients in the PICU.

Exclusion Criteria

ECMO Patients
Patients receiving continuous Paralytics
Status Epilepticus
Increased ICP/Traumatic Brain Injury with a target goal of burst suppression

State Behavioral Scale (SBS)

Score as patient's response to voice, then touch, then noxious stimuli

Planned ETT suctioning or < 5 seconds of nail bed pressure

Score	Description	Definition
-3	**Unresponsive**	No spontaneous respiratory effort No cough or coughs only with suctioning No response to noxious stimuli Unable to pay attention to care provider Does not distress with any procedure (including noxious) Does not move
-2	**Responsive to Noxious Stimuli**	Spontaneous yet supported breathing Coughs with suctioning/repositioning Responds to noxious stimuli Unable to pay attention to care provider Will distress with a noxious procedure Does not move/occasional movement of extremities or shifting of position
-1	**Responsive to Gentle Touch or Voice**	Spontaneous but ineffective non-supported breaths Coughs with suctioning/repositioning Responds to touch/voice Able to pay attention but drifts off after stimulation Distresses with procedures Able to calm with comforting touch or voice when stimulus removed Occasional movement of extremities or shifting of position
0	**Awake and Able to Calm**	Spontaneous and effective breathing Coughs when repositioned/occasional spontaneous cough Responds to voice/no external stimulus is required to elicit response Spontaneously pays attention to care provider Distresses with procedures Able to calm with comforting touch or voice when stimulus removed Occasional movement of extremities or shifting of position/increased movement (restless, squirming)
+1	**Restless and Difficult to Calm**	Spontaneous effective breathing/having difficulty breathing with ventilator Occasional spontaneous cough Responds to voice/no external stimulus is required to elicit response Drifts off/spontaneously pays attention to care provider Intermittently unsafe Does not consistently calm despite 5 minute attempt/unable to console Increased movement (restless, squirming)
+2	**Agitated**	May have difficulty breathing with ventilator Coughing spontaneously No external stimulus required to elicit response Spontaneously pays attention to care provider Unsafe (biting ETT, pulling at lines, cannot be left alone) Unable to console Increased movement (restless, squirming or thrashing side-to-side, kicking legs)

Pain Scales

FLACC	Term NB – 7 yrs
FACES	≥3 yrs, able to self-report
Numeric Rating Scale	>5 years

Expected Length of Intubation < 48 Hours

INITIATION

Patient with Expected Length of Intubation **<48 hours**

↓

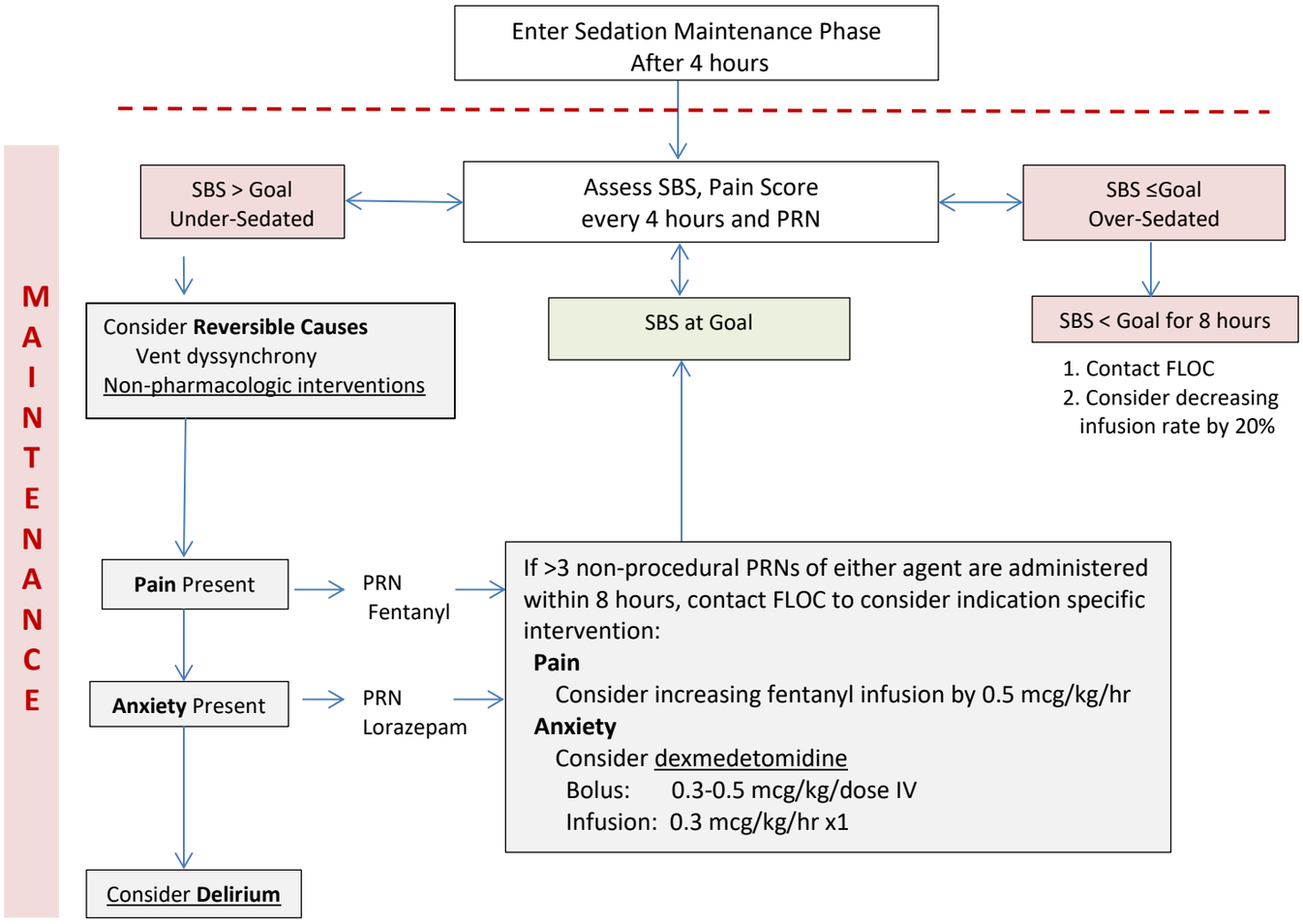
Set SBS Goal
Initiate Fentanyl Infusion

↓

PRN SBS Management (Hour 0-4)
0-4 Hour: PRN fentanyl available q 30m
Additional Lorazepam x1 per FLOC

↓

PICU Pathway for Sedation/Analgesia in the Mechanically Ventilated Patient



PICU Pathway for Sedation/Analgesia in the Mechanically Ventilated Patient

Target	< 48 hours expected intubation
Medication Infusion- Initial Dose	Fentanyl 0.5 mcg/kg/hr MAX 50mcg/hr
Incremental Infusion Change	Fentanyl 0.5 mcg/kg/hr MAX 25mcg/hr
Assess / Titration	Use **SBS** score and **pain score** Assess both every 4 hrs, at minimum Assess 30 minutes after PRN doses
PRN Doses	PRN Fentanyl 1 mcg/kg q1h prn MAX starting dose: 50mcg PRN Lorazepam 0.05-0.1mg/kg/dose IV Q4h MAX starting dose: 4mg Selection of PRN agent is based on pain **Pain** Present Fentanyl **No Pain** Perceived Lorazepam

Delirium

Consider delirium if:

After day 2 of intubation *AND* infusions have doubled in the last 24 hours
OR patient is difficult to sedate

Consider substituting dexmedetomidine for midazolam

PICU Pathway for Sedation/Analgesia in the Mechanically Ventilated Patient

Patients <50 kg

Medication Infusions Initial Doses	Fentanyl *and* Midazolam (If midazolam contraindicated- consider dexmedetomidine) Fentanyl 1 mcg/kg/hr Midazolam 0.05 mg/kg/hr
Incremental Infusion Change	Fentanyl 0.5 mcg/kg/hr Midazolam 0.02 mg/kg/hr
Assess / Titration	Use SBS and pain scores Assess both every 4 hrs, at minimum Assess 30 minutes after PRN doses
PRN Doses	**PRN dose matches hourly infusion dose for fentanyl and midazolam** Selection of PRN agent is based on pain score **Pain** Present Fentanyl **No Pain** Midazolam

INITIATION

Patient **< 50 kg**

Set SBS Goal
Initiate: Fentanyl and Midazolam

PRN SBS Management (Hour 0-4)
0-4 Hours: PRNs available q 30m

Enter Sedation Maintenance Phase
After 4 hours
Set Appropriate SBS Goal Daily

MAINTENANCE

Assess SBS, Pain Score every 4 hours and PRN

SBS > Goal Under-Sedated

SBS ≤Goal Over-Sedated

SBS at Goal

SBS < Goal for 8 hours

1. Contact FLOC
2. Consider decreasing infusion rate by 20%

Consider **reversible causes**
Vent dyssynchrony
Nasal ETT appropriate?
Non-pharmacologic interventions

Pain Present → PRN fentanyl

Anxiety Present → PRN midazolam

If >3 non-procedural PRNs of either agent are administered within 8 hours, consider increasing indication specific infusion

Continued Pain or SBS > Goal

1. FLOC to come to bedside
2. Consider Fentanyl PRN for sedation
3. Increasing infusions more often than q8h is not recommended. Instead, consider Opioid Rotation or alternative agents.

Consider **Delirium**

Opioid Rotation and Alternative Agents

Opioid Rotation

If a fentanyl infusion is increased by ≥ 2mcg/kg/hr (or increased by ≥ 100mcg/hr in patients ≥ 50 kg) in a 24-hour period, OR if a total fentanyl infusion dose of >5mcg/kg/hr (or >150mcg/hr in patients ≥ 50 kg) opioid rotation should be considered.

Converting from a continuous IV fentanyl infusion to an alternative continuous opioid:

Continuous Opioid Alternative	Conversion Calculations
Hydromorphone (mg/kg/hr)	Fentanyl ___ mcg/kg/hr x 0.005 = __ mg/kg/hr IV hydromorphone *Example: Fentanyl 5mcg/kg/hr = 0.025 mg/kg/hr IV hydromorphone*
Morphine (mg/kg/hr)	Fentanyl ___ mcg/kg/hr x 0.02 = ___ mg/kg/hr IV morphine *Example: Fentanyl 5mcg/kg/hr = 0.1 mg/kg/hr IV morphine*

Alternative agents (link to Sedation in Intensive Care Units in the CHOP formulary)

- Pentobarbital
- Ketamine
- Dexmedetomidine

PICU Pathway for Sedation/Analgesia in the Mechanically Ventilated Patient

Patients ≥ 50 kg

Medication Infusions Initial Doses	Fentanyl *and* Midazolam (If midazolam contraindicated- consider dexmedetomidine) Reference Weight Based Guidelines
Incremental Infusion Change	Fentanyl 25 mcg/hr Reference Weight Based Guidelines Midazolam 1 mg/hr
Assess / Titration	Use SBS and pain scores Assess both every 4 hrs, at minimum Assess 30 minutes after PRN doses
PRN Doses	**PRN dose matches hourly infusion dose for fentanyl and midazolam** Selection of PRN agent is based on pain score Pain Present Fentanyl No Pain Midazolam

INITIATION

Patient **≥ 50 kg**

Set SBS Goal
Reference weight based guidelines
Initiate: Fentanyl and Midazolam

PRN SBS Management (Hour 0-4)
0-4 Hours: PRNs available q 30m

Enter Sedation Maintenance Phase
After 4 hours
Set Appropriate SBS Goal Daily

MAINTENANCE

SBS > Goal
Under-Sedated

SBS at Goal

SBS ≤Goal
Over-Sedated

Consider **reversible causes**
Vent dyssynchrony
Nasal ETT appropriate?
Non-pharmacologic interventions

Assess SBS, Pain Score
every 4 hours and PRN

SBS < Goal for 8 hours

1. Contact FLOC
2. Consider decreasing infusion rate by 20%

Pain Present → PRN fentanyl

Anxiety Present → PRN midazolam

If >3 non-procedural PRNs of either agent are administered within 8 hours, consider increasing indication specific infusion by weight

Continued Pain or SBS > Goal

1. FLOC to come to bedside
2. Consider Fentanyl PRN for sedation
3. Increasing infusions more often than q8h is not recommended. Instead, consider Opioid Rotation or Alternative Agents

Consider **Delirium**

PICU Pathway for Sedation/Analgesia in the Mechanically Ventilated Patient

≥50 kg

Weight Based Dosing Guidelines for Patients ≥ 50kg

Initial Dose and Titration by Weight Range

Weight (kg)	Fentanyl mcg/kg/hr		Midazolam mg/kg/hr	
	Initial dose	Titration	Initial dose	Titration
50 - 60	0.9	0.45	0.05	0.02
60.1 - 70	0.8	0.4	0.045	0.018
70.1 - 80	0.7	0.35	0.04	0.016
80.1 - 90	0.6	0.3	0.035	0.014
90.1 - 100	0.5	0.25	0.03	0.012

Weight Based Titration Guidance

The titration tables below are tools to provide guidance for weight-based titration of continuous sedative and analgesic infusions in all patients ≥50 kg. Non weight-based dosing of continuous medication infusions is a standard practice in adult medicine; however, due to safety constraints within CHOP weight-based dosing for continuous medication infusions must be uniformly utilized in pediatric and adult patients alike. In an effort to avoid oversedation of patients ≥ 50 kg, the goal of the titration tables below is to translate non weight-based dose titrations into the language of weight-based dosing.

Patient Weight	FENTANYL Titration		MIDAZOLAM Titration	
	Infusion mcg/kg/hr	PRN mcg	Infusion mg/kg/hr	PRN mg
50-60	0.9	50	0.05	2.5
	1.35	75	0.07	3.5
	1.8	100	0.09	4.5
	2.25	125	0.11	5.0
	2.7	150	0.13	5.0
	3.15	150	0.15	7.5
	3.6	150	0.17	7.5
	4.05	150	0.19	7.5
60.1 - 70	0.8	50	0.045	2.5
	1.2	75	0.063	3.5
	1.6	100	0.081	4.5
	2.0	125	0.099	5.0
	2.4	150	0.117	5.0
	2.8	150	0.135	7.5
	3.2	150	0.153	7.5
	3.6	150		
70.1 - 80	0.7	50	0.04	2.5
	1.05	75	0.056	3.5
	1.4	100	0.072	4.5
	1.75	125	0.088	5.0
	2.1	150	0.12	7.5
	2.45	150	0.136	7.5
	2.8	150	0.152	7.5
	3.15	150		
80.1 - 90	0.06	50	0.035	2.5
	0.9	75	0.049	3.5
	1.2	100	0.063	4.5
	1.5	125	0.077	5.0
	1.8	150	0.091	7.5
	2.1	150	0.105	7.5
	2.4	150	0.119	7.5
	2.7	150	0.133	7.5
90.1 – 100	0.5	50	0.03	2.5
	0.75	75	0.042	3.5
	1	100	0.054	4.5
	1.25	125	0.066	5.0
	1.5	150	0.078	7.5
	1.75	150	0.09	7.5
	2.0	150	0.1	7.5
	2.25	150	0.112	7.5

PICU Pathway for Sedation/Analgesia in the Mechanically Ventilated Patient

PICU Sedation/Analgesia Weaning

Patient Intubated (Titrating)

Patient Likely to be Extubated in the Next 24 Hours

↓

Assess Risk of Withdrawal Associated Adverse Outcomes

→ <5 days of continuous sedation and Low Risk → Turn sedation off prior to extubation. Monitor for signs of pain, withdrawal

↓

≥5 days of continuous sedation or High Risk

↓

Titrate sedation to desired level of wakefulness for extubation

↓

Patient Extubated

Patient Extubated (Weaning)

↓

Wean sedation/analgesia incrementally until Conversion Thresholds are reached

Weaning Increments to reach Conversion Threshold Levels

Medication	Titration Increment	Titration interval
Fentanyl	1 mcg/kg/hr	Every 12 hours
Morphine	0.02 mg/kg/hr	Every 12 hours
Hydromorphone	0.008 mg/kg/hr	Every 12 hours
Midazolam	0.05 mg/kg/hr	Every 12 hours

For patients on both opioid and benzodiazepine infusions, each agent should be weaned in an alternating fashion every 6 hours.

↓

Once at IV Conversion Threshold to Initiate Wean Plan
Assess ability to tolerate Enteral Sedation

IV Conversion Thresholds to Initiate Duration-Specific Wean Plan

Medication	Goal IV Threshold
Fentanyl	3 mcg/kg/hr
Morphine	0.1 mg/kg/hr
Hydromorphone	0.01 mg/kg/hr
Midazolam	0.15 mg/kg/hr

Wean IV Sedation
Calculate Sedation Duration

Duration 5-9 days or High Risk < 5 days -IV
Duration 10-21 days or High Risk 5-9 days -IV
Duration > 21 days or High Risk 10-21 days -IV

PO: Convert IV to Enteral Sedation Agent
Transitioning from IV to PO

Opioid Conversion
Benzodiazepine Conversion

↓

Monitor 24 hours after conversion before weaning

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Wean Enteral Sedation
Calculate Sedation Duration

Duration 5-9 days or High Risk < 5 days -PO
Duration 10-21 days or High Risk 5-9 days -PO
Duration > 21 days or High Risk 10-21 days -PO

↓

Monitor Withdrawal Symptoms, (WAT-1 Scale), Pain Scores
Consider Non-Pharmacologic Interventions

↓

Pain Present

WAT Score >3

Monitor for Over-Sedation

- Contact FLOC if concerned for over-sedation
- Consider decreasing opioid and benzodiazepine doses or skip a scheduled dose

Assessing Risk of Withdrawal Associated Adverse Outcomes

Low Risk (little to no risk of adverse events if withdrawal symptoms occur)

No high risk criteria present

High Risk (increased risk of adverse events if withdrawal symptoms occur)

Seizure disorders
Hemodynamically significant congenital heart disease
Pulmonary hypertension
Prior history of weaning difficulty or complications from withdrawal

Weaning Threshold Levels of IV Sedation to Initiate Duration-Specific Wean Plan

Titrate opioid and benzodiazepine drips down to target doses before starting wean plans (IV or Enteral)
These doses can safely be converted to enteral agents based on available medication strengths, formulations and resulting volumes
Starting point for percentage –based infusion wean in patients that cannot tolerate enteral medications

Medication	Goal Threshold IV Continuous Threshold (≤)
Fentanyl	3 mcg/kg/hr
Morphine	0.1 mg/kg/hr
Hydromorphone	0.01 mg/kg/hr
Midazolam	0.15 mg/kg/hr

Monitor Withdrawal Symptoms

Physical signs, symptoms manifest when opioid or benzodiazepine administration is abruptly discontinued
Symptoms mimic many clinical conditions
Can appear up to 2-3 days after decreasing/stopping medication (can be longer with methadone)
Diagnosis of exclusion, assess for other conditions with similar symptoms:

- Hypoxia
- Hypercarbia
- Electrolyte Imbalance
- Metabolic Dysfunction
- Low Cardiac Output
- Sepsis
- Feeding Intolerance

Common Withdrawal symptoms

Central Nervous System	Gastrointestinal Disturbances	Autonomic Dysfunction
Poor sleep pattern	Diarrhea	Fever
Irritability	Vomiting	Sweating
Tremors Convulsions	Gagging	Yawning
Uncoordinated suck/swallow	Abdominal pain	Piloerection
Hallucinations	Increased secretions	Tachycardia
		Hypertension
		Tachypnea

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2775493/table/T4/

Note: ***Consider the patient's baseline (i.e. pre-sedation or pre-weaning) status with regard to chronic underlying symptoms that could be incorrectly misinterpreted as withdrawal.*** *Withdrawal symptoms mimic many clinical conditions. When evaluating the patient, physicians should assess for conditions such as low cardiac output syndrome, hypoxia, hypercarbia, sepsis, electrolyte imbalances, feeding intolerance, and metabolic dysfunctions that can present with symptoms similar to withdrawal syndrome. Withdrawal syndrome is a diagnosis of exclusion. It should be kept in mind that severe signs and symptoms of withdrawal can appear up to two- three days after a decrease or cessation of sedation medication (may be longer with methadone).*

Titrating IV Sedation to Extubation Ready Level of Sedation

Medication	Weaning increment	Weaning interval
Fentanyl	1 mcg/kg/hr	Every 12 hours
Morphine	0.02 mg/kg/hr	Every 12 hours
Hydromorphone	0.008 mg/kg/hr	Every 12 hours
Midazolam	0.05 mg/kg/hr	Every 12 hours

For patients on both opioid and benzodiazepine infusions, each agent should be weaned in an alternating fashion every 6 hours.

Converting IV to Enteral Sedation- Calculating the Dose for Opioids

Continuous Medication Infusion(CMI)	Enteral Agent (PO/GT/JT/NG/NJ/ND)
Fentanyl 3 mcg/kg/hr	Hydromorphone 0.14 mg/kg/dose q 4h
	Methadone 0.14 mg/kg/dose q 6h x 48h then space to q 8h
	Morphine 0.55 mg/kg/dose q 4h
	Oxycodone 0.4 mg/kg/dose q 4h
Fentanyl <3 mcg/kg/hr	**Step 1 Calculate enteral morphine equivalent** Fentanyl ___ mcg/kg/hr x___ kg x 0.18 = ___mg enteral morphine/dose Calculated dose should be given q4h **Step 2 Convert to desired enteral agent if other than enteral morphine** **Enteral morphine to Enteral hydromorphone** ___ mg enteral morphine/dose x 0.25 = ___ mg enteral hydromorphone/dose Calculated dose should be given q 4h **Enteral morphine to Enteral methadone** ___ mg enteral morphine/dose x 0.25 = ___ mg enteral methadone/dose Calculated dose should be given q 6h x 48 hours, then spaced to q 8h **Enteral morphine to Enteral oxycodone** ___ mg enteral morphine/dose x 0.67 = ___ mg enteral oxycodone/dose Calculated doses should be given q 4h
Morphine 0.1 mg/kg/hr	Hydromorphone 0.3mg/kg/dose q 4h
	Methadone 0.3 mg/kg/dose q 6h x 48h then space to q 8h
	Morphine 1.2 mg/kg/dose q 4h
	Oxycodone 0.8 mg/kg/dose q 4h
Morphine <0.1 mg/kg/hr	**Step 1: Calculate enteral morphine equivalent** Morphine ___ mg/kg/hr x ___ kg x 12 = ___ mg enteral morphine/dose Calculated dose should be given q4h **Step 2: Convert to desired enteral agent if other than enteral morphine** **Enteral morphine to Enteral hydromorphone** ___ mg enteral morphine/dose x 0.25 = ___ mg enteral hydromorphone/dose Calculated dose should be given q4h **Enteral morphine to Enteral methadone** ___ mg enteral morphine/dose x 0.25 = ___ mg enteral methadone/dose Calculated dose should be given q6h x48 hours, then spaced to q8h **Enteral morphine to Enteral oxycodone** ___ mg enteral morphine/dose x 0.67 = ___ mg enteral oxycodone/dose Calculated enteral oxycodone dose should be given q 4h
Hydromorphone 0.01 mg/kg/hr	Hydromorphone 0.2 mg/kg/dose q 4 h
	Methadone 0.2 mg/kg/dose q 6h x48h then space to q 8h
	Morphine 0.8 mg/kg/dose q 4h
	Oxycodone 0.5 mg/kg/dose q 4h
Hydromorphone <0.01 mg/kg/hr	**Step 1: Calculate enteral morphine equivalent** Hydromorphone ___ mg/kg/hr x ___ kg x 80 = ___ mg enteral morphine/dose Calculated dose should be given q4h **Step 2: Convert to desired enteral agent if other than enteral morphine** enteral **morphine to** enteral **hydromorphone** ___ mg enteral morphine/dose x 0.25 = ___ mg enteral hydromorphone/dose Calculated dose should be given q 4h **Enteral morphine to Enteral methadone** ___ mg enteral morphine/dose x 0.25 = ___ mg enteral methadone/dose Calculated dose should be given q 6h x 48 hours, then spaced to q 8h **PO morphine to Enteral oxycodone** ___ mg enteral morphine/dose x 0.67 = ___ mg enteral oxycodone/dose Calculated dose should be given q 4h

Converting IV to Enteral Sedation- Calculating the Dose for Benzodiazepenes

Continuous Medication Infusion (CMI)	Enteral agent (PO/GT/JT/NG/NJ/ND)
Midazolam 0.15 mg/kg/hr	Diazepam 0.3 mg/kg/dose q 6h
	Lorazepam 0.2 mg/kg/dose q 4h
Midazolam <0.15 mg/kg/hr	Midazolam___ mg/kg/hr x ___kg x 1.8 = ___mg **diazepam**/dose Calculated enteral diazepam dose should be given q6h Midazolam ___ mg/kg/hr x ___kg x 1.2 =___ mg **lorazepam**/dose Calculated enteral lorazepam dose should be given q4h

Benzodiazepine conversions based on historical CHOP experience.

Transitioning from Continuous IV Sedation to Intermittent PO regimen

IV to PO Opioid

Step 1	Start PO opioid agent at dose calculated Conversion from IV to PO Opioid
Step 2	Wean opioid infusion by 50% 30 minutes after the 2nd PO opioid dose
Step 3	Turn opioid infusion off 30 minutes after the 3rd PO opioid dose

IV to PO Benzodiazepine

Step 1	Start PO benzodiazepine agent at dose calculated Conversion from IV to PO Benzodiazepene
Step 2	Wean benzodiazepine infusion by 50% 30 minutes after the 1st PO benzodiazepine dose
Step 3	Turn benzodiazepine infusion off 30 minutes after the 2nd PO benzodiazepine dose

IV Wean Plans for Patients Unable to Tolerate Enteral Sedation

5-9 days (consider for High risk <5 days)

Assign Day 0 to threshold dose (≤) for each agent
Calculate 10% of Day 0 continuous infusion opioid and/or benzodiazepine dose(s)
Wean opioid infusion by 10% of Day 0 dose every 12 hours
Wean benzodiazepine infusion by 10% of Day 0 dose every 12 hours
For patients on opioid and benzodiazepine infusions, wean every 6 hours in an alternating fashion
*Total wean should take about 5 days

10-21 days (consider for High risk 5-9 days)

Assign Day 0 to threshold dose (≤) for each agent
Calculate 10% of Day 0 continuous infusion opioid and/or benzodiazepine dose(s)
Wean opioid infusion by 10% of Day 0 dose every 24 hours
Wean benzodiazepine infusion by 10% of Day 0 dose every 24 hours
For patients on opioid and benzodiazepine infusions, wean every 12 hours in an alternating fashion
*Total wean should take about 10 days

>21 days (consider for High risk 10-21 days)

Assign Day 0 to threshold dose (≤) for each agent
Calculate 10% of Day 0 continuous infusion opioid and/or benzodiazepine dose(s)
Wean opioid infusion by 10% of Day 0 dose every 48 hours
Wean benzodiazepine infusion by 10% of Day 0 dose every 48 hours
For patients on opioid and benzodiazepine infusions, wean every 24 hours in an alternating fashion
*Total wean should take about 20 days

Enteral Weaning Plans

5-9 days (consider for High risk <5 days)

Initiate opioid and benzodiazepine wean on the same day to allow for concurrent daily weans
Calculate 20% of initial opioid and benzodiazepine doses (Day 0) = increment for stepwise dose weaning
Wean BOTH opioid and benzodiazepine every 24h by 20% of Day 0 doses
Once ≤ the lowest starting dose is reached, space opioid and benzodiazepine frequencies in a daily stepwise fashion until off
(i.e. q4h ->q6h ->q8h ->q12h -> OFF)

Lowest Starting Doses for Enteral Agents

Medication	Lowest starting dose (<50kg) mg/kg PO	Lowest starting dose (≥50kg) mg PO
Opioids		
Morphine	0.15	7.5
Hydromorphone	0.03	2
Methadone	0.05	2.5
Oxycodone	0.1	5
Benzodiazepines		
Diazepam	0. 05	2.5
Lorazepam	0. 05	2.5

*Total wean should take about 5-9 days
*Methadone is not recommend for short term weans over 5-9 days

Example:
10kg patient on continuous fentanyl/midazolam for 7 days.
Fentanyl IV 3mcg/kg/hr converted to morphine 5.5mg PO q4h (0.55mg/kg/dose)
Midazolam IV 0.15mg/kg/hr converted to diazepam 3mg PO q6h (0.3mg/kg/dose)

1. Calculate 20% increment for stepwise dose weaning:
   Morphine PO 5.5mg/dose (Day 0) x 20% = 1.1mg/dose
   Diazepam PO 3mg/dose (Day 0) x 20% = 0.6mg/dose
2. Wean BOTH opioid and benzodiazepine doses (Day 0) each day by calculated 20% increment
3. Determine lowest starting enteral dose for opioid and benzodiazepine.
   Morphine 0.15mg/kg/dose = 1.5mg/dose
   Diazepam 0.05mg/kg/dose = 0.5mg/dose
4. Once the patient's dose is approximately at the lowest starting dose, space opioid and benzodiazepine frequencies in a daily stepwise fashion (see example chart below)

Step	Morphine	Diazepam	Date Wean Step Completed
Current dose (Day 0)	5.5 mg PO q4h	3 mg PO q6h	---
1	4.4 mg PO q4h	2.4 mg PO q6h	
2	3.3 mg PO q4h	1.8 mg PO q6h	
3	2.2 mg PO q4h	1.2 mg PO q6h	
4	1.1 mg PO q4h	0.6 mg PO q6h	
5	1.1 mg PO q6h	0.6 mg PO q8h	
6	1.1 mg PO q8h	0.6 mg PO q12h	
7	1.1 mg PO q12h	Diazepam OFF	
8	Morphine OFF	---	

10 -21 days (High risk 5-9 days)

Initiate opioid and benzodiazepine weans on consecutive days to allow staggered weans
Calculate 20% of initial opioid and benzodiazepine doses (Day 0) = increment for stepwise dose weaning
Wean opioid by 20% of Day 0 dose every 48 hours.
Wean benzodiazepine by 20% of Day 0 dose every 48 hours.
Once ≤ the lowest starting dose is reached (see Table 2), alternate spacing opioid and benzodiazepine frequencies in a daily stepwise fashion until off
(i.e. q4h ->q6h ->q8h ->q12h -> OFF)

Lowest Starting Doses for PO Agents

Medication	Lowest starting dose (<50kg)	Lowest starting dose (≥50kg)
Opioids		
Morphine	0.15 mg/kg/dose PO	7.5mg PO
Hydromorphone	0.03 mg/kg/dose PO	2mg PO
Methadone	0.05 mg/kg/dose PO	2.5mg PO
Oxycodone	0.1 mg/kg/dose PO	5mg PO
Benzodiazepines		
Diazepam	0. 05mg/kg/dose PO	2.5mg PO
Lorazepam	0. 05mg/kg/dose PO	2.5mg PO

*Total wean should take about 14-21 days.
Example:

PICU Pathway for Sedation/Analgesia in the Mechanically Ventilated Patient

10kg patient on continuous fentanyl/midazolam for 15 days.
Fentanyl IV 3mcg/kg/hr converted to morphine 5.5mg PO q4h (0.55mg/kg/dose)
Midazolam IV 0.15mg/kg/hr converted to diazepam 3mg PO q6h (0.3mg/kg/dose)

1. Calculate 20% increment for stepwise dose weaning
   Morphine PO 5.5mg/dose (Day 0) x 20% = 1.1mg/dose
   Diazepam PO 3mg/dose (Day 0) x 20% = 0.6mg/dose
2. Wean opioid dose (Day 0) every 48 hours by calculated 20% increment
3. Wean benzodiazepine dose (Day 0) every 48h hours by calculated 20% increment
4. Determine lowest starting enteral dose for opioid and benzodiazepine.
   Morphine 0.15mg/kg/dose = 1.5mg/dose
   Diazepam 0.05mg/kg/dose = 0.5mg/dose
5. Once the patient's dose is approximately at the lowest starting dose, space opioid and benzodiazepine frequencies in a daily stepwise fashion (see example chart below)

Step	Morphine	Diazepam	Date Wean Step Completed
Current dose (Day 0)	5.5mg PO q4h	3mg PO q6h	---
1	4.4mg PO q4h		
2		2.4mg PO q6h	
3	3.3mg PO q4h		
4		1.8mg PO q6h	
5	2.2mg PO q4h		
6		1.2mg PO q6h	
7	1.1mg PO q4h		
8		0.6mg PO q6h	
9	1.1mg PO q6h		
10		0.6mg PO q8h	
11	1.1mg PO q8h		
12		0.6mg PO q12h	
13	1.1mg PO q12h		
14		Diazepam OFF	
15	Morphine OFF		

>21 days (High risk 10-21 days)

Initiate opioid and benzodiazepine weans on consecutive days to allow staggered wean
(e.g., wean morphine on day 1 and then wean diazepam on day 2, etc).
Calculate 10% of initial opioid and benzodiazepine doses (Day 0) prior to initiation of weaning protocol. (This will be the increment for stepwise dose weaning.)
Wean opioid by 10% of Day 0 dose every 48 hours.
Wean benzodiazepine by 10% of Day 0 dose every 48 hours.
Once ≤ the lowest starting dose is reached (see Table 2), alternate spacing opioid and benzodiazepine frequencies in a daily stepwise fashion until off
(i.e. q4h ->q6h ->q8h ->q12h -> OFF)

Lowest Starting Doses for PO Agents

Medication	Lowest starting dose (<50kg)	Lowest starting dose (≥50kg)
Opioids		
Morphine	0.15 mg/kg/dose PO	7.5mg PO
Hydromorphone	0.03 mg/kg/dose PO	2mg PO
Methadone	0.05 mg/kg/dose PO	2.5mg PO
Oxycodone	0.1 mg/kg/dose PO	5mg PO
Benzodiazepines		
Diazepam	0. 05mg/kg/dose PO	2.5mg PO
Lorazepam	0. 05mg/kg/dose PO	2.5mg PO

*Total wean should take about 22-26 days.

Example:

10kg patient on continuous fentanyl/midazolam for 30 days.
Fentanyl IV 3mcg/kg/hr converted to morphine 5.5mg PO q4h (0.55mg/kg/dose)
Midazolam IV 0.15mg/kg/hr converted to diazepam 3mg PO q6h (0.3mg/kg/dose)

1. Calculate 10% increment for stepwise dose weaning:
   Morphine PO 5.5mg/dose (Day 0) x 10% = 0.6mg/dose
   Diazepam PO 3mg/dose (Day 0) x 10% = 0.3mg/dose
2. Wean opioid dose (Day 0) every 48 hours by calculated 10% increment
3. Wean benzodiazepine dose (Day 0) every 48h hours by calculated 10% increment
4. Determine lowest starting enteral dose for opioid and benzodiazepine.
   Morphine 0.15mg/kg/dose = 1.5mg/dose
   Diazepam 0.05mg/kg/dose = 0.5mg/dose
5. Once the patient's dose is approximately at the lowest starting dose, space opioid and benzodiazepine frequencies in a daily stepwise fashion (see example chart below)

Step	Morphine	Diazepam	Date Wean Step Completed
Current dose (Day 0)	5.5mg PO q4h	3mg PO q6h	---
1	4.9mg PO q4h		
2		2.7mg PO q6h	
3	4.3mg PO q4h		
4		2.4mg PO q6h	

5	3.7mg PO q4h		
6		2.1mg PO q6h	
7	3.1mg PO q4h		
8		1.8mg PO q6h	
9	2.5mg PO q4h		
10		1.5mg PO q6h	
11	1.9mg PO q4h		
12		1.2mg PO q6h	
13	1.3mg PO q4h		
14		0.9mg PO q6h	
15	1.3mg PO q6h		
16		0.6mg PO q6h	
17	1.3mg PO q8h		
18		0.6mg PO q8h	
19	1.3mg PO q12h		
20		0.6mg PO q12h	
21	Morphine OFF		
22		Diazepam OFF	

Breakthrough Opioid Dose for Pain

Patients on intermittent morphine or hydromorphone (PO or IV):

Give 100% of the standing opioid dose (IV or PO)

-Applies to patients on doses higher than initial starting doses due to opioid tolerance

-A dose given for active pain should be no less than an initial starting dose in an opioid-naïve patient

Or treatment dose of morphine if the standing dosage is less than the dose being weaned.

Patients on intermittent PO methadone:

Give a PRN dose of morphine (IV or PO) as per the CHOP Formulary.

May need titration if presence of opioid tolerance.

Patients on continuous opioid infusion:

Give a bolus dose equivalent to the amount of opioids administered over 1 hour.

Consider continuing benzodiazepine wean first if a patient is stable and pain is not musculoskeletal in nature.

Resume opioid wean when pain is resolved or controlled.

Withdrawal Present - Weaning Rescue Dose Guidance

PRN dose equivalent 50% of standing opioid/benzodiazepine dose

Presence of Withdrawal Symptoms

Always carefully consider other causes

STEP 1

Give a PRN benzodiazepine dose equivalent to 50% of the current standing dose (PO or IV).
If the patient is on a continuous benzodiazepine infusion, give a benzodiazepine bolus dose equivalent to 50% of the current hourly dose.
Benzodiazepines can treat the symptoms of both opioid and benzodiazepine withdrawal, hence, the recommendation to start with a benzodiazepine PRN when withdrawal is suspected.

STEP 2

If patient remains agitated one hour after the rescue dose of benzodiazepine, administer a rescue dose of opioid equivalent to 50% of the current PO or IV dosage.
If patient is on continuous infusion, give an opioid bolus dose equivalent to 50% of the current hourly dose.

If more than 3 rescue doses are required in a 24-hour period, devise a new weaning plan with a more gradual tapering. Consult Pain Service or clinical pharmacy if patient remains agitated after 3 rescue doses of either benzodiazepine or opioid.

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Calculating Sedation Duration

Weaning Definitions	
Wean Day 0	Date on which weaning threshold of IV sedation is reached and weaning is begun
Sedation Duration	Length of time between beginning IV sedation and Wean Day 0