

DOCUMENT CONTROL PAGE	
Title	<p>Guidance for Acute Paediatric Intubation</p> <p>The guideline is intended for use by any hospital team caring for infants and children across the Paediatric Critical Care Network in the North West & North Wales region.</p> <p>Version: 1</p> <p>Reference Number: PCCN5</p>
Supersedes	<p>Supersedes: Nil</p> <p>Description of amendment(s): New guideline – not applicable</p>
Minor Amendment	<p>Date:</p> <p>Notified To:</p> <p>Summary of amendments:</p> <p>Date:</p>
Authors	<p>Originated By: Pete Murphy</p> <p>Designation: NWTS Consultant and Consultant Paediatric Anaesthetist, AHFT</p> <p>Co-Authors: (1) Ralph MacKinnon; (2) Kate Parkins; (3) Rachael Barber; (4) Richard Craig; (5) Adam Donne; (6) Richard McGuire; (7) Amit Dawar; (8) Neil Oakes</p> <p>Designation: (1) NWTS Consultant and Consultant Paediatric Anaesthetist, CMFT; (2) Lead Consultant NWTS and Consultant Paediatric Intensivist, AHFT; (3) NWTS Consultant and Consultant Paediatric Intensivist, CMFT; (4) Consultant Anaesthetist, AHFT; (5) Consultant ENT Surgeon, AHFT; (6) ST Trainee, Northern Deanery; (7) Consultant anaesthetist, Countess of Chester Hospital (8) Consultant anaesthetist, Arrowe Park Hospital</p> <p>NWTS is a regional Paediatric Intensive Care transport service for the North West & North Wales region, providing advice on patient management, in addition to clinical teams that stabilise and transport critically sick or injured children.</p>
Ratification	<p>Ratified by:</p> <ol style="list-style-type: none"> 1. CMFT (Host Trust): <ul style="list-style-type: none"> - Paediatric Medicines Management Committee (MMC) on: 2nd April 2015 - Divisional Children’s Clinical Effectiveness Committee on: 2nd April 2015 2. AHFT: <ul style="list-style-type: none"> - CDEG (Clinical Development & Evaluation Group) on: 21st April 2015
Application	Children only
Circulation	<p>Issue Date: 6th May 2015</p> <p>Circulated by: Clinical Lead, North West & North Wales Paediatric Critical Care Network</p> <p>Dissemination and Implementation: NWTS & PCCN circulation lists</p>
Review	<p>Review Date: May 2018</p> <p>Responsibility of: Clinical Lead, North West & North Wales Paediatric Transport Service (NWTS)</p>
<p>Date placed on the Intranet: 6th May 2015</p>	
<p>Please enter your EqIA Registration Number here: To be Confirmed</p>	

1. Detail of Procedural Document

Guidance for Acute Paediatric Intubation - for use by clinical teams managing infants and children in the North West & North Wales region.

2. Equality Impact Assessment

TBC EQIA registration number..

3. Consultation, Approval and Ratification Process

This guideline was developed with input from:

- North West and North Wales Paediatric Transport Service (NWTS) - medical & nursing
- Representatives from both Paediatric Intensive Care Units (Royal Manchester Children's Hospital and Alder Hey Children's Hospital) - medical, nursing and paediatric intensive care pharmacists.
- Representatives from the North West and North Wales Paediatric Critical Care Network (PCCN) - medical, nursing and AHP (paediatrics, anaesthetics, and emergency medicine teams)
- Representatives from ENT (Alder Hey)

These guidelines were circulated amongst the Consultants from both Paediatric Intensive Care Units (Central Manchester University Hospitals NHS Foundation Trust and Alder Hey NHS Foundation Trust), the guidelines working group, and the Consultants from the North West and North Wales Paediatric Transport Service (NWTS) for comments on the **15th February 2013**.

These guidelines were circulated amongst the North West and North Wales Paediatric Critical Care Network for comments on the **20th March 2013**

All comments received have been reviewed and appropriate amendments incorporated.

These guidelines were signed off by the Network/NWTS Clinical Lead on 23rd March 2015

For ratification process see appendix 1.

4. References and Bibliography

Paediatric difficult airway guidelines 2012, APA/DAS

Downloadable via <http://www.apagbi.org.uk/publications/apa-guidelines>

Difficult airway guidelines , DAS, 2004

Downloadable via <http://www.das.uk.com/guidelines/downloads.html>

Paediatr Anaesth. 2010 May;20(5):454-64. Weiss M, Engelhardt T.

Proposal for management of the unexpected difficult pediatric airway

Paediatr Anaesth. 2009 Jul;19 Suppl 1:66-76. Coté CJ, Hartnick CJ.

Pediatric transtracheal and cricothyrotomy airway devices for emergency use: which are appropriate for infants and children?

Drug doses, Frank Shann, 15th edition 2010

5. Disclaimer

These clinical guidelines represent the views of the North West and North Wales Paediatric Critical Care Network and North West and North Wales Paediatric Transport Service (NWTS), and were produced after careful consideration of available evidence in conjunction with clinical expertise and experience. It is intended that trusts within the Paediatric Critical Care Network will adopt this guideline and educational resource after review 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.

Guidance for acute paediatric intubation

Think?

Airway assessment?
Most appropriate place that time allows?
Most appropriate staff that time allows?
Right equipment and drugs prepared?
Monitoring (especially capnography)?
Pre-intubation checklist before induction (page 5)

Potential difficult airway?

NO

YES

**Call senior anaesthetist and
E.N.T. surgeon**

Consider using theatre
Consider volatile induction

Cardiovascular risk?

(Congenital heart disease or shock)

Available: Atropine 20microgram/kg (min 100 micrograms)
& Adrenaline 10 microgram/kg (0.1 ml/kg of 1 in 10,000)
& Fluid bolus 10ml/Kg

YES

**Ketamine 1-2 mg/kg +/-
Fentanyl 1-2 micrograms/kg**
Alternative: Thiopentone 1-2 mg/kg

NO

Thiopentone 2-5 mg/kg
OR Propofol 2-4 mg/kg

Aspiration risk?

(Most sick children have gastric stasis)

YES

Rapid sequence induction
(with cricoid pressure)
Suxamethonium 1-2 mg/kg or
Rocuronium 1 mg/kg (long acting)

NO

Atracurium 0.5 mg/kg
OR Rocuronium 0.6mg/kg

Success?

Confirm clinically and E.T.CO₂

YES

Secure tube, note length
NGT / OGT and CXR
On-going sedation
www.crashcall.net

NO

Maintain oxygenation

Follow "Unanticipated difficult intubation following RSI in paediatric patient" (page 3)

Guidance for acute paediatric intubation — associated notes

Consider potential airway difficulties (problems with mask ventilation / laryngoscopy / intubation):

Patient factors (syndromes / deformities etc.) – ensure thorough airway examination

Previous difficult intubation (check grade laryngoscopy in notes / method of intubation used)

Disease factors (infections/trauma/allergy/foreign bodies etc.) affecting the head, neck or airways

WARNING: do not examine airway if patient has stridor—may cause deterioration pre-intubation

Consider significant deterioration on induction:

Potential limited cardiac reserve e.g. sepsis, low output states, congenital heart disease, arrhythmias

Potential limited pulmonary reserve e.g. pulmonary oedema, chronic lung disease, asthma

IF HIGH RISK DO NOT PROCEED WITHOUT CONSULTANT ADVICE (local and NWTs)

If difficulty is anticipated and time allows move patient to the anaesthetic room / theatre or move equipment and personnel to patient: ensure consultant anaesthetist and ODP (or equivalent) present.

Pre-oxygenation: If possible pre-oxygenate with 100% oxygen for 3 minutes

Rapid sequence induction unless gas induction by senior anaesthetist indicated (difficult or obstructed airway)

Cricoid pressure by trained practitioner

Modified RSI (infants and most sick children): may need to give low tidal volume breaths with cricoid pressure on to preclude desaturation before intubation (low oxygen reserve/ high consumption and paralysis may take longer to take effect if any CVS compromise).

Induction agents: (Intraosseous route can be used safely for all induction agents and muscle relaxants)

Cardiovascularly unstable patients: consider ketamine +/- fentanyl (ketamine may (lacks evidence) increase intracranial pressure) balance risk/benefit in raised ICP

Thiopentone reduces intracranial pressure but causes hypotension.

Neonates: consider using fentanyl for unstable neonates as a sole induction agent (1-3microgram/kg)

Inhalational anaesthetics: only by doctors familiar with the anaesthetic machine and technique

Inotropes: should be immediately available to offset negative effects of induction agents (i.e. drawn up and in the infusion pumps or ready to bolus www.crashcall.net) if not available then 1 ml aliquots of (0.1 ml/ kg of 1:10,000 adrenaline solution made up to 10 mls total with 0.9% NaCl) is useful for hypotension

Muscle relaxants:

Suxamethonium is drug of choice for RSI (onset 30-45sec, duration 3-5 min) but many contra-indications (including hyperkalaemia, some neuro-muscular pathologies, suspected malignant hyperthermia or 24 hrs after burn or spinal injury).

Rocuronium - rapid onset of action at 1mg/kg (approx 1 min and no fasciculations) but a much longer duration (>40min). Can be reversed rapidly (if patient suitable to be woken up!) with sugammadex 16mg/Kg (but this is not widely available (especially outside theatre) and is **NOT** carried by NWTs)

Post intubation checks: See ET tube through cords, **E.T.CO₂**, SpO₂ and auscultation

Check tube length, minimal leak, Melbourne strapping and CXR for ET tube position

Cuffed endotracheal tubes: Consider if poor compliance expected, airway soiling or difficulty sizing tube.

Microcuff[®] tubes are becoming more popular in >3Kg children but sizing and markings on tube are slightly different (careful with length). Ensure cuff is at minimum pressure possible (max 20 cm H₂O).

Oro/Nasogastric tube to decompress stomach: contra-indications to NGT include basal skull fracture and coagulopathy.

Maintenance of anaesthesia, sedation and ventilation:

Consider morphine and midazolam infusion/boluses as per www.crashcall.net guideline except:

Bronchospasm (consider ketamine / midazolam / fentanyl), renal / liver failure (fentanyl / midazolam).

Have post-procedure sedation and paralysis ready to commence prior to induction.

Failure to intubate - Maintain oxygenation

follow “Unanticipated difficult intubation following RSI in paediatric patient” guideline (page 3)

Unanticipated difficult intubation following RSI in paediatric patient

(assumes pre-oxygenation performed and 100% O₂ used throughout)

Plan A

Initial tracheal intubation

Difficult laryngoscopy? - CALL FOR SENIOR HELP

Check head/neck position appropriate for age
Check laryngoscopy technique and vector
External laryngeal manipulation by laryngoscopist
Ongoing poor view:

- reduce cricoid force / bougie
- alternative laryngoscope blade / 2 person technique

Not more than 3 attempts at laryngoscopy by any individual and **max 5 attempts in total**
Maintain oxygenation & anaesthesia throughout

Successful intubation

Confirm intubation

Visualise tube going through cords?
Chest movement and bilateral auscultation?
And CAPNOGRAPHY?

Failed intubation

Plan B

Oxygenation and secondary intubation

Insert supraglottic airway device (e.g.LMA)

not >3 attempts (remove cricoid force if required)

Successful oxygenation & ventilation

Senior discussion about how to proceed?

Suitable to be woken up safely? (**Plan C**)
consider sugammadex 16mg/kg if rocuronium or vecuronium used to paralyse

Is consultant anaesthetist present?
skills and equipment to perform video / fiberoptic intubation?

Local ENT surgeon?
NWTS consultant advice? (0800 084 8382)
Neonatologist (if appropriate)?
Tertiary ENT/anaesthetics to DGH? (d/w NWTS)
Transfer to tertiary centre utilising LMA?

Failed Oxygenation & Ventilation

Maintain sats >80%

(lower sats may be acceptable with cyanotic heart disease)

Maintenance of oxygenation and ventilation via facemask

Optimize head position and chin lift/jaw thrust
Insert oropharyngeal and/or nasopharyngeal airway
Ventilate using 2 person bag mask technique (*high PEEP*)
Manage gastric distention using OG/NG tube (*large bore*)
Consider reducing cricoid force further

Ensure Help Is On The Way

Successful oxygenation & ventilation

Failed oxygenation & ventilation

Plan D

Rescue techniques

CAN'T INTUBATE CAN'T VENTILATE SCENARIO

Call for help again if not arrived — Call for ENT surgeon

Unable to wake / progressive hypoxia / falling heart rate

Airway rescue techniques

All have high complication and failure rates (especially <8Yrs)
SURGICAL SUCCESS RATES ARE HIGHER

ENT available

Consider (depending on time / skills / equipment):
Surgical cricothyroidotomy / direct tracheostomy
Rigid bronchoscopy & intubate via scope
Rigid bronchoscopy & ventilate via scope

ENT unavailable

Percutaneous cannula cricothyroidotomy
Narrow bore eg Venflon® (*high pressure O₂ needed*) **OR**
Wide bore eg Quicktrach® (*standard 15mm connector*)

Note: Cricothyroidotomy/surgical techniques can have serious complications and training is required—only use in life threatening situations and convert to a definitive airway as soon as possible

Failure to oxygenate

ENT still unavailable

Surgical cricothyroidotomy

Unanticipated difficult intubation following RSI in paediatric patient

Notes and advice on procedures

Tips to achieve intubation:

- Check position of head and neck: aim for neutral alignment in neonates and infants, “sniffing the morning air” in the older child
- Check laryngoscope vector (midline) and technique (scope in vallecula or lifting epiglottis directly, try both)
- External laryngeal manipulation by the person doing laryngoscopy: use little finger in neonates and infants
- Cricoid pressure can distort/occlude the airway—reduce/remove and reassess change
- Consider alternative laryngoscope blade
 - Cardiff blade in neonates
 - McCoy blade in older children
- Consider a bougie if poor view of glottis. Do not seek hold up (adult technique of pushing bougie until it lodges in bronchi) as high risk of perforation/pneumothorax especially in neonates/infants
- Consider 2 person technique:
 - Operator 1 - laryngoscope + external laryngeal manipulation
 - Operator 2 - insertion of bougie/endotracheal tube over operator 1’s shoulder
- Bag mask ventilation to maintain oxygenation between attempts - use OG/NG tube to continually decompress stomach

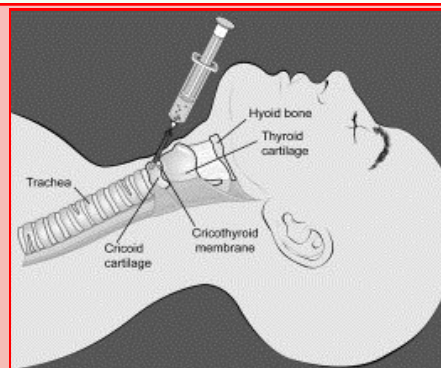
No more than 3 attempts at intubation by initial operator. A second operator (preferably consultant anaesthetist or someone more experience in paed airway management) may have further attempts at direct laryngoscopy up to a maximum of 5 in total (when combined with all previous attempts). If unsuccessful a different strategy should be employed to ventilate and secure the airway- **repeated unsuccessful attempts at laryngoscopy will cause airway oedema and exacerbate the situation.**

If oxygenation and ventilation are not adequate at any point between attempts - proceed down failed intubation pathway - oxygenation is paramount.

Percutaneous cannula cricothyroidotomy:

Stiffened cannulas (e.g. Ravussin®) better than standard cannula (e.g. Venflon®)
Ravussin 16G Infant / 14G Child / 13G Adult

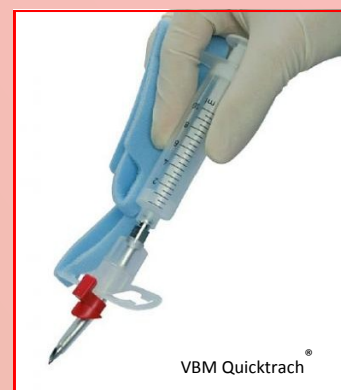
- Identify cricothyroid membrane (full head and neck extension, shoulder roll/head ring)
- Insert cannula through cricothyroid membrane (45° caudal angle)
- Confirm tracheal position by air aspiration
- Attach insufflation system to cannula using Luer-lock connector (Need high pressure source e.g. manujet injector / Enks oxygen flow meter)
- Commence cautious inflation (manujet colour coded / Enks—start with flow in L/min equal to age in years)
- Continue to increase pressure / flow until chest rise adequate (1L/min increments to max 15)
- Confirm inflation of lungs and exhalation through upper airway (upper airway patency is required for this technique to work)
- 1 second inflation - 4 second exhalation
- If inflation fails or surgical emphysema develops convert immediately to surgical cricothyroidotomy



Large bore cannula cricothyroidotomy:

VBM Quicktrach® 1.5mm I.D. Infant / 2mm I.D. Child / 4mm I.D. Adult (All 3 sizes carried by NWTs)

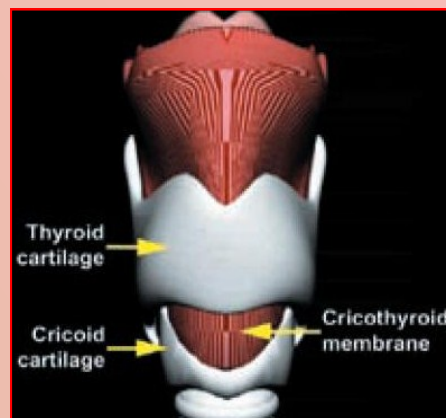
- Identify cricothyroid membrane (Full head and neck extension, shoulder roll/head ring)
- Hold syringe firmly and puncture skin at 90° angle with needle bevel facing caudally
- Once through skin, flatten needle to 60° angle
- Advance Quicktrach® into trachea up to stopper
- Aspirate - should freely aspirate air (if not reposition)
- Remove stopper
- Slide the plastic cannula over needle until flange is flush with skin
- Remove needle and syringe
- Secure cannula with tracheostomy tape
- Insufflate via anaesthetic circuit or self-inflating bag. Steadily increase pressure if no chest rise.
- 1 second inflation - 4 second exhalation
- (Depending on the degree of upper airway obstruction present, it may be necessary to occlude the patient’s mouth and nose to adequately inflate the lungs as most of the gas may escape through the upper airway during attempts at inflation). Exhalation must still take place via the upper airway



NB: VBM Quicktrach® 1.5mm I.D. also has a Luer-lock connection that can be attached to a high pressure O₂ source as well if low pressure is inadequate to inflate lungs.

Surgical cricothyroidotomy:

- Identify cricothyroid membrane (full head and neck extension, shoulder roll/head ring)
- Single stab incision through skin and membrane using scalpel
- Enlarge incision using blunt dissection
- Insert tracheal or tracheostomy tube of appropriate size (a bougie can be used to hold open tract and act as a guide)
- Secure tube and ventilate (capnography to confirm ventilation)
- Ventilate via anaesthetic circuit or self-inflating bag.



These techniques have serious complications - use only in life threatening situations.

Convert to definitive airway as soon as possible

(Ultrasound can be used to assist above techniques if available/trained/no delay)

Acute paediatric intubation checklist (ensure all equipment is size appropriate before starting)

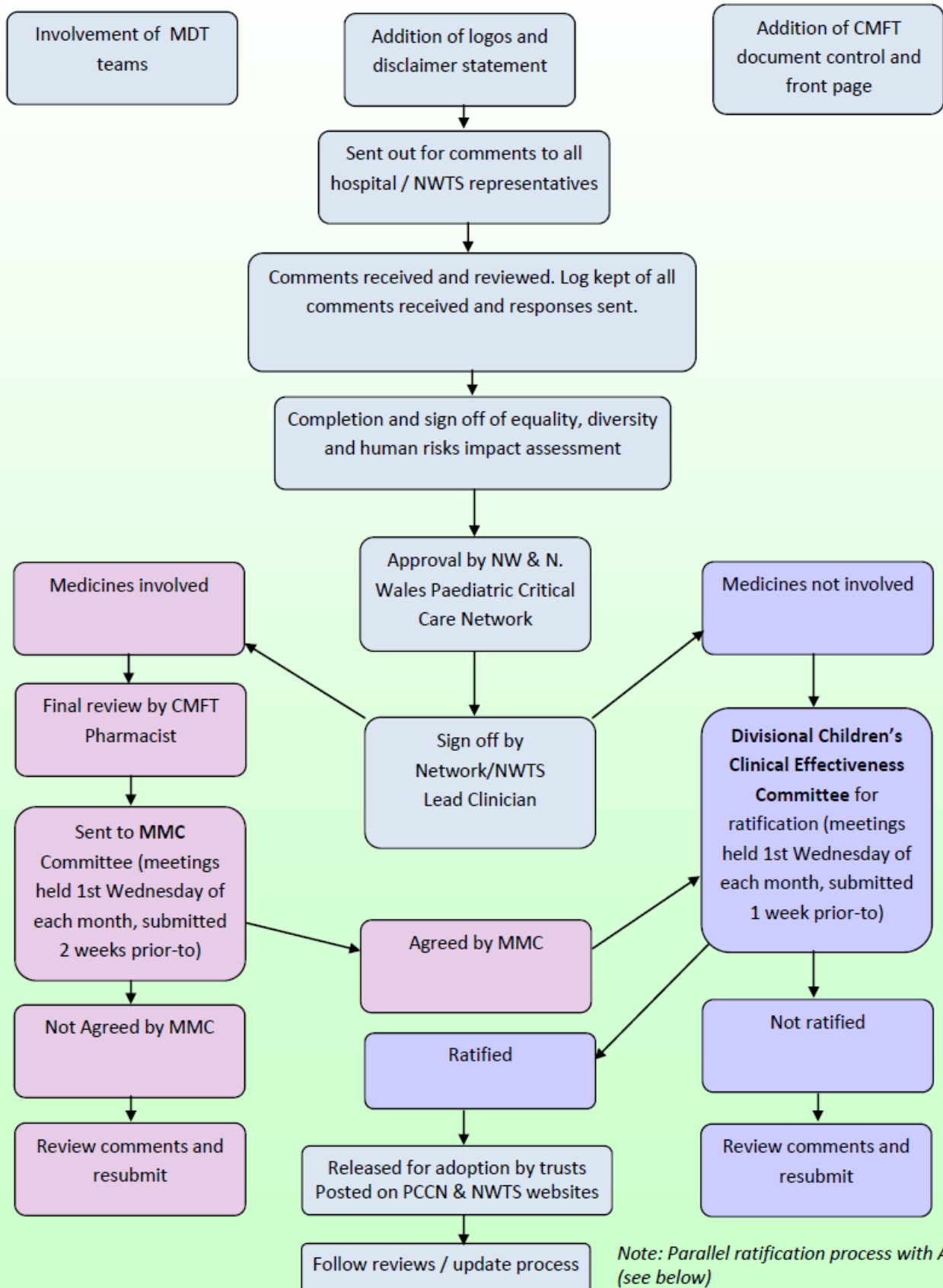
Age	Plain E.T.T. Internal Diameter (#ID, mm)	Length Oral	Length Nasal (cm at nose)	Microcuff Size (#ID, mm)	Bougie Size (Ch or FG)	LMA Size	Suction (Ch or FG)	Cricothyroid Needle (G)	Quicktrach (#ID, mm)
Preterm <2kg	2.0,2.5	6-7	7.5-9	-	5 = 1.7mm	1	6	18G =1.27mm	1.5
Preterm 2-4kg	3.0,3.5	7-8.5	9-10.5	3 (if >3kg)	5	1	6,7	18G	1.5
Term -3 months	3.5	8.5-10	10.5-12	3	5	1	7	16G =1.65mm	1.5
3 m- 1year	3.5,4.0	10-11	12-14	3, 3.5	5	1.5	7,8	16G	1.5
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)

*All sizes / distances are guides and should be confirmed clinically and by CXR

Microcuff tubes not recommended by manufacturer <3Kg — Check compatibilities of your equipment as manufacturers vary

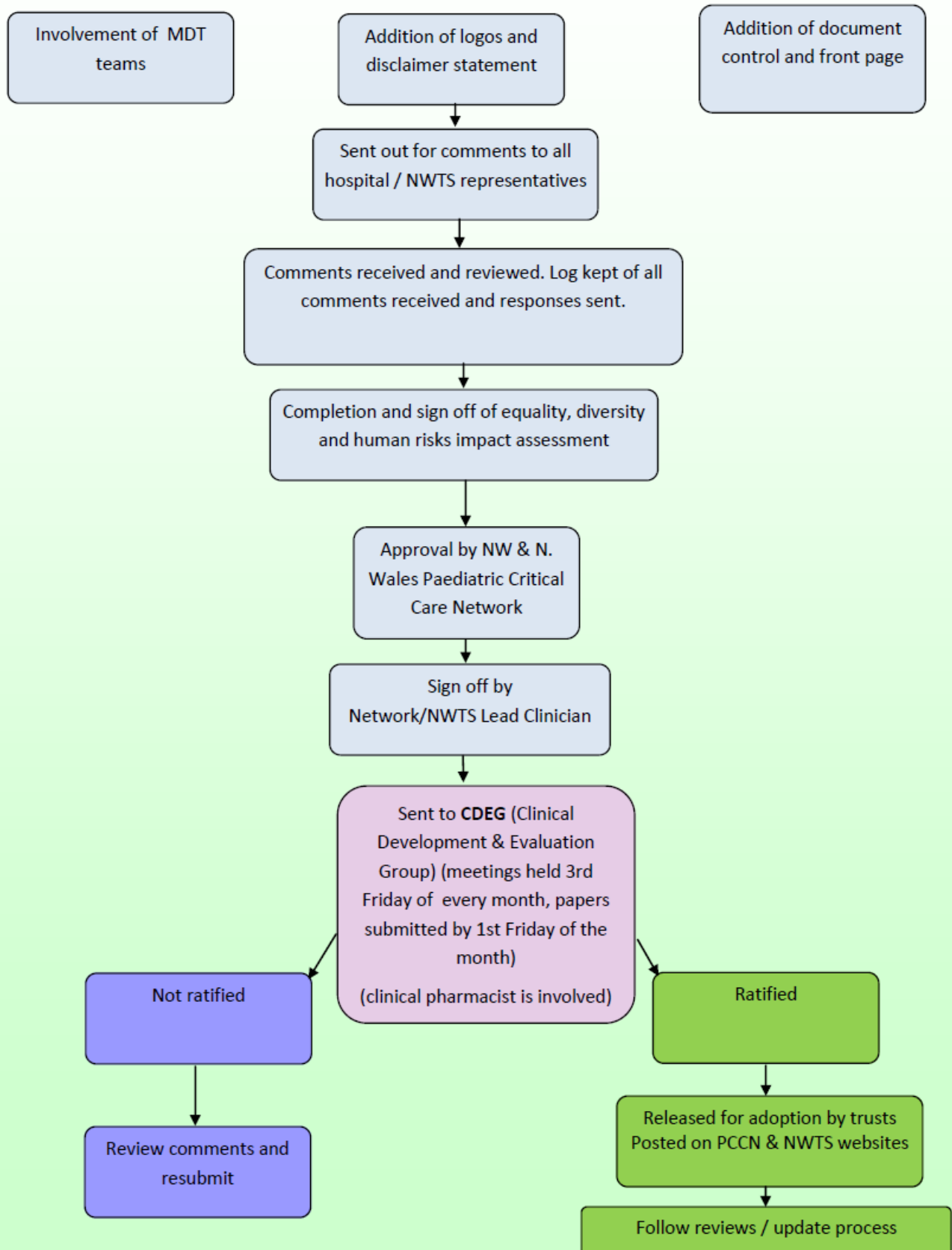
<p>PLANNING / PREPARATION / LOCATION</p> <p>Alternative airway plan discussed in case of difficulties? Do you need ENT? <input type="checkbox"/></p> <p>C-spine stable? Positioning optimised for age / condition? <input type="checkbox"/></p> <p>Plan for cardiac decompensation? <input type="checkbox"/></p> <p>NG tube / PEG aspirated? <input type="checkbox"/></p> <p>IV/IO—working? <input type="checkbox"/></p> <p>Team roles - Intubator <input type="checkbox"/></p> <p>Cricoid / airway assistant <input type="checkbox"/></p> <p>Drugs / runner (minimum 3 people required for RSI) <input type="checkbox"/></p> <p>HELP— who / how / where will it be coming from ? <input type="checkbox"/></p> <p>Pre-oxygenation <input type="checkbox"/></p>	<p>EQUIPMENT</p> <p>Face mask / airways (oral and nasal)? <input type="checkbox"/></p> <p>Laryngoscope type/size and checked? (preferably 2) <input type="checkbox"/></p> <p>ETT— above and below expected size available (consider microcuff)? <input type="checkbox"/></p> <p>Breathing circuit ? (Bag-valve mask available) <input type="checkbox"/></p> <p>Tube tapes / ties? <input type="checkbox"/></p> <p>Bougie / introducer / Magill's ? <input type="checkbox"/></p> <p>Suction (Yankauer and catheter)? NGT / OGT (if not in already)? <input type="checkbox"/></p> <p>Monitoring— Capnography, SPO2, stethoscope, BP, ECG? <input type="checkbox"/></p> <p>Alternative airway plan / rescue devices (e.g LMA / cricothyroid etc.)? <input type="checkbox"/></p>	<p>DRUGS</p> <p>Check drug doses and labelling (www.crashcall.net) <input type="checkbox"/></p> <p>Induction agent: / paralysis (sux/roc)? <input type="checkbox"/></p> <p>Ongoing sedation/anaesthesia ? <input type="checkbox"/></p> <p>Fluids drawn up? / vasopressor required? / inotrope required? <input type="checkbox"/></p> <p>Crash drugs— adrenaline/ atropine drawn up? <input type="checkbox"/></p>
<p>Patients Name: _____</p>		<p>Date: ___/___/___ Team signature: _____</p>

Ratification of Guidelines with Host Organisation (CMFT)



Note: Parallel ratification process with AHFT (see below)

Ratification of Guidelines with Alder Hey



Resources

www.crashcall.net - for intubation drugs / sedation regime

Contact numbers:

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

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

NWTS (North West & North Wales Paediatric Transport Service) 01925 853 550

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Neil Oakes, ST Trainee, Mersey Deanery

Consulted parties:

North West & North Wales Paediatric Transport Service (NWTS)

North West and North Wales Paediatric Critical Care Network

PICU, Royal Manchester Children's Hospital

PICU, Alder Hey Children's Hospital

Date of Review: To be confirmed

Guideline contact point: peter.murphy@alderhey.nhs.uk

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

or

www.networks.nhs.uk/nhs-networks/north-west-north-wales-paediatric-critical-care