

Title:	Care of a critically sick child / young person under 16 years outside of paediatric critical care level 3 environment in extreme and exceptional circumstances
Version:	1
Supersedes:	New guideline
Application:	For all children under 16 years age

Originated By / Designation:	<p>North West (England) and North Wales Paediatric Transport Service (NWTS)</p> <p>Following request from colleagues in North West (England) and North Wales Paediatric Critical Care ODN</p> <p>Guideline authors:</p> <p>Kate Parkins, PICM Consultant NWTS</p> <p>Katie Higgins, Clinical Nurse Specialist, NWTS</p> <p>Nicola Longden, Clinical Nurse Specialist, NWTS</p> <p>Amicia Hill, Band 6 Nurse, NWTS</p> <p>Emma Roach, Band 6 Nurse, NWTS</p> <p>Andrew McTavish, NWTS transport doctor & Anaesthetic Consultant, Royal Bolton</p> <p>Sophina Mahmood, Paediatric Pharmacist, PCC ODN & RMCH</p>
Ratified by:	Paediatric Critical Care ODN oversight group
Date of Ratification:	10.08.23
Ratified by:	RMCH Policies & Guidelines Committee & Paediatric Medicines Management Committee
Date of Ratification:	08.12.23 & 08.07.24

Issue / Circulation Date:	08.07.24
Circulated by:	PCC ODN team
Dissemination and Implementation:	Via PCC ODN & NWTS team to regional hospitals
Date placed on the Intranet:	

Planned Review Date:	July 2027
Responsibility of:	North West & North Wales PCC ODN & NWTS Guideline Team

Minor Amendment (If applicable) Notified To:	
Date notified:	

EqIA Registration Number:	2023-171
----------------------------------	-----------------

1. Detail of Procedural Document

Care of a critically sick child / young person under 16 years outside of paediatric critical care level 3 environment in extreme and exceptional circumstances

2. Equality Impact Assessment (RMCH) 2023-171

3. Consultation, Approval and Ratification Process

This guideline was developed with input from:

- North West (England) and North Wales Paediatric Transport Service (NWTS).
- North West and North Wales Paediatric Critical Care Operational Delivery Network
- Representatives from the local hospitals within network above.

The guideline has been circulated amongst North West and North Wales Paediatric Critical Care Network colleagues for comments on the 30th June 2023.

In addition, it was circulated amongst colleagues from the 3 regional Adult Critical Care Networks (Cheshire and Mersey, Greater Manchester, and South Cumbria and Lancashire) for comments in September 2023.

All comments received have been reviewed and appropriate amendments incorporated.

This guideline has been developed alongside the Standard operating pathway for the care of the critically sick child / young person (CYP) under 16 years outside of the paediatric critical care level 3 environment in extreme and exceptional circumstances.

For ratification process for network guidelines see page 16

4. Disclaimer

These clinical guidelines represent the views of the North West (England) and North Wales Paediatric Transport Service (NWTS) and the North West and North Wales Paediatric Critical Care Operational Delivery Network (PCCN). They have been produced after careful consideration of available evidence in conjunction with clinical expertise and experience.

It is intended that trusts within the Network will adopt this guideline and educational resource after review and ratification (including equality impact assessment) through their own clinical governance structures.

The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient.

Clinical advice is always available from NWTS on a case by case basis.

Please feel free to **contact NWTS (01925 853 550)** regarding these documents if there are any queries.

Contents: How to care for critically sick CYP under 16 years by systems A-E

Page 3-5: Airway, Ventilation and Extubation

Page 6: Cardiovascular support & line access

Page 7: Blood products, feeding and fluids

Page 8: Encephalopathy and parental support

Page 9: Quick reference sedation guide for intubated and ventilated young persons ≥ 12 years or ≥ 40 KG (IBW)

Page 10: Specific nursing care and safeguarding

Page 11: Size guide for equipment for paediatric airways

Page 12: NWTS Lines (including central and arterial) and tubes size guide

Page 13—14: Paediatric Glasgow Coma Score, parameters using MANChews (paediatric early warning score)

Page 15: Contact numbers, references and resources

Page 16: Ratification pathway

AIRWAY

Always intubate orally in first instance

Never cut endotracheal tubes (ETT) - easier to secure and less chance of kinking

Use size chart in appendix of this or NWTS intubation guideline for everything airway related (page 11)

NB size & estimated length ETT on **Crashcall** = **uncuffed** ETT. **NWTS chart relates to both types ETT**
Cuffed ET tubes (eg Microcuff®) are **preferred** in all children, and are suitable for those approx. ≥ 3kg.

NB cuff may not need to be inflated. Keep cuff pressures 10-20cm H₂O.

Fix ETT with fabric plaster Melbourne strapping ("trouser legs") as per NWTS ET tube fixation policy
(with Duoderm® or similar underneath to protect skin)

ETT tapes may need re-applying if become loose (eg due to secretions) to prevent accidental extubation

NB application of Cavilon® or similar may help with adherence of tapes (especially if lots of secretions)

Place nasogastric tube (NGT) ASAP & deflate stomach to remove gastric splinting of diaphragm

Check position ETT & NGT on CXR: ideally position ETT at base T2

OR mid-way between heads of clavicle and carina (aim min 1 cm above carina)

Size suction catheter = 2x size of ETT e.g. 8 Fr catheter fits size 4.0 ETT

Please make sure ETT size & length are clearly documented & ideally on bed head sign

Only consider change to nasal ETT in those under 5-6 years if stable, skills available and no contra-indications.

Nasal ETT may be better tolerated, and have a reduced incidence of accidental extubation

Tracheostomy: NB acute tracheostomy is NEVER routine in paediatric patients

Many long-term ventilation children/young people may have a tracheostomy.

Most do not have cuffed tracheostomy in place.

If patient has an acute LRTI and needs higher levels of ventilation they may need a tracheostomy change to a cuffed tracheostomy or (temporarily) cuffed ETT (via tracheostomy hole) to reduce the leak and improve gas exchange. Don't forget to check the length and place new tracheostomy or cuffed ETT to same length as usual tracheostomy (as above in many of these children/young people mm can make the difference). Parents/carers will have details of size/length of their child's tracheostomy & will know what is usually needed.

Parents/carers are usually experts in changing their child's tracheostomy & may be happy to do the change themselves (especially if changing for same size/type if tracheostomy blocks).

GUIDELINES: www.nwts.nhs.uk/clinicalguidelines

INTUBATION GUIDELINE including management of paediatric difficult airway

NWTS LocSIPPS / Checklists includes sizes of ETT

ENDOTRACHEAL TUBE FIXATION POLICIES

Emergency Tracheostomy Management (NTSP) link for paediatrics (national)

For appropriate sizes of suction catheters and tubes see appendix page 11

EDUCATION: www.nwts.nhs.uk/education-website

Recorded sessions on: management of paediatric airway including difficult airway

Paediatric tracheostomy care

Login details for education site are available from your nursing and medical paediatric critical care (PCC) operational delivery network (ODN) links

VENTILATION

ALWAYS humidify the ventilator circuit.

Heat and moisture exchange (HME) of an appropriate size may be used for the first 12-24 hours

For those under 25 kg use small (15 mm) diameter ventilator circuit

VENTILATOR SETTINGS: Aim: $\text{SpO}_2 > 92\%$, ET CO_2 4-7kPa. Pressure control/support ventilation mode is generally preferred, with appropriate TV and MV alarms set (eg maximum TV 8-10 mL/kg)

PIP / plateau pressure appropriate to move chest; aim $\text{PIP} \leq 30 \text{ cmH}_2\text{O}$, but may need higher pressure initially

Minimum PEEP 5 cmH_2O NB there are no clinical situations when PEEP is not used — it prevents atelectasis

Aim: TV = 6-8mL/kg; max = 10 mL/kg

Respiratory Rate = physiologically appropriate for age

I:E ratio 1:1—1:2 I:E ratio $\geq 1:3$ if patient has bronchospasm

Example: typical initial settings for those under 2-3 years old:

PEEP 6 cmH_2O PIP to move chest / generate appropriate TV (6-8 mL/kg) eg 22-26 cmH_2O

RR 25-30 /min $\text{Ti} = 0.8-1.0$ I:E ratio 1:1.5

POSSIBLE VENTILATION PROBLEMS: inadequate sedation / muscle relaxant (especially during stabilisation)

Large leak around ETT in child requiring high ventilator pressures (need to upsize ETT)

Check using appropriate size HME or whether HME is water-logged—both may lead to hypercarbia

Nurse head bed up as any other ICU patient

UNINTENDED ENDOBRONCHIAL INTUBATION: check position on CXR. If low or high accurately measure on the CXR (using appropriate measurement tool) to reposition, especially in younger child / infant as often 0.5-1cm may make difference between too low or too high and accidental extubation.

Consider physiotherapy and suction with 0.9% sodium chloride instillation via ETT after repositioning

Physiotherapy/suction: if secretions are thick / pluggy often instillation 0.9% sodium chloride will help to clear secretions. More prone to air trapping due to size of airways especially in younger / smaller patients so may need manual decompression, otherwise same technique / frequency physiotherapy or suction as any other ICU patient.

Paediatric ARDS is managed similarly to adult ARDS

Increase PEEP (8-15 $\text{cm H}_2\text{O}$)

PIP to move the chest: aim TV 5-6 mL/kg (max 10 mL/kg)

Tolerate SpO_2 down to 88%

Permissive hypercapnoea: ETCO_2 up to 10kPa; $\text{pH} \geq 7.2$

Consider infusion neuromuscular relaxant

Consider trial prone position

DESATURATION: Like adults, the rate of change and oxygen requirement is important eg SpO_2 92% in FiO_2 0.21 is better than SpO_2 97% in FiO_2 0.6

An acute desaturation is not OK: call for help, try increasing FiO_2 , +/- hand ventilation as this is often very effective in managing even a profound desaturation.

Desaturation may be triggered by secretions. Always assess whether suction is required +/- 0.9% sodium chloride

Most tolerate desaturation without progression to cardiac arrest even below 60% as long as it is acted on quickly

GUIDELINES: www.nwts.nhs.uk/clinicalguidelines

Specific ventilation strategies for patients with:

Severe asthma and Bronchiolitis see relevant guidelines

EDUCATION: www.nwts.nhs.uk/education-website

Recorded sessions on: ventilation strategies, management of asthma, management of bronchiolitis

Login details for education site are available from your nursing and medical PCC ODN links

OR via email: info@nwts.nhs.uk

WEANING TO EXTUBATION:

NWTS team is always available for advice if needed. May need to wean rapidly as ventilation improves
NB the average length of ventilation on PICU 2-4 days

Consider whether patient needs dose of dexamethasone (0.2 mg/kg MAX 12mg): 8-12 hourly for 2-3 doses starting 4-6 hours before extubation. This is usually used to reduce risk of post extubation stridor due to airway oedema in any age child/young person with a difficult airway or those who required multiple attempts at intubation.

Assessment of Readiness to extubate: perform a Spontaneous Breathing Trial (SBT) usually twice daily

Criteria for SBT: $\text{FiO}_2 \leq 0.45$ $\text{SpO}_2 \geq 95\%$ (or as appropriate to underlying condition)
 $\text{PEEP} \leq 8 \text{ cmH}_2\text{O}$ $\text{PIP} \leq 22 \text{ cmH}_2\text{O}$
Cough / gag present Minimal sedation requirements
Other stable parameters (eg BP, no neurological concerns)

Spontaneous Breathing Trial: change ventilator mode: PEEP 5 cmH₂O + Pressure Support 5 cmH₂O (above PEEP)

Observe for signs of tolerance over next 1-2 hours: monitor for signs of respiratory distress eg

- Clinically significant increase in heart rate & respiratory rate (above pre-SBT rates)
- Signs ↑ WOB: nasal flaring, tracheal tug, marked sternal/subcostal/intercostal recession, head bobbing or asynchronous breathing
- Sweating
- Apnoeic episodes
- Change in level of alertness

SBT not tolerated: If any signs respiratory distress, increase child's ventilator settings back to a level that provides appropriate support and is tolerated

SBT tolerated: if breathing spontaneously without any distress, consider extubation. Hold sedation and opiate prior to extubation. Record date/time of extubation OR record the reasons why not extubated.

NB neonates / infants / young child or those with neuromuscular disease should not be left for prolonged period on CPAP via ET tube awaiting extubation once they have 'passed' their SBT. Once SBT completed they should go back onto pre-SBT settings until ready to extubate.

Post-extubation management

Post-extubation stridor: options: IV dexamethasone 0.6 mg/kg STAT (MAX 12 mg) & then 0.2 mg/kg (MAX 12 mg) 8-12 hourly +/- nebulised adrenaline 1:1,000 0.5 mL/kg (max dose 5 mL) every 30 minutes.

Respiratory support: May need NIV CPAP/BiPAP or High flow humidified nasal cannular oxygen post-extubation

Feeding: decision based on WOB / level of respiratory support, blood gases, including lactate (must be < 2 mmol/L, conscious level (GCS > 8-10/15 to ensure able to protect airway) and whether if airway protect reflexes present/ safe swallow (may need SALT assessment before oral feeding if uncertain).

GUIDELINES: www.nwts.nhs.uk/clinicalguidelines

Bronchiolitis and status epilepticus guidelines both include de-escalation pathways

EDUCATION: www.nwts.nhs.uk/education-website

Recorded session on: management of status epilepticus for discussion on when to extubate

Login details for education site are available from your nursing and medical PCC ODN links

OR via email: info@nwts.nhs.uk

CARDIOVASCULAR SUPPORT

Continuous 3-5 minute cuff BP readings during stabilisation; once cardiovascularly stable or arterial line inserted switch to cuff BP every 15-20 minutes. Check BP cuff 2/3 width upper arm

Fluid boluses ideally use balanced crystalloid eg Plasmalyte 148 or Hartmann's solution:

- 10 mL/kg aliquots if sepsis
- 5mL/kg aliquots in those with congenital heart disease or cardiomyopathy / myocarditis

Regularly re-assess: 'own every mL' of fluid given

Check for palpable +/- enlarging liver or gallop rhythm or pulmonary oedema.

WHEN TO START INOTROPES

If 40-60 mL/kg fluid resuscitation given, and patient remains haemodynamically unstable, start inotropes

If patient has a palpable +/- enlarging liver or gallop rhythm or pulmonary oedema start inotropes

NB this may occur before 40-60 mL/kg fluid bolus has been given so check regularly after each bolus

Consider starting inotropes earlier in those with congenital heart disease or cardiomyopathy / myocarditis (may be a provisional diagnosis if cardiomegaly seen on CXR).

Inotropes can run via intra-osseous or peripheral line before a central line is available: see NWTS sepsis guideline.

Guidelines include advice on administration of all inotropes & concentrations for PERIPHERAL inotrope infusions

NB Crashcall only has CENTRAL concentrations for all inotropes (includes vasopressin), and other drug infusions eg ketamine, salbutamol, aminophylline and potassium chloride.

Central concentrations are indicated by red spots / dots on Crashcall printout (always print in colour if able).

All central concentrations of drug infusions can run via an intra-osseous line.

First line inotrope: Adrenaline Second line: Noradrenaline (see sepsis guideline for more details)

If using more than one inotrope, consider using low dose hydrocortisone 1mg/kg (see NWTS sepsis guidelines).

Check random cortisol level before starting hydrocortisone.

Urine output and lactate are good markers of adequacy of tissue end organ perfusion

ARTERIAL LINES: indications for insertion: $\text{FiO}_2 > 0.6$ $\text{ETCO}_2 > 8 \text{ kPa}$ Starting inotropes
Use a non-ported cannula e.g. Jelco[®] or Seldinger devices (Arrow[®] or Vygon[®] Leaderflex 22/24G for small child).
Usual preferred sites: radial/posterior tibial > femoral > axillary (avoid brachial) & ultrasound guidance preferred
See lines & tubes chart on page 12

Transducer sets: use 0.9% sodium chloride (in a pressure bag) via a transducer in majority of children.
For those under 10 kg use 50 mL syringe 0.9% sodium chloride running in a syringe driver via the transducer rather than pressure bag to limit volume fluid infused to 1-2mL/hr

CENTRAL LINES: Insert if starting inotropes

NB intra-osseous lines may be used until central line inserted. IO is faster to insert than central line, and then it's easier to place a central line in infant or small child if appropriately resuscitated and stable (see NWTS guidelines)

Usually inserted in femoral or internal jugular veins using ultrasound guidance

Paediatric lines are usually triple lumen, except for those larger / adult patients for whom it would be appropriate to use a larger size line which may have 4-5 lumens (size chart see page 12)

Suture all lines in place and cover with chlorhexidine dressing to reduce risk of CLABSI.

CAUTION: for arterial or central lines, if catheter to vessel lumen ratio is high there is a much higher risk of complications eg vasospasm, thrombosis and thromboembolism, and ischaemic injury/loss of limb

GUIDELINES: www.nwts.nhs.uk/clinicalguidelines

Sepsis guidelines (peripheral concentration inotropes) and NWTS LocSIPPs includes sizes of lines & catheters

Crashcall = regional drug calculator for central concentrations of inotropes

EDUCATION: www.nwts.nhs.uk/education-website

Recorded session on: management of sepsis

BLOOD PRODUCTS

Try and avoid unnecessary blood sampling as this equates to significant blood loss in small children.

Usually 'discard' blood from arterial lines is given back to children to minimise iatrogenic blood loss.

Packed cells (10-20 mL/kg) only if **Hb < 70 g/L** in **haemodynamically stable** patient.

Higher target threshold **Hb 100 g/L** is used for **haemodynamically unstable** patient or **severe hypoxaemia**

Coagulopathy/Thrombocytopenia:

- ◆ Consider treatment with 10-20 mL/kg Fresh Frozen Plasma (FFP) if actively bleeding
- ◆ Low platelet counts in the absence of active bleeding should not be supplemented unless $< 20 \times 10^9/L$
- ◆ If bleeding or invasive procedures are planned, aim to keep platelets $> 50 \times 10^9/L$
- ◆ Low fibrinogen ($< 0.75g/L$) is suggestive of DIC: consider giving 5-10 mL/kg Cryoprecipitate or using fibrinogen concentrate as advised by haematology

Consider giving dose vitamin K if prothrombin time / INR noted to be prolonged (see BNFc for dose)

Consider IV tranexamic acid if actively bleeding (10 mg/kg MAX 1 gram)

FEEDING AND MAINTENANCE FLUIDS: $Wt = (age \times 3) + 7$

Use nasogastric (NG) tube (even for those with gastrostomy) to deflate a distended stomach (air swallowing).

As a rough guide use the largest NG tube that easily fits the nostril (approximately double size of ETT).

Enteral (NG/PEG) feeding preferred: continuous (with 4-6 hour break/24 hrs) OR 2-4 hourly boluses as tolerated

Laxatives may be required to ensure that enteral feeding is tolerated

Keep an accurate fluid balance for all critically ill children. Give full (100%) total maintenance unless patient has acute renal failure (seek appropriate renal advice), always include intravenous drugs in daily total fluid given and adjust intravenous maintenance fluid appropriately: see Crashcall or below for maintenance fluid calculation

Monitor input / output and overall fluid balance closely: usually aim for 1-2 mL/kg/hr urine output.

Monitor blood glucose 6 hourly: aim 4-8 mmol/L. Hypoglycaemia is defined as blood glucose ≤ 3 mmol/L

If persistent hypoglycaemia send appropriate bloods eg cortisol, GH, TFTs, Insulin levels

Plus calculate glucose intake in mg/kg/min

TYPE OF CRYSTALLOID IF FEED NOT TOLERATED OR ENTERAL FEEDS CONTRAINDICATED EG LACTATE >2 MMOL/L

< 10 kg use Plasmalyte 148 + 5% glucose or 0.9% sodium chloride + 5% or 10% glucose

> 10 kg use Plasmalyte 148 + 5% glucose or Plasmalyte 148 or Hartmann's solution

As long as blood glucose is maintained above 4 mmol/L

Weight (kg)	Hourly Fluid (100% maintenance) NB resus fluid is usually extra to this
<10 kg	4 mL/kg/hr
10-20 kg	40 mL + 2 mL/kg/hr for every kg over 10 kg
>20 kg	60 mL + 1 mL/kg/hr for every kg > 20 kg MAX 125 mL/hr

DKA patients: discuss with tertiary paediatric diabetes specialist if require intensive care (BSPED guideline)

URINARY CATHETERS see appendix page 12 for appropriate size catheters

Avoid unless shock, AKI or urinary retention when sedated and neuromuscular blockade used

Weigh nappies and monitor input/output carefully

Appropriate UO < 12 yrs = 1-2 mL/kg/hr ; > 12 yrs = 0.5-1 mL/kg/hr

GUIDELINES: www.nwts.nhs.uk/clinicalguidelines

DKA: use National BSPED guidelines for those under 16 years

National AKI guidelines

Massive Haemorrhage (children) guideline

EDUCATION: www.nwts.nhs.uk/education-website

Recorded sessions on: DKA, renal and liver failure

ENCEPHALOPATHY INVESTIGATIONS

Should consider CT scan to exclude intra-cranial pathology

Always send ammonia, LFTs, blood for paracetamol, salicylate and alcohol levels and urine for toxicology

See National Guideline from RCPCH in Acute Decrease in Conscious level (see below)

STANDARD INTRAVENOUS SEDATION FOR INTUBATED AND VENTILATED PATIENTS ON PICU

NEONATE / INFANT / CHILD: CONCENTRATIONS AS PER CRASHCALL

INTRAVENOUS SEDATION:

Morphine or Fentanyl +/- midazolam or enteral sedative. Exception: prolonged seizure (see NWTS guideline)

Morphine 10 to 30 micrograms/kg/hour (neonates ie up to 44 weeks CGA = 5 to 20 microgram/kg/hour)

If patient has evidence of bronchospasm or cardiac disease or pulmonary hypertension or renal failure, preference is to use fentanyl not morphine

Fentanyl infusion 1-4 microgram/kg/hr

Midazolam 60 – 180 microgram/kg/hour (maximum 10 mg/hr) – avoid if feasible in neonates

Neuro-muscular relaxant (as required) eg IV rocuronium 0.6 - 1mg/kg boluses or infusion 0.3-0.6 mg/kg/hr

Alternative NMR: atracurium 0.5 mg/kg bolus OR infusion 0.3-1.2 mg/kg/hr NB caution in pts with bronchospasm

If using an infusion of NMR consider daily rocuronium/atracurium hold (sedation infusions usually continue in PCC).

Be aware children, especially toddlers, may wake quickly.

If agitated and trying to pull tubes or lines out give a sedation bolus if not suitable for extubation.

Neonates, infants and toddlers often need less sedation if swaddled & fed enterally.

A sedation hold may be required for those who have been intubated for prolonged seizures or post-overdose, once muscle relaxant worn off/checking train of 4

Enteral sedation consider if child (in exceptional circumstances) remains ventilated at local hospital for > 24 hours.

Enteral sedation may be started as soon as tolerating feeds (wean off midazolam ASAP)

Clonidine 1 - 3 microgram/kg 8 hourly MAX initial doses 50 microgram 8 hourly OR

Promethazine hydrochloride 0.5-1 mg/kg 6 hourly (MAX 25 mg/dose if < 11 yrs; MAX 50 mg/dose if 12-17 yrs)

COMFORT and COMFORT Behaviour scale is used to assess level sedation on PICU, using alertness; calmness/ agitation; respiratory response; physical movement; blood pressure; heart rate; muscle tone and facial tension.

Information on COMFORT score: <https://www.qub.ac.uk/sites/sandwich/SANDWICHQIBundle/COMFORT/>

PARENTS

Encourage them to be at the bedside and be involved with caring for their child eg assist with nappy changes, bed bathing if appropriate. Encourage parents to talk to their child /young person, hold their hand, play favourite music or read favourite book, as this can help reduce their child's anxiety and distress, and may reduce the dose of sedation/analgesia required.

Encourage them to eat, drink and rest, their child / young person will need them to be 'at their best' when they recover.

GUIDELINES: www.nwts.nhs.uk/clinicalguidelines

Acute Decreased Conscious Level Guideline (national guidance)

Status Epilepticus (regional)

Crashcall = regional drug calculator

EDUCATION: www.nwts.nhs.uk/education-website

Recorded sessions on: Status epilepticus

Login details for education site are available from your nursing and medical PCC ODN links

OR via email: info@nwts.nhs.uk

QUICK REFERENCE GUIDE: SEDATION FOR INTUBATED AND VENTILATED YOUNG PERSON AGED ≥ 12 YEARS OR ≥ 40 KG (IBW)

Please refer to the Crashcall drug calculator on the NWTs website for alternative drug doses and infusion rates.

1st line recommendation is propofol plus which ever opiate your unit usually uses for adult critical care patients.

Caution: propofol may worsen instability if used for patients with cardiovascular instability +/- signs of shock.

Hypotension is a late sign of shock in patients < 16 years and usually sign patient is peri-arrest.

To reduce the risk of over sedation and drug accumulation we suggest the use of up to 4 bolus doses within an hour prior to increasing the background infusion rate

Please administer using either Ideal Body Weight or Lean Body Weight for drug calculation

NB regular administration of intravenous paracetamol may reduce the requirement for opioids

1st line SEDATION: please choose ONE agent				
DRUG	INFUSION RATE	MAX INFUSION RATE	BOLUS DOSE	MAX BOLUS DOSE
Propofol	0.3– 4 mg/kg/hr	4 mg/kg/hr To avoid propofol infusion syndrome	0.5-1 mg/kg	
NB Propofol use in children/young people is not recommended beyond 48 hours because of the potential risk of propofol infusion syndrome. AFTER 48 HOURS , if extubation is not imminent consider changing from propofol to midazolam plus your usual opiate.				
OR				
Midazolam	30-200 microgram/kg/hr 1-2 microgram/kg/min	10 mg/hr	50 - 100 microgram/kg 0.5-2 mg	5 mg
PLUS 1st line ANALGESIA: please choose ONE agent				
DRUG	INFUSION RATE	MAX INFUSION RATE	BOLUS DOSE	MAX BOLUS DOSE
Fentanyl	1-5 microgram/kg/hr	10 microgram/kg/hr	1-5 microgram/kg	50–100
OR				
Morphine	10-40 microgram/kg/hr	60 microgram/kg/hr	50-200 microgram/kg	1-2 mg
OR				
Remifentanyl	0.05 - 2 microgram/kg/min		1 microgram/kg over	Caution with bolus
OR				
Alfentanil	0.8 -2 microgram/kg/min		15-30 microgram/kg over 30 secs	

The place of human contact and reassurance are important in the frightening and unfamiliar surroundings of ICU. Encouraging parents to visit and talk to their child /young adult, hold their hand, play favourite music or read favourite book can help reduce anxiety and distress. Also, the manner, behaviour and communication skills of medical and nursing staff can reduce the need for sedatives. In particular, patients benefit from regular reassurance and explanations prior to procedures. Agitation may arise from a critically ill patient's inability to perform basic bodily functions, so management of basic thirst, hunger, constipation and full bladder are essential. Attention must also be paid to minimising pain, nausea and vomiting.

SPECIFIC NURSING CARE

Mouth care: for sedated / ventilated patients, in order to avoid ventilator associated pneumonia

If they have teeth, brush twice daily, followed 30 minutes later with chlorhexidine mouth wash

Use mouth swab / gauze and sterile water 4-6 hourly to maintain moisture

Check that the ETT is taped safely and not causing pressure sore at angle of mouth or lips

Eye care: 4 hourly clean with sterile water and gauze and then add lubricant eg lacrilube if sedated / partial eye opening, and especially if muscle relaxed. Use a gel pad eg hydrosorb to keep eyes closed and prevent from drying (but only if muscle relaxed). Avoid using tape to keep eyes closed, will cause distress if child wakes and often marks

Pressure area care: turn patient every 4 hours: from left to right, supine and prone. Use pillows to help with positioning and between legs to prevent bony prominences rubbing. When prone place a roll under both pelvic and shoulder girdles. Always check not lying on any lines or wires. In particular watch for skin breakdown in nappy area (use a barrier cream) and check ears at least hourly or make sure lying on gel pad to provide pressure relief. Change oxygen saturation probe and NIV BP cuff site every 2-4 hours.

Toileting: majority wear a pad or nappy and pass stool /urine into this

Opiates, especially morphine, may lead to urinary retention and patient will require urinary catheter

Fluid balance: maintain an accurate input / output and document hourly. Weigh nappies / pads. Include any fluid boluses in addition to maintenance fluids or feeds in total input.

Gastric protection: PPI eg esomeprazole or omeprazole if child / young person remains nil by mouth

Ensure patient has a nasogastric tube or PEG, and this is aspirated regularly.

Glucose: maintain between 4-8 mmol/L

Hypoglycaemia is defined as less than 3 mmol/L and should be treated with 3 mL/kg 10% glucose and review of maintenance fluids / feeding regime.

Prolonged hyperglycaemia puts patients at increased risk of infection. Attempts to tightly control blood glucose have not reliably shown improvements in patient outcome and have resulted in an increased incidence of hypoglycaemia. Most acutely sick patients have a transient rise in blood glucose that returns to normal within 6-12 hours. All adult ICUs and most PICUs do aim to keep blood glucose in a "reasonable" range though there is wide variation on the upper limit, please discuss with NWTS if considering starting treatment with insulin.

DKA patients: use BSPED guidelines; discuss with tertiary paediatric diabetes specialist if require intensive care

VTE prophylaxis: see separate NWTS guideline

SAFEGUARDING

Paediatricians should take the lead role, and link with local safeguarding team +/- police when appropriate

NB these patients may also need referral to CAMHS team once medically fit for assessment.

Consider informing the local safeguarding team for any patient following:

- Overdose or alcohol ingestion requiring intensive care admission
- Non-accidental trauma (including adolescent trauma) or ingestion of toxin
- Out of hospital cardiac or respiratory arrest
- Delayed admission, unkempt or failing to thrive (no medical reason)

Check who has parental responsibility, as it may be shared between parent(s) and social services for 'looked after' child / young person but they will be living with foster carers. Social services should be informed of the admission, and can advise on any ongoing child protection issues and visiting rights. If parent/carer needs supervision during visits, this should not be the responsibility of a bedside nurse, and should be provided by social services or police. Don't forget about any siblings, and check who is caring for them and if that is appropriate / not left home alone. Document everything clearly (including date, time, name and signature) as you would for any assault or patient presenting with an unexplained collapse eg any marks/bruising noted, and any discussion with family. If unsure what is required, discuss with paediatric and safeguarding colleagues.

AIRWAY INCLUDING ADJUNCTS SIZE GUIDE

Age	Plain E.T.T. Internal Diameter (#ID, mm)	Length Oral (cm at cm at	Length Nasal (cm at nose)	Microcuff Size (#ID, mm)	Bougie Size (Ch or FG)	LMA Size	Suction (Ch or FG)	Cricothyroid Needle (G)	Quicktrach (#ID, mm)
Preterm <2kg	2.0, 2.5	6-7	7.5-9	-	5 = 1.7mm	1	6	18G = 1.27mm	2.0
Preterm 2-4kg	3.0, 3.5	7-8.5	9-10.5	3 (if >3kg)	5	1	6,7	18G	2.0
Term - 3 months	3.5	8.5-10	10.5-12	3	5	1	7	16G = 1.65mm	2.0
3 m- 1year	3.5, 4.0	10-11	12-14	3, 3.5	5	1.5	7,8	16G	2.0
1 year	4.0, 4.5	11-12	14-15	3.5	5	1.5, 2	8,10	14G = 2.11mm	2.0
2 year	4.5, 5.0	12-13	15-16	4.0	10=3.3mm	2	10	14G	2.0
3 year	5.0	13-14	16-17	4.0	10	2	10	14G	2.0
4-6 years	5.0, 5.5	14-15	17-19	4.5	10	2, 2.5	10, 12	14G	2.0
6 -8years	6.0, 6.5	15-16	19-21	5.0	15 = 5mm	2.5	12	14G	2.0
>8 years	6.5, 7.0, 7.5	16-20	20-23	5.5	15	3	14	14G	2.0 (<35Kg) 4.0 (>35 Kg)

NWTS LINES and TUBES SIZES CHART

For central and arterial lines always use the smallest size and smallest number of lumens clinically required.

NB femoral lines in those under 16 years are associated with marked increased risk of thrombus.

↑size = ↑complications

↑lumens = ↑complications

Top tips: Babywires (0.012") pass through ≤ 22G needles.

Guidewires from Vygon leaderflex 22G lines will pass through 24 G Jelco cannulas

AGE	ARTERIAL LINE Eg Arrow or Vygon Leaderflex lines	CENTRAL LINE Unless stated can be used at any site, but be aware of length if I.J.V. / S.C.V. EG Vygon or Arrow lines	NASO-GASTRIC TUBE	URINARY CATHETER NB sizes 8Fr and larger may contain temperature probe	CHEST DRAIN (Seldinger type)
Neonate	24G / 2.5 cm or 24G Cannula eg Jelco	4.5F / 6 cm	6F	6F	8F
Infant	24G / 2.5cm (radial) 22G / 5cm (femoral)	4.5F / 6 cm 4.5F / 8 cm (femoral)	8F	6-8F	8-10F
1-8 yrs	22G / 5cm	4.5F / 6 cm 5 F / 5cm 4.5F / 8 cm 5.5 F / 8 cm 4.5F / 12.5 cm 5.5 F / 13 cm	8-10F	8-10F	10-14F
8 yrs – Adult	22G / 5cm (radial) 20G / 8cm (femoral)	5.5 F 8 cm 7F / 8 cm 7 or 7.5 F / 16cm (femoral)	10-12F	10-14F	14 ⁺ F
Adult sized	20G / 8 cm	8.5 F / 12.5 cm 8.5F / 16 cm (femoral)	12-16F	14-16F	14 ⁺ F

PAEDIATRIC GLASGOW COMA SCALE (GCS)

	> 1 YEAR	< 1 YEAR		SCORE
EYE OPENING E	Spontaneously	Spontaneously		4
	To Verbal command	To shout		3
	To Pain	To pain		2
	No response	No response		1
TOTAL FOR EYE OPENING OUT OF 4				
MOTOR RESPONSE M	Obeys	Spontaneous		6
	Localizes pain	Localizes pain		5
	Flexion-withdrawal	Flexion-withdrawal		4
	Flexion-abnormal (decorticate rigidity)	Flexion-abnormal (decorticate rigidity)		3
	Extension (decerebrate rigidity)	Extension (decerebrate rigidity)		2
	No response	No response		1
TOTAL FOR MOTOR RESPONSE OUT OF 6				
VERBAL / GRIMACE RESPONSE V	>2 YEARS	0-23 MONTHS	GRIMACE FOR NON-VERBAL PATIENTS	
	Oriented / Appropriate words/phrases	Smiles/coos appropriately	Spontaneous normal facial/ oro-motor activity	5
	Disoriented/ confused Inappropriate words	Cries and is consolable	Less than usual spontaneous ability or only response to touch stimuli	4
	Inappropriate words, Persistent cries and screams	Persistent inappropriate crying and / or screaming	Vigorous grimace to pain	3
	In-comprehensible sounds Grunts	Grunts, agitated, and restless	Mild grimace to pain	2
	No response	No response	No response to pain	1
	TOTAL FOR VERBAL / GRIMACE RESPONSE OUT OF 5			
TOTAL GCS OUT OF 15				
If the GCS is 8 or less the patient's airway is compromised. Urgent anaesthetic review and consideration regarding intubation is required.				
Application of pain as a stimuli should be central—supra-orbital pressure (press hard with thumb beneath medial end of eyebrow) or trapezius squeeze Do NOT use sternal rub—this does not give a true reflection of CNS activity & can cause significant bruising If supra-orbital pressure is contraindicated (due to facial swelling or fracture) pinch the ear lobe Score as usual in presence or possibility of sedative drugs but note what a patient has received				

ALERT	VOICE	PAIN	UNRESPONSIVE	PUPIL REACTION	Brisk	Sluggish	Fixed	ASSYMMETRY?
15/15	12/15	8/15	3/15	PUPIL SIZE (mm)	Pinpoint	Midsized	Dilated	Yes / No

ManCHEWS = PAEDIATRIC EARLY WARNING SCORE

RESPIRATORY RATE

AGE	SEVERE	MODERATE	NORMAL	MODERATE	SEVERE
< 4 m	<20	20-29	30-39	40-54	>54
4 m – 2 y	<15	15-24	25-34	35-55	>55
2 – 5 y	<10	10-19	20-29	30-45	>45
5 – 12 y	<10	10-19	20-29	30-45	>45
>12 y	<10	10-14	15-24	25-45	>45

$$Wt = (age \times 3) + 7$$

HEART RATE

AGE	SEVERE	MODERATE	NORMAL	MODERATE	SEVERE
< 4 m	<80	80-109	110-160	160-189	>190
4 m – 2 y	<80	80-99	100-149	150-179	>180
2 – 5 y	<60	60-79	80-119	120-150	>150
5 – 12 y	<60	60-69	70-119	120-150	>150
>12 y	<55	55-64	65-99	100-150	>150

SYSTOLIC BLOOD PRESSURE

AGE	SEVERE	MODERATE	NORMAL	MODERATE	SEVERE
< 4 m	<50	50-59	60-80	81-99	>100
4 m – 2 y	<60	60-69	70-90	90-110	>110
2 – 5 y	<80	80-89	90-129	130-150	>150
5 – 12 y	<80	80-89	90-129	130-150	>150
>12 y	<80	80-89	90-129	130-150	>150

BLOOD PRESSURE PARAMETERS: SHOCKED PATIENT (from NWTS sepsis guidelines)

SYSTOLIC BP ¹⁸	NORMAL	MODERATE	SEVERE		DIASTOLIC BP	TARGET mean BP
37–44 weeks (neonate)	60-80	50-59	< 50		35-53	40-45
< 4 months	60-80	50-59	< 50		37-56	45-50
4 m–2 yr	70-90	60-69	< 60		42-63	50-55
2–5 yr	90-129	80-89	< 80		46-72	55-60
5-12 yr	90-129	80-89	< 80		57-76	60
> 12 yr	110-130	91-100	≤ 90		64-83	65

NB remember **hypotension is a pre-terminal / peri-arrest red flag** in a child / young person and need to respond quickly with fluid bolus +/- inotropes to regain stability

RAISED ICP PATIENTS: eg post-acute intracranial bleed or head trauma
assume / estimate ICP 10-20 and aim for higher mean BP to maintain an
adequate cerebral perfusion pressure (CPP).

Discuss with trauma team leader / paediatric neurosurgeons and organise
a time critical transfer to paediatric tertiary centre

NWTS will provide advice on transfer if needed - use STOPP (safe transfer of paediatric patients) document for any
paediatric inter-hospital transfers www.nwts.nhs.uk/clinicalguidelines

AGE	Mean BP	Aim CPP
< 1 yr	55-65	> 40
1-5 yrs	70-80	> 50
6-11 yrs	80-90	>60
12-14 yrs	85-95	>70

CONTACT NUMBERS:

NWTS (North West (England) & North Wales Paediatric Transport Service): referrals 08000 84 83 82

Alder Hey Childrens Hospital Regional Paediatric Intensive Care Unit: 0151 252 5241

Royal Manchester Childrens Hospital Regional Paediatric Intensive Care Unit: 0161 701 8000

REFERENCES AND BIBLIOGRAPHY

1. NWTS Clinical Guidelines – www.nwts.nhs.uk/clinicalguidelines

NWTS guidelines referred to: sepsis; intubation / difficult airway; status epilepticus; asthma; bronchiolitis

2. PCCS Standards 6th Edition 2021 Page 110-121: standards A-404; A-502; N-503

3. Intensive Care Society Guidelines for the provision of Intensive Care Services version 2.1 pg 128-130 July 2022

4. STRS Guidelines <https://www.evelinalondon.nhs.uk/resources/our-services/hospital/south-thames-retrieval-service/child-ventilated-in-adult-icu-april-2018.pdf>

5. Nixon, C. How long should an internal jugular catheter be? Anesth Analg. 2000; 90: 500

6. Intensive Care Society Review of Best Practice for Analgesia and Sedation in Critical Care June 2014

7. Wood, D, Goodwin S, Pappachan J, Davis P, Parslow R, Harrison D & Ramnarayan P Characteristics of adolescents requiring intensive care in UK: a retrospective cohort study J intensive Care Soc 2018; 19(3): 209-213

8. Singer, Mervyn, and Andrew Webb. Oxford Handbook of Critical Care : Oxford Handbook of Critical Care, Oxford University Press, Incorporated, 2009.

9. Owen J, John R Childhood obesity and the anaesthetist. Continuing education in Anaesthesia, Critical Care & Pain 2012; 12 (4): 169-175

FOR DRUG DOSES: British National Formulary for Children

Crashcall = regional PCC drugs / fluids / infusions calculator via:

<https://www.nwts.nhs.uk/documentation/crashcall>

GUIDELINES: www.nwts.nhs.uk/clinicalguidelines

Includes regional and relevant national guidelines

EDUCATION: via education website tab on NWTS website

www.nwts.nhs.uk/education-website

Login details for NWTS education site are available from your nursing, AHP and medical paediatric critical care operational delivery network links

OR via email: info@nwts.nhs.uk

RECORDED SESSIONS ON A WIDE VARIETY OF PAEDIATRIC CRITICAL CARE TOPICS WHICH INCLUDES:

Care of critically sick child or young adult on adult intensive care (nursing & medical)

Intubation of infants and children

Severe Asthma; Bronchiolitis; Management of respiratory patients

Septic shock

Status epilepticus

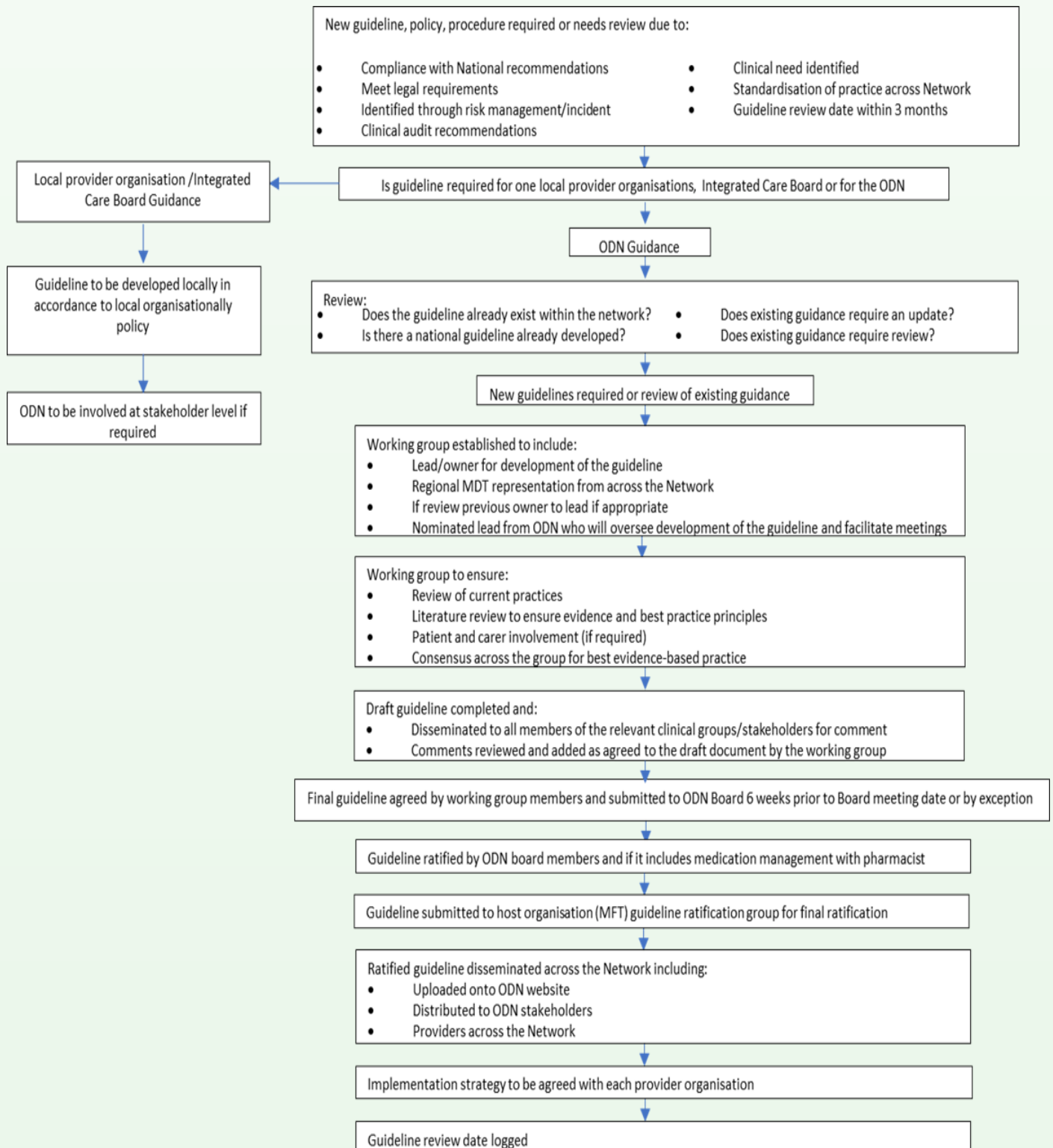
DKA management

Sick neonate / infant

Time critical transfers

Major Trauma including hanging, drowning and burns

RATIFICATION PROCESS



GUIDELINE CONTACT POINT @ NWTS:

Kate.parkins@nwts.nhs.uk, anna.mcnamara2@mft.nhs.uk & Nicola.longden@mft.nhs.uk

Please visit NWTS website for the most up to date version of this guideline: www.nwts.nhs.uk/guidelines