the children's hospital at Westmead

PAIN MANAGEMENT - CHW

PRACTICE GUIDELINE ©

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

Approved by:	SCHN Policy, Procedure & Guideline Committee	
Date Effective:	1st April 2020	**Review Period:** 3 years
Team Leader:	Staff Anaesthetist	**Area/Dept:** Department of Pain Medicine

DOCUMENT SUMMARY/KEY POINTS

- Pain Management is an important part of the care of all children at the Children's Hospital at Westmead (CHW):
  - Successful pain management depends on regular pain assessment, appropriate drug dosage and route, multi-modal techniques and careful management of side effects.
- Safety is afforded by consistency in prescribing patterns, regular observation and timely review of patients.
  - The pain management observation chart (MR34B) is used to standardise and document relevant observations.
- A referral to the Department of Pain Medicine is an integral part of all ward prescriptions of systemic opioids (PCA, NCA, Infusion), local anaesthetic infusions and complex pain management regimens.
  - The pain management chart (M46J) is used in conjunction with B Braun pumps and Baxter Epidural pumps for acute pain management.
  - Complex pain in Oncology patients, in Palliative care patients and in -opioid tolerant patients is usually managed with a CADD® pump and the M46C pain management chart.
- The Pain Service provides these guidelines to help all hospital staff optimise analgesia in children at CHW.
- Restrictions on prescribing apply to:
  - Intravenous paracetamol Section 4.1.2
  - Neuraxial and Regional local analgesia infusions. Section 7 and Section 8
  - Hydromorphone Section Section 5.4.1
  - Intravenous Parecoxib and Ibuprofen Section 4.2.7
- Restrictions on administration apply to Nitrous Oxide
- Further Information (NSW Health PD): **High-Risk Medicines Management Policy**

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Date Effective:	1st April 2020	**Review Period**: 3 years
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CHANGE SUMMARY

The maximum concentration for ketamine infusion is now 200mg in 50mL.

READ ACKNOWLEDGEMENT

- Clinical Staff required to read and acknowledge the document:
  - All members of the Department of Pain Medicine
  - Nurse Educators
- Staff required to acknowledge the document:
  - Chairman of the drug committee
  - Head of Dept of Anaesthesia
  - Head of PICU
  - Head of Pharmacy

1 Introduction

Paediatric pain management is now recognised as one of the most important parts of patient recovery and well-being.

These guidelines are primarily aimed at dealing with the practicalities of the pharmacological treatment of pain in children. It covers simple non-opioid analgesics to more advanced methods of pain control, such as Patient Controlled Analgesia (PCA) and Epidural Analgesia Infusions.

Non-pharmacological pain management is equally important and includes behavioural techniques e.g. relaxation therapy, distraction, movement, mobilisation and hypnosis. Parents play a vital role in supporting and comforting their child.

1.1 What is pain?

- "Pain is whatever the experiencing person says it is, existing whenever the experiencing person says it does"
- "Pain is an unpleasant sensory and emotional experience, associated with or expressed in terms of actual or potential tissue damage"
- Pain has also been defined as the perceptual counterpart of the body's response to stimuli that threaten the integrity of its tissues. It thus functions as a sensory warning system.

These definitions emphasise the subjective nature of the experience and therefore assume both consciousness and the capacity for expression and or action.

To explore correlations between perception and neural mechanisms three dimensions of pain can be analysed: Pain sensation (nociception), unpleasantness (emotions pertaining to the present and short term implications) and secondary affect (emotions directed toward long term implications).

The first of these three dimensions considers the purely sensory aspects of perception and leads to the definition of nociception. Nociception then refers to the activation of specific neural elements (primarily sensory A delta and C primary afferent fibres) by high intensity, potentially tissue-damaging stimuli. The term nociception may also be used to describe reflex responses, autonomic activation and hypothalamic-pituitary alterations in response to noxious stimuli.

The latter two dimensions (unpleasantness and secondary affect) are accompanied by the desire to terminate or escape the presence of pain and are reflected in the proposal that pain is best seen as a "need state" much like hunger or thirst.In this state, attention, orientation, analysis and cognitive planning are geared toward responses that abolish the pain producing stimulus. It can therefore be viewed as a fundamental and essential "organism-generated provocation to action".

1.2 Myths Concerning Paediatric Pain

- Children experience less pain than adults
- Pain is character building for children
- Children are more likely to become addicted to opioids

Apart from these myths, paediatric pain management faces several other significant challenges.

- Pain assessment in pre-verbal and cognitively impaired infants and children is difficult and indirect. Physiological and behavioural parameters must act as proxies for the self-report of pain. Unfortunately, these parameters often lack specificity. In these patients various assumptions and indirect conclusions must be made regarding pain perception and memory.
- There is no major economic imperative to treat paediatric pain. This results in fewer pharmacological options and formulations for children.
- There is continuing debate about the long-term effects of pain experiences and treatment in early development.
- Ethical constraints on pharmacological research in paediatrics limit the available data regarding drug efficacy and toxicology in infants and children.

Education of medical and nursing staff has created a dramatic improvement in knowledge, attitude and treatment of paediatric pain. Pain management in children is recognised a humanitarian and ethical necessity. Good analgesia may potentially reduce disability and suffering in later life.

1.3 Classification of Pain

While anatomic and time-based classifications of pain remain important, a mechanism- based classification may be more useful. Reflecting this, pain management guidelines within CHW are often provided on a 'procedure specific basis (refer to Section 12 for more information). Pain can be classified and defined as follows:

1.3.1 Procedural (transient or physiological) Pain

- Perception of acute nociception that is not associated with significant tissue damage or an inflammatory response. It does not outlast the duration of the procedure and has an obvious self-protective function.

1.3.2 Inflammatory (Acute) Pain

- Nociception that is associated with significant tissue damage and an inflammatory response but does not involve damage to peripheral or central neurons. Typically postoperative or trauma-related pain i.e. usually of recent onset and limited duration. Inflammatory pain occurs in the setting of local tissue injury where the injury does not overwhelm the body's reparative mechanisms: "healing" can occur without medical intervention. It is characterized by on-going activity and modulation of nociceptors and pathways as they innervate damaged tissues. This activity and its modulation are linked to inflammatory and healing processes within these tissues. The pain experiences associated with surgery and tissue damage may be termed a 'pain state', implying an altered neuro-physiology. This form of pain, expressed as hyperalgesia, spontaneous pain and allodynia, can be seen as a 'protective reminder system'- causing the subject to shield, protect and immobilize the affected body part.

1.3.3 Neuropathic Pain

- The perception of pain that is associated with nerve damage either peripheral, autonomic or central. Typically, the damage sustained by the nervous system cannot be repaired e.g. limb amputation and spinal cord lesions. Neuropathic pain may be reported following surgery that involves stretching or manipulation of mixed nerves (neuropraxia).

1.3.4 Chronic Pain

- Nociceptive responses that are associated with hyperalgesia, allodynia, spontaneous or referred pain and/or sympathetic dysfunction in the absence of continuing inflammation or beyond the expected period of healing. It may or may not be associated with a significant inflammatory response or neural damage. Typical examples: headache, complex regional pain syndrome, recurrent abdominal pain, arthritis. Typically, this classification is used when symptoms occur for more than 6 weeks.

1.4 How do we measure paediatric pain?

Pain is recognised as the most common symptom experienced by children in hospital. All children should have pain scores measured and documented on presentation. Children receiving analgesic interventions should have pain scores documented regularly. Unfortunately, pain measurement in non-verbal patients remains difficult so a variety of measuring tools based on behavioural and physiological parameters must be selected to act as proxies for the self-report of pain.

Although not a "vital sign" per se, pain severity measurement, by incorporation into the 'BTF electronic documentation', is appropriately accorded the same importance as the measurement of the other vital signs.

1.5 Principles of pain measurement tools

At The Children's Hospital at Westmead (CHW), the selection of pain measuring tools has been standardised so as to allow a consistent approach throughout the hospital. The tools have been selected on the basis of their validity, reliability and clinical utility. These scales share a common metric (generally 0-10) and are printed on the back of the Pain Management prescription chart (M46J/C). These are also available through 'BTF electronic documentation'.

Tools used at The Children's Hospital at Westmead

1.5.1 Neonates Pain Rating Scale

For neonates (term babies up to 4 weeks of age) the CRIES scale should be used. Babies in Grace Centre for Newborn Care (often pre-term babies) have pain scoring performed using tools specifically developed for use within the nursery.

CRIES PAIN RATING SCALE			
	0	**1**	**2**
Crying	**No**	**High pitched**	**Inconsolable**
Requires O_2 for Sat >95%	**No**	**<30%**	**>30%**
Increased vital signs	**HR and BP < or = pre-op**	**HR and BP increased <20% of pre-op**	**HR and BP increased >20% of pre-op**
Expression	**None**	**Grimace**	**Grimace/ grunt**
Sleepless	**No**	**Wakes at frequent intervals**	**Constantly awake**

Krechel SW, Bildner J.. Paediatric Anaesthesia. 1995; 5: 53-61.

1.5.2 Infants

Infants (1month to approximately 4 years) are assessed using the FLACC measuring tool. Scoring should be done by staff after observing the infant for 1 minute. For infants who show good comprehension and motor skills, the Faces scale can be used as an alternative.

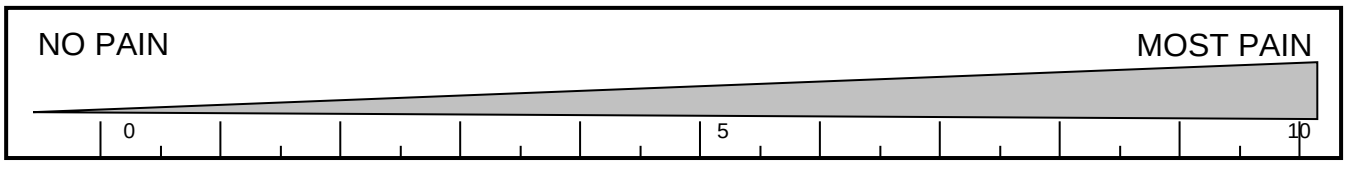
FLACC behavioural Pain Assessment Tool			
	0	**1**	**2**
Face	No particular expression or smile	Occasional grimace/frown withdrawn or disinterested	Frequent/ constant quivering chin, clenched jaw
Legs	Normal position or relaxed	Uneasy, restless or tense	Kicking or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
Cry	No cry	Moans or whimpers, occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content or relaxed	Reassured by occasional touching, hugging or being talked to, distractible	Difficult to console or comfort

1.5.3 Older Children

For older children, the use of a self-reporting scale can be helpful to staff and empowering to the patient. Below is the Faces scale, currently used by The Children's Hospital at Westmead:

These faces show how much something can hurt. From no pain, the faces show more and more pain to the face that shows very much pain. Point to the face that shows how much you hurt. *Hicks CL. and von Baeyer CL. et al. Pain 93: 173-183; 2001*

Older children and adolescents may respond better to a typical visual analogue scale:



1.5.4 Cognitively impaired children

Pain assessment and management in cognitively impaired children must be tailored to individual needs and setting. Carers of these children are often a particularly valuable resource. The revised FLACC (r-FLACC) tool allows the recording of additional pain behaviours that may be unique to a particular child. Carers should be asked to nominate these behaviours as soon as practical.

Revised FLACC behavioural Pain Assessment Tool			
	0	**1**	**2**
Face	No particular expression or smile.	Occasional grimace/frown withdrawn or disinterested. ***Appears sad or worried.***	Frequent/ constant quivering chin, clenched jaw. ***Distressed-looking face; expression of fright or panic.***
Legs	Normal position or relaxed. ***Usual tone & motion to limbs.***	Uneasy, restless or tense. ***Occasional tremors.***	Kicking or legs drawn up. ***Marked increase in spasticity, constant tremors or jerking.***
Activity	Lying quietly, normal position, moves easily***. Regular, rhythmic respirations.***	Squirming, shifting back and forth, tense. ***Tense or guarded movements; mildly agitated (e.g. head back and forth, aggression); shallow, splinting respirations, intermittent sighs.***	Arched, rigid or jerking. ***Severe agitation; head banging; shivering (not rigors); breath holding, gasping or sharp intake of breaths, severe splinting.***
Cry	No cry.	Moans or whimpers, occasional complaint. ***Occasional verbal outburst or grunt.***	Crying steadily, screams or sobs, frequent complaints. ***Repeated outbursts, constant grunting.***
Consolability	Content or relaxed.	Reassured by occasional touching, hugging or being talked to, distractible.	Difficult to console or comfort. ***Pushing away caregiver, resisting care or comfort measures.***

Malviya S. Voepel-Lewis T. et al. Ped Anesth 2006; 16:258-265

For each category, individualize the tool by asking parents/ carers if a specific or unique behaviour denotes pain in their child. Add this to the category description as appropriate.

1.6 Documenting pain scores

- Pain scores should be documented for all children at least once each shift.
- Children who have a recognised painful illness should have pain scores documented more frequently.
- All children who receive ***regular*** oral analgesics OR oral ***opioids*** (on either a regular or PRN basis) should have pain scores documented at least every 4 hours. (Record a score of 1S during natural sleep)
- Children receiving more complex analgesic interventions (intravenous, epidural or regional infusions) should have pain scores together with sedation scores and infusion parameters documented **hourly** on the Pain Management Observation chart (MR34B) or through the related 'BTF electronic documentation'.
- Incident pain (pain on coughing or movement) may be significantly different to background levels of pain. These differences are important and should be elicited when assessing children's pain.

1.7 Observation protocols

OBSERVATION PROTOCOL

Opioid Infusion/ NCA/ PCA

Heart Rate, Respiratory Rate, Pain Score & Sedation Score: hourly while infusion continues

Children <6 months of age must have continuous pulse oximetry monitoring and recording

Epidural/ Regional Infusion

Heart Rate, Respiratory Rate, Pain Score & Sedation Score: hourly while infusion continues

Blood Pressure Measurement: hourly for 6 hours → 4th hourly thereafter if stable

Pump delivery parameters need to be recorded hourly on the M34B chart.

*Following an epidural bolus of **concentrated** local anaesthetic (>0.2%bupivacaine)*

Blood pressure, respiratory rate, pain and motor scores – 15 minutely for 1 hour

Pulse oximetry continuously for 1 hour

Temperature monitoring should continue according to medical and surgical guidelines and be recorded appropriately. All patients with indwelling analgesia catheters/ lines (e.g. epidural and regional catheters) must have their temperature documented at least 4th hourly.

Sedation is scored and documented on the Pain Management Observation chart (MR34B) according to the following schedule:

Sedation Score	Description
0	Awake, alert
1	Minimally sedated, tired/sleepy, responds to conversation and/or sound
1S	Asleep, easy to rouse
2	Moderately sedated, easily roused with tactile stimulation or verbal commands
3	Deep sedation, rousable only with significant physical stimulation
4	Unrousable

The Pain Management Observation chart (MR34B) or the eMR should also be used to record any **adverse reactions and side effects** of analgesic regimens. The following coding may be useful.

COMPLICATIONS

N = NAUSEA

P = PRURITUS

S = STARTLE

V = VOMIT

Children who have epidural or lower limb regional infusions in progress should have the degree of motor block documented hourly according to the following scale.

MOTOR SCORE (Modified Bromage scale)

1 = Complete block, unable to move feet or knees

2 = Able to move feet only

3 = Just able to move knees

4 = Detectable weakness of hip flexion

5 = No detectable weakness

Key Points

- Remember that each child is an individual. Maturity does not always correlate with age. Family dynamics, previous experiences, social and cultural factors can affect the way a child responds to pain.
- Pain in response to movement or coughing is a very useful index of the quality of analgesia being delivered. Wherever possible, it should be ascertained and documented.

2 Managing Pain

Four basic principles underpin pain management at CHW:

1. regular pain assessment
2. multi-modal analgesia- using appropriate drug combinations
3. the use of non-pharmacological techniques
4. careful management of side effects

2.1 Routes of Administration

2.1.1 Oral

In most settings this is the most painless and convenient way to deliver medications. Palatability is a problem for some drugs (e.g. Ibuprofen). Some children cannot swallow medications e.g. children with mucositis.

2.1.2 Rectal

This route is disliked by children and adolescents but is well tolerated by young infants (<12months). Drug absorption can be variable. This route is useful in the peri-operative setting and for infants and children who have an 'ileus' and are therefore 'nil by mouth' or who have severe nausea and vomiting. Always obtain consent from parents/ carers before using this route.

2.1.3 Transdermal

Though convenient and painless, only a few drugs can be administered this way. The prime example is the 'Fentanyl patch'. While generally not used for acute pain it is potentially a suitable agent in chronic pain and palliative care settings. **N.B.** It is not possible to titrate doses of transdermal fentanyl making it inappropriate in the setting of acute and rapidly changing pain states. Care must be taken when disposing of used patches. Residual drug contained on discarded patches represents a potential health hazard to infants and children.

2.1.4 Transmucosal

Intranasal fentanyl is a rapid, painless, and safe method of administering opioids to paediatric patients in whom there is no intravenous access or who cannot tolerate the parental route of administration. It can be used for burns dressings and acute fracture manipulation.

- **Intranasal Fentanyl used in the Emergency Department for Pain Relief Practice Guideline**: http://webapps.schn.health.nsw.gov.au/epolicy/policy/4820

2.1.5 Intravenous

Intravenous therapy is rapid and easily titratable as it by-passes issues of absorption. This route is preferred for opioid infusions, PCAs and NCAs.

2.1.6 Subcutaneous

This is convenient because it avoids the need for an intravenous cannula and is occasionally used for post-operative pain following minor procedures i.e. where pain is likely to be controlled with only one or two subcutaneous doses. A 24 gauge cannula (e.g. Insuflon®) without extension tubing is used. Reliable sites for placements include thigh, infra-clavicular area. The subcutaneous route should be avoided in cases where peripheral perfusion is not stable.

2.1.7 Intramuscular

Intramuscular injections can be painful and are not recommended in children.

2.1.8 Epidural infusions

In suitable cases, epidural catheters are placed by anaesthetists or by operating surgeons (spinal surgery). They are usually placed under general anaesthesia. Infusions and catheter insertion sites must be reviewed regularly. Infusions are run through dedicated and clearly labelled infusion systems to avoid inadvertent injection of other medicines.

2.1.9 Plexus and field block infusions (including 'wound catheters')

Infusions of local anaesthetic can be delivered directly into nerve plexus compartments or tissue fields. Examples include brachial and femoral plexus blocks, paravertebral, intercostal and interpleural catheter infusions, wound catheters and rectus abdominis sheath infusions. Infusions are run through dedicated and clearly labelled infusion systems to avoid inadvertent injection of other medicines.

N.B. Paravertebral infusions should not be confused with epidural infusions.

2.2 Consultation Process for Pain Management Team

2.2.1 Chronic and Complex pain

For complex/chronic pain consultations, follow hospital policy and fill out a consultation form (Referral guide to adult and paediatric chronic pain services SMR010.730). Then notify the appropriate Pain Fellow (page #6848).

NOTIFY THE PAIN TEAM OF ALL NEW REFERRALS

(After hours, the on-call anaesthetic registrar (page #6008) should be notified)

2.2.2 Post-operative

Referrals for acute post-operative pain management are made by completing an Acute Pain referral form (M46F) and notifying the acute pain fellow (page #6236) or acute pain CNC (#6151). This referral form can be found and completed 'on-line' prior to printing (see Acute Pain Referral icon delivered through Novell®). The referral form can also be found on the SCHN website (see eMR/Forms). It should be printed and left with the patient medical record or left on the 'Recovery room pain clip-board' for the acute pain team.

For patients referred by anaesthetists following surgery, the anaesthetist will complete a Pain management prescription chart (M46J or M46C) and return it together with any appropriate infusion to the recovery ward. Recovery ward staff will then create a pain referral form using

the Pain management database (see Acute Pain Referral icon delivered through Novell®). Completed referral forms are kept in the recovery ward for collection each morning by the pain CNC.

2.2.3 Outpatients

For those wishing to access the Chronic and Complex Pain Clinic, call the hospital switch-board and ask for the Pain Service. (See: Referral guide to adult and paediatric chronic pain services SMR010.730)

2.2.4 Patients being discharged from PICU

All patients who are considered to have significant analgesic requirements or who are on a PCA, NCA or opioid infusion should be referred to the Acute Pain Service (or Palliative Care Service if appropriate) before discharge.

A careful and detailed handover should be a priority for:

- Surgical patients who have been receiving opioids or benzodiazepines for 7 days or more.
- Any patient who has been commenced on a withdrawal regimen, i.e. when analgesics or sedatives are being withdrawn slowly and/or there is a risk of withdrawal syndrome.
- All patients with burns
- Any patient with an epidural or regional infusion.

Notification to the Pain Service should occur before the expected date/ time of discharge. The Pain Service will visit PICU each morning (Mon-Sat) and collect names of expected discharges.

It is the responsibility of the PICU physicians to ensure that all relevant medication and Pain Management/Observation charts (M46J or M46CC and M34B) are correct and complete prior to discharge.

Complicated schedules for reduction of opioids and other drugs should be clearly documented in detail, including exact doses and dose frequency.

- **Note:** When a child is discharged out of hours, please notify the Duty Anaesthetic registrar (pager #6008).

Following prolonged ICU admissions, a PICU analgesia and sedation transition plan should be documented on the M46H form: https://intranet.schn.health.nsw.gov.au/files/picu_analgesia_and_sedation_transition_plan_0.pdf

2.3 Acute pain ward rounds

Acute pain ward rounds commence at 08:30am each **weekday** morning after collection of the new referral sheets (M46F) from the recovery ward. These rounds are generally attended by a consultant, the Pain Fellow and a Pain CNC. The Pain Fellow or Pain CNC may complete an evening review of complex patients also. Records of the round are kept in the "Pain folder" and changes to management are documented in the electronic medical record (EMR).

- On **Saturdays**, the round commences at 09:00am and is completed by the duty anaesthetic registrar ("Day Registrar") and a Pain CNC or NP. It should aim to review all patients by 12:00 mid-day before the registrar takes over anaesthesia duties in the

operating suite. *N.B.* the duty pager (#6008) should remain in theatres with the 'theatre registrar')

- On **Sundays and public holidays**, the duty anaesthetic registrar should attempt to see patients before 1pm. It is important that information from the previous days round is passed onto the Sunday duty registrar so that patient reviews can be prioritised according to need.

2.4 Documentation and record keeping

All prescriptions of opioid infusions/PCAs/NCAs and epidural or regional infusions must be made on the Pain Management Prescription chart -M46J or M46C. A 'place holder' prescription should be made in the eMM system. This does not include opioid infusions used for sedation in ventilated PICU/NICU patients. . The M46J/C prescription is valid for up to 7 days after the last dated prescription line or alteration. After 7 days, the prescription should be reviewed, dated and signed by a medical officer.

NB: this does not necessarily require a new chart to be completed. The prescription can be written, signed and dated on a new (alteration) line of the original chart if space allows.

The M46J chart is used in conjunction with the B Braun PCA/NCA pumps. The M46C charts are used in conjunction with CADD solis PCA/NCA pumps.

All patients receiving opioid infusions/PCAs/NCAs and epidural or regional infusions must have pain and sedation scores and pump parameters documented on the Pain Management observation chart (M34B).

The DPM (Department of Pain Medicine) maintains a "Case folder" of in-patients who have been referred to the service.

The DPM will make daily entries in the patient's progress notes to facilitate communication between referring physicians and the DPM. Anaesthesia registrars who review patients on weekends and after hours are encouraged to document their reviews in the medical record and add relevant details to the referral sheet (M46F) in the case folder.

2.5 Procedural pain

- Few common or typical analgesic drugs are effective for procedural pain. In most cases, a combination of local anaesthesia (LA) (especially topical LA creams) and brief sedation can be used to good effect. Relative analgesia afforded by inhaled nitrous oxide can often facilitate diagnostic and therapeutic procedures. Guidelines for its use are given below. Also refer to the Procedural Sedation Guidelines for more information on oral sedative agents and for sedation for specific procedures.
    - **Procedural Sedation (Paediatric Ward, Clinic and Imaging Areas) Practice Guideline**: http://webapps.schn.health.nsw.gov.au/epolicy/policy/4358
- Oral sucrose can be an effective intervention for procedural pain in neonates. Typical procedures include venipuncture, capillary blood sampling (heel lance), venous cannulation and lumbar puncture.
    - **Sucrose: Management of Short Duration Procedural Pain in Infants Practice Guidelines**: http://webapps.schn.health.nsw.gov.au/epolicy/policy/4022

- Closed fracture manipulation and application of plaster in the ED.

  Intranasal fentanyl has been identified as a rapid, painless, and safe method of administering opioids to paediatric patients in whom there is no intravenous access or who cannot tolerate the parenteral route of administration. It is suitable for children with moderate to severe procedure-related pain (>6 on an age appropriate pain scale) who might otherwise require intravenous opioids. It requires familiarity with the Mucosal Atomiser Device® (MAD). A typical dose is 1.5microg/kg which can be repeated once after 5-10 minutes (maximum dose of 3microg/kg). Children who receive intranasal fentanyl should be monitored with the same vigilance and precautions as a child receiving intravenous opioids. If no other restrictions to practice exist (see below), accredited registered nursing staff can deliver nitrous oxide following premedication with IN fentanyl.

  - **Intranasal Fentanyl used in the Emergency Department for Pain Relief Practice Guideline**: http://webapps.schn.health.nsw.gov.au/epolicy/policy/4820

3 Nitrous Oxide - Relative Analgesia

Nitrous oxide (N_2O) relative analgesia may be administered for painful procedures. Appropriate equipment must be used. Relative analgesia can be administered by:

- Members of the Department of Anaesthesia.
- Medical staff who are familiar with the technique and have had approval to administer relative analgesia from the Head of the Department of Anaesthesia or the Acute Pain Service.
- Registered nurses who have undergone required training. These registered nurses must have had at least 12 months paediatric experience. Registered nurses from all areas (ED, wards, Radiology, out-patients) are encouraged to undergo 'N_2O training'.
- Self-administered 50% N_2O (Entonox) can be made available for selected patients after consultation with the pain team.

3.1 Accreditation

This involves:

- Attendance at a SIM workshop.
- Successful completion of the nitrous oxide accreditation education package.
- Review of the sedation protocols.
- Safely administering relative analgesia on three separate occasions under observation from an accredited Registered Nurse or Medical Officer.
- Successful completion of the nitrous oxide 'Nursing Clinical Skills Assessment' with CNE or appropriate person

The accredited nurse's name will then be entered into HETI by the CNE.

All accredited staff are encouraged to attend a refresher session whenever they desire. These sessions are comprehensive education sessions and are available throughout the year.

3.2 Contra-indications

N_2O Relative analgesia must not be administered before consulting an anaesthetist where:

- There is impending airway obstruction.
- A child has an acutely impaired level of consciousness.
- A gas filled cavity may cause deterioration e.g. undrained pneumothorax, recent middle ear surgery or intracranial surgery (nitrous oxide diffuses into gas-containing cavities).
- There a known cobalamin-dependent inborn errors of metabolism (e.g. MTHFR deficiency).

3.3 Restrictions to Practice

Registered nurses **are not** to administer nitrous oxide relative analgesia to infants who are under the age of 12 months.

Accredited registered nurses (with the exception of the Clinical Nurse Consultants and Pain Service members) **must consult an anaesthetist or senior medical staff before** administering nitrous oxide procedural analgesia to patients:

- with airway or facial burns.
- with difficult airways.
- with a recent tracheostomy (i.e. a tracheostomy before its first tube change).
- with an impaired level of consciousness.
- with a pneumothorax or who has had recent middle ear surgery or recent neurosurgery.
- with respiratory distress or disease.
- who are ventilated in the Paediatric Intensive Care Unit (PICU).
- who have been extubated within the last 24 hours.
- who require IV sedation as premedication for the procedure.
- in an area without resuscitation equipment.

Notes: *Where any of the conditions above exist, members of the Anaesthetic Department,Pain Service or senior medical ED staff will undertake an assessment and can advise on the administration of nitrous oxide if they deem it appropriate.*

Accredited registered nurses may administer nitrous oxide to children receiving systemic opioids (PCA, NCA or infusion) if these have provided stable analgesia in the preceding hour. Nursing staff may administer nitrous oxide to children who have received intranasal fentanyl as a premedication for fracture manipulation and application of plaster in the ED, if no other restrictions to practice exist.

3.4 Equipment

- Nitrous oxide machine with Matrix Quantiflex head
- Nitrous oxide circuit
- Minimum volume anti–viral, anti–bacterial filter (for children greater than 10kg)
- Appropriate mask

- Gas scavenge circuit
- Pulse oximeter
- Yankeur sucker and (wall or portable) suction
- Resuscitation equipment must be available within the ward/department

Circuits, masks and filters are available from the Inhalation Therapy Department on level 3 and masks should be returned for cleaning (the antiviral filter and circuits are disposable).

All components of the circuit must be thoroughly checked before administration of the gas commences. The circuit check should be completed by the Sedationist.

To familiarise yourself with the Quantiflex machine and N_2O circuit see:
http://chw.schn.health.nsw.gov.au/ou/pain/resources/guides_and_in_service_packages/nitrous_oxide_for_procedural_sedation.pdf

3.5 Before Administration of Nitrous Oxide

Note: Nitrous oxide must be prescribed by a Medical Officer on the Procedural sedation prescription chart (M16B) or via the eMM system. The patient must be assessed by a medical officer and an order written on the Procedural sedation chart (M16B) or via eMM. This prescription may allow for single use or repeated use during a course of treatments (i.e. Burns dressings).

- For outpatients, the prescription may be written on the procedure request form.
- Parents and/or patients should provide informed consent.

3.6 Fasting

- The patient should be adequately fasted to prevent vomiting.
- No oral food/milk/fluid or intragastric feeds for two (2) hours prior to the procedure.
- If an oral or IV premedication is to be given, the patient must be fasted from food, milk and intra-gastric feeds for four (4) hours. Clear fluids can be given up to 2 hours prior to sedation.

Note: Nitrous oxide procedural analgesia is aimed at providing a level of sedation with a low risk of losing upper airway reflexes. If, for any reason, a proposed sedation regimen is judged to have a moderate or high risk of reflex loss, then longer fasting times will be necessary and serious consideration should be given to general anaesthesia techniques.

Parents/carers should be issued with a **parent information sheet**: available at:
https://www.schn.health.nsw.gov.au/parents-and-carers/fact-sheets/nitrous-oxide

3.7 Procedure

The sedationist should only be responsible for the delivery of the nitrous oxide procedural analgesia and **must not** perform any part of the procedure.

1. The patient must have a pulse oximeter in situ and the sedationist must maintain verbal contact with the patient throughout the procedure.

2. Nitrous oxide should be administered for 3-4 minutes before commencement of the procedure. 100% oxygen is to be administered for 3 minutes post procedure to prevent diffusion hypoxia.
3. If the nitrous oxide is removed for greater than 30 secs at any stage, 100% oxygen should be applied for three (3) minutes, to prevent diffusion hypoxia.

Notes:

- Take care during patient transfers immediately following N_2O as gait and co-ordination may be affected.
- Outpatients and children in the Emergency dept should not leave the department until they have returned to their pre-sedation state.

3.8 Documentation

A written record of the administration must be kept in the patient's clinical record. This is most easily done by using the 'Procedural sedation form (M16B) which acts as an assessment, prescription and observation chart: https://intranet.schn.health.nsw.gov.au/files/procedural_sedation_0.pdf

3.9 Repeated exposure to Nitrous oxide

Nitrous oxide is regularly used for procedural sedation at CHW and is generally found to be effective and safe. Some children require repeated sedation with this gas to facilitate procedures such as dressing changes. Typically, these are children who have sustained large areas of burns and have been through periods of severe illness including prolonged intensive care support. They are often nutritionally depleted and often have an on-going pain syndrome.

N_2O is known to interfere with Vitamin B12 and folate metabolism. Megaloblastic bone marrow changes can be detected following exposures of several hours. Leucopaenia, megaloblastic anaemia and subacute combined degeneration of the cord are well recognised complications of prolonged exposure to nitrous oxide.

- The risks of repeated brief exposures to nitrous oxide are unknown.

  Given the potential for adverse outcomes and the relative safety of vitamin supplements, the Pain Service at CHW recommends the following approach.

- For all cases that require nitrous oxide administrations three times a week or more for a period of two weeks or more:

Add regular folate 250-500 microgram/kg/dose oral daily (max 10 mg) and Vitamin B-12 5 mg orally per dose daily
Folate is available as an oral solution (500 microgram/mL) or as 500 microgram tablets.
Vit B12 (Hydroxycobalamin) is available as an oral solution 5 mg/mL
Note: Pentavite contains neither folate nor Vit B12

3.10 Sedation delivered by anaesthetists to burns patients

The department of anaesthesia provides an Anaesthesia fellow to facilitate procedural sedation for patients with major burns in Clubbe Ward. Where sedation cannot be delivered by accredited ward nursing staff (see 3.3 Restrictions to Practice), this anaesthesia fellow may be called on to assess and deliver nitrous oxide if appropriate.

The Anaesthesia pain/Sedation Fellow will generally liaise closely with the team leader in Clubbe Ward on a daily basis and will often be available to advise on acute pain management problems within that ward. If the Anaesthesia pain/Sedation Fellow is not available, please discuss any concerns with the duty Consultant Anaesthetist (page #6777).

The Anaesthesia pain/Sedation Fellow will document all administrations of nitrous oxide using the Procedural sedation form- M16B.

3.11 Recovery from nitrous oxide sedation

Criteria signifying complete recovery:

- conscious level: appropriate to developmental stage
- stable vital signs (HR and Respiratory rate no greater than 30% above or below pre-sedation values, Room air oxygen saturation >94%)
- cough and gag reflex normal
- ambulation consistent with developmental stage
- absence of respiratory distress
- absence of nausea, vomiting and dizziness.

That a child accepts/ tolerates oral fluids is usually a good sign of “home readiness”, but it is not essential. Similarly, post sedation voiding is not a precondition for discharge.

3.12 Adverse events and prolonged recovery from nitrous oxide

The following is relevant for out-patients. In the event of an adverse event or prolonged recovery (i.e. 1 hour following procedure, the patient is still not transferred to a chair or continues to require supplemental oxygen or intravenous fluids, is distressed and inconsolable, has persistent nausea and or vomiting or is too dizzy to ambulate) the following should be observed.

The sedationist should notify the duty Anaesthetist (page #6777) to discuss the advisability of transferring the patient to a recovery ward.

On deciding to do so:

- the operating theatre floor manager (#52380 or 52381) should be notified. The NUM of Main recovery (Todman Ward) or the NUM of Short stay (Middleton Ward) will then be notified. The child should be transferred to whichever ward is deemed most appropriate by the pain consultant/duty anaesthetist.
- the referring physician/surgeon should be notified.
- the Registrar of the referring team should be notified and is responsible for ensuring appropriate admission papers (short stay) are completed.

- should an overnight stay be required, the operating theatre floor manager (page #6182) must be notified so that the bed manager may make appropriate arrangements. The registrar of the appropriate team should be notified and remains responsible for eventual patient discharge.
- specific care (e.g. intravenous fluids, sedation, anti-emetics, bronchodilator therapy) will be prescribed and managed by the acute pain fellow or pain consultant of the day.

In the event of a major adverse event requiring intensive therapy, management should proceed following liaison between the Sedationist, Pain Consultant of the day, ICU staff and the general medical admitting officer for the day. The referring physician/surgeon should be notified that care of his patient will be continued by the "on-take" Physician of the day.

> In the event of cardio-respiratory arrest, call **2222** and follow CPR Practice Guidelines: http://webapps.schn.health.nsw.gov.au/epolicy/policy/4947

4 Management of Pain Using Simple Oral Analgesics: Acute-mild-moderate pain

The management of acute mild-moderate pain at CHW is based on a multi-modal approach that is both inexpensive and simple. Paracetamol, NSAIDs, local anaesthesia and oral opioids can all be used.

4.1 Paracetamol (Acetaminophen)

NSW Health Policy Directive: https://www1.health.nsw.gov.au/pds/Pages/doc.aspx?dn=PD2019_058

Paracetamol acts both centrally and peripherally, in part by inhibiting prostaglandin synthesis.

Actions:

Apart from significant antipyretic effects, paracetamol is analgesic in its own right for mild to moderate pain. It has proven efficacy in acute, post-operative and chronic pain including migraine and musculoskeletal pain. For severe pain, it is synergistic with non-steroidal anti-inflammatory drugs (NSAIDs) and reduces opioid requirements.

Pharmacokinetics in infants and children:

Oral doses are subject to first pass hepatic metabolism of 10-40%.

Clearance is reduced in neonates. Patterns of biotransformation are also age-dependent. The relative importance of sulphation is gradually reduced as glucuronide conjugation systems mature.

Rectal administration is associated with slower absorption. Mean relative bioavailability following rectal administration is 78% (95%CI 55-101%). Rectal dosing of paracetamol may be associated with subtherapeutic plasma concentrations unless doses of 40mg/kg are used for loading.

In the peri-operative pain setting, it is wise to administer paracetamol up to two hours before expected painful procedures as there are well documented delays between dosing and peak analgesic effect. For both elective and urgent surgery, paracetamol can be used with good effect if given as a part of any pre-medication for anaesthesia. Peri-operative analgesia can be

optimised by combining paracetamol with local or regional analgesia, opioids and non-steroidal anti-inflammatory drugs.

When treating moderate to severe pain of predictable and short duration, it is reasonable to prescribe paracetamol on a regular dosing schedule (rather than on an "as needed basis") for up to 48 hours.

Extended use of paracetamol

Extreme care should be taken when prescribing paracetamol for extended periods of time. Hepatotoxicity has been reported in children following chronic therapeutic dosing. The following table may be used to guide extended use of paracetamol.

	Maximum daily dosing - (Absolute = 4g/day)	
	Oral or rectal administration	**IV administration**
First 48 hour period	90 mg/kg/day (children >3 months) 60 mg/kg/day (infants <3 months	60 mg/kg/day
Subsequent days	60 mg/kg/day *all paracetamol prescriptions should be reviewed after 48 hours*	
After 8 days of administration	Consider reducing maximum daily dose to 45 mg/kg/d	
After 14 days of regular administration	Consider reducing maximum daily dose to 30 mg/kg/d	

Potential hepatotoxicity

Paracetamol in overdose is known to be hepatotoxic. It may result in fulminant hepatic failure and death. The introduction of intravenous paracetamol to CHW mandates that all staff are aware of the risks of paracetamol-induced liver dysfunction.

The potential for inadvertent administration of oral formulations via an intravenous line should also be borne in mind.

Single ingestions of more than 10 times the recommended dose are potentially hepatotoxic as are exposures greater than 140 mg/kg/day for several days. Hepatoxicity results from the formation of reactive intermediate metabolites in particular N-acetyl-p-benzoquinone via the cytochrome P-450 enzyme system. These metabolites are usually rendered non-toxic and eliminated after conjugation with glutathione. Production of toxic metabolites increases if sulphation and glucuronidation pathways become saturated. Paracetamol may display a higher therapeutic index in neonates as a result of reduced cytochrome P450 enzyme function and relatively greater glutathione synthetic rates. Despite this, and the lower incidence of liver failure due to paracetamol overdose in infants, vigilance must be maintained as neonates are capable of producing reactive intermediate metabolites. Risk factors for paracetamol hepatoxicity include: prolonged fasting/ vomiting/ dehydration, systemic sepsis/febrile illness, severe hepatic impairment, chronic undernutrition and prior paracetamol intake. Each of these factors are thought to deplete glutathione stores and/or sulphate and glucuronide precursors that are critical in the metabolism and elimination of paracetamol and its metabolites.

- Rectal medication should be avoided in neutropaenic patients.

- Contra-indications to use:
  - Known sensitivity to paracetamol
  - Severe liver disease
- Caution should be exercised when prescribing paracetamol to children who are malnourished or dehydrated.

Preparations:

There are a wide variety of commercial preparations of differing concentrations and formulations available. The doses prescribed on these packets may differ from the doses prescribed within CHW. Care must be taken when administering paracetamol syrup as at least three commercially available strengths are available (24 mg/mL, 48 mg/mL and 100 mg/mL oral drops).

1. **Oral liquid** = 240 mg/5 mL
2. **Oral drops** = 100 mg/mL (not used at CHW)
3. **Oral tablets** = 500 mg
4. **Rectal suppositories**: 50mg, 125mg, 250mg and 500mg (These cannot be 'cut down')
5. **IV paracetamol**
   - 10 mg/mL 100 mL bag see section 4.2.2 below

Routes and dosage:

1. **Oral**
   - Oral dosage recommendations for children 3 month to 12 years are:
     - 15 mg/kg per dose every four to six hours as required, to a maximum of 90 mg/kg in any 24 hour period (but not more than 4 grams total dose).
   - In infants up to 3 months of age recommended doses are 15 mg/kg per dose every 6-8 hours, to a maximum 60 mg/kg in any 24 hour period.
   - In the setting of acute injury or surgery an initial loading dose of 20-30 mg/kg should be considered.
2. **Rectal**

   For infants and children who do not tolerate oral medication, who are being kept strictly "nil by mouth" or who are nauseated and vomiting, paracetamol may be administered as a rectal suppository. (Suppositories should not be used in neutropaenic patients or patients who are severely immunocompromised.)

   Initial loading doses should be of 40 mg/kg and subsequent doses of 20 mg/kg per dose may be given every 6-8 hours. Loading doses for neonates (<3 months) should be 30 mg/kg.

   Note: The loading dose makes up a significant part of the total allowance for the first day of treatment.

3. Intravenous

Intravenous paracetamol should only be used where the enteral route is genuinely not available.

Prescriptions should specify a SINGLE route of administration.

Do NOT provide alternative routes e.g. oral or intravenous within the same prescription.

Dosage guidelines are based on estimated lean body weight (LBW). For *obese* children, this is less than their measured weight. The *'ideal weight'* for dose calculation purposes for a child may be approximated using growth charts which can be accessed at: http://www.cdc.gov/growthcharts/

If age and height are known, a height growth chart will indicate the percentile at which to read the weight from a weight growth chart.

If only age is known, reading from the 50th percentile on a weight growth chart is a practical and expedient method for weight (LBW) estimation.

For *underweight, malnourished or inactive* children recommended dose is based on actual bodyweight whilst taking into consideration general nutritional status and precautions as discussed under risk factors.

Document the dosing weight in the EMR.

- *For more information refer to NSW Health High Risk medication Management Policy* https://www1.health.nsw.gov.au/pds/Pages/doc.aspx?dn=PD2019_058

4.1.1 Paracetamol dosing guideline (enteral administration)

PARACETAMOL								
	Oral			Rectal				
	Loading Dose	Maintenance Dose	Dosing interval	Loading Dose	Maintenance Dose	Dosing interval	**Maximum Daily dose**	Duration at maximum dose
Age group	(mg/kg)	(mg/kg)	(h)	(mg/kg)	(mg/kg)	(h)	**mg/kg/d**	(h)
28- 32 weeks PCA	25	10	8	25	15	12	**40**	48
32- 44 weeks PCA	25	10-15	6	30	20	8	**60**	48
1-3 months	20-30	15-20	6	20-30	20	8	**60**	48
>3 months	30	15	4-6	30-40	20	6	**90 (for 48 hours then 60)** **Max:4g/day**	48

Paracetamol should not be administered regularly to children for more than 48 hours without seeking medical review.

4.1.2 Intravenous paracetamol

Intravenous paracetamol should only be used where the enteral route is genuinely not available.

Formulation

- Aqueous solution 10 mg/mL paracetamol 100 mL bags.

Always double check the milligram prescription and calculate the medication volume carefully.

Indications for IV Paracetamol

- Children who are fasting or NBM post-operatively. Typically children undergoing laparotomy/ bowel surgery.
- Intra-operative loading of paracetamol for children undergoing long surgical procedures.

  Typically: neurosurgery, spinal surgery, craniofacial surgery, multilevel orthopaedic surgery where oral intake will likely be delayed due to sedation or nausea.

  Note: Short cases will continue to be managed using oral paracetamol premedication and/or peri-operative (under GA) rectal suppositories.
- In emergency cases in children undergoing major surgery where Pre-operative oral dosing is not feasible. (Typically trauma surgery)
- Children with mucositis in whom oral, rectal or nasogastric-tube paracetamol administration is not feasible.
- Children with acute pain crises e.g. sickle cell pain crisis who are unlikely to tolerate oral formulations.

IV paracetamol should NOT be used where alternative routes of administration are available.

Dosing

DO NOT CONFUSE MEDICATION DOSE (mg) WITH VOLUME (mL)!

INTRA-VENOUS PARACETAMOL DOSING			
	Maintenance Dose	Dosing interval	**Maximum Daily dose**
Age group	(mg/kg)	(h)	**mg/kg/d**
28- 32 weeks PCA *(Post conceptional age)*	10	8	**30**
32- 44 weeks PCA	10	6	**40**
In neonates, medication volumes are <5mL			
1 – 3 months	15	8	**45**
>3 months	15	6	**60**

If using maximal allowable daily amounts of IV paracetamol, administration should not exceed 48 hours. All IV paracetamol orders should be reviewed daily.

In neonates – medication administration volumes are SMALL i.e. 1.5 to 5 mL only.

Always double check the milligram prescription and calculate medication volumes carefully

AVOID MEDICATION ERRORS AND INADVERTENT OVER-DOSE

Risk Management strategy

The following risk management strategies for IV paracetamol have been put in place at CHW.

- The CHW pharmacy will supply only one brand/formulation of IV paracetamol to all clinical areas at any point in time.
- Vials/bags will not be connected directly to an IV giving set but drawn up in an appropriately sized syringe and delivered via an infusion burette.
- Prescriptions will be documented in milligrams only. They should specify a maximum daily dose and require review after 48hours.
- Dosage and indications are made available through 'Med4Kids' and departmental practice guidelines e.g. Pain Management Guidelines, ED pain management guidelines.
- Particular care must be taken in neonates as volume doses are relatively small.

4.2 Non-Steroidal anti-inflammatory drugs (NSAIDs)

The use of non-steroidal anti-inflammatory drugs (NSAIDs) has been shown to decrease opioid consumption and improve the quality of analgesia without increasing the incidence of side effects. The combination of paracetamol with an NSAID has been shown to be particularly effective in acute pain management. NSAID drugs are now available in oral, rectal and intravenous formulations. The oral route is preferred whenever it is feasible. See contra-indications/ precautions below.

4.2.1 Aspirin

Not recommended for use in **paediatric acute pain management** due to the risk of Reye's syndrome although it is regularly used in paediatric rheumatology and cardiology.

4.2.2 Ibuprofen (Nurofen®)

Ibuprofen is effective for acute post-operative pain, dental, musculoskeletal pain and headache.

Dose

- Oral = 10 mg/kg per dose (max 400 mg per dose) PRN q6-8 hourly (max 40 mg/Kg per day or 1.6 gm per day in divided doses.

Preparation

- Oral liquid containing100 mg/5mL
- Oral tablets 200 mg

4.2.3 Intravenous Ibuprofen (Caldolor®)

Dose

- Intravenous 10 mg/kg per dose (max 400 mg per dose) PRN q6-8 hourly (max 40mg/Kg per day or 1.6 gm per day

See Meds4Kids: *http://webapps.schn.health.nsw.gov.au/meds4kids/browse/I*

Preparation

Concentrated injection for intravenous administration= 800 mg in 8 mL for dilution. The drug must be diluted to a maximum concentration of 4 mg/mL with sodium chloride 0.9% or 5% glucose.

Indications

1. Surgical patients who require IV analgesia especially those undergoing orthopaedic surgery, general surgery such as appendicectomy and dental surgery.
2. Surgical patients requiring IV analgesia not suitable to receive opioid analgesia or where opioid-sparing is important- for example patients at risk of respiratory depression (e.g: obstructive sleep apnoea).
3. Patients nil by mouth or unable to tolerate oral medication immediately following surgery.

Authorised prescribers:

- Anaesthetists and the Pain Team

ALWAYS DILUTE CALDOLOR APPROPRIATELY. ADMINISTER INTO A SECURE AND FREE FLOWING INTRAVENOUS CANNULA PLACED IN A LARGE VEIN. AVOID VENOUS STASIS DURING DELIVERY. DO NOT MIX WITH OTHER MEDICATIONS.

4.2.4 Indomethacin (Indocid®)

Indomethacin is effective for, post-operative bone pain and dysmenorrhoea.

Oral Dose

- 0.5 -1mg/kg per dose PRN q6-8 hourly (max 200 mg per day)

Other preparations

- Rectal suppositories = 100 mg (suitable for children over 70 kg)

  Dose: 100mg bd for children over 70kg

Do not cut down suppositories for smaller doses, as the suppository contents are not distributed evenly.

4.2.5 Diclofenac (Voltaren®)

Children >10 kg: This drug is particularly useful in the peri-operative setting for mild-moderate post-operative pain. It can be combined with paracetamol, opioids and local anaesthetic techniques. Always obtain consent from parents/guardians prior to administration.

Dose

- Oral = 1 mg/kg/dose (max 50mg) q 8 hourly
- Rectal = 3 mg/kg per day PRN divided q8-12 hourly (max 3 mg/kg/day or 150 mg/d whichever is less)

Preparation

- Tablets 25 mg and 50 mg
- Suppositories 12.5 mg, 25 mg and 50 mg

The use of suppositories

- Parental consent (verbal) must be obtained before suppositories are used.
- Suppositories should not be used in neutropenic patients or patients who are severely immunocompromised.

4.2.6 Ketorolac (Toradol®)

Ketorolac trometamol is a potent NSAID that inhibits peripheral prostaglandin synthesis. It is available in the theatre suite in a 1mL glass ampoule containing 10 mg/mL. (It is not available on the general wards).

Dose

- 0.5 mg/kg intramuscular injection Max 10 mg/dose

Note: Although only licensed for intra-muscular use. Ketorolac is typically administered IV as a single intra-operative dose

4.2.7 Parecoxib (Dynastat®)

Parecoxib is a selective cyclooxygenase-2 (COX-2) inhibitor. Being selective, it has a lesser impact on platelet aggregation, bronchial tone and gastric mucosal integrity than non-selective inhibitors.

Dose: A single intravenous dose of 0.5-1 mg/kg (maximum of 40 mg) can be administered by the anaesthetist in theatres or as part of specific ERAS (Enhanced Recovery After Surgery) protocols. The following weight based doses can be used:

10–15 kg, IV	0.9 mg/kg.	
15–25 kg, IV	0.8 mg/kg.	
25–40 kg, IV	0.7 mg/kg.	
>40 kg, IV	0.6 mg/kg	(maximum 40 mg).

As the drug may be active for 12-24 hours, further NSAIDs should be withheld until the following day.

Preparation: 5mL vial containing 40 mg preservative-free, lyophilised powder for reconstitution and dilution. Available in theatres only.

Authorised prescribers:

- Anaesthetists and Pain team only

Contraindications to NSAIDs:

- Gastro-intestinal ulceration, ulcerative colitis or Crohn's disease.
- Liver dysfunction.
- Clotting coagulation abnormality or presence or potential for active bleeding.
- Acute spinal cord injuries.
- Severe asthma or acute rhinitis, especially if exacerbated by aspirin.
- Renal disease, diuretic therapy or situations of decreased renal perfusion eg. hypotension, hypovolemia, rhabdomyolysis, significant dehydration.
- Some orthopaedic procedures, where bone healing may be compromised.
- Children with un-treated bone or joint sepsis i.e. osteomyelitis or septic arthritis.

Caution is advised in children receiving ACE-inhibitors, diuretics, nephrotoxic medications, probenecid, lithium, psychoactive medications e.g. fluoxetine.

Key Points

- Note the previous history and check contraindications before prescribing NSAIDs.
- Extreme caution in intracranial neurosurgery where even a small increased risk of bleeding may be catastrophic. See Section 12.6 Analgesia following neurosurgery.
- NSAIDs are very useful on their own, but are especially effective when used in combination with paracetamol and/or opioids.

ALWAYS ENSURE PATIENTS ARE ADEQUATELY HYDRATED WHEN USING NSAIDs

5 Managing Pain Using Oral Opioid Medications

5.1 Opioids

Opioid medications are the mainstay in the management of moderate to severe pain in paediatrics. Opioids provide analgesia by binding to the opioid receptors both within and outside the central nervous system. The differences between various opioids are principally kinetic and often linked to solubility

	Partition co-efficient Octanol: pH7.4	Total body clearance mL/kg/min	Elimination half life hrs	Volume of distribution L/kg
Morphine	1.4	12 - 34	1.4 - 4	1.1 - 2.1
Fentanyl	813	12 - 15	2- 5	3 - 4.5
Oxycodone	0.7	10 - 15	3 - 5	2.6
Methadone	highly lipid soluble	1- 6	36- 44	5.3- 6
Hydromorphone	525	26	2.3 - 2.6	4.3
Remifentanil	17.9	30-40	0.7- 1.2	0.2- 0.3
Tramadol	1.35	6-9	5-7	2-3

Opioids act on the central nervous system as receptor agonists. The most important opioid receptor site relevant to clinical analgesia is the 'mu' receptor.

Opioids are analgesic by virtue of their effect on both central (peri-aqueductal grey) and spinal neurones. Central mu receptor effects are also responsible for side effects such as respiratory depression, miosis, and nausea and vomiting. Pruritus may be the result of actions at the level of the spinal cord. Constipation is the result of direct action on the gut. Pharmacodynamic differences between opioids are difficult to demonstrate but anecdotal evidence suggests that these differences do exist.

When prescribing opioids always ensure that carers and patients and fully informed of the rationale, benefits and risks of these drugs. Be aware of previous responses to these drugs and the potential requirement of anti-emetic and laxative medications. Ensure naloxone reversal is readily available.

5.1.1 Morphine

Morphine remains important in the management of acute pain.

The important kinetic features of morphine are a:

- high total body clearance (reflecting a high plasma clearance rate and lower CNS clearance rate) and
- a relatively small volume of distribution.

These features make morphine a good choice for infusion techniques as it affords greater titratability with less risk of accumulation.

Morphine kinetics is age dependent. The table below describes how kinetic parameters change during development.

AGE GROUP	Volume of distribution (L/kg)	Clearance (mL/kg/min)	Half life (hours)
Pre-term neonate	1.8 - 5.2	2.7 - 9.6	7.4 - 10.6
Term neonate	2.9 - 3.4	2.3 - 20	6.7 - 13.9
1 - 8yrs	1.4 - 3.1	6.2 - 56.2	0.8 - 1.2
Adult	1.1 - 2.1	12 - 34	1.4 - 3

5.1.2 Fentanyl

Fentanyl is a highly lipid soluble, synthetic opioid with a potency almost 100 times that of morphine. It is metabolised by the liver and its elimination half-life is therefore sensitive to hepatic blood flow. It has a low propensity to cause histamine release and is very widely used for intra-operative analgesia.

5.1.3 Hydromorphone

Hydromorphone is a hydrated morphine ketone, and is a mu agonist. It is thought to be approximately seven (7) times as potent as morphine. Both intravenous and oral forms are available.

Prescription is restricted to Pain Team members, Anaesthetists, Oncologists and Intensivists.

Hydromorphone is registered as a high risk medication at CHW

5.1.4 Oxycodone

Oxycodone is a semi-synthetic mu agonist whose active metabolite, oxymorphone has a higher opioid-receptor binding affinity.

It has a good bioavailability (up to 80%) as opposed to that of morphine whose bioavailability is only 20%. The volume of distribution of oxycodone is similar to that of morphine (2-3L/kg) but its elimination is slower (t1/2 =3-5 hours after immediate release preparation. Metabolism is principally via O-demethylation to oxymorphone. Clearance is reduced in renal failure with a resultant increase in half-life (t1/2=3.9 hours in uraemic patients). Changes in clearance and half-life are more marked in liver failure.

The analgesic effects of oxycodone are similar to morphine, though in adults it is said to have a more rapid onset and longer duration. Both drugs morphine and oxycodone cause typical opioid-related side effects but several reports suggest that hallucinations may be less frequent with oxycodone. Oxycodone releases significantly less histamine than morphine.

5.1.5 Tramadol

Tramadol is a synthetic analgesic (first introduced into Germany in 1977) that acts centrally on mu opioid agonist and also inhibits neuronal monoamine re-uptake. The analgesic action of tramadol appears to result from a complementary effect of these two mechanisms.

It is rapidly and almost fully absorbed (oral bioavailability 65-75%) after oral administration. A ceiling effect makes tramadol unsuitable for the treatment of severe pain or mild-to-moderate escalating pain.

The most common adverse effects of tramadol use include dizziness, nausea, constipation, headache, and somnolence. Nausea and vomiting can be a problem and ondansetron is ineffective in its treatment. Respiratory depression is a particular risk if tramadol is used in combination with pure opioids. Initial slow titration of tramadol may minimize adverse effects such as nausea, vomiting, and dysphoria.

5.2 First line oral Opioids

These include oxycodone, morphine and tramadol.

5.2.1 Oxycodone (Endone®, Oxynorm® and Oxycontin®)

Oxycodone is available in at least three oral formulations, a slow release (Oxycontin® and Targin® tablets) and immediate release (Endone® tablets) form and an immediate release syrup (Oxynorm®).

Oxycodone is suitable for prescription as a "background and break-through" combination. Oxycontin® is usually prescribed as a twice-daily regular medication for 'background analgesia' and Endone® or Oxynorm® as a PRN- 4th hourly medication for break-through pain.

TAKE CARE WHEN PRESCRIBING. AVOID CONFUSION BETWEEN SLOW RELEASE AND IMMEDIATE RELEASE PREPARATIONS

5.2.2 Oxycodone

Preparation

- Endone® tablets: 5 mg
- Oxycontin®: 10, 20, 40 and 80 mg slow release tablets
- Oxycodone liquid: 5mg/5mL (Oxynorm® 250 mL bottles for ward use, clear colourless to straw coloured liquid)
- Oxycodone syrup for discharge ('prepared pack') 5 mg/5 mL available in 10 mL, 25 mL and 50 mL bottles.
- Oxycodone for intravenous use: 10mg/mL (1mL vial)

Dose

When a total daily morphine requirement is not established from previous experience, initial dosing is:

- Oxycodone (Endone® tablets or syrup): 0.1 - 0.2 mg/kg per dose 4 - 6 hourly PRN

5.2.3 Converting to oral Oxycodone

Oxycodone is one of the most common oral immediate release opoids in current use at CHW. The following table may help to calculate equivalent opioid doses.

Total oral **oxycodone equivalent (mg/day)=** Total **prior opioid (**mg/day**)** x factor	
Prior opioid	**Factor to calculate equivalent amount of oxycodone**
Morphine (enteral- oral)	0.5
Morphine (parenteral- intravenous)	3
Codeine (enteral- oral)	0.15
Hydromorphone (enteral- oral)	4
Hydromorphone (parenteral- intravenous)	20
Pethidine (parenteral- intravenous)	0.4
Methadone (enteral- oral)	1.5
Methadone ((parenteral- intravenous)	3

5.2.4 Morphine (immediate release)

Morphine is a widely used and highly effective analgesic. It has a low oral bioavailability (30-40%) hence oral doses are 2-3 times larger than parenteral doses.

Dose

- Oral = 0.2 - 0.5 mg/kg per dose PRN q4 hourly
- Infants under 12 months 0.1 -0.2 mg/kg/dose PRN q4 hourly

Preparation

- Oral liquid = 1 mg/mL, 2 mg/mL, 5 mg/mL, 10 mg/mL
- Tablets = 30 mg

5.2.5 Tramadol

Tramadol should be avoided in patients who take other serotonin re-uptake inhibitors and/or tricyclic antidepressants. Tramadol lowers seizure thresholds; therefore care should be taken when using it in conjunction with any other drug that also lowers the seizure threshold. Care is recommended when prescribing tramadol with drugs such as promethazine, opioids, monoamine oxidase inhibitors and anti-neuroleptics.

Abrupt discontinuation of tramadol may result in withdrawal symptoms; gradually tapering doses downward is the best course to prevent this.

Dose

- Oral = 1 mg/kg per dose PRN q4 hourly
  (Max 6mg/kg/day or 400mg/day whichever is less)

Preparation

- Capsule = 50 mg
- Oral liquid ('Tramadol drops') 100 mg/mL - NOT RECOMMENDED FOR ACUTE PAIN MANAGEMENT AT CHW ('5 drops deliver 12.5 mg')

Precautions

- Patients with epilepsy as tramadol lowers seizure threshold.
- Patients with hepatic or renal impairment as hepatic impairment reduces drug metabolism, renal impairment decreases excretion. In patients with creatinine clearances of less than 30 mL/minute, dosage reduction is recommended. Tramadol is not recommended in patients with severe renal impairment (creatinine clearance <10 mL/minute)

Drug interactions

Tramadol should be used with caution in patients on concomitant medications which lower seizure threshold, such as tricyclic antidepressants, selective serotonin reuptake inhibitors (SSRIs), major tranquillisers, fentanyl and especially pethidine. Tramadol is contraindicated in patients who have taken monoamine oxidase inhibitors within the previous two weeks.

A serotonin syndrome may occur with the concomitant administration of other serotonergic agents such as selective serotonin reuptake inhibitors (SSRIs) or monoamine oxidase inhibitors (moclobemide, phenelzine).

The interaction of tramadol with coumarin anticoagulants resulting in increased International Normalised Ratio (INR) has been reported.

Tramadol is metabolised by the CYP2D6 isoenzyme of the cytochrome P-450 enzyme system. CYP2D6 metabolises a multitude of drugs including tricyclic anti-depressants, haloperidol, risperidone, flecainide, dextromethorphan and codeine. Drugs that selectively inhibit this isoenzyme (e.g. fluoxetine, paroxetine, quinidine, phenothiazines, and antipsychotic agents) may cause increased concentrations of tramadol and decreased concentrations of its major metabolite. The clinical significance of these interactions has not been fully investigated.

Concomitant administration of carbamazepine increases the metabolism of tramadol.

5.2.6 Codeine

This previously widely used opioid has less potency than morphine. Once absorbed it is converted to morphine (the likely active metabolite) in the liver. It has a good oral bioavailability (60-70%). Increasing the dose causes more side effects without increased analgesia. Because Codeine is a prodrug and relies on hepatic metabolism for conversion to morphine its efficacy is variable. The prevalence of the necessary enzyme varies between ethnic groups. Ten percent of the caucasian population lack the enzyme that converts codeine to morphine. Codeine is now infrequently prescribed. Codeine should not be used in children undergoing airway-related surgeries.

Dose

- Oral = 1 mg/kg per dose PRN q4 hourly (dose limit: 60 mg per dose)

Preparation

- Oral linctus = 25 mg/5mL
- Oral tablet = 30 mg

Note: Codeine is an S8 drug.
Combination products (S4) are not prescribed at CHW
The parenteral form is no longer available.

5.3 Slow release formulations

5.3.1 Slow Release Morphine

Slow release morphine (MS Contin®) is used with good effect in patients who require on-going 'background analgesia' such as patients with burns or following major trauma. The dosage interval is 12 hourly and doses are titrated as required. Slow release morphine is not useful for acute incident or breakthrough pain. There are two preparations available (Controlled release tablets and MS Contin granules for suspension). The choice of preparation is based on patient convenience and dosing requirements.

Dose

- Calculate total daily morphine consumption. 25 to 35% of this total is delivered in slow release form twice a day (bd). Typical doses start at 0.4 - 0.6 mg/kg per dose given twice daily (applies to both MR morphine and MS Contin). This allows further opioid requirement to be met with immediate release formulations on an as-needed basis.

Preparations

- Controlled (modified) release tablets
  - MR tablets = 5 mg, 10 mg, 30 mg and 100 mg

Tablets should not be chewed.

5.3.2 MS Contin® Sachet

- Oral (granules for suspension) available in either 20 mg or 30 mg sachet

MS Contin sachets (20 mg or 30 mg) should be diluted as directed. This preparation is convenient for fractional or small doses and for weaning regimens. The suspension can also be put down NG tubes if followed by a suitable flush. Granules must not be crushed or chewed. Confirm availability of this product before prescribing.

Whenever prescribing slow release preparations, it is useful to prescribe an immediate acting opioid on a PRN basis for "break-through pain". This dose is usually equal to 10% of the daily morphine requirement administered up to every 4 hours PRN..

TAKE CARE WHEN PRESCRIBING. AVOID CONFUSION BETWEEN SLOW RELEASE AND IMMEDIATE RELEASE PREPARATIONS

5.3.3 *Oxycontin® (Slow release oxycodone)*

Preparation

- Oxycontin: 10 mg, 20 mg, 40 mg and 80 mg tablets

Dose

When a total daily morphine requirement is not established from previous experience, contact the Pain Team.

5.3.4 *Targin® (Slow release oxycodone with naloxone)*

Preparation

- Oxycontin/naloxone combinations: 2.5 mg/1.25 mg, 5 mg/2.5 mg, 10 mg/5 mg, 20 mg/10 mg and 40 mg/20 mg

Dose

- When a total daily morphine requirement is not established from previous experience, contact the Pain Team.

Recommendations

- Use Targin:
  - where opioid requirements are likely to be prolonged (>2weeks)
  - in children who are prone to constipation

TAKE CARE WHEN PRESCRIBING. AVOID CONFUSION BETWEEN SLOW RELEASE AND IMMEDIATE RELEASE PREPARATIONS

CONTROLLED RELEASE TABLETS MUST NOT BE CRUSHED.

WHEN CONTROLLED RELEASE OPIOIDS NEED TO BE FRACTIONATED – USE MS CONTIN SACHETS.

5.4 Second line opioids and management of on-going pain (Methadone & Hydromorphone)

5.4.1 *Hydromorphone*

Hydromorphone – a semisynthetic derivative of morphine- is a mu agonist that is approximately seven times more potent (in intravenous form) than morphine. As it also has a higher oral bioavailability than morphine, its apparent oral potency is almost nine times greater than that of morphine. It'slipid solubility sits between that of morphine and fentanyl. It has a medium duration of clinical activity (3-4 hours).

Hydromorphone is a useful drug for those children who cannot tolerate the side effects of morphine or fentanyl. Hydromorphone's potency and concentrated formulation make it suited

for use in children with high opioid requirements and/or opioid tolerance e.g. children with cancer-related pain.

Prescription is restricted to Pain Team members, Anaesthetists, Oncologists and Intensivists.

Hydromorphone is registered as a high risk medication at CHW

Dose

- Oral 25 – 55 micrograms/kg/dose q 4 hourly PRN
- Intravenous Titrate q 10 minutely up to 20 micrograms/kg in increments of 4micrograms/kg/dose (medically administered at bedside with continuous monitoring)

Preparation

- Hydromorphone tablets: (immediate release) 2mg,4mg and 8mg tablets
  (modified release tablets are also available- see Pharmacy)
- Oral mixture: 1 mg/mL
- Intravenous: 2 mg/mL (1 mL vial); 10 mg/mL (1 mL and 5 mL)

Conversion of *oral* Morphine to Hydromorphone:

Divide morphine dose by **9** (maintain same dosing interval).

Conversion of *IV* Morphine to Hydromorphone:

Divide morphine dose by **7** (maintain same dosing interval).

Hydromorphone may give rise to critical incidents

Hydromorphone should not be confused with morphine.

It is available in different preparations and strengths.

Parenteral hydromorphone is three times more potent than oral hydromorphone.

Always double check the medication order and preparation prior to administration.

Be especially careful when using high potency ampoules. Double check decimal points in the medication order. Double check complex calculations when fractionating solutions.

Wards will be stocked on an individual patient basis - return all un-used stock to pharmacy as soon as the patient is discharged or the prescription is ceased. Clearly separate hydromorphone from morphine during storage.

DOUBLE CHECK PRESCRIPTIONS, CONCENTRATIONS AND DILUTIONS

(Use independent double check principles)

5.4.2 Methadone

Methadone is a synthetic opioid with a good bioavailability and a long duration of action due to its slow elimination (half-life: 8-18Hrs). It is highly lipid soluble and has a high oral bioavailability (approaching 100%). Methadone is often used as part of an opioid-weaning regime.

Prescription is restricted to Pain Team members, Anaesthetists, Oncologists and Intensivists.

Dose

- Oral = 0.1 – 0.2 mg/kg per dose, usually q8h-q12h (max 20 mg per dose)

Preparations

- 25 mg/5 mL liquid
- 10 mg tabs
- 10 mg/mL IV

Conversion of oral Morphine to oral Methadone:

Calculate the average oral morphine consumption per 24 hour period. Multiply the morphine dose by 0.6.

25 to 35% of this daily total can be delivered as oral methadone twice a day (bd).

Conversion of IV Morphine to oral Methadone:

Calculate the average intravenous morphine consumption per 24 hour period. Multiply the morphine dose by 2.

25 to 35% of this daily total can be delivered as oral methadone twice a day (bd).

Further opioid requirements can be met using immediate release formulations.

5.5 Switching opioids (opioid rotation) and Equivalence Table

Opioid equivalency tables provide a very rough guide for dosing. Many patient factors influence the choice of drug and dose. Finding an optimal dose requires a comprehensive evaluation of pain, the intensity of adverse effects, comorbidities, and concomitant drugs. The process of reaching an optimal dose should be highly individualized, particularly when patients are switched from high doses of opioids.

Opioid Equivalence table

Drug	Oral Potency Equivalents	IV Potency Equivalents	Oral Bioavailability	Duration (hrs)
Morphine	30 mg	10mg	30%	3 – 4
Slow release Morphine	30 mg	-	40 – 50%	8 – 12
Oxycodone	10 mg		60 – 80%	3 – 4
Slow release Oxycodone	20 mg			8 – 12
Hydromorphone	3 mg	1.5 mg	60%	3 – 4
Methadone	18 mg	10 mg	100%	12 – 18
Fentanyl *(N.b. Morphine equivalence ratios vary from 15:1 to 50:1 depending on the clinical context)*	-	250 – 500 micrograms	-	1
Codeine	200 mg		60 – 70%	3 – 4

NB: In the acute care setting, prescribing opioid doses based solely on opioid conversion tables may result in inappropriate dosing.

At CHW, useful conversion factors are provided by the standard PCA/NCA/Infusion guidelines, that is:

	Standard Solution	Concentration	Typical bolus	Implied conversion factor relative to morphine
Morphine and Oxycodone	1 mg/kg in 50 mL	20 microg/kg/mL	20 microg /kg	1:1
Fentanyl	50 microg/kg in 50 mL	1 microg/kg/mL	1 microg /kg	1:20
Hydromorphone	150 microg/kg in 50 mL	3 microg/kg/mL	3 microg /kg	1:7

5.6 Transitioning from intravenous to oral opioids

For simple transitions (i.e. following brief opioid exposure) use recommended doses of oral opioids.

Transitioning from intravenous to oral opioids after prolonged opioid exposure should be planned early and sudden switching should be avoided.

In general:

- Introduce a (low dose) slow release oral opioid 1-2days before ceasing the intravenous drug. Soon after the first dose of oral opioid, the intravenous drug can be reduced or changed to a bolus-only PCA/NCA.
- Increase the slow release oral opioid dose incrementally, while reducing the intravenous drug delivery.
- Aim to provide 50% of opioid requirement through slow release formulations and the balance on an as-needed basis to manage on-going pain.
- When there is no on-going pain (i.e. opioid is being weaned to avoid withdrawal symptoms) – see section below.
- All conversions are figured through IV morphine equivalents, for example:
- A child on 20microgram/kg/hr of IV morphine (~0.5 mg/kg/day) or
- 1microgram/kg/hr fentanyl (~24 microgram/kg/d) converts to:
  - *Morphine:* approx. 1.5 mg/kg/day (50% of which could be given in 4 divided doses)
    - Typically: **0.2 mg/kg morphine sulfate (Ordine) orally qid.**

  OR

  - *MS Contin:* approx. 1.5 mg/kg per day (25-35% of which could be given in 2 divided doses)
    - Typically: **0.25 mg/kg MS Contin (aliquot from dissolved sachet) orally b.d**

5.7 Weaning opioids and sedatives

5.7.1 Opioids

Patients who have received potent opioids REGULARLY for less than 5 days can have these ceased if analgesia is no longer required. They will not be routinely monitored for withdrawal symptoms.

Patients who have received potent opioids REGULARLY for between 5 and 9 days can have these drugs weaned by about 50% each day for 2 days before ceasing the drug. i.e. 2 day wean. Provide opioids on an 'as needed basis' (PRN) for moderate- severe pain. Monitor for signs of withdrawal.

Patients who have received potent opioids REGULARLY for more than 9 days should not have these drugs ceased abruptly. When analgesic requirements reduce, these opioids should be weaned gradually. Patients who have received potent opioids REGULARLY for more than 9 days can have these drugs weaned by about 10-20% of the original dose every day. i.e. 5- 10 day wean. Provide opioids on an 'as needed basis' (PRN) for moderate- severe pain.

Children and infants who have received opioids for prolonged periods are often best managed by introducing a slow-release (enteral) opioid early in their management (even if they are receiving intravenous opioids). This reduces reliance on intravenous access during the transition.

In general, regular administration of controlled release opioids can stop once analgesic requirements reach an oral morphine equivalent of 0.5mg/kg/day.

Analgesia requirements are best judged by considering the number of 'break-through' doses required each day. Weaning regimens can be prescribed at the time of discharge OR at follow-up at the pain clinic.

- Use an opioid withdrawal scoring chart to monitor for signs of withdrawal: https://intranet.schn.health.nsw.gov.au/files/scn110530_0.pdf
- When weaning from multiple analgesics/ sedatives, it is generally wise to stagger the completion of each wean. Typically, ketamine is completed first, then clonidine, benzodiazepines and finally opioids. This allows staggered concurrent (often alternate day) weaning regimens and final opioid weans to be completed after discharge.
- Refer to the guide on weaning opioids when planning a weaning schedule. http://chw.schn.health.nsw.gov.au/ou/pain/resources/guides_and_in_service_packages/guide_to_weaning.pdf

5.7.2 Clonidine

Intravenous clonidine (usual dose range: 0.5- 2 microg/kg/hr) can be converted to oral/NG clonidine when requirements are less than 0.75 microg/kg/hr). The same dose is divided for tds. administration (i.e. 4-6 microg/kg orally tds.).

If a patient has received regular clonidine for > 5 days, the dose should be weaned daily by 1microg/kg/dose. The frequency of dosing can then be reduced once the clonidine dose is 1mcrog/kg/dose. Monitor for withdrawal (same symptoms as for opioid withdrawal) and rebound hypertension.

5.7.3 Ketamine

Ketamine is generally used in low doses (50-200 microg/kg/hr). On general wards it is usually infused for 48 hours. It can be ceased without weaning when clinically appropriate.

5.7.4 Benzodiazepines

If a patient has received regular benzodiazepines for >5days, the dose should be weaned by about 20- 50% each day before ceasing the drug. i.e. 2- 5 day wean. Monitor for withdrawal (same symptoms as for opioid withdrawal). Intravenous midazolam is converted to oral/NG diazepam in the ICU using the following formula:

Diazepam oral/NG dose in mg tds =

Midazolam infusion rate microg/kg/min x weight in Kg x 0.16

5.7.5 Weaning at the time of discharge from hospital

If weaning is to commence at discharge- please use the 'Opioid weaning schedule' when prescribing weaning regimens at discharge.

Send a copy of this form with the prescription to the Pharmacy. Pharmacy will provide the parents/carer with these written instructions at discharge.

Provide detailed written parent/carer information on weaning regimens before discharge. A pharmacist will provide further advice and education on medication administration of discharge medications.

If weaning is to commence after pain team (out-patient) review- discharge the patient on a regular fixed dose and organise timely follow-up at a pain clinic.

Always prescribe immediate acting opioid medication for breakthrough pain during and immediately following the weaning period.

- A form to instruct carers on the administration of opioids during weaning is available at: https://intranet.schn.health.nsw.gov.au/files/weaning_schedule_for_opioids_after_discharge_0.pdf
- The PICU analgesia and sedation transition plan is also useful: https://intranet.schn.health.nsw.gov.au/files/picu_analgesia_and_sedation_transition_plan_0.pdf

N.B. Aliquots of small doses of MS Contin after dilution (typically 20 mg into 20 mL) is only possible to a dose of 0.5mg (i.e. 0.5 mL). Aliquots of smaller volumes become impractical. If gradual weaning from this dose is still required, use immediate release oral morphine syrup or wean by altering dose frequency.

5.8 Prescribing opioids at the time of discharge

5.8.1 Immediate release PRN analgesia

All CHW medical staff are able to prescribe oral opioids for short term acute pain. Prescriptions- using the EMM system, require:

- a separate hospital prescription to other non-S8 medications. (i.e. detail only **one** drug, strength, dose & route per prescription)
-
- **handwritten details** by the medical officer, including prescribers name, signature and prescription date no addressograph labels.
-
- the **total quantity in number** of tablets/ampoules etc in **words & numbers**.

(NB. most external 'script pads' are annotated "Not for S8 drugs")
http://chw.schn.health.nsw.gov.au/ou/pharmacy/resources/how_to_write_prescriptions.php

For after-hours discharges, liaise with the on-call pharmacist.

Parents/ carers should be provided with relevant education and written information regarding doses, side-effects, risks (including drug/sedative interactions) and expected durations of treatments.

Parents should seek appropriate medical review if they need the prescription extended, repeated or if the dosing frequency escalates.

5.8.2 Controlled release preparations

It is wise to involve the pain team when controlled-release opioid preparations are clinically indicated.

Controlled release opioids can be prescribed at discharge if:

- Carers have an adequate understanding of the indications for and adverse effects of opioid analgesia and the capacity to administer the medication safely.
- The patient has a stable or reducing opioid requirement prior to discharge.
- There are no problematic side effects.
- Adequate follow-up has been arranged. i.e. telephone contact with the family or by review in the Complex Pain Clinic.

Which opioid?

Generally Oxycontin® or Targin® (controlled release oxycodone) is used in children who can swallow tablets and MS Contin® sachet (controlled release morphine) in children who can only take syrup or require small doses. Confirm availability of MS Contin before prescribing.

Provide detailed written parent/carer information on weaning regimens before discharge. A pharmacist will provide further advice and education on medication administration of discharge medications.

- Opioid weaning schedule: https://intranet.schn.health.nsw.gov.au/files/weaning_schedule_for_opioids_after_discharge_0.pdf

5.8.3 Identifying the opioid dependent patient

Always consider opioid dependence in:

- Patients who have been treated with opioids for more than 9 days.
- Patients who have been managed in intensive care for prolonged periods.
- Patients recovering from major burn injuries.
- Oncology patients who have been treated for mucositis.

Do not stop opioid administration abruptly in opioid dependent patients.

Use an opioid withdrawal scoring chart (M34E) when weaning opioids in opioid dependent patients.

Use the PICU sedation and analgesia transition plan chart (M46H) where appropriate: https://intranet.schn.health.nsw.gov.au/files/scn110530_0.pdf

Follow-up

In general, patients on controlled release opioid preparations can be reviewed in the pain clinic.

- Pain clinics run all day on Tuesday and on Thursday mornings.
- Call (02) 98452573 or (02) 98452525 to make appointment before discharging patient.

SIMPLICITY IS THE KEY TO SAFETY AND SUCCESS

If parents/ carers are asked to administer MS Contin sachets (particularly if the dose is a fraction of the sachet size) ENSURE they have been educated and SUPERVISED by nursing staff in drug preparation, dilution and administration prior to discharge.

In general, parents/carers will need to learn how to dilute a 20mg sachet in 20mL of water and administer gradually decreasing volumes over the weaning period.. (A 30mg sachet for dilution in 30mL is also available)

When prescribing Oxycontin® or MS Contin® tablets, ensure that doses correspond to available tablets or tablet combinations.

Controlled release tablets and granules CANNOT be crushed, chewed or halved.

5.9 Oral Opioid Preparations in use at CHW

	Immediate release		Controlled release	
Morphine	Liquid	1 mg, 2 mg, 5 mg and 10 mg per mL	Suspension	MS Contin Sachets Check availability
			Tablets	5 mg, 10 mg , 30 mg and 100 mg MS Contin
Oxycodone	Tablets	5 mg	Tablets	5 mg, 10 mg, 15 mg 20 mg, 40 mg and 80 mg tablets (Oxycontin)
	Capsule	10 mg		
	Liquid	1 mg/mL		
Oxycodone/ Naloxone combination (Targin®)			Tablets	2.5/1.25 mg, 5 mg/2.5 mg, 10 mg/5 mg, 20 mg/10 mg, 40 mg/20 mg
Hydromorphone	Tablet	2mg ,4mg & 8mg	Tablet	4mg, 8mg, 16mg & 32mg (Jurnista)
	Liquid	1mg/mL		
Tramadol	Capsules	50 mg		

CONTROLLED RELEASE TABLETS MUST NOT BE CRUSHED.

WHEN CONTROLLED RELEASE OPIOIDS NEED TO BE FRACTIONATED – USE MS CONTIN SACHETS.

6 Management of Pain Using Bolus of Opioids

6.1 Subcutaneous Administration

The subcutaneous route of administration for opioids has similar absorption characteristics as intramuscular injections. An in-dwelling subcutaneous cannula eliminates the need for repeated intra-muscular injections.

- Usual sites for cannula placement include subclavian, upper arm and upper thigh. Orders for post-operative intermittent subcutaneous analgesia will be charted on the PRN medication chart.

Patients should be monitored appropriately.

Indications for Use

Pain of a duration that would normally require only 2-3 administrations of an opioid but not severe or prolonged enough to require an opioid infusion or PCA.

Equipment

- 24g x 22 mm Surflo®, Insyte® or Insuflon® cannula
- Transparent dressing (e.g. Tegaderm®)

- a needle free injection port
- a non-injectable cannula cap.

6.1.1 Technique

1. Draw up the ordered dose of morphine (volume should be less than 1 mL).
2. Remove the cannula cap and attach the syringe to needle free port and inject the morphine slowly (over 30-60 seconds) - this might cause some discomfort.
3. Flush with 0.25 mL normal 0.9% sodium chloride over 1 minute.
4. Replace with a new cannula cap.

Doses

- *Morphine*: 0.1 – 0.15 mg/kg per dose SC 3rd hourly

Removal

Remove occlusive dressing/tape and slide out cannula. The site does not need a dressing post removal.

Key Points

- Inject slowly:
  - Children who are to be nursed prone need a S/C site that is accessible
  - Make sure that the connections are tight (leakage of small volumes can be significant)
  - Remove cannula if not used for 12 hours
  - Pethidine is not recommended for subcutaneous use, due to stinging
  - Gently massaging the insertion area during and after administration helps to relieve discomfort and distribute the medication.

6.2 Intramuscular Injection

Intramuscular injections are actively discouraged at CHW. There are few indications left for this route of drug administration. Very occasionally, intramuscular analgesia may be indicated in cases where intravenous access is not easily and immediately available (e.g. acute trauma without haemodynamic compromise) or where it cannot be easily maintained (e.g. behaviourally challenged children).

Doses

- *Morphine*: 0.1-0.15 mg/kg per dose IMI 3rd hourly

Key Points

- Exhaust all possibilities before choosing this route
- Thoroughly explain the procedure to the child and parents
- Gently massaging the site post-injection, this helps to disperse the medication and potentially alleviates pain and bruising.

7 Management of Pain using Intravenous Infusions; PCAs and NCAs

7.1 Intravenous Analgesic Infusion Modalities

The aim of an intravenous analgesic infusion is to provide reliable and rapidly titratable delivery of opioid drugs. Once effective analgesia is attained, frequent assessment and monitoring of patients by trained staff, allows titration of the infusion to meet the patient's need.

There are currently four (4) different infusion modalities through which an analgesic infusion may be prescribed.

1. As a continuous infusion
2. NCA (Nurse Controlled Analgesia) and
3. PCA (Patient Controlled Analgesia).
4. PENCA (Parent-Engaged NCA) –applicable to Oncology patients only.

TAKE CARE: Syringe preparations and prescribing patterns for children weighing less than 50kg differ from those who weigh more than 50kg

All are prescribed on the M46J -Acute Pain Management chart for use with a BBraun Smart pump or the M46C Pain Management Chart –for use with a CADD pump (Oncology and Palliative care). Standard solutions together with recommendations for initial program settings are given on the front of this chart.

NOTE: PCAs, NCAs and OPIOID INFUSIONS FOR ACUTE PAIN MANAGEMENT ARE DELIVERED USING BBRAUN SMART PUMPS AND WEIGHT-BASED PRESCRIBING UNITS see M46J. ONCOLOGY AND PALLIATIVE CARE PATIENTS ARE MANAGED USING CADD PUMPS. PRESCRIPTION UNITS ARE 'mL'. see M46C.

The Pain Service reviews every child receiving intravenous analgesia on a daily basis. At this time the effect of the analgesia is assessed and a plan for analgesia will be made for the next 24hrs. If this plan is inadequate at any stage the Pain Service should be contacted to review the situation and make further plans or changes. After hours and on weekends, reviews are carried out by the duty anaesthetic registrar

The standard observation guidelines for all children receiving intravenous analgesic infusions can be found on the front cover of the Pain Management Chart (M34B). Section 1.7

7.2 Continuous Infusion

Currently this mode of delivery (continuous infusion) is predominantly used in children without the cognitive, verbal or motor skills required to use PCA. It is particularly suitable where pain is thought to be low grade and continuous in nature (i.e. where movement or incident pain is not a large feature) e.g. palatal surgery, burns that do not extend over joints, craniofacial surgery.

Prescriptions for opioid infusions should include a range of infusion rates and a starting rate. Accredited registered nursing staff members are able to titrate the infusion to the needs of each patient.

Morphine Infusion

- Intravenous Solution:

Add 1 mg/kg (max 50mg) to 0.9% sodium chloride or 5% glucose to make a total of 50 mL

Each mL delivers 20 microgram/kg

- Infusion range: 0 – 50 microgram/kg/hr (= 0 - 2.5 mL/hr)

Fentanyl Infusion-

Not recommended for babies less than 3 months of age.

- Solution:

  Add 50 microgram/kg (max 2500 micrograms) to 0.9% sodium chloride or 5% glucose to make a total of 50 mL

  Each mL delivers 1 microgram/kg

- Infusion range: 0 - 2.5 microgram/kg/hr (= 0 - 2.5 mL/hr)

7.2.1 Adjusting an Infusion

Following pain assessment, nurses can change the rate of the infusion within the limits of the charted orders. This is to be done by two registered nurses, one of whom has been accredited in the care of opioid infusions. If analgesia is inadequate, the infusion may be increased within the limits of the range. Increasing the infusion rate alone in response to inadequate analgesia will result in considerable delays in achieving analgesia. If analgesia is inadequate, an increase in analgesic concentration is best achieved by an administration of a small bolus dose before increasing the infusion rate. Contact the Pain Service, anaesthetic registrar or the child's admitting team to order the bolus dose.

7.3 PCA (Patient Controlled Analgesia)

Patient Controlled Analgesia refers to the intravenous infusion device, which can be activated by the patient to self-administer a set dose of analgesic drug. Both modes (PCA and NCA) are suited to providing analgesia where there is a large component of 'incident pain' e.g. pain on movement or coughing.

Morphine PCA:	**INITIAL PROGRAMMING**
IV Solution:	1 mg/kg added to 50 mL total volume
Maximum concentration	50 mg in 50 mL
Background infusion:	0- 10 microgram/kg/hr (=0.5 mL/hr)
Bolus dose:	20 microgram/kg (=1 mL)
Lockout:	5 mins
Hourly dose limit:	150 microgram/kg in any hour

Oxycodone PCA:	**INITIAL PROGRAMMING**
IV Solution:	1 mg/kg added to 50 mL total volume
Maximum concentration	50 mg in 50 mL
Background infusion:	0- 10 microgram/kg/hr (=0.5 mL/hr)
Bolus dose:	20 microgram/kg (=1 mL)
Lockout:	5 mins
Hourly dose limit:	150 microgram/kg in any hour

Fentanyl PCA:	**INITIAL PROGRAMMING**
IV Solution:	50 microgram/kg added to 50 mL total volume
Maximum concentration	2500 micrograms in 50 mL
Background infusion:	0- 0.5 microgram/kg/hr (=0.5 mL/hr)
Bolus dose:	1 microgram/kg (=1 mL)
Lockout:	5 mins
Hourly dose limit:	5 microgram/kg in any hour

The hourly dose limit is ordered by the referring doctor, and set within a safe dose limit for each child's weight. The recommendation on the front of the M46J is a general guide which may be varied according to the clinical situation. Hourly dose limits are an important part of the safety of the PCA and NCA prescriptions. If prescribing limits outside those suggested, the prescribing doctor should make a note in the special orders section on the front of the Pain Management Chart - M46J/C.

Each hour the number of attempts at bolusing and the actual bolus's given are recorded. This information allows adjustments to be made in the programming of the PCA by the pain team.

PCAs should only be prescribed for children who understand the concept of self-administered analgesia and who have the physical ability to control the button provided.

Both the child and their parent/care giver need to be educated in how to use the PCA.

Typical instructions for patients:

Use your 'button' whenever you are in pain. (Don't wait until it is unbearable).

Give the PCA 5 – 10 minutes to work. Push again if you are still uncomfortable.

Only you are allowed to press the button.

You can press your button 5 – 10 minutes before doing something painful e.g. before physiotherapy, having drains removed or mobilising for the first time.

Carers must NEVER interfere with a patient's PCA.

- PCA with a background infusion provides the child with a consistent blood concentration of an analgesic medication, and the availability to use a bolus to control incident pain.

  This mode is particularly useful for children who have mild-moderate background pain and moderate- severe incident pain. Post-operative patients, larger burns, sickle cell crisis and mucositis pain are examples of children who readily benefit from a PCA with background.

  In some clinical situations, a background infusion is relatively contra-indicated e.g. upper limb fractures where there is a risk of compartment syndrome and children who have received neuraxial (spinal or epidural) opioids within the preceding 24 hours.

- Bolus only PCA (without a background infusion) means the child only receives a dose of analgesia when they press the button. It is suitable for patients who require intermittent strong analgesia or strong analgesia prior to ongoing procedural pain. It may also be the modality of choice when surgical teams require to know the exact morphine requirement of a child e.g. upper limb fractures, head injury, post neurosurgical procedure.

  It is also useful following neuraxial (epidural and spinal) blocks that have included opioids.

  If the bolus dose is being used for procedural pain (e.g. dressings, turning post-surgery, eating with mucositis) it is useful to suggest to the child to give themselves a bolus dose 5-10 mins prior to commencing the procedure.

7.4 NCA (Nurse Controlled Analgesia)

Nurse controlled analgesia is appropriate for the control of pain in infants and pre-verbal children who cannot use a PCA. It is useful for moderate to severe pain that has a significant incident /movement component. It allows for a continuous low dose background infusion and a nurse-initiated intermittent bolus when required.

It is never appropriate for a parent or guardian to press the bolus button on an NCA (see Section 7.6 PENCA below). In general, patients, parents and visitors are instructed that–"Only your nurse is allowed to press the button".

For longer-term analgesia in oncology and palliative care patients, see section 7.6 below:

Morphine NCA:	INITIAL PROGRAMMING
Solution:	1 mg/kg added to 50 mL total volume
Maximum concentration	50 mg in 50 mL
Background infusion:	0- 10 microgram/kg/hr (=0.5 mL/hr)
Bolus dose:	20 microgram/kg (=1 mL)
Lockout:	10 – 30 mins
Hourly dose limit:	120 microgram/kg in any hour

Oxycodone NCA:	INITIAL PROGRAMMING
Solution:	1 mg/kg added to 50 mL total volume
Maximum concentration	50 mg in 50 mL
Background infusion:	0- 10 microgram/kg/hr (=0.5 mL/hr)
Bolus dose:	20 microgram/kg (=1 mL)
Lockout:	10 – 30 mins
Hourly dose limit:	120 microgram/kg in any hour

Fentanyl NCA:	INITIAL PROGRAMMING
Solution:	50 microgram/kg added to 50 mL total volume
Maximum concentration	2500 micrograms in 50 mL
Background infusion:	0- 0.5 microgram/kg/hr (=0.5 mL/hr)
Bolus dose:	1 microgram/kg (=1 mL)
Lockout:	10 – 30 mins
Hourly dose limit:	3 microgram/kg in any hour

Neonates are typically managed within the Grace Centre for Newborn Care (GCNC). Staff there are most familiar with morphine infusions. Neonates may display particular sensitivity to highly lipid soluble opioids (e.g. fentanyl).

7.5 Summary of initial programming for Infusions, PCAs & NCAs

Acute pain management

The following summarises the **BBraun drug library** for analgesia prescriptions
The table outlines the default settings. All parameters can be adjusted from within the library.
For children <50Kg (Note: 'units of prescription' change at specified weight limits)

Mode	Syringe prescription [units for programming]	Default Basal rate [microg/kg/hr]	Default patient Bolus [microg/kg]	Default lockout Interval [mins]	Default Hourly Limit [microg/kg/hr]
Morphine PCA	1mg/kg in 50mL (max 50mg) [mg]	10	20	5	150
Morphine NCA		10	20	10	120
Morphine Infusion		10	N/A	N/A	60
Oxycodone PCA	1mg/kg in 50mL (max 50mg) [mg]	10	20	5	150
Oxycodone NCA		10	20	10	120
Fentanyl PCA	50 microgram/kg in 50mL (max 2500microg) [microg]	0.5	1	5	5
Fentanyl NCA		0.5	1	10	3
Fentanyl Infusion		0.5	N/A	N/A	3
Hydromorphone PCA	0.15 mg/kg in 50mL (max 7.5mg) [mg]	1.5	3	5	20
Hydromorphone NCA		1.5	3	10	15
Hydromorphone Infusion		1.5	N/A	N/A	9
Naloxone infusion (for pruritus)	25 microgram/kg in 50mL (max 1250microg) [microg]	0.5	N/A	N/A	1.5
Children <40Kg					
Ketamine infusion	5 mg/kg ketamine in 50mL (max 200mg) [mg]	100	N/A	N/A	300

For children >50kg: Mode	Syringe prescription [units for programming]	Default Basal rate	Default patient Bolus	Default lockout Interval [mins]	Hard Limit
Morphine PCA	50 mg in 50mL [mg]	0.5 mg/hr	1mg	5	7.5 mg/hr
Morphine NCA		0.5 mg/hr	1mg	10	6 mg/hr
Morphine Infusion		0.5 mg/hr	N/A	N/A	3 mg/hr
Oxycodone PCA	50 mg in 50mL [mg]	0.5 mg/hr	1mg	5	7.5 mg/hr
Oxycodone NCA		0.5 mg/hr	1 mg	10	6 mg/hr
Fentanyl PCA	2500 micrograms in 50mL [microg]	25 microg/hr	50 microg	5	250 microg/hr
Fentanyl NCA		25 microg/hr	50 microg	10	150 microg/hr
Fentanyl Infusion		25 microg/hr	N/A	N/A	150 microg/hr
Hydromorphone PCA	7.5 mg in 50mL [mg]	75 microg/hr	150 microg	5	1000 microg/hr
Hydromorphone NCA		75 microg/hr	150 microg	10	750 microg/hr
Hydromorphone Infusion		75 microg/hr	N/A	N/A	450 microg/hr
Naloxone infusion (for pruritus)	1250 micrograms in 50mL [microg]	25 microg/hr	N/A	N/A	75 microg/hr
Children >40Kg					
Ketamine infusion	200 mg ketamine in 50mL [mg]	4 mg/hr	N/A	N/A	15 mg/hr

7.6 Long-term intravenous opioid analgesia & PENCA (Parent-engaged NCA)

Oncology and Palliative Care

Occasional patients may require on-going intravenous opioid analgesia as part of symptom management for malignant or chronic illness. The can be provided through alternative portable IV PCA pumps, e.g. CADD Legacy pumps, CADD Solis pumps.

The Pain Service or Palliative Care service will assess patients for suitability to use these infusions. The prescriptions for these infusions will be charted on the Pain Management Chart M46C.

NOTE: ONCOLOGY AND PALLIATIVE CARE PATIENTS ARE MANAGED USING CADD PUMPS. AS PRESCRIPTION UNITS ARE 'mL'. see M46C.

PCAs, NCAs and OPIOID INFUSIONS FOR ACUTE PAIN MANAGEMENT ARE DELIVERED USING BBRAUN SMART PUMPS AND WEIGHT-BASED PRESCRIBING UNITS see M46J.

Summary of initial programming PCA, NCA and opioid infusion **in a CADD pump**- 'mL' as prescription unit.

Mode	Concentration	Continuous Infusion	Patient Bolus	Lockout Interval	Hourly Dose Limit
Morphine PCA	2mg/kg in 100mL	0 to 2.5 mL/hr	1 mL	5 minutes	7.5 mL 150 microgram/kg/hr
Morphine NCA		0 to 2.5 mL/hr	1 mL	10 – 30 minutes	6mL 120 microgram/kg/hr
Morphine Infusion		0 to 2.5 mL/hr	N/A	N/A	N/A
Oxycodone PCA	2mg/kg in 100mL	0 to 2.5 mL/hr	1mL	5	7.5 mL/hr
Oxycodone NCA		0 to 2.5 mL/hr	1 mL	10	6 mL/hr
Fentanyl PCA	100 microgram/kg in 100mL (max 2.5mgs)	0.5 mL/hr	1mL	5 minutes	5 mL 5 microgram/kg/hr
Fentanyl NCA		0.5 mL/hr	1mL	10 – 30 minutes	3 mL 3 microgram/kg/hr
Fentanyl Infusion		0 to 2.5 mL/hr	N/A	N/A	N/A
Hydromorphone PCA	300 microgram/kg in 100mL	0.5 mL/hr	1mL	5 minutes	6.5 mL 20 microgram/kg/hr
Hydromorphone NCA		0 .5 mL/hr	1mL	10 – 30 minutes	5 mL 15 microgram/kg/hr
Hydromorphone Infusion		0 to 2.5 mL/hr	N/A	N/A	N/A
Ketamine infusion	Run a separate infusion: 10 mg/kg ketamine (max 400mg) in 100mL and run at 0.5 - 2 mL/hr (ketamine is delivered at 50 – 200 micrograms/kg/hr).				
Naloxone (may be administered by nursing staff if the standing order on the M46C has been signed by medical staff)	Give 5 microgram/kg IV injection over 1 – 2 minutes if sedation score = 4 and respiratory rate is below that specified in the standing order. Repeat if necessary. Notify Pain Service immediately (page #6151 or #6236				

This table is for use with CADD pumps (see Section 7.5 for B Braun pumps)

Observation requirements will be made on an individual basis. Solutions (often double or quadruple strength) can be ordered and made up through Pharmacy.

It is possible to use some of these pumps on an out-patient basis.

Patients who are on a gate-pass (and their parents/carers) need to be given appropriate information to maintain the care of the portable pump. They must also be given a ward-contact number in case of problems with the device.

Parent engagement in NCA (PENCA)

Parent/carer engagement in NCA can be considered for patients:

a) in the care of the Oncology or Palliative care service who

b) have received appropriate (including written) education and who

c) have been assessed by either the Palliative care or Pain fellow (this must be documented and confirmed with the Camperdown ward NUM).

For some patients, (on oncology wards or receiving palliative care) bolus doses may be required for repeated (and predictable) painful procedural events (e.g. dressing changes, eating with mucositis, nappy changes with mucositis, physiotherapy sessions, nasogastric tube changes) or clearly defined, patient-specific pain behaviours e.g. sputum accumulation. In these situations, a parent may be instructed to initiate a bolus just prior to the nominated procedure(s) or in response to a previously identified pain behaviour. These parents/carers must be informed of the rationale and risks of using an NCA device in this fashion. Parent/carer education is a pre-requisite to this modality. All usual monitoring and documentation guidelines must be followed. Nursing staff must be informed of all bolus doses. Parental involvement in providing this type of analgesia does not reduce nursing responsibility for the overall assessment and management of a child's pain.

It is never appropriate to

- bolus opioids in children who are asleep.
- bolus opioids to manage anxiety
- allow a carer-bolus in children who have had an anaesthetic in the preceding 24hrs
- allow a carer-bolus if the carer/parent does not understand the rationale of NCA or who does not agree with the definition of painful procedural events

7.7 Adjunctive analgesic drugs

Adjuvant drugs are used to improve the quality of analgesia being delivered by a primary analgesic drug. These drugs may or may not have intrinsic analgesic properties. They may help to relieve pain by elevating mood, reducing anxiety levels, or minimising the dose of the primary analgesic drugs.

Continual re-assessment of the indications for and the efficacy of, adjuvant drugs should guide their use in acute or chronic pain in children.

Adjuvant analgesic examples: anti-convulsants, anti-depressants, ketamine, anti-spasmodics, gabapentin, paracetamol as an adjuvant for opioid analgesia.

Adjuncts are drugs delivered with a primary analgesic drug to reduce expected side-effects e.g. antiemetics, laxatives, anti-pruritics.).

7.7.1 Ketamine (HCl) (low dose for analgesia)

Ketamine is a rapid acting general anaesthetic drug which produces an anaesthetic state characterised by profound analgesia, somewhat preserved pharyngeal/laryngeal reflexes, normal or slightly enhanced muscle tone and cardiovascular and respiratory stimulation. When used as a sole anaesthetic agent (doses 5 – 15 mg/kg per dose IV or IM), it can cause hallucinations and emergence phenomenon ('bad dreams').

Used in sub-anaesthetic doses (<1 mg/kg per dose IV or 1 – 2 mg/kg per dose IM), it is an analgesic and amnesic agent. Ketamine has been effectively used for sedation and analgesia for brief painful procedures and can be used in combination with midazolam or fentanyl [refer to Procedural Sedation (Paediatric Ward Clinic & Imaging Areas) Practice Guideline].

- In very low doses (50-200microg/kg/hr) it is an excellent adjunct to opioid analgesia.
- It is this low dose range that is used when ketamine is prescribed for pain management.
- Ketamine (HCl) can be delivered by:
    - Running a separate intravenous infusion of ketamine (5 mg/kg in 50 mL 0.9% sodium chloride) at. 50 – 200 micrograms/kg/hr. Start at 100microg/kg/hr.
    - Less usually, ketamine can be added to opioid infusion / PCA / NCA at a dose of 1 mg/kg in 50mL opioid solution. This will typically deliver between 20 and 80 micrograms/kg/hr. (Ketamine is compatible with morphine, fentanyl, oxycodone and hydromorphone)

7.7.2 Clonidine hydrochloride

Clonidine is an alpha2-adrenergic agonist that produces analgesia in a non-opioid mechanism (the exact site of action is unclear).

Intrathecal and epidural administered clonidine has been demonstrated to enhance analgesic effects and duration of opioids and local anaesthetics.

Clonidine may be prescribed and added to epidural infusions at the discretion of the consulting anaesthetist. Typical dosing is based on delivering 1-2 microgram/kg per 24 hours via the epidural route.

The standard observation guidelines for children receiving intrathecal, epidural and regional analgesia can be found on the front cover of the Pain Management Chart (M46C). See section 9.5

8 Managing Pain Using Regional Infusions

Regional analgesia is a technique for providing continuous analgesia for post-operative pain. These modes of analgesia include rectus sheath, transversus-abdominis plane, intercostal, extra-pleural, erector spinae, axillary and femoral catheter infusions. (N.B Regional *intravenous* local anaesthesia techniques are NOT practised at CHW.) Regional analgesia catheters (sometimes called *wound catheter infusions*) are often inserted under direct vision (during the operation) or under ultra-sound control by an anaesthetist or surgeon. In general:

- The catheter is inserted at the time of surgery. Multi-hole catheters are used for 'field block' and 'wound catheter' infusions. They are available in 3 'perforation lengths' (2.5, 6.5 and 12.5 cm lengths).
- Maintenance and supervision of regional analgesia will remain the responsibility of the Department of Anaesthetics and the Pain Service.
- Regional analgesia will be commenced in the operating theatre and recovery.
- Local anaesthetic administration will be via a continuous infusion.

Local anaesthetic drugs are infused via dedicated infusion systems aiming to prevent the inadvertent administration of other medicines. This is crucial to patient safety.

When administering local anaesthetic drugs always:

- Use a dedicated (Yellow-faced) BBraun infusion pump.

- Use a dedicated BBraun (colour coded) infusion line (i.e. no injection ports).

- Always use a burrette. Label the line and burette clearly.

8.1 Monitoring

While the catheter is in place, the patient will be monitored by an experienced registered nurse, who has undergone appropriate education to care for local anaesthetic infusions/epidurals.

Observation protocol Epidural/ Regional Infusion

Respiratory Rate, Pain Score & Sedation Score: hourly while infusion continues

Blood Pressure Measurement: hourly for 6 hours → 4th hourly thereafter

Infants <6 months: continuous pulse oximetry

8.2 Side effects

- Most frequent:
  - Local irritation, redness and oedema
  - Leakage of anaesthetic solution around catheter insertion site
  - Un-intended dense motor block (femoral and axillary catheters)

- Serious: (usually associated with massive un-intended intravenous bolus doses)
  - Central nervous system toxicity- may present with circum-oral numbness/ paraesthesia, dizziness, tremor. May progress to seizure and coma.
  - Cardiovascular toxicity- initial subtle ECG changes may progress to arrhythmia and cardiac arrest.

Even the earliest signs of local anaesthetic toxicity are a medical emergency

8.3 Dosage

There are two commonly used long acting local anaesthetic drugs at CHW, bupivacaine and ropivacaine.

- Bupivacaine (racemic) – an amino amide local anaesthetic.
- Ropivacaine is a single enantiomer amino amide agent which, is thought to produce less motor blockade and be less cardiotoxic than bupivavcaine.

Dosing schedules are dependent on patient weight as well as the site of infusion. **Maximum infusion doses must not be exceeded.**

- Maximum bupivacaine dosage is:
  - For infants <3 months 0.25 mg/kg/hr
  - For infants/children >3 months 0.5 mg/kg/hr
- Maximum ropivacaine dosage is:
  - For infants <3 months 0.375 mg/kg/hr
  - For infants/children >3 months 0.5 mg/kg/hr

Always use the dedicated Epidural/Regional Infusion systems for local anaesthetic drug infusions. DO NOT USE AN ORDINARY INTRAVENOUS INFUSION SYSTEM TO DELIVER LOCAL ANAESTHETIC DRUGS.

Regional and wound catheter infusions can be effective with even modest infusion rates and often do not incur motor blockade. This may allow more concentrated local anaesthetic solutions to be used. The following table provides a weight-based guide for the maximum infusion of bupivacaine 0.125% (0.2 and 0.4 mL/kg/hr) and Ropivacaine 0.2% (0.25 mL/kg/hr) solutions.

8.4 Dosing reference Table – Wound catheter infusions

Patient Size		Local Anaesthetic **Bupivacaine 0.125%** Max. dose 0.25 mg/kg/hr Max. rate 0.2 mL/kg/hr	
Age	**Wt (kg)**	**Recommended rate (mL/kg/hr)**	**Recommended rate (mL/hr)**
<3 month old	**1.5**	**0.2mL/kg/hr**	**0.3**
	2		**0.4**
	2.5		**0.5**
	3		**0.6**
	3.5		**0.7**
	4		**0.8**
	4.5		**0.9**
	5		**1**
>3 month old		**Bupivacaine 0.125%** Max. dose 0.5 mg/kg/hr Max. rate 0.4 mL/kg/hr	**Ropivacaine 0.2%** Max. dose 0.5 mg/kg/hr Max. rate 0.25 mL/kg/hr
	Wt (kg)	**Recommended rate (mL/kg/hr)**	**mL/hr**	**Recommended rate (mL/hr)**
	6	**0.4**	**2.4**	**1.5**
	7		**2.8**	**1.7**
	8		**3.2**	**2**
	9		**3.6**	**2.2**
	10		**4**	**2.5**
	12.5		**5**	**3.1**
	15	**0.4**	**6***	**3.7**
	17.5	**0.4**	**7***	**4.3**
	20	**0.4**	**8***	**5**
	25	**0.4**	**10***	**6.2***
	30	**0.3**	**10***	**7.5***
	40	**0.25**	**10***	**10***
	50	**0.2**	**10***	**10***

In general, flow rates should be limited to 5mL/hr per catheter site. Larger infusion rates may cause swelling and leakage.

*Dual catheter infusions can also be used. The combined infusion rate should not exceed the maximums listed above.

Regional blocks that utilise expandable anatomical tissue planes (e.g. erector spinae and fascia iliaca blocks) can be managed with programmed intermittent boluses (PIB). Prescriptions for these infusions and PIBs are made at the discretion of the anaesthetist.

8.5 Education resources and In-service packages

In service packages are available for all interested staff who look after regional and neuraxial infusions of local anaesthetics. These can be found as follows:

- **Epidural analgesia at CHW**:
  http://chw.schn.health.nsw.gov.au/ou/pain/resources/guides_and_in_service_packages/epidural_analgesia.pdf
- **Paravertebral analgesia**:
  http://chw.schn.health.nsw.gov.au/ou/pain/resources/guides_and_in_service_packages/paravertebral_analgesia.pdf
- **Thoracic epidural analgesia at CHW**:
  http://chw.schn.health.nsw.gov.au/ou/pain/resources/guides_and_in_service_packages/thoracic_analgesia.pdf
- **Regional & Wound catheter analgesia**:
  http://chw.schn.health.nsw.gov.au/ou/pain/resources/guides_and_in_service_packages/regional_analgesia.pdf

Take care!

Epidural, paravertebral and regional infusions provide distinct patterns of analgesia. Each have distinct risks and side-effects.

Importantly, paravertebral infusions do **not** cause lower limb weakness, bowel or bladder dysfunction nor numbness/paraesthesia in un-related dermatomes.

9 Managing Pain Using Epidural Analgesia

Local anaesthetics via epidural or regional infusion may provide distinct advantages over opioids following major abdominal and thoracic surgery. These techniques are especially useful in managing dynamic pain i.e. pain on coughing and moving and allow cooperation with physiotherapy and mobilisation.

The pain team and/or the anaesthetic registrar will be first line managers of epidural infusions, with the initial and overall responsibility being held by the consultant anaesthetist who inserted or supervised the insertion of the epidural catheter. If difficulties are experienced with the administration of epidural analgesia, the problem should be referred to the consultant anaesthetist responsible for the insertion, or, if not available, to a senior consultant who is experienced in epidural management. Any subsequent management and management plans should be clearly documented in the patient's notes.

- The Department of Anaesthetics will assess the patient for appropriateness and the need for the epidural analgesia, consent obtained at this stage.
- The Anaesthetist or member of the Pain Service will provide relevant information to the child and family.
- Only members of the Department of Anaesthesia will insert epidural catheters. Ward maintenance and supervision of epidural analgesia will remain the responsibility of the Pain Service and the Department of Anaesthetics.
- All patients must have a patent intravenous cannula in situ (for emergency use) while the epidural is in situ.

The prescription and management of epidural analgesic infusions is the responsibility of members of the Department of Anaesthesia and the Department of Pain Medicine.

9.1 Epidural catheter care and dressings

The catheter should be taped securely in place and anchored to the patients back from the site of entry to the upper back, along the path of the catheter; this will reduce the likelihood of dislodgment, kinking or infection. Occlusive dressing (Lockit® device) is to be placed over catheter from the site and water proof occlusive tape e.g. sleek or Hypafix®, will secure the catheter from the site to the upper back. This will reduce the likelihood of movement or dislodgment.

Avoid un-necessary adjustments to epidural catheter dressings. This helps to reduce the risk of the catheter and filter being disconnected or dislodged and guards against the risk of infection. Leakage around an epidural catheter is common..

9.2 Epidural Infusions

Epidural infusions are delivered using dedicated giving sets (without extraneous injection ports), Infusions are run through a volumetric delivery pump (Yellow-faced BBraun infusion pumps).

- The infusion must run continuously using a dedicated BBraun volumetric pump.
- Infusions can be made up by pharmacy staff, anaesthetists, pain team members and senior ward nursing staff who have been accredited to manage regional/epidural infusions. Appropriate medication safety and handling guidelines must be adhered to at all times. In particular 'double checking' of all solutions and patient IDs is mandatory.
- The epidural must be assessed by the Pain Service or by a member of the Department of Anaesthetics at least every 24 hours.

Local anaesthetic drugs are infused via dedicated infusion systems that largely prevent the inadvertent administration of other medicines. This is crucial to patient safety.

When administering local anaesthetic drugs always:

- Use a dedicated (Yellow-faced BBraun) infusion pump.

- Use a dedicated (colour coded) infusion line (i.e. no injection ports).
- Always use a burrette. Label the line and burette clearly.

9.3 Dosage

There are two commonly used long acting local anaesthetic drugs at CHW, bupivacaine and ropivacaine.

- Bupivacaine (racemic) – an amino amide local anaesthetic.
- Ropivacaine is a single enantiomer amino amide agent which, is thought to produce less motor blockade and be less cardiotoxic than bupivavcaine.

Dosing schedules are dependent on patient weight as well as the site of infusion. **Maximum infusion doses must not be exceeded.**

- Maximum bupivacaine dosage is:

- For infants <3 months 0.25 mg/kg/hr
- For infants/children >3months 0.5 mg/kg/hr

- Maximum ropivacaine dosage is:
  - For infants <3 months 0.375 mg/kg/hr
  - For infants/children >3months 0.5 mg/kg/hr

Typical infusion regimens are given below:

Solution	Formulation	Recommended rate	Programmed intermittent bolus (PIB)	Frequency of PIB	Dose limiter
Bupivacaine 0.125% with fentanyl 2mcg/mL	200mL polybag	0.2 – 0.4mL/kg/hr	0.2mL/kg	8hourly	2mL/kg in 4 hours
Bupivacaine 0.125% plain	200mL polybag	0.2 – 0.4mL/kg/hr	0.2mL/kg	8hourly	2mL/kg in 4 hours
Ropivacaine 0.2%	100mL polybag	0.2 – 0.4mL/kg/hr	0.2mL/kg	8hourly	2mL/kg in 4 hours

Non-standard solutions (e.g. 0.0625% or 0.1% solutions of either Bupivacaine or Ropivacaine) can be requested from pharmacy for individual cases.
Advance notice (at least 24 hours) must be given.
The first bag must therefore be made up by the anaesthetist in theatre. Subsequent bags will be supplied by the pharmacy.

For information regarding the addition of clonidine, click here.

9.4 Programmed Intermittent Bolus (PIB) Epidural analgesia

Programmed intermittent bolus epidural analgesia is appropriate for children who currently have a working epidural catheter. Intermittent bolus injections are thought to improve the spread of local anaesthetic solution within the epidural space and therefore improve the quality of analgesia.

Prescriptions for epidural infusions may include a prescription for a programmed bolus dose that will be delivered automatically every 8 hours. The bolus size and frequency are prescribed by the anaesthetist on the M46J prescription chart.

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9.5 Epidural bolus using more concentrated solutions

If an epidural sensory block has regressed significantly, a bolus dose using a more concentrated solution (>0.2% bupivacaine) may be required. This can be completed after review by an anaesthetists or pain team member. Only an anaesthetist or pain team member can administer an epidural bolus of concentrated (>0.2%) local anaesthetic.

- When administering an epidural bolus injection, the anaesthetist or pain team member will:
  - complete a pain assessment prior to injection.
  - ensure the epidural catheter is intact and functioning. A sensory level may be tested for in older children.
  - administer the prescribed bolus dose, as per the M46J Epidural Bolus section in the presence of a second Registered Nurse.
  - **remain present at the bedside during the bolus dose, continuously monitoring the patient and the effects of the bolus dose**.

Equipment required: dressing pack, gloves, appropriate alcohol wipes, sterile 0.5% or 0.25% bupivacaine solutions.

Observation protocol following a bolus with concentrated solution.

Following a bolus injection of a concentrated solution, the following observation protocol should be observed.

- Blood pressure and respiratory rate; every 15 minutes for 1 hour
- Continuous pulse oximetry for 1 hour
- Pain & motor scores; every 15 minutes for 1 hour

Documentation

Manual bolus doses must be documented on the M46J prescription chart. Care provided will be documented in the patient's pain management observation chart (M34B) and in the progress notes.

9.6 Clonidine in epidural infusions

Clonidine is regularly added to local anaesthetic solutions for epidural infusion. At a spinal level, the alpha-2 agonist is thought to improve the quality and duration of analgesia. Clonidine can be added after selecting a '***microgram/kg/day dose'*** (typical between 1 and 2 microgram/kg/day) and knowing the rate of epidural infusion (mL/kg/hr).

The following table and calculation formula may be useful.

Adding clonidine to a 200mL polybag of local anaesthetic for epidural infusion		
Desired daily dose of clonidine: (microg/kg/d)	1 microg/kg/d	2 microg/kg/d

Epidural infusion rate (mL/kg/hr)	Amount of clonidine -in micrograms -to be added to a 200mL polybag *(rounded for convenience)*	
0.2	40	80
0.3	30	60
0.4	20	40

The calculations can be derived as follows:

Amount of clonidine (in micrograms) to be added to a polybag

= 200mL/bag x desired dose (microg/kg/d) ÷ rate (mL/kg/hr) x 24 hrs/d

Note: 1. As *both* the selected clonidine dose and the infusion rate are weight-based, the amount of clonidine added to a polybag is *independent* of weight.

2. Changing the rate of infusion may necessitate changing the amount of clonidine in the bag i.e. a new polybag will have to be made up.

9.7 Running epidural AND systemic opioids

In the intensive care setting (i.e. where one-to-one nursing, continuous pulse oximetry and respiratory rate monitoring occur) it is possible to run an opioid-containing epidural infusion together with a systemic opioid 'bolus-only' NCA.

If the child is not in an intensive care setting, consult the anaesthetist who inserted the epidural or a senior pain team member.

9.8 Precautions

There is increased potential for pressure areas caused by sensory loss and decreased mobility. Pressure area care must be attended 4/24 including heels.

- Turning should be done 2 hourly to prevent pooling of epidural drugs in dependant spaces. This will help prevent unilateral blocks.
- The child may be positioned in or out of bed with both legs supported.
- Urinary output should be monitored carefully. Urinary retention must be identified early in children without urinary catheters.
- Manage constipation actively.

Observation Protocol Epidural/ Regional Infusion

Heart Rate, Respiratory Rate, Pain Score & Sedation Score: hourly while infusion continues

Blood Pressure Measurement: hourly for 6 hours → 4th hourly thereafter

Children <6 months of age must have continuous pulse oximetry monitoring and recording

Check the dressing and site every 4 hours for redness, tenderness, swelling, leakage, dislodgement.

Temperature monitoring should continue according to medical and surgical guidelines and be recorded on the Standard paediatric observation chart (SPOC). All patients with indwelling catheters/ lines (including epidural and regional catheters) must have their temperature documented at least 4th hourly.

Sedation is scored and documented on the Pain Management Observation chart (MR34b) according to the following schedule:

Sedation Score	Description
0	Awake, alert
1	Minimally sedated, tired/sleepy, responds to conversation and/or sound
1S	Asleep, easy to rouse
2	Moderately sedated, easily roused with tactile stimulation or verbal commands
3	Deep sedation, rousable only with significant physical stimulation
4	Unrousable

Children who have epidural or lower limb regional infusions in progress should have the degree of motor block documented hourly according to the following scale.

MOTOR SCORE (Modified Bromage scale)
1 = Complete block unable to move feet or knees
2 = Able to move feet only
3 = Just able to move knees
4 = Detectable weakness of hip flexion
5 = No detectable weakness

ALL WARD AREAS must record these observations on the Pain Management Observation Chart (M46C).

Notify the Pain team or anaesthesia registrar (after hours) if a motor score of 1 is recorded.

9.9 'TROUBLE SHOOTING' an epidural block

Generally patients on epidural infusions are less sedated than those on parenteral opioid infusions but they may be more distressed by such things as IV lines and naso-gastric tubes and fasting and require extra comforting for these problems.

Make sure the epidural infusion is running at the prescribed rate and that it has not become disconnected. Make sure the epidural dressing is intact and the catheter is still in place.

Epidural analgesia may regress with time. In this event, analgesia can be regained by appropriate bolusing and increases in the infusion rate.

Initial bolus injections can be administered by an anaesthetist, pain team member or accredited nurse according to the prescription charted on the M46J.

Bolus injections of LA solutions are only to be given by an Anaesthetist, Pain team member or accredited nurse.

The Pain Service/Registrar if called to a patient in pain with an epidural in situ should determine whether the epidural catheter is intact and functioning. A sensory level may be tested for in older children. It may require bolusing with more concentrated local anaesthetic such as 0.25% bupivacaine, taking into account the potential for local anaesthetic toxicity.

The Anaesthetic Registrar or Pain Fellow may choose to use adjunctive drugs via the epidural such as clonidine or morphine. All such injections should be followed by close observation.

Note: This observation protocol is similar to that applied to all new post-operative admissions to the recovery ward with epidural catheters in place.

After bolus injection, observe the following:

- Blood pressure; every 15 minutes for 1 hour
- Pulse, respirations; every 15 minutes for 1 hour
- Continuous pulse oximetry for 1 hour
- Pain & motor scores ; every 15 minutes for 1 hour

If the epidural is demonstrated to be in the epidural space and extra analgesia or sedation is required, the concentration of fentanyl in the solution may be increased from the standard 2micrograms/mL to 4micrograms /mL. Alternatively PCA or NCA can be run in conjunction with an epidural infusion of plain local anaesthetic after consultation with the anaesthetist.

9.10 Removal and care with anticoagulation

The decision to remove the epidural catheter is made by an Anaesthetist or by the Pain Service.

- The catheter may be removed by medical staff or members of the pain service. Experienced nursing staff may remove epidural catheters after consultation with the pain service.
- The catheter should be checked to ensure it is intact. Its removal should be documented in the electronic medical record.
- The epidural catheter should not be removed from a patient who is coagulopathic or anticoagulated as bleeding into the epidural space may result. Coagulopathy should be corrected prior to epidural removal. For patients on BD subcutaneous unfractionated heparin the catheter may be removed 6hrs after the last dose. For patients on daily low molecular weight heparin it should be removed at least 12hrs after the last dose and 2hrs

prior to any subsequent doses. Patients on twice daily low molecular weight heparin may have to omit a dose to enable safe epidural catheter removal.

- Patients on continuous heparin infusions (generally low dose infusion, as therapeutic anti-coagulation is a contra-indication to epidural insertion) require careful planning and full consultation with all involved teams before epidural catheters are removed.

Coagulation status	Epidural insertion	Epidural removal	Next dose
Therapeutic anti-coagulation with heparin or warfarin *(This includes therapeutic BD subcutaneous dosing with low molecular weight heparins e.g. clexane 1mg/kg bd).* Documented coagulopathy	Contra-indicated		
Previously anti-coagulated with heparin (therapeutic)	More than 6 hours after ceasing heparin. APPT in normal range.		May commence heparin 1 hour after removal
Previously anti-coagulated with warfarin (therapeutic)	At least 5 days since ceasing warfarin and documented INR<1.5		May commence warfarin 4 hours after removal
Prophylactic BD subcutaneous unfractionated heparin	At least 6 hours after the last dose	At least 6 hours after the last dose	1 hour after insertion or removal
Prophylactic low molecular weight heparin. *(This is usually delivered daily but can occasionally be delivered in divided doses bd e.g. clexane 0.5mg/kg bd)*	At least 12 hours after the last dose	At least 12 hours after the last dose	12 hours after insertion **2hours after removal**

9.11 Epidural catheters and infection risks

Epidural infection is a rare but serious complication of epidural catheterisation. Signs of infection include:

- Un-explained fever
- Back pain
- Pain at the site of catheter insertion.
- Pain on gentle percussion of the spine
- Neurological deficit in a dermatomal or spinal nerve root distribution.

Epidural space infection may progress to overt meningitis at which time headache; photophobia, neck stiffness and a positive leg raising sign may be detected.

Epidural infection may present some weeks after epidural insertion (including after discharge from hospital).

Risk factors for epidural infection may include:

- Prolonged duration of catheterisation
- Immunocompromised patients
- Systemic sepsis/bacteraemia while a catheter is in-situ

If the epidural site is red or inflamed a swab should be taken and anaesthetic staff notified. It may be appropriate to commence antibiotics and arrange appropriate medical imaging. This requires consultation with the Neurosurgical, Infection diseases and Radiology departments. *Warning: Nuss bars (Biomet/Lorenz Medical) are made from stainless steel. They have 'MRI conditional status'. Radiological imaging must be discussed with a radiologist.*

All patients or parents of patients who have had an epidural should be given a card detailing signs and symptoms of possible epidural space infection with details of who to contact if they are worried.

10 Time limits for infusions

All pain management infusions- systemic opioids, regional local anaesthetic and major neuraxial infusions are administered in a sterile fashion. All reasonable measures must be taken to avoid line sepsis, venous-thrombosis, phlebitis, PIVC-related cellulitis and septicaemia. The following table can be used as a guideline for syringe and line changes.

Intravenous infusions

Volume	Drug	Venous access	Equipment (Reservoir & Line)	Time limit (hrs)	Comments
50mL	Opioids & ketamine NCA/PCA/Inf	PIVC	BBraun Syringe	48	
			Line	48	
50mL	Opioids & ketamine NCA/PCA/Inf	Central	BBraun Syringe	48	
			Line	48	
100mL	Opioids & ketamine NCA/PCA/Inf	PIVC	CADD Cassette	72	
			Line	72	
100mL	Opioids & ketamine NCA/PCA/Inf	Central	CADD Cassette	72	
			Line	72	
100mL Pall care-outpatient	Opioids & NCA/PCA/Inf	Central	CADD Cassette	72	Can be extended to twice weekly e.g. Mon/Thurs when appropriate.
			Line	72	

Epidural and Regional infusions.

Volume	Drug	Venous access	Equipment (Reservoir & Line)	Time limit (hrs)	Comments
50mL	Local anaesthetic	Epidural	Syringe	72	Always use a 0.2micron filter
			Line + filter	96	
50mL	"	Regional	Syringe	72	
			Line + filter	96	
200mL polybag	"	Epidural	Polybag	48	
			Line +filter	96	
200mL polybag	"	Regional	Polybag	48	
			Line +filter	96	

11 Managing Adverse Effects and Common Side-Effects

11.1 Respiratory Depression

If overdose is suspected (slow shallow respirations, deep sedation or loss of consciousness):

- **DIAL 2222** and obtain help.
- **Give Oxygen** (assist ventilation if necessary)
- **Stop Infusion**
- **Call anaesthetic**, duty medical or surgical registrar
- **Give naloxone 5 micrograms/kg IV** if standing order is signed (M46C)

  OR
- **Have Naloxone available** (initial dose 1-5 microg/kg to be administered by Medical Officer)
- **Notify Pain Service**

11.2 Nausea and Vomiting

Pain management strategies often incur the unpleasant side-effects of nausea and vomiting. Nausea and vomiting are also common side-effects of many general anaesthetics and surgical procedures-post operative nausea and vomiting (PONV). Nausea and vomiting is also a well-recognised side-effect of many chemotherapeutic regimens and some forms of radiotherapy.

Management of nausea and vomiting in the peri-operative setting should take into account the following: a) identifying risk factors b) reducing baseline risks c) optimising prophylaxis d) optimising anti-emetic treatment.

11.2.1 Identifying primary risk factors for PONV in children and infants

Risk factors

- History of PONV/ motion sickness in children,
- Sex differences are not seen before puberty (Rowley 1982). Post-puberty, it is more common in girls.
- Risk increases as children age
- Use of volatile anaesthetics
- Use of Nitrous oxide
- Use of intra-operative and post-operative opioids
- Duration of surgery
- Type of surgery- laparoscopy/ laparotomy, ENT surgery, orchidopexy and strabismus surgery.

11.2.2 Optimizing prophylaxis

Indications

- Past history of PONV or motion sickness
- Where PONV is detrimental to the postoperative course e.g. eye and craniofacial surgery, neurosurgery, fundoplication, interdental wiring.
- Day surgery to minimise hospital stay e.g. adenoidectomy, tonsillectomy
- Surgery associated with high incidence of PONV (e.g. squint, adenotonsillectomy)

Recommendation

- Dexamethasone 150 microgram/kg IV (max 8mg)
- Where two or more indications exist: add Ondansetron 50-100 microgram/kg IV (max 4mg) i.e. high risk patients should receive combination therapy prophylaxis using drugs from different classes.

11.2.3 Recommendations for POV prophylaxis in children

	Prophylaxis Dose
Ondansetron	50-100 microgram/kg per dose (max 4mg)
Dexamethasone	150 microgram/kg per dose (max 8mg)
Droperidol	20- 50 microgram/kg per dose (max 0.625mg) Reserved for patients who have failed other treatments and are inpatients **NB CHW dose recommendation is 10-20 microgram/kg/dose**
Metoclopramide	150 microgram/kg per dose (max 10mg)

11.2.4 Optimizing treatment/rescue

- Before using anti-emetic drugs always ensure that patients are adequately hydrated and analgesed and that hypoglycaemia and hypotension are not causative factors.
- Where either dexamethasone or no prophylactic anti-emetic has been given:
  - Give Ondansetron 100 microgram/kg per dose IV (max 4mg per dose, three doses for PONV)
- Where both dexamethasone and ondansetron have been given:
  - Ensure adequate hydration, analgesia, blood sugar and blood pressure.
- Ondansetron may be repeated if the previous dose was given more than 6 hours prior. Ondansetron use in post-operative nausea and vomiting is limited to three doses before medical review is required.
- If nausea and/or vomiting persist consider giving Droperidol 10 – 20 microgram/kg per dose (N.B. this is a smaller dose than that quoted in the table above). This may be given 30 minutes after the last dose of ondansetron.

- Suggest use of acupressure (P6 "Neiguan" point location) using digital pressure, massage or light bandage.

11.2.5 Persistent PONV

- Ensure that there are no surgical causes for nausea and vomiting e.g. bowel obstruction, blood in stomach. Review the response to any prescribed intervention.
- Ensure adequate trial of first line agents (ondansetron, dexamethasone, low dose droperidol 10-20 micrograms/kg/dose)
- Consider cyclizine 500- 1000micrograms/kg up to every 8hours. (max 25mg if <12yrs, max 50mg if >12 yrs)
- Consider low dose Diazepam 50 microgram/kg per dose IV (max 1 mg) or
- Metoclopromide 150 microgram/kg/dose (max 10 mg)

11.3 Chemotherapy-induced nausea and vomiting (CINV)

- **Refer to Oncology treatment guidelines for further detail.**

11.4 Pruritus

This is a well-recognised side effect of opioid medication and a very common symptom in infants and children receiving opioid analgesia.

The mechanism of the effect remains uncertain and its treatment is difficult.

At CHW the following measures can be taken in the attempt to reduce distress:

1. Ensure general skin care is optimised i.e. change old dressings, adequate skin washing, use skin moisturisers etc.
2. Ensure that pruritus is not the result of uraemia or hyperbilirubinaemia.
3. Try cetirizine 125 - 250 micrograms/kg/dose up to twice daily (max 10 mg/d).
4. Try ondansetron 100micrograms/kg per dose IV or oral (max 4 mg). If this is effective, it may be repeated at 8 hourly intervals (max 3 doses for pruritus).
5. Change opioid i.e. morphine to fentanyl or oxycodone.
6. Try a single low dose of naloxone IV e.g. 0.5 -1.5 micrograms/kg titrated in aliquots of 0.5 micrograms/kg over 10-15 minutes. Max 2.5 micrograms/kg.
7. Cease opioid altogether.

Pruritus is more common with spinally administered opioids particularly morphine and in this case does not seem related to histamine release. Though common, it is usually a minor irritation rather than a major source of distress. If it is distressing it may be relieved by IV naloxone 0.5 microgram/kg. If this proves effective consideration should be given to continuing this as an infusion for 12 hrs.

Naloxone continuous infusion. At low infusion rates, the risk of reversing analgesia is very low. This infusion can be run on general wards. Continue hourly observation of pain and sedation scores as per PCA/NCA/Opioid protocols.

Category	Syringe prescription [units for programming]	Default Basal rate [microg/kg/hr]	Default patient Bolus [microg/kg]	Default lockout Interval [mins]	Default Hourly Limit [microg/kg/hr]
<50kg	25 microgram/kg in 50mL (max 1250microg) [microg]	0.5	N/A	N/A	1.5
>50kg	1250 micrograms in 50mL [microg]	25 microg/hr	N/A	N/A	75 microg/hr

11.4.1 Pruritus in patients with burns

Pruritus is a common problem in children with healing burns. In this setting it is likely to be of multi-factorial origin.

Additional measures to those listed above may include the use of:

- Low dose naloxone infusions.
- Baths incorporating 5% colloidal oatmeal in paraffin.
- Gabapentin 5- 10 mg/kg orally up to tds

11.5 Tolerance and dependence

Declining analgesia and/or an increase in opioid dose requirement is often described as the patient becoming 'tolerant' to the effect of a drug.

Tolerance to opioid drugs occurs after repeated administration. Changes to the opioid receptor system within the central nervous system can result in progressively higher opioid requirements. Tolerance is one of many factors involved in the need for more opioid.

Whenever increased opioid doses are needed to relieve previously controlled pain, the child must be reviewed and assessed by their admitting team, to determine aetiology of the increased analgesic requirement.

Pain is often the first sign of advancing illness or disease.

Opioid dependence refers to a physiological state in which abrupt opioid withdrawal results in adverse symptoms and signs.

11.5.1 Identifying the opioid dependent patient

Always consider opioid dependence when:

- Patients have been treated with opioids for more than 9 days.
- Patients who have been managed in intensive care for prolonged periods.

- Patients recovering from major burn injuries.
- Oncology patients who have been treated for mucositis.

Do not stop opioid administration abruptly in opioid dependent patients.

Use an opioid withdrawal scoring chart (M34E) when weaning opioids in opioid dependent patients.

Use the PICU sedation and analgesia transition plan chart (M46H) where appropriate: https://intranet.schn.health.nsw.gov.au/files/picu_analgesia_and_sedation_transition_plan_0.pdf

11.6 Opioid Withdrawal

Opioid withdrawal syndrome (OWS) may develop in infants and children who have been exposed to opioids for prolonged periods.

Risk factors:

- Ward transfer following prolonged PICU admission requiring analgesia-sedation
- Sudden loss of intravenous access and usual opioid delivery
- Un-expected alterations in gut function, e.g. gastroenteritis, NBM orders
- Discharge from hospital without an adequate opioid weaning plan

Prevention

- Identification of patients at risk e.g. when rounding in PICU
- Educating parents on the importance of avoiding disruption to opioid administration

Diagnosis and monitoring

- Opioid withdrawal symptoms can take many forms and involve all body systems. Agitation, irritability, tachycardia, tachypnoea, sweating, GIT up-set, sleep and temperature disturbance can all result from sudden opioid withdrawal.
- Use the opioid withdrawal scoring chart in patients at risk to diagnose OWS and monitor progress.
- Link: https://intranet.schn.health.nsw.gov.au/files/scn110530_0.pdf

Immediate management

Provide a rescue dose of opioid (previous usual dose). Chart regular doses or slow the weaning schedule as appropriate. Clonidine (single dose 1-2 micrograms/kg oral or 0.5 - 1 micrograms/kg/hr by infusion) can be used to treat the symptoms of opioid withdrawal. N.B. Cessation of clonidine itself, after prolonged exposure can cause a withdrawal syndrome with a similar presentation to opioid withdrawal.

11.7 Addiction

Addiction refers to overwhelming behavioural patterns centred on obtaining and using a drug primarily for its euphoric effects. This is an extremely rare problem in children who receive opioids in a well supervised clinical context for pain management.

11.8 Opioid induced hyperalgesia (OIH)

Very occasionally, exposure to potent opioids may result in a paradoxical response in which the patient experiences increasing pain despite escalating doses of the opioid.

The exact mechanism of this phenomenon is unclear but appears to be associated with generalised hyperalgesia and allodynia. It should be suspected if:

- a child reports pain (or displays pain behaviours) despite increased doses of a potent opioid.
- no other explanation for increased pain can be identified.
- there is evidence of generalised hyperalgesia and/or allodynia (i.e. in areas away from the original surgical site)
- pain (or pain behaviours) increase in response to increased opioid doses.

The diagnosis is substantiated if pain (or pain behaviour) significantly and rapidly reduces in response to de-escalation of opioid doses.

Contact the Pain team if OIH is suspected in any child.

11.9 Local anaesthetic toxicity reactions

Local anaesthetic toxicity can result from inadvertent overdose, inadvertent intravenous injection or drug accumulation following infusion for regional analgesia.

Although rare, it can have catastrophic consequences. Prevention remains the cornerstone of all clinical techniques involving local anaesthetic agents.

Local anaesthetics reversibly block nerve fibre impulse propagation by blocking transmembrane sodium channels. Blockade of small (C) fibre afferents reduces nociception while blockade of larger (myelinated) fibres can result in motor blockade. At higher (toxic) doses, blockade of central neuronal and cardiac sodium channels can result in seizures and/or cardiac arrest.

Toxicity (both cardiac and neurological) is related to the unbound fraction of the drug. This has special relevance in neonatal practice, as levels of plasma alpha-1-acid glycoprotein (a significant binding domain of the drug) are known to undergo significant post-natal changes.

Early symptoms result from central nervous system involvement and include dizziness, circum-oral paraesthesia, disorientation, agitation and tremor. These can lead onto frank seizure activity. Higher plasma concentrations result in impaired cardiac conduction, arrhythmia and cardiac arrest.

Cardiac arrest due to local anaesthetic toxicity is notoriously refractory to standard resuscitation techniques. Resuscitation may be prolonged and require extra-corporeal membrane oxygenation (ECMO).

11.9.1 Management of impending local anaesthetic toxicity

1. If local anaesthetic toxicity is suspected:
   - recognised inadvertent overdose,
   - symptoms suggestive of CNS toxicity (dizziness, circum-oral paraesthesia, disorientation, agitation or tremor)
   - seizure
2. Cease the local anaesthetic infusion immediately. **Call an arrest team (Ring #2222).**
3. Inject lipid emulsion (SMOF or Intralipid 20%) as soon as convenient.
   - 1.5mL/kg over 1 min
   - repeat twice if necessary every 3-5 minutes
   - Follow with an infusion of 0.25 mL/kg/min
   - Maximum dose 8 mL/kg

11.9.2 Cardiac Resuscitation in the event of suspected overdose of local anaesthetic agents

- Institute and continue APLS according to current protocols.
- Call an arrest team (**ring #2222**)
- Inject a lipid emulsion (SMOF or Intralipid 20%) as soon as possible.
  - 1.5 mL/kg over 1 min
  - repeat if necessary every 3-5 minutes
  - Maximum dose 8 mL/kg
- Follow with an infusion of 0.25 mL/kg/min until haemodynamic stability is restored.

If possible, collect blood samples into a plain tube and a heparinised tube (to measure LA and Triglyceride levels) before and after lipid emulsion administration and at hourly intervals thereafter.

12 Procedure Specific Management Guidelines

12.1 Analgesia following cleft palate surgery

The following recommendations are suggested:

1. Safety is the predominant concern; however this should not preclude appropriate analgesia from a humanitarian perspective. Consideration should be given to obtaining a PICU consultation if the airway is significantly impaired to the extent that opiates cannot be used with safety.
2. To be effective an opioid infusion needs an appropriate loading dose given during surgery, with supplementation in the early postoperative period if indicated. It is suggested that morphine 0.1 mg/kg be given at commencement of surgery with further increment of 0.05 mg/kg at completion of surgery if required. Any further boluses in recovery should be given by the anaesthetist after review.
3. Providing the airway is stable an infusion should be commenced shortly after arrival in recovery to enable further adjustments to be made prior to transfer back to the ward. Infusions can run between 4 and 20 micrograms/kg/hr and usually start at 8micrograms/kg/hr. Cleft palate patients should remain in recovery for 1 hour following arrival and should be reviewed by the anaesthetist prior to discharge.
4. All patients should be monitored with continuous oximetry (with appropriate alarms) and cared for by trained staff able to respond quickly. In the event of deterioration the morphine infusion should be ceased immediately, oxygen given by face mask and anaesthetic registrar or PICU registrar called. In the event of respiratory depression DIAL 2222 and obtain help.
5. In most cases the infusion can be discontinued the day after surgery once oral analgesia is initiated and is more likely to be effective.
6. Older children having pharyngoplasty (> 5 years) or bone-graft repair to alveolar clefts (age 12 +) should be considered as to suitability for Patient Controlled Analgesia techniques.
7. The Acute Pain Service will follow up all patients on the day after surgery and ensure smooth transition to alternative forms of analgesia if appropriate.
8. Peri-operative dexamethasone may reduce swelling and pain following surgery.

12.2 Analgesia following Ilazarov surgery

Patients undergoing this form of surgery often experience substantial amounts of post-operative pain related to long bone osteotomies.

Opioids remain the mainstay of early post-operative pain management and are most effectively delivered by either intravenous PCA or NCA. Optimising analgesia is the key to early mobilisation and discharge.

Recommendations

- Loading doses of paracetamol may be given pre-operatively (oral) or intra-operatively (intravenous or suppositories).
- Judicious use of opioids and regional local anaesthesia intra-operatively at the discretion of the consultant anaesthetist.
- Regular oral paracetamol should commence immediately after surgery and continue for 48 hours if no other contra-indication exists (see under Paracetamol above).
- Intravenous opioid (morphine or fentanyl) PCA or NCA should be commenced in the recovery room under the direction of the consultant anaesthetist.
- NSAIDS may inhibit bone healing / re-modelling. They are contra-indicated where the risk of non-union is high.
- On return to a normal diet and after review by the acute pain service – oral opioids (e.g. Oxycodone or oral morphine) can be started (PRN or regular for 24 hrs).
- If on-going analgesic requirements are predicted to be high – slow release oral opioid can be started (Oxycontin® or MS Contin®). As soon as the first dose is given, the PCA/NCA should change to a "bolus-only" regimen to provide "breakthrough" analgesia only. If analgesic requirements persist or patients complain of allodynia and/or hyperalgesia, consider neuropathic mechanisms and specific management strategies.

12.3 Analgesia following Limb Fractures

Limb fractures can sometimes be complicated by compartment syndrome.

Signs of compartment syndrome include disproportionate pain, pallor, paraesthesia and loss of movement. While it is important that analgesic regimens do not mask these signs, analgesia must not be withheld from children with fractures.

Always discuss the risk of compartment syndrome with the Orthopaedic Surgeon.

Consult a senior anaesthetist whenever prescribing opioid infusions, PCAs or NCAs in children with forearm fractures. Where there is a significant risk of compartment syndrome and systemic opioids are required for analgesia, it may be wise to prescribe a 'bolus-only' PCA or NCA (rather than an infusion or PCA/NCA with background). Careful thought should be given to the setting of the maximal hourly limit and "Special orders" should be documented along the following lines: "Notify the orthopaedic registrar immediately if the hourly maximum limit is reached."

Unexpected increases in analgesic requirements should trigger clinical review.

Scenario	Recommendation
Simple fracture reduced closed.	Simple oral analgesia PRN
Fracture requiring minimal manipulation and percutaneous wiring.	Simple oral analgesia PRN including PRN oral opioids
Fracture requiring aggressive manipulation and/or open reduction including medullary nailing or plate and screw fixation. Limb at risk of developing compartment syndrome.	Regular oral paracetamol (24-48 hours) and NSAID Bolus-only Opioid PCA/ NCA. **Special care when setting hourly limit.** Special order: *"Notify the orthopaedic registrar immediately if the hourly maximum limit is reached."*

N.B: 1) Intra-operative analgesia is managed at the discretion of the anaesthetist.

2) Moderate – severe post-operative pain in children NOT at risk of compartment syndrome can be managed with a typical PCA/NCA (background and bolus) at the discretion of the anaesthetist.

12.4 Analgesia following Spinal surgery

Surgery for spinal deformity generally falls into 4 main groups: anterior release only via thoracotomy, posterior correction alone, or anterior and posterior procedures performed as a combined procedure, or as a staged procedure separated by 1-2 weeks. Patients undergoing these surgeries often experience significant post-operative pain related to large wounds, extensive soft-tissue dissection, thoracotomy, intercostal catheters or drains, and vertebral manipulation/ instrumentation.

These patients often require multimodal analgesia – combinations of intravenous opioid and non-opioid analgesics. Some children may also receive neuraxial opioids or regional analgesia (epidural or paravertebral infusions of local anaesthetic). Excellent analgesia facilitates optimal respiratory function and early post-operative mobilisation. Planned re-mobilisation and 'bowel care' enhance recovery

Selected children (most often, otherwise well children with idiopathic scoliosis) can be managed using an 'Enhanced Recovery After Surgery (ERAS)' protocol.

Recommendations

- **Pre-operatively** -A loading dose of paracetamol may be given pre-operatively or intra-operatively.
- **Intra-operatively** - judicious use of opioids and regional local anaesthesia at the discretion of the consultant anaesthetist. This might include:
  - 'Single-shot' intrathecal morphine: usually 5 microgram/kg (up to 250 microg total)
  - Intravenous remifentanil infusion followed by a loading dose of a longer-acting opioid before the end of the case.
  - Low dose ketamine infusion to help reduce the development of acute opioid tolerance and/or opioid-induced hyperalgesia.

- Intravenous methadone: usually 0.1 to 0.2 mg/kg toward the end of the case.
- An epidural or paravertebral catheter may be placed by the surgeon at the end of the procedure. A plain local anaesthetic infusion is often commenced in the recovery ward. Epidural fentanyl may be added if long acting opioids (methadone/ IT morphine) have not been used.
- An intravenous dose of parecoxib -as the first dose in a course of 3 daily doses.

- **Post-operatively** - Intravenous opioid (morphine or fentanyl) PCA or NCA should be commenced in the recovery room under the direction of the consultant anaesthetist. Typically a 'bolus only' regimen if intrathecal or epidural opioids have been used or if methadone has been used intra-operatively. A background infusion can be started following pain team or anaesthesia review.
- Low dose Ketamine infusion where no contra-indications exist. (add 5 mg/kg to 50mL 0.9% saline and run at 50 to 200 microgram/kg/hr).
- When a paravertebral or epidural catheter is inserted intra-operatively, the infusion will be prescribed by the anaesthetist and the intended duration of the infusion will also be indicated on the pain service prescription form MR46J. Should the catheter need to be removed earlier the pain service and or anaesthetist should be informed.

Thoracic paravertebral blocks do *not* cause:
- Lower limb weakness.
- Bowel or bladder dysfunction.
- Numbness or paraesthesia in un-related dermatomes.

Thoracic paravertebral blocks *can* cause:
- Upper limb paraesthesia
- Uni-lateral Horners syndrome
- Pneumothorax

- Regular intra-venous paracetamol should continue after surgery for 48 hours if no other contra-indication exists (see Paracetamol). This can be converted to an oral formulation when appropriate.
- Regular anti-emetics should be considered especially for children who have received IT morphine
- Oral gabapentin 5-10 mg/kg nocte can be added post-operatively when oral intake is tolerated. A three day course can be prescribed for its opioid-sparing effect.
- NSAIDs can be used if reasonable haemostasis has been achieved at the end of surgery and there are no contra-indications. Parecoxib can be used as 3 daily doses. **Always discuss the use of NSAIDs with the Orthopaedic Surgeon before prescribing.**
- Paravertebral infusions, PCAs and NCAs should not been regarded as an impediment to mobilisation. Patients should be encouraged to use their PCA to facilitate movement and physiotherapy.
- Once the child tolerates clear fluids and after review by the acute pain service, oral opioids (oral Oxycodone) can be started. A slow-release formulation e.g. Targin® (oxycodone/naloxone) can be added if needed (usually after Pain team review).

Enhanced Recovery after Surgery (ERAS) - Spinal surgery)

- The following recovery plan can be applied to selected children undergoing spinal surgery (those with idiopathic scoliosis and who are otherwise well).

Post-op day	Analgesia regimen	Anti-emetics, Diet and Bowel care	Mobilisation
0	Regular IV paracetamol (qid 72hrs) Bolus-only PCA/NCA Low dose ketamine infusion (48hrs) Consider nocte gabapentin (3 night course)	Regular anti-emetic (48hrs) Ice-to-suck Trial of clear fluids Consider sugar-free chewing gum	Log roll every 2 hrs Sit on edge of bed if able
1	Parecoxib IV –daily dose for 2 days (3 doses in total) Regular paracetamol- change to oral as tolerated Bolus-only PCA/NCA Low dose ketamine infusion Commence Targin bd*	Regular anti-emetic Clear fluids Trial of light diet Cease IV fluids when drinking adequately Commence stool softeners	Sit out of bed Commence mobilisation in the afternoon
2	Parecoxib IV –morning dose Regular oral paracetamol Cease PCA/NCA oral oxycodone for breakthrough pain Cease ketamine infusion	Light diet. Cease anti-emetics Progress to normal diet as tolerated Continue stool softeners	Mobilise tds
3	Cease parecoxib. Commence regular ibuprofen (24 hour course) Continue regular paracetamol Continue Targin if clinically indicated Oral oxycodone for breakthrough pain PRN	Normal diet Continue stool softeners Add microlax or fleet enema if needed	Mobilise tds Trial of stairs
4	Reduce regular paracetamol to tds Prepare Targin weaning plan if this has been used. Cease regular ibuprofen	Normal diet Continue stool softeners Add fleet enema if needed	Mobilise tds Assess mobility and safety for discharge

12.5 Sickle Cell disease

Sickle cell disease is an autosomal recessive disorder that is more common among people of African and Mediterranean descent. Abnormal production of (sickle) haemoglobin, results in chronic haemolytic anaemia, susceptibility to infection, pain, stroke, and multiple organ dysfunction. Episodes of pain are generally nociceptive and secondary to tissue ischaemia. Occlusion of the microcirculation by less deformable red blood cells leads to ischaemic pain often from multiple sites (abdominal, chest, lumbar and lower limbs). Severe chest pain during 'chest crises' can impede ventilation, increase hypoxaemia and exacerbate the problem. Acute bone pain appears to originate from ischaemia of bone marrow. The pain is usually episodic but it can be chronic. About 90% of hospital admissions of patients with sickle cell disease are for the treatment of acute pain. Analgesic requirements can escalate quickly and importantly, can resolve quickly also. Appropriate titration requires regular review.

Management of severe pain is based principally on opioids and early aggressive analgesia is thought to aid recovery. Prompt analgesia for children presenting with sickle-cell related pain is a priority and various mechanisms within medical systems can be developed to avoid un-necessary delays e.g. 'the CHW child's passport'.

Recommendations

1. Regular simple oral analgesics (paracetamol and an NSAID) should be instituted early. NSAIDs should be avoided in children with renal impairment, dehydration and/or exposure to nephrotoxins.
2. Intravenous opioids remain the mainstay of analgesia regimens for these children.. Although opioids can be delivered orally, intravenous infusions (PCAs or NCAs) are preferred for acute management of moderate or severe episodes.

   Prescriptions for appropriate opioid infusions/NCAs/PCAs must be completed soon after triage and instituted without delay. Notify both the haematology and pain teams immediately.

   Although PCAs and NCAs are generally prescribed with a fixed background rate, added flexibility is useful during acute sickle cell pain crises. The background rate can be prescribed as a range.

   Persistent pain can be managed by the addition of a ketamine infusion at 50-200microg/kg/hr for children <40kg (4mg/hr if >40kg).
3. Daily review by haematology and pain teams. Senior haematologists can adjust the PCA/NCA infusion paramaters as clinically indicated. Good communication between both teams is essential.
4. Oral opioids can be commenced once pain begins to resolve. Slow release preparations may be useful if prescribed for short (24-48 hr) courses.

   N.B. After hours and at weekends, timely and effective analgesia is best achieved if senior staff communicate patient needs directly to the ward anaesthesia registrar (#6008) and/or duty anaesthetist.

12.6 Neurosurgical patients

Please consult a senior anaesthetist when prescribing parenteral opioids for peri-operative pain management in children undergoing neurosurgery.

Many children who undergo a simple craniotomy may be managed using simple oral analgesics (paracetamol and ibuprofen). Simple oral analgesics may not provide adequate analgesia if surgery involves facial bones (some cranial vault re-constructions) or significant muscle masses (e.g. nuchal muscles for posterior fossa craniotomy and foramen magnum decompression, paraspinal muscles for laminectomy).

Monitoring of neurological status is of critical importance following all neurosurgical procedures. Sedation-induced hypoxia and hypercarbia can be dangerous.

Judicious use of opioid infusions is justified in certain situations and is always predicated on close neurological monitoring.

The following recommendations are suggested:

- Providing the airway is stable and immediate neurological status is satisfactory, a 'bolus only' opioid PCA or NCA should be commenced in recovery. Fentanyl is the drug of first choice as its' rapid re-distribution makes it very titratable when used for short durations. Initial bolus doses =0.5 microg/kg -see below.
- Following craniotomy, patients should be monitored with continuous oximetry (with appropriate alarms) and hourly neuro-obs. Simple oral analgesics should be continued.
- If adequate analgesia cannot be obtained using a "bolus-only" mode then a background infusion can be commenced at any time following medical staff review (anaesthetist or neurosurgeon). At this time, simple oral analgesia (paracetamol and ibuprofen) should be prescribed on a regular basis for 48 hours.
- The Acute Pain Service will follow up all patients on the day after surgery and ensure smooth transition to alternative forms of analgesia if appropriate.

12.7 Multi-level Orthopaedic Surgery

Multilevel orthopaedic surgery is one of several therapeutic options being offered to children with CP at CHW. It involves soft tissue and bony procedures at different levels on one or both lower limbs and is usually performed between the ages of 6 and 12 years when gait has matured.

Surgical treatment is aimed at preventing or reducing severity of contractures, spasms and pain and increase the functional level. The overall goal is to maintain or improve independence or in the case of severely affected children, to improve ease of care.

Children with cerebral palsy have their degree of motor disability classified according to the following internationally recognised system.

Gross Motor Function Classification System for Cerebral Palsy (GMFCS)

- Between 6th and 12th Birthday

Level I

Children walk indoors and outdoors, and climb stairs without limitations. Children perform gross motor skills including running and jumping but speed, balance, and coordination are reduced.

Level II

Children walk indoors and outdoors, and climb stairs holding onto a railing but experience limitations walking on uneven surfaces and inclines, and walking in crowds or confined spaces. Children have at best only minimal ability to perform gross motor skills such as running and jumping.

Level III

Children walk indoors or outdoors on a level surface with an assistive mobility device. Children may climb stairs holding onto a railing. Depending on upper limb function, children propel a wheelchair manually or are transported when travelling for long distances or outdoors on uneven terrain.

Level IV

Children may maintain levels of function achieved before age 6 or rely more on wheeled mobility at home, school, and in the community. Children may achieve self-mobility using a power wheelchair.

Level V

Physical impairments restrict voluntary control of movement and the ability to maintain antigravity head and trunk postures. All areas of motor function are limited. Functional limitations in sitting and standing re not fully compensated for through the use of adaptive equipment and assistive technology. At Level V, children have no means of independent mobility and are transported. Some children achieve self-mobility using a power wheelchair with extensive adaptations.

These pain guidelines are also offered to children who have orthopaedic surgery for hip dysplasia, congenital short limb and Perthes disease.

Recommendations

These children experience a significant amount of pain in the post-operative period.

1. Peri-operative analgesia may include paracetamol (pre-op or intra-op) and an NSAID.
2. Neuraxial (epidural) block is an effective analgesic technique in selected patients. Typically a combination of local anaesthetic, opiate (fentanyl 1-2.5 microgram/mL) and clonidine (1-2 microgram/kg/24 hours) is used- (n.b different units of prescribing for each). Epidural infusions can be safely managed for up to 72 hours. Patients with significant respiratory compromise or sensitivity to systemic opioids may benefit from extending the duration of the infusion to 96 hours. All epidural catheters must be monitored closely for catheter-related problems.
3. Systemic opioids are not usually required with appropriate pro-active epidural management. If considered necessary, a bolus only PCA / NCA can be added. The epidural opioid need not be removed, if the systemic opioid is strictly 'bolus-only'. If a background infusion of systemic opioid is required, then the epidural opioid should be removed (i.e. use plain local anaesthetic). Strict attention to sedation levels is mandatory at all times.
4. Regular oral paracetamol can commence once oral intake is resumed.
5. NSAIDS may be particularly useful in patients undergoing extensive orthopaedic procedures and may especially assist in reducing opioid related side effects and help with

dynamic pain control during mobilisation. They should usually be commenced once oral intake resumes. NSAIDs should be avoided in children with renal impairment, dehydration and/or exposure to nephrotoxins.

6. Stepping down from systemic opioids or epidural analgesia usually involves oral opioids: typically: oxycodone (0.1-0.2 mg/kg orally up to 4th hourly). Children who have undergone osteotomies will generally require a combination of slow-release and immediate release formulations i.e. MS Contin, Targin or Oxycontin (slow release) twice daily with oxycodone (immediate release) for breakthrough.
7. **Muscle spasm** is a particularly difficult problem to manage in these children and is in part related to muscle transfers and lengthening. Other pre-existing medications may include clonazepam and baclofen for spasm. Diazepam may be prescribed on an alternative on an 'as needed (PRN)' basis. Particular care must be taken to avoid over-sedation when benzodiazepines are combined with opioids.
8. **Neuropathic pain** may complicate surgery in which peripheral nerves have been stretched (particularly after corrective surgery for knee flexion deformities). Adjustment of plaster casts may be needed to alleviate symptoms. Gabapentin can be commenced if symptoms persist. Suggested dosing: 5-10mg/kg tds
    - Maintenance - titrate to clinical effect (up to 40 mg/kg/day divided into 3 doses, dose limit 2.4 g/day).
9. Children who are receiving systemic opioids, epidural infusions, slow release opioid formulations and gabapentin will be reviewed daily by the Pain Service.
10. At the time of discharge, children who remain on slow release opioid formulations will be followed up by the pain service by phone. The orthopaedic team will decide which children require formal follow-up by the chronic pain team (generally children who have significant neuropathic pain at the time of discharge, children on gabapentin) or follow-up by the rehabilitation unit.

In general:

Neuraxial (epidural) block is an effective analgesic technique with significant advantages (particularly in relation to reduced sedation and subsequent respiratory compromise) over systemic opioids in this group of patients.

Symptom management and relation to GMFCS classification

GMFCS level	Typical problem	Recommendation
Level I - II	Post-op pain is often related to soft tissue incision. May need multiple osteotomies. No difficulties with communication.	These children have high levels of function allowing more reliable pain assessment.
Level III	Post-op pain often more severe due to osteotomy. May need multiple osteotomies.	Bone pain responds well to opioids and NSAIDs.
Level IV - V	Respiratory function often compromised. Muscle spasm is often a problem. Communication and assessment of pain will need to occur in context of cognitive impairment.	**Benzodiazepines and opioids can be given in smaller dose and with caution.** Constipation is often pre-existing and needs to be managed aggressively

Follow-up Arrangements

Clinical scenario	Pain and Symptom follow-up
Children on 'PRN' analgesics and PRN diazepam	Orthopaedic advanced Nurse practitioner, Orthopaedic clinic and GP
Children on regular slow release opioids, or complex weaning regimes	Orthopaedic advanced Nurse practitioner, Orthopaedic clinic and GP **+ Acute pain service phone follow-up**
DM Dystrophy children. Patients who have required complex analgesic regimens in hospital. Patients with significant neuropathic pain.	Orthopaedic advanced Nurse practitioner, Orthopaedic clinic and GP **+ Chronic pain clinic appointment**
Children with on-going rehabilitation issues. Children on Baclofen either orally or intra-thecally Children requiring further interventions such as Botox injection etc.	Orthopaedic advanced Nurse practitioner, Orthopaedic clinic and GP + Rehabilitation clinic appointment

12.8 Managing the pain of mucositis

Oral mucositis has long been associated with both intensive chemotherapy and radiotherapy for cancer. It has an overall incidence of about 40%.

It has several important implications including:

- Pain and discomfort- reducing quality of life
- Compromises nutrition
- Can limit cancer therapy dosage with direct impact on cure rates and survival
- May provide a portal of entry for systemic infection in neutropaenic patients.

The advent of cytokine therapies which reduce the haematologic toxicities of chemotherapy has resulted in mucositis being a more important "dose limiter" in cancer management. The development and severity of oral mucositis is correlated with cytotoxic regimen used (worse with melphalan and busulphalan containing regimes) and the mode of haemopoietic reconstruction (peripheral stem cells worse than allogeneic BM and autologous BM). Few interventions have documented efficacy in the treatment of mucositis. Only two agents, allopurinol and vitamin E had any effect on improving the condition.

While topical approaches to pain management may be used in the early and late phases of ulcerative mucositis, the mainstay of pain management remains opioid infusions typically as patient controlled analgesia or nurse controlled analgesia.

At CHW children with mucositis can be referred to the pain service via the Palliative Care Fellow (Camperdown Ward patients, page# 6807) or the Pain Fellow (All other Wards, page #6236). Recommendations include:

- Early institution of systemic opioids.
- Daily review
- Adjunctive use of ketamine and intravenous paracetamol when appropriate.
- Providing flexibility for experienced staff (i.e. staff on Camperdown and Variety wards) caring for these children.
    - Prescriptions for appropriate opioid infusions/NCAs/PCAs can be left with the ward team leader for children who are developing mucositis. The prescription can be completed and delivered when required. This is a particularly useful strategy for after-hours and weekend management.
    - Although PCAs and NCAs are generally prescribed with a fixed background rate, added flexibility can be given to Camperdown and Variety ward staff to adjust this background rate by providing a small range e.g. "0 – 1 mL/hr" or "reduce background rate if comfortable".

It is worth noting that severe mucositis can last several weeks. Aggressive weaning regimens may NOT be appropriate.

Hydromorphone use for severe mucositis

- In general, hydromorphone is used following a dose escalation of either morphine or fentanyl or in response to side–effects of these opioids. It is rarely used in opioid naïve children.
- Prescription is restricted to Palliative Care, Pain team members and Intensivists.
- Notify the Palliative care fellow of all prescriptions for hydromorphone in oncology patients.
- Use the M46C prescription chart.
- Nursing staff administering hydromorphone must have completed an appropriate opioid administration package and be accredited with appropriate competencies.
- Monitoring standards apply as for other systemic opioid regimens.
- Patients who have stable opioid requirements for 48 hours may have their monitoring frequency reduced after review by the Palliative care or pain teams.

Use a CADD pump

Initial drug dilution 300 microg/kg in 100 mL
(up to 15mg in 100mL)

Initial programming:	background:	0- 1 mL/hr
Bolus dose:		1 mL
Lock-out time:		5 mins for PCA
		10 mins for NCA
Hourly dose limit:		20 microg/kg

- When dose escalation is required a double strength solution may be used. Please consult the Palliative Care team for advice. Ensure the ward NUM and pharmacy are aware of the prescription.

12.9 Managing pain related to chest drains

Children with empyema are managed with intravenous antibiotics and often require insertion of a chest drain. Pain may be due to the catheter itself, irritation of the pleura by the catheter, or traction on the skin from stitches or adhesive tape. Loculated pleural collections are often managed with intra-pleural fibrinolytic agents, such as urokinase, which may cause additional pain when injected through the chest catheter.

Post-procedure pain can have a significant impact on recovery, impairing respiratory effort and clearance of airway secretions. Poor chest expansion and impaired coughing predisposes the child to segmental atelectasis and collapse, especially in those with suppurative lung disease. Pain also impacts on co-operation with physiotherapy. Good analgesia can help facilitate aggressive physiotherapy and post-operative recovery. Adequate analgesia will also help prevent secondary scoliosis and aids mobilisation.

Recommendations

Patients admitted for chest drain insertion should be referred to the pain team, ideally notifying pre-operatively to facilitate prompt post-operative analgesia. Following insertion of a chest

drain, a PCA / NCA should be prescribed initially without a background (i.e. bolus-only). Daily review should occur to assess the need for the PCA / NCA, but for chest drains may need to continue until the drain is removed.

Regular administration of paracetamol and a Non-steroidal anti-inflammatory drug for 48 hours should also be encouraged. Use of paracetamol and an NSAID can reduce opioid requirements. Caution should be used with NSAIDs in patients with co-existing asthma, renal impairment, dehydration and/or exposure to nephrotoxins.

Intrapleural bupivacaine may be useful in controlling pain related to the use of fibrinolytic agents. It may be particularly useful when there is a small amount of fluid left. Intrapleural bupivacaine 0.25% can be instilled (0.5–1 mL/kg) at the same time as the urokinase (1) up to once daily.

Smaller children may require sedation during chest drain removal. Local anaesthetic cream applied to the adjacent skin 3 hours before removal is as effective as intravenous morphine for pain control.

Respiratory Failure

Extreme caution should be exercised if prescribing opioids to children with severe respiratory compromise. Pain, sedation levels and pulse oximetry need to be closely monitored. CO_2 retention may be an issue in those children with established lung disease or severe upper airway obstruction.

Analgesia using paracetamol and non-steroidal anti-inflammatory drugs should be maximised. Doses and dose increments should be conservative.

12.10 Burn injuries – Transitioning to the ward from PICU

Children who have suffered major burn injuries often require protracted care in the PICU prior to discharge to the ward.

These children are at particular risk of:

- Developing ***drug tolerance*** (notably to opioids and benzodiazepines)
- Developing ***drug withdrawal*** symptoms during the recovery (and weaning) period.
- Developing '***Post -ICU delirium'***. Many factors can potentially contribute to this state including- pain, sepsis, initial burn trauma, pre-morbid psychological and family stability and drug effects (in particular polypharmacy and drug interactions).

1. Opioid tolerance

Tolerance to opioids can develop rapidly. There is no ceiling effect for commonly used opioids (morphine, fentanyl, hydromorphone, and oxycodone). Doses should be escalated as needed.

Tolerance can be moderated by rotating opioids, using low dose ketamine (50 -200 microg/kg/hr), or adding regular methadone.

2. Drug withdrawal

Symptoms listed below may ensue if either opioids or benzodiazepines are withdrawn abruptly.

Early symptoms	Late symptoms
Agitation	Abdominal cramping
Anxiety	Diarrhoea
Muscle aches	Dilated pupils
Increased tearing	Goose bumps
Insomnia	Nausea
Runny nose	Vomiting
Sweating	Hypertension
Yawning	Flushes, piloerection, mottled skin
Tachycardia	
Increased startling/ Moro response	

Score and document symptoms on the 'Opioid withdrawal Scoring chart M34E' in all children at risk

- **Low dose ketamine** does not need to be weaned and can be discontinued as soon as appropriate. Avoid the use of high dose ketamine (>300 microgram/kg/hr).
- **Clonidine** If a patient has received regular clonidine for >5days, the dose should be weaned by about 50% each day for 2 days before ceasing the drug. i.e. 2 day wean. Monitor for withdrawal (same symptoms as for opioid withdrawal).
- **Benzodiazepines** If a patient has received regular benzodiazepaines for >5 days, the dose should be weaned by about 50% each day for 2 days before ceasing the drug. i.e. 2 day wean. Monitor for withdrawal (same symptoms as for opioid withdrawal.

Opioid weaning regimens should be planned, documented and instituted prior to discharge from PICU. Typically opioids (if in regular use for more than 9 days) are weaned by about 10-20% of the original dose every day. i.e. 5- 10 day wean if pain has resolved and no further procedures are planned. Provide opioids on an 'as needed basis' (PRN) for moderate-severe pain. Weaning from intravenous opioids can be facilitated by introducing oral slow release opioid preparations early.

3. Post ICU delirium

Disturbances of cognition and consciousness are common following intensive care. Delirium is associated with increased morbidity, prolonged hospital stay and potentially adverse long term outcomes.

In the absence of a well validated measuring tool, the Paediatric Anaesthesia Emergence Delirium scale should be used to measure and document the incidence and severity of delirium in children at risk.

The Paediatric Anaesthesia Emergence Delirium scale					
	Not at all	Just a little	Quite a bit	Very much	extremely
The child makes eye contact with the caregiver	4	3	2	1	0
The child's actions are purposeful	4	3	2	1	0
The child is aware of his/her surroundings	4	3	2	1	0
The child is restless	0	1	2	3	4
The child is inconsolable	0	1	2	3	4

Sum scores for each item to obtain total PAED score (0-20)

Document scores on the PICU Analgesia and Sedation Plan M46H:
https://intranet.schn.health.nsw.gov.au/files/picu_analgesia_and_sedation_transition_plan_0.pdf

I Prevention

- Avoid inappropriate poly-pharmacy
- Treat pain aggressively. Titrate opioids using an NCA regimen.
- Avoid high dose ketamine (i.e. keep doses below 4 microg/kg/min at all times).
- Avoid rapid withdrawal of opioids and benzodiazepines.

II Find the cause and manage as appropriate

The ICU and primary care (burns) team will investigate each case for sepsis, electrolyte disturbances, hypoxia, overload and or cardiac failure among many other causes of delirium. Ensure that drug withdrawal has not been precipitated by hasty weaning of opioids or benzodiazepines.

III Pro-active intervention

Institute a regular program of 'sensory re-orientation' including:

- The creation of a familiar environment (as far as is possible) (e.g. sights/ sounds/ smells/ routine/ sleep).
- Avoid excessive stimulation (venepuncture, catheters).
- Cluster cares to allow longer periods of rest.
- Tailor sedation to facilitate a diurnal pattern of sleep/ wakefulness.

Family & carers should become involved in this management intervention wherever possible.

In many cases, the child will require 'One-to-one nursing' for up to several days. This MUST be planned and arranged *PRIOR* to discharge from PICU.
A child with a PAED score of ≥10 (for three consecutive hours) should have one-to-one nursing.
Medical review and consideration of specific sedative agents should be considered if:

- PAED score is ≥16
- The child is at risk of harming him/herself

12.11 Nuss Bar procedure

Nuss bar insertion under thoracoscopic assistance is a procedure offered to children (most often adolescent boys) with severe pectus excavatum. It involves per-cutaneous insertion of a pre-formed, rigid metal bar through a small intercostal incision. The bar is rotated into a final position that forcibly corrects the sternal deformity. Positioning of the bar results in costo-chondral fractures and pressure that is usually painful for some weeks. The bar remains in place for up to 2 years.

Providing adequate analgesia will allow earlier mobilisation, improved respiratory effort and a reduced hospital stay.

Recommendations:

i. Peri-operative analgesia may include i) paracetamol (pre-op loading or intra-op) ii) Gabapentin (10 mg/kg orally) can be given 1-2 hours before surgery and continued at 10 mg/kg tds for 72 hours. It is aimed at reducing peri-operative opioid requirements.

ii. Neuraxial (epidural) block is an effective analgesic technique and is often offered to the family by the surgeon. Best results are obtained with mid-thoracic catheters (T6-8 insertion with catheter tip at T4-5). Typically a combination of local anaesthetic and opiate (fentanyl 1-2.5 microgram/mL) is used. Epidural infusions can be safely managed for up to 72 hours. The significant advantages of epidural infusions in this particular group of patients warrants extending the duration to 96 hours. All epidural catheters must be monitored closely for catheter-related problems. Thoracic epidurals are subject to especially close monitoring- please see the 'Thoracic Epidural Analgesia in-service package'.

iii. An effective epidural block may make systemic opioids un-necessary. If considered necessary, a bolus only PCA can be added after consultation with the anaesthetist who inserted the epidural or a senior pain team member.

iv. When an epidural catheter has not been placed in theatre, consider an opioid PCA combined with a 'low dose ketamine infusion' (50-200 microgram/kg/hr). Ketamine can be delivered as follows:

5 mg/kg in 50 mL 0.9% sodium chloride) at 50-200 micrograms/kg/hr (i.e.0.5 – 2 mL/hr).

v. Regular oral paracetamol (i.e. 60 mg/kg/day) can commence once oral intake is resumed. After 5 days, the dose should be reduced to 45 mg/kg/day.

vi. Regular NSAIDS (Ibuprofen 30 mg/kg/day) may be particularly useful in these patients. They should be commenced once oral intake resumes.

vii. Epidural infusions are ceased after 72hours. Cessation of the epidural infusion and removal of the epidural catheter should be carefully planned and done early in the morning. Systemic opioids should be commenced at the time of ceasing the epidural infusion. Transitioning to systemic opioids can involve a combination of: **(1)** a brief period of IV PCA use, **(2)** regular (bd) doses of slow release opioids **(3)** regular immediate release oral opioids. Simple oral analgesics should continue on a regular basis.

viii. Mobilisation and general care: First 24 hours: No turning or twisting of torso. Head of bed elevated 35-45°. Encourage deep breathing and leg exercises hourly. May sit out of bed for 6 hours Day 0 if stable. Day 1 post-op- may gently ambulate with physiotherapist. Commence stool softeners when oral intake is established. A urinary catheter is usually inserted under anaesthesia. Once bladder sensation returns, the catheter can be removed – usually on day 2 post-op.

ix. Children who are receiving systemic opioids, epidural infusions, slow release opioid formulations and gabapentin will be reviewed daily by the Pain Service.

x. At the time of discharge, children often have on-going opioid requirements. These can be tapered under parental supervision or by the pain team over 1-2 weeks. Simple analgesics (paracetamol and NSAIDs should continue until pain has subsided.

In all children with neuraxial catheters, urgent medical review is required if any of the following are noted:
- **Un-explained dense motor block or upper limb weakness**
- **Un-explained fever, tachycardia**
- **Back pain**
- **Incontinence**
- **Headache associated with photophobia**

Notify both the surgical and anaesthesia teams.

- Nuss bars (Biomet/Lorenz Medical) are made from stainless steel. They have 'MRI-conditional status'.
- In the event of cardiac arrest, greater chest compression force may be needed.
- Defibrillator pads should be placed in the anterior-posterior orientation.

12.12 Managing pain in children with cystic fibrosis

Children with CF often require interventions that impact on their underlying respiratory function. These include venous port insertions, gastrostomies and insertion of chest drains. Pain can severely impact respiratory effort, coughing, the ability to clear secretions and cooperation with physiotherapy. This can have a significant impact on recovery. Poor chest expansion and impaired coughing predisposes the child to segmental atelectasis and collapse, especially in those with suppurative lung disease. Good analgesia can help facilitate aggressive physiotherapy and post-operative recovery. Adequate analgesia will also help prevent secondary scoliosis and aids mobilisation.

Recommendations

Following insertion of a port, gastrostomy or chest drain, a PCA / NCA should be prescribed initially without a background (i.e. bolus-only). Daily review should occur to assess the on-going need for systemic opioids. Regular administration of paracetamol and a Non-steroidal anti-inflammatory drug for 48 hours should also be encouraged. Use of paracetamol and an NSAID can reduce opioid requirements. Caution should be used with NSAIDs in patients with co-existing asthma, renal impairment, dehydration and/or exposure to nephrotoxins.

Smaller children may require sedation during chest drain removal. Local anaesthetic cream applied to the adjacent skin 3 hours before removal is as effective as intravenous morphine for pain control.

Respiratory Failure

Extreme caution should be exercised if prescribing opioids to children with severe respiratory compromise. Pain, sedation levels and pulse oximetry need to be closely monitored. CO_2 retention may be an issue in those children with established lung disease or severe upper airway obstruction.

Analgesia using paracetamol and non-steroidal anti-inflammatory drugs should be maximised. Doses and dose increments should be conservative.

12.13 Managing pain related to monoclonal anti-body therapy

Neuroblastoma treatment may include the use of monoclonal antibodies. This therapy can induce a painful neuropathy. The following recommendations are made:

Prior to first cycle of therapy:

- Gabapentin 10 mg/kg/dose to be started 3 days prior to starting infusion and to be uptitrated (ie, nocte for 1/7, then BD for 1/7, then TDS for ongoing days)
- To continue at TDS dosing for at least 24 hours post cessation of infusion (ie, to be ceased [without weaning] on Day 6, which is typically Saturday for most patients)

For the second and subsequent cycles:

- Gabapentin 10 mg/kg/dose TDS to be started 3 days prior to starting infusion, without needing to be titrated
- To continue at TDS dosing for at least 24 hours post cessation of infusion (ie, to be ceased [without weaning] on Day 6, which is typically Saturday for most patients)

12.14 Managing pain following selective dorsal rhizotomy

Selective dorsal rhizotomy is carried out for the management of muscle tone and spasm in children with cerebral palsy and related conditions. The procedure involves a laminectomy (or 'trapdoor laminoplasty'), isolation and division of sensory nerve rootlets using electrophysiological guidance.

Post-operative analgesia includes:

- Nurse Controlled Analgesia – morphine, oxycodone or fentanyl at anaesthetists discretion- see programming parameters in Section 7
- Ketamine infusion 50-200micrograms/kg/hr – usually a 48-72 hour infusion
- Transition to oral Oxycodone 0.1-0.2mg/kg/dose PRN q4th hourly when oral diet tolerated
- Intravenous paracetamol 15mg/kg/dose given 6 hourly regularly for 48 hours. Transition to oral formulation as tolerated.
- Ondansetron 100microgramsg/kg/dose regularly 8 hourly (iv or oral) for 24 hours or until nausea and vomiting settles.
- Diazepam 0.1 mg/kg/dose 8 hourly orally PRN for muscle spasm and then for targeted physiotherapy sessions as needed for approx. 2/52
- Ibuprofen 10 mg/kg/dose when oral diet tolerated
- Gabapentin 10 mg /kg/dose tds start pre surgery; continued for about 3 months if tolerated. Alternatives to gabapentin include:
- Amitriptyline (after ensuring a normal ECG) 0.1 mg/kg/ day daily dose maximum 20 mg per day start with 5 mg (check for anticholinergic side effects).
- Pregabalin initially 25 mg bd titrate up to 100 mg bd (adult dose is 150mg BD)

12.15 Analgesia following hip surgery (DDH)

Developmental dysplasia of the hip (DDH) varies in severity and age of presentation. Early presentation allows non-surgical management. Surgical intervention may become necessary if neonatal bracing has failed, the hip abnormality is severe or if presentation has been delayed.

Surgical intervention ranges from closed reduction through to open reduction requiring pelvic and femoral osteotomies. Intervention may be unilateral or bilateral. In all cases, some form of hip fixation (brace or spica) is required in the post-operative period.

A combination of regional analgesia, systemic opioids and simple analgesics remains the mainstay of early post-operative pain management.

Recommendations

- Loading doses of paracetamol may be given pre-operatively (oral) or intra-operatively.
- **Intra-operatively** - judicious use of opioids and regional local anaesthesia at the discretion of the consultant anaesthetist. This might include:

Surgical intervention	Recommendation	Notes
1. Closed reduction and application of spica	Simple oral analgesics with PRN oral opioids.	Usually aged <18months
2. Open reduction 3. Bilateral open reduction 4. Pelvic osteotomy alone	Single shot caudal injection or Single shot spinal morphine Regular oral simple analgesics 48hrs Opioid PCA/NCA 24hrs	Transition to oral opioids PRN on D1 post-op
5. Open reduction with pelvic osteotomy 6. Open reduction, pelvic osteotomy and femoral osteotomy	Regular oral simple analgesics 48hrs Consider lumbar epidural LA continuous infusion OR Opioid PCA/NCA	
6. Bilateral pelvic osteotomy 7. Bilateral open reduction with pelvic osteotomy 8. Bilateral open reduction, pelvic osteotomy and femoral osteotomy	Regular oral simple analgesics 48hrs Lumbar epidural LA continuous infusion 72 hrs Opioid PCA/NCA (if epidural does not include opioid) Ketamine infusion (if regional not effective)	Epidural insertion site made visible i.e. window to be cut in spica while in OT

- Regular oral paracetamol and ibuprofen should commence immediately after surgery and continue for 48 hours if no other contra-indication exists (see under Paracetamol above).
- Intravenous opioid (morphine or fentanyl) PCA or NCA should be commenced in the recovery room under the direction of the consultant anaesthetist.

- For epidurals: the insertion site must be made visible for monitoring purposes i.e. a window will need to be cut in the spica in theatre, which is large enough for the epidural site to be inspected and for the epidural catheter to be removed on the ward.

13 Chronic and Complex Pain

13.1 Types of Chronic and complex pain

- Cancer related pain
- Arthritis
- Back pain of greater than 6 months duration
- Chronic regional pain syndromes
- Chronic or recurrent headache
- Other muscular-skeletal pain of greater than 6 weeks duration
- Pain related to chronic diseases
- Amputation and pain
- Functional gastro-intestinal disorders
- Pain following complex surgery or burns

For in-patients with chronic pain and/or palliative care needs, follow hospital policy and fill out a consultation form (MR8b). Then notify the Complex pain fellow (page #6848) or Nurse practitioner (#6252).

For out-patients, the chronic pain clinic, can be accessed through the hospital switch-board (ask for the Pain and Palliative Care Service) or via the numbers below.

- Pain clinics run on Tuesday and Thursday mornings.
- Call (02) 98452573 or (02) 98452525 to make appointment before discharging patient.

13.2 Analgesic agents used for chronic pain

13.2.1 Gabapentin and Pregabalin

Gabapentin - a GABA-ergic anticonvulsant – was approved in 1993 for the adjunct treatment of complex partial seizures (CPS) with and without generalization. It has also been shown to be useful in the management of neuropathic pain. The overlap between the underlying pathophysiologic mechanisms of some epilepsy models and neuropathic pain models supports the rationale for using certain anti-epileptic drugs in the treatment of neuropathic pain.

There are no significant drug interactions and main adverse effects are dry mouth, peripheral oedema, weight gain, abnormal gait, amnesia, ataxia, confusion, dizziness, hypo-aesthesia, somnolence, abnormal thinking, vertigo, rash and amblyopia. There is no need to monitor drug levels and clinical benefit is usually seen after 1-2 weeks of initiating therapy.

1. Gabapentin for the management of neuropathic pain

- Always consult the pain team.
- Dose
  - Starting dose 5mg/kg/dose tds. Increase dose as tolerated over 5-7 days.Maintenance - titrate to clinical effect (up to 40mg/kg/day divided into 3 doses, dose limit 2.4 g/day)
  - In outpatient setting dose escalation is slower i.e. every 3 days

2. Gabapentin for the management of acute pain

It is used for major surgery, with known significant opioid requirements and risks of opioid-related AEs and where there is a potential for neuropathic pain. Typically spinal surgery, multi-level surgery, Dorsal Rhizotomy, Thoracotomy

- Typical duration 72 hours
- Typical dose 10 mg/kg tds starting 2-12 hours pre-op

3 Pregabalin

- Please consult senior Pain management consultants before prescribing pregabalin for pain relief.
- Advantages of this drug include:
  - greater oral bioavailability than gabapentin.
  - linear kinetics
  - twice daily dosing.
- Recommendations: consider pregabalin for:
  - patients likely to be require the drug for longer than 3 months
  - patients who have not responded to gabapentin
  - patients who will benefit from twice-daily dosing (rather that tds dosing) e.g. children attending school.
- Preparation
  - Pregabalin is available as 25 mg, 75 mg, 150 mg and 300 mg capsules
  - Dose: 5- 8 mg/kg/day in two divided doses. Maximum 600mg/day

N.B. This is a total daily dose recommendation: Typically delivered in divided doses (b.d.).

13.2.2 Amitriptyline

- Please consult senior Pain management consultants before prescribing amitriptyline for pain relief.

13.2.3 Fentanyl patches

- Please consult senior Pain management consultants before prescribing fentanyl patches for pain relief. Fentanyl patches are not used for acute pain management.
- Always ensure that:
  - Patients and their caregivers are aware of the potential for an increased effect from fentanyl patches if they take certain other medicines or drink alcohol; or have an increase in body temperature or are exposed to heat.
  - Caregivers are aware of the signs of fentanyl overdose. Signs of fentanyl overdose include trouble breathing or shallow breathing, tiredness, extreme sleepiness or sedation, inability to think, talk or walk normally, and feeling faint, dizzy or confused.
  - Patients and their caregivers are aware of safe storage practices for fentanyl skin patches. The Consumer Medicine Information leaflet recommends storage in a locked cupboard at least one-and-a half metres above the ground.
- Fentanyl patches are available in several dosages.
- Doses are expressed as the number of micrograms delivered per hour — 12, 25, 50, 75 and 100 micrograms per hour.
- Dose adjustments can be made using 12 or 25 microgram-per-hour patches at 72-hour intervals (not less).