

## Sedation for Ventilated Children.

These guidelines are for the care of children requiring ventilation (as opposed to stabilisation) in areas outside PICU and have been written to support staff in those areas during a flu pandemic.

Sedation and analgesia should be considered separately, although some agents (e.g. morphine, clonidine, ketamine) exhibit both effects whilst others are almost exclusively analgesics (e.g. fentanyl, paracetamol) or sedatives (e.g. propofol, choral hydrate).

**Analgesia** should be administered to any children who may be expected to have pain or discomfort. In practice the degree of pain is usually difficult to assess so the majority of children on ICU receive an analgesic.

### **Muscle relaxants.**

- Most children are paralysed at the start of their period of ventilation.
- Once they are established on a ventilator the continuing need for muscle relaxants must be reviewed.
- The default position is that the relaxants are stopped because of the risks and complications associated with their continued use.
- It is especially important to stop muscle relaxants as soon as possible in children with neurological problems in order to enable neurological assessment and observation of abnormal movements/fits.
- Whenever muscle relaxants are used, adequate levels of sedation and analgesia **must be** ensured.
- Muscle relaxants may be continued in children who are cardiovascularly unstable or in whom it is difficult to achieve compliance with the ventilator.

**Sedation** is given in order to:

- reduce anxiety and stress responses while on PICU
- maintain safe placement of tubes and lines
- reduce post ICU psychological complications.

All sedation can cause:

- Hypotension and cardiovascular depression
- Reduced secretion clearance and immunosuppression
- Paradoxical excitation
- Dependence and withdrawal phenomena

In addition opiates cause impaired gastric emptying and GI stasis.

All sedatives need to be administered cautiously (especially in the cardiovascularly unstable patients) using the lowest effective dose.

The level of sedation and analgesia must be reviewed by a Consultant 12-24 hourly.

The use of scoring systems (see boxes 2 & 3 below) is recommended.

Before increasing the degree of sedation in an agitated/uncomfortable/unsettled child exclude and treat any irritant factors (see box1).

Under normal circumstances children start with IV sedation and once enteral (nasogastric or nasojejunal) feeding is established, there is a transition to enteral sedation. In those children in whom there are problems with venous access and the enteral route cannot be used, subcutaneous, rectal or (rarely) intramuscular, buccal or intranasal administration may be considered (depending on the drug chosen). The IV route may also be unavailable because available access is being used for drugs/fluids which are incompatible with the sedation.

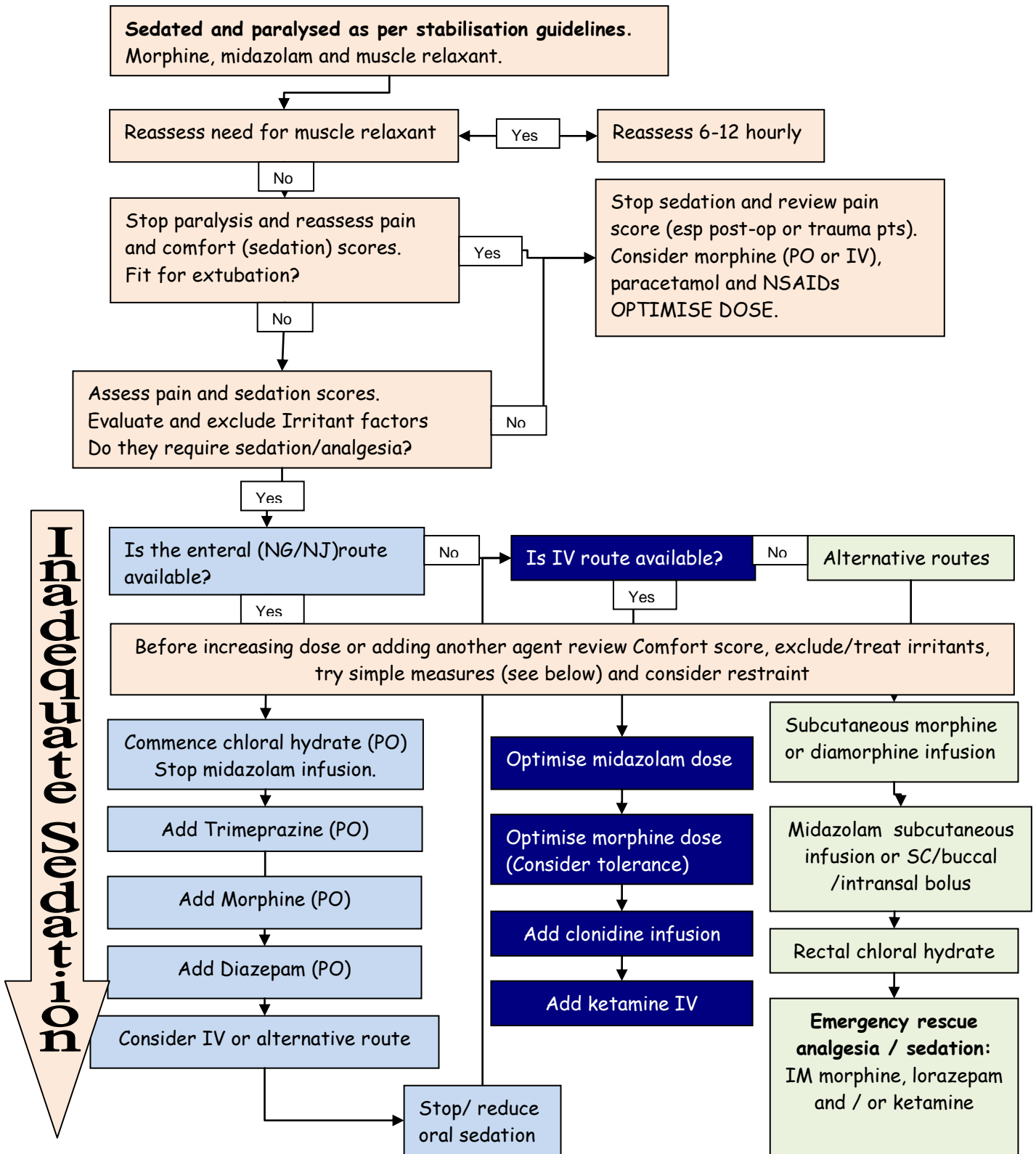
### **Box 1. Irritant Factors**

Exclude:

Pain, hypoxia, hypercarbia, secretions, full bladder, hunger, thirst, hot/cold, noise/lighting, position, nausea, constipation/colic, soiled nappy, pruritis.

Are they ready for extubation and is the ET tube acting as an irritant?

## Paediatric Sedation Flowchart



### Sedation and Pain Scores

Sedation must be reviewed against the Comfort score (Box 2). A score of 2- 4 is appropriate in most situations. Pain scores tend to subjective, but children should achieve pain scores of 0 – 1 on PICU.

### Simple (non-pharmacological) measures

In addition to the use and regular re-assessment of irritant factors in the unsettled child, infants will often settle if swaddled tightly, allowed a dummy and cuddled or comforted (if possible). In older children, physical contact and verbal reassurance can help to settle a child

When using more than one oral sedative agent, it sometimes useful to alternate dosing. For example a child may be prescribed Chloral Hydrate 6 hourly and Clonidine 8 hourly. 3-4 hours after the administration of Chloral they require some more sedation and we would give Clonidine at that point and use chloral for the next dose.

Box 2. Comfort (Sedation) Scale		
Score	Descriptor	Qualifier(s)
1	Agitated	
2	Tolerant and Comfortable	Awake and settled on minimal sedation
3	Light	Moves spontaneously or to touch
4	Moderate	No spontaneous movement but responds to touch
5	Sluggish	Dull or sluggish response to stimulation
6	Flat	No response to stimulation
S	Asleep	
P	Paralysed	

### Sedation for procedures.

- Physiotherapy - try to time sessions with doses of oral sedation (allowing 15 - 30 min for absorption).
- Children on IV sedation can have a bolus (up to 1hr of infusion given as a bolus).
- For more painful procedures, ketamine (IV or IM) is a useful agent.
- In children awaiting extubation the measures described above may produce prolonged sedation and propofol 1% by (carefully titrated) bolus dose can be considered.

Box 3. Pain Score	
0	No Pain
1	Mild Pain
2	Moderate Pain
3	Severe Pain
4	Excruciating

### Restraint.

- In older children restraint is a contentious issue and it is not routinely practiced on PICUs in the UK although it is common practice in other countries.
- The objective of restraint is to prevent a child from being able to move sufficiently far to extubate or to reach and remove lines, catheters etc.
- Swaddling is a form of restraint, and all parents restrain their children to prevent them from coming to harm (reins, car seats etc).
- The use of restraint allows staff to feel comfortable with lighter levels of sedation than might be possible without it. It is likely to be of benefit where staff are unfamiliar with the care of ventilated children.
- Physical restraint is almost certainly safer for the patient than chemical restraint with drugs that have significant side effects and complications.
- A survey conducted on our PICU (unpublished) found that parents were comfortable with the use of physical restraint once its purpose was explained to them.
- Sedation levels in children can fluctuate and the use of restraint will allow safety at times of light sedation whilst minimising the risk of over-sedation.

**Methods of restraint.**

Swaddling

Arm splinting

Wrist and ankle ties.

**Withdrawal.**

Consider the occurrence of withdrawal after 7 days use. After prolonged sedation withdrawal phenomena may not be seen until some days after discontinuation of sedation. Titrate oral sedation until symptomatic control has been achieved and then reduce dose by 10% per day as tolerated. See neonatal abstinence guidelines for more information.

**Drug notes (See Appendix 1 for more information.)****Do not exceed maximum adult dose.**

Drug	Route(s) of administration	Dosage	Comments
<b>Midazolam</b>	IV bolus	0.1 - 0.3 mg/kg	
	IV infusion	0 - 6 microgram/kg/min	
	Oral	0.5 mg/kg	
	Rectal	0.3 - 0.5 mg/kg	
	Buccal	0.2 - 0.3 mg/kg	
<b>Lorazepam</b>	IV bolus	25 - 50 microgram/kg	Max starting dose 2 mg. 2 -4 hourly boluses
	IV infusion	25 microgram/kg/hr	
	Oral	50 - 100 microgram/kg	8 - 12 hourly
<b>Chloral Hydrate</b>	Oral, Rectal	25 - 50 mg/kg	6 hourly
<b>Clonidine</b>	Oral	1 - 5 microgram/kg	8 hourly. Give test dose of 1 microgram/kg, watch for hypotension. Escalate in increments 1,3 then 5 microgram/kg/dose every 8 hours. Titrate to effect and BP. Achieve Max dose (if necessary) within 24 hrs.
	IV infusion	0.2 - 2 microgram/kg/hr	
<b>Alimemazine (trimeprazine)</b>	Oral	1-2mg/kg	6 hourly
<b>Diazepam</b>	Oral/rectal/IV	Oral/rectal 100 microgram/kg	Max 10 mg/dose 8 – 12 hourly
<b>Ketamine</b>	IV bolus	1 - 2 mg/kg	
	IM	5 - 10 mg/kg	
	IV infusion	5 - 10 microgram/kg/min	
<b>Morphine</b>	IV bolus	50 - 100 microgram/kg	
	IV infusion	10 - 40 microgram/kg/hr	
	Oral, rectal	80 - 500 microgram/kg	4 hrly, see BNF for children
	SC infusion	10 - 20 microgram/kg/hr	
<b>Diamorphine</b>	SC infusion	5 - 10 microgram/kg/hr	Start at 33% of previous IV morphine dose
	Oral	100 - 200 microgram/kg	4 hourly

	<b>Morphine</b>	<b>Alimemazine (Trimeprazine)</b>	<b>Diazepam</b>	<b>Chloral Hydrate</b>	<b>Midazolam</b>
<b>Action</b>	Analgesic, Sedative Opioid Receptors	Phenothiazine derivate with central sedative effect	Benzodiazepine		Benzodiazepine. Hypnotic, anxiolytic, amnesic, muscle relaxant & anticonvulsant GABA receptors
<b>Pharmacokinetics</b>	$t_{1/2}$ =1.5-4.5 hrs (longer in neonates). Hepatic metabolism (active metabolites). Renal excretion.	Well absorbed normally. Usually takes 2 hours before desired effect	Long acting. $t_{1/2}$ =20-100hrs and this is prolonged in neonates. It is extensively metabolised in liver and excreted in the urine		$t_{1/2}$ =3-4.5hrs, short acting, $t_{1/2}$ prolonged in neonates & liver impairment. Hepatic metabolism (active metabolites). Renal excretion.
<b>Administration</b>	IV bolus or infusion, Oral	Oral	Oral		IV bolus or infusion, Oral
<b>Side Effects</b>	-Respiratory depression (neonates & infants ↑ susceptibility). -Hypotension & tachycardia. -↓gastric emptying, constipation, pruritus. -Tolerance, dependence, withdrawal if discontinued abruptly.	- Urinary retention - Dry mouth - blurred vision	Respiratory/circulatory depression. Rapid tolerance & dependence		Respiratory/circulatory depression. Rapid tolerance & dependence. Thrombophlebitis.
<b>Cautions</b>	Lower doses in neonates & hepatic/renal failure	Avoid in hepatic or renal dysfunction, epilepsy and hypothyroidism. Caution in children with arrhythmias	Patients with muscle weakness, impaired liver or kidney function		High risk for drug withdrawal if used >48h.
<b>Advantages</b>	Potent analgesic	Long acting oral sedative	Long acting oral sedative		Rapid effect with infusion.

<b>Action</b>	Benzodiazepine. Hypnotic, anxiolytic, amnesic & anticonvulsant GABA receptors	Analgesic, Sedative $\alpha$ 2-adrenoreceptors	Sedative	Analgesic, sedative and dissociative anaesthetic.
<b>Pharmacokinetics</b>	$t_{1/2}$ =10-20 hrs. Increased to 30 hours in neonates. Hepatic metabolism (inactive metabolite). Renal excretion.	$t_{1/2}$ =8-12hrs. Hepatic metabolism (inactive metabolites). Renal excretion.	$t_{1/2}$ =6-8hrs (in babies $t_{1/2}$ is 3 times longer, it can lead to accumulation and toxicity). Hepatic metabolism to active molecule: trichloroethanol.	$t_{1/2}$ =1-2 hrs Hepatic metabolism Renal excretion
<b>Administration</b>	IV bolus	IV infusion, Oral	Oral, rectal	IV bolus or infusion
<b>Side Effects</b>	Respiratory/circulatory depression. As midazolam but less marked. Less hepatic metabolism than midazolam (safer in liver disease)	-Hypotension. -Bradycardia. -Rebound hypertension if stopped abruptly. -Dry mouth.	Respiratory/circulatory depression. -Hepatotoxicity. -Gastric irritation (corrosive to skin and mucous membranes). -Tolerance & dependence with prolonged used.	-Raise Intracranial Pressure -Hallucinations. -Tachycardia. -Cardiac tachyarrhythmias. -Hypertension. -Increased secretions. -Respiratory depression -apnoea if rapid IV administration
<b>Cautions</b>	Patients with muscle weakness, impaired liver or kidney function. High doses or parenteral administration may cause hypotension.	Hypotension & sepsis	Hypotension & sepsis	Use together with benzodiazepine to prevent agitation. DO NOT use when intracranial pressures are high. i.e head injury
<b>Advantages</b>	Less side effects compared to midazolam.	Analgesic & sedative. $\downarrow$ morphine requirements $\downarrow$ Drug withdrawal It does not cause respiratory depression.	Strong sedative.	Bronchodilatory, minimal respiratory depression.