North West & North Wales Paediatric Transport Service

NHS North West & North Wales Paediatric Critical Care Network

DOCUMENT CONTROL PAGE

Title	**Guidance for Acute Paediatric Intubation** 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. **Version**: 1 **Reference Number**: PCCN5
Supersedes	**Supersedes**: Nil **Description of amendment(s)**: New guideline – not applicable
Minor Amendment	**Date**: **Notified To**: **Date**: **Summary of amendments**:
Authors	**Originated By**: Pete Murphy **Designation**: NWTS Consultant and Consultant Paediatric Anaesthetist, AHFT **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 **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 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.
Ratification	**Ratified by:** 1. CMFT (Host Trust): - Paediatric Medicines Management Committee (MMC) on: 2nd April 2015 - Divisional Children's Clinical Effectiveness Committee on: 2nd April 2015 2. AHFT: - CDEG (Clinical Development & Evaluation Group) on: 21st April 2015
Application	Children only
Circulation	Issue Date: 6th May 2015 Circulated by: Clinical Lead, North West & North Wales Paediatric Critical Care Network Dissemination and Implementation: NWTS & PCCN circulation lists
Review	Review Date: May 2018 Responsibility of: Clinical Lead, North West & North Wales Paediatric Transport Service (NWTS)

Date placed on the Intranet: 6th May 2015	Please enter your EqIA Registration Number here: To be Confirmed

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?

YES → **Call senior anaesthetist and E.N.T. surgeon**
Consider using theatre
Consider volatile induction

NO

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:Thiopentone1-2 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.CO_2

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.CO_2**, SpO_2 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 H_2O).

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% O_2 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

Maintain sats >80%

(lower sats may be acceptable with cyanotic heart disease)

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 ↓

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 O_2 needed)* **OR**
Wide bore eg Quicktrach® (*standard 15mm connector)*

Failure to oxygenate ↓

ENT still unavailable
Surgical cricothyroidotomy

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

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

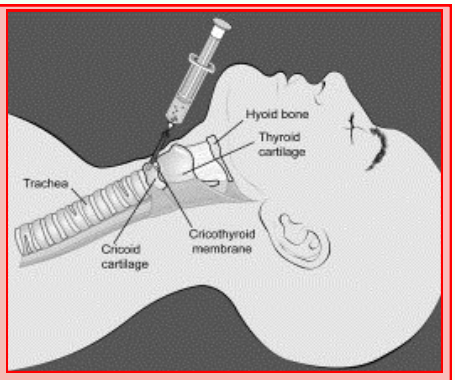
Consider a bougie if poor view of glottis. Do not seek hold up (adult technique of pushing bougie until it lodges in bronchi) as high risk of perforation/pneumothorax especially in neonates/infants
Consider 2 person technique:
- Operator 1 - laryngoscope + external laryngeal manipulation
- Operator 2 - 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 paeds airway management) may have further attempts at direct laryngoscopy up to a maximum of 5 in total (when com bined 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:

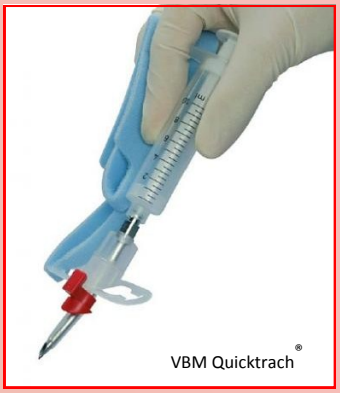


Stiffened cannulas (e.g. Ravussin®) better than standard cannula (e.g. Venflon®)
Ravussin 16G Infant / 14G Child / 13G Adult

Identify cricothyroid membrane (full head and neck extension, shoulder roll/head ring)
Insert cannula through cricothyroid membrane (45^0 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:

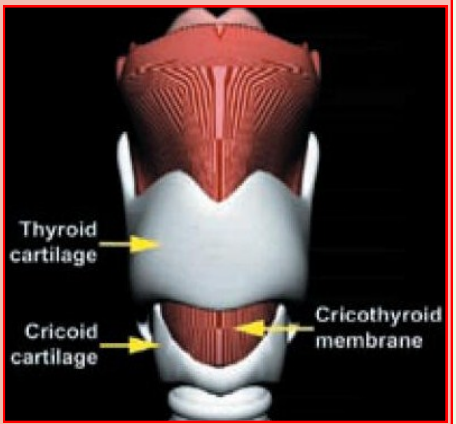
VBM Quicktrach® 1.5mm I.D. Infant / 2mm I.D. Child / 4mm I.D. Adult (All 3 sizes carried by NWTS)



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 O_2 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)

PLANNING / PREPARATION / LOCATION

- ☐ Alternative airway plan discussed in case of difficulties? Do you need ENT?
- ☐ C-spine stable? Positioning optimised for age / condition?
- ☐ Plan for cardiac decompensation?
- ☐ NG tube / PEG aspirated?
- ☐ IV/IO—working?
- Team roles - Intubator
  - Cricoid / airway assistant
  - ☐ Drugs / runner (minimum 3 people required for RSI)
- ☐ HELP—who / how / where will it be coming from ?
- ☐ Pre-oxygenation

EQUIPMENT

- ☐ Face mask / airways (oral and nasal)?
- ☐ Laryngoscope type/size and checked? (preferably 2)
- ☐ ETT— above and below expected size available (consider microcuff)?
- ☐ Breathing circuit ? (Bag-valve mask available)
- ☐ Tube tapes / ties?
- ☐ Bougie / introducer / Magill's ?
- ☐ Suction (Yankauer and catheter)? NGT / OGT (if not in already)?
- ☐ Monitoring– **Capnography**, SPO2, stethoscope, BP, ECG?
- ☐ Alternative airway plan / rescue devices (e.g LMA / cricothyroid etc.)?

DRUGS

- ☐ Check drug doses and labelling **(www.crashcall.net)**
- ☐ Induction agent: / paralysis (sux/roc)?
- ☐ Ongoing sedation/anaesthesia ?
- ☐ Fluids drawn up? / vasopressor required? / inotrope required?
- ☐ Crash drugs– adrenaline/ atropine drawn up?

Patients Name: Date: __/__/__ Team signature:

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)

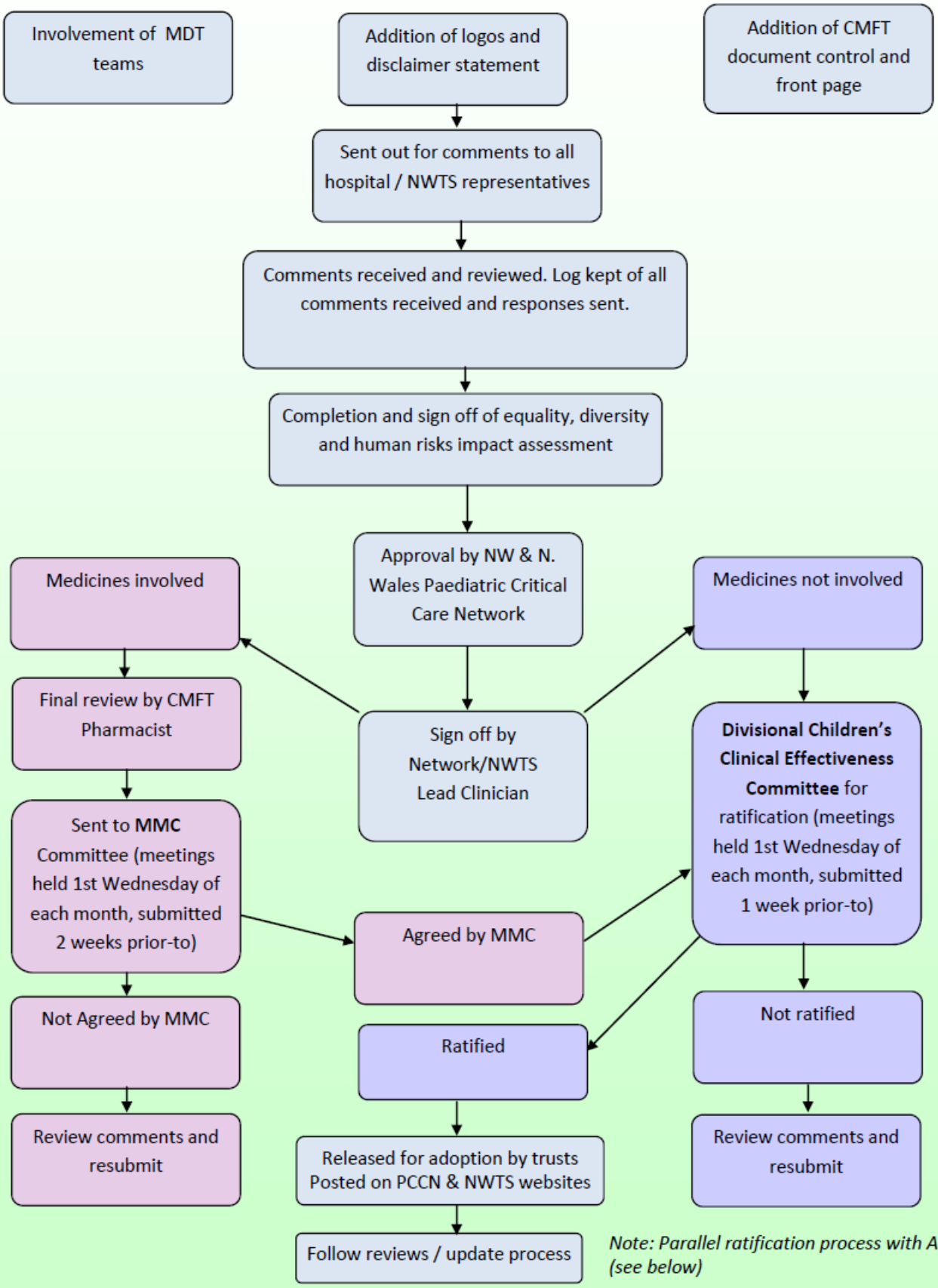
***All sizes / distances are guides and should be confirmed clinically and by CXR**

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

Appendix 1

Alder Hey Children's NHS Foundation Trust | NHS North West & North Wales Paediatric Critical Care Network | Central Manchester University Hospitals NHS Foundation Trust

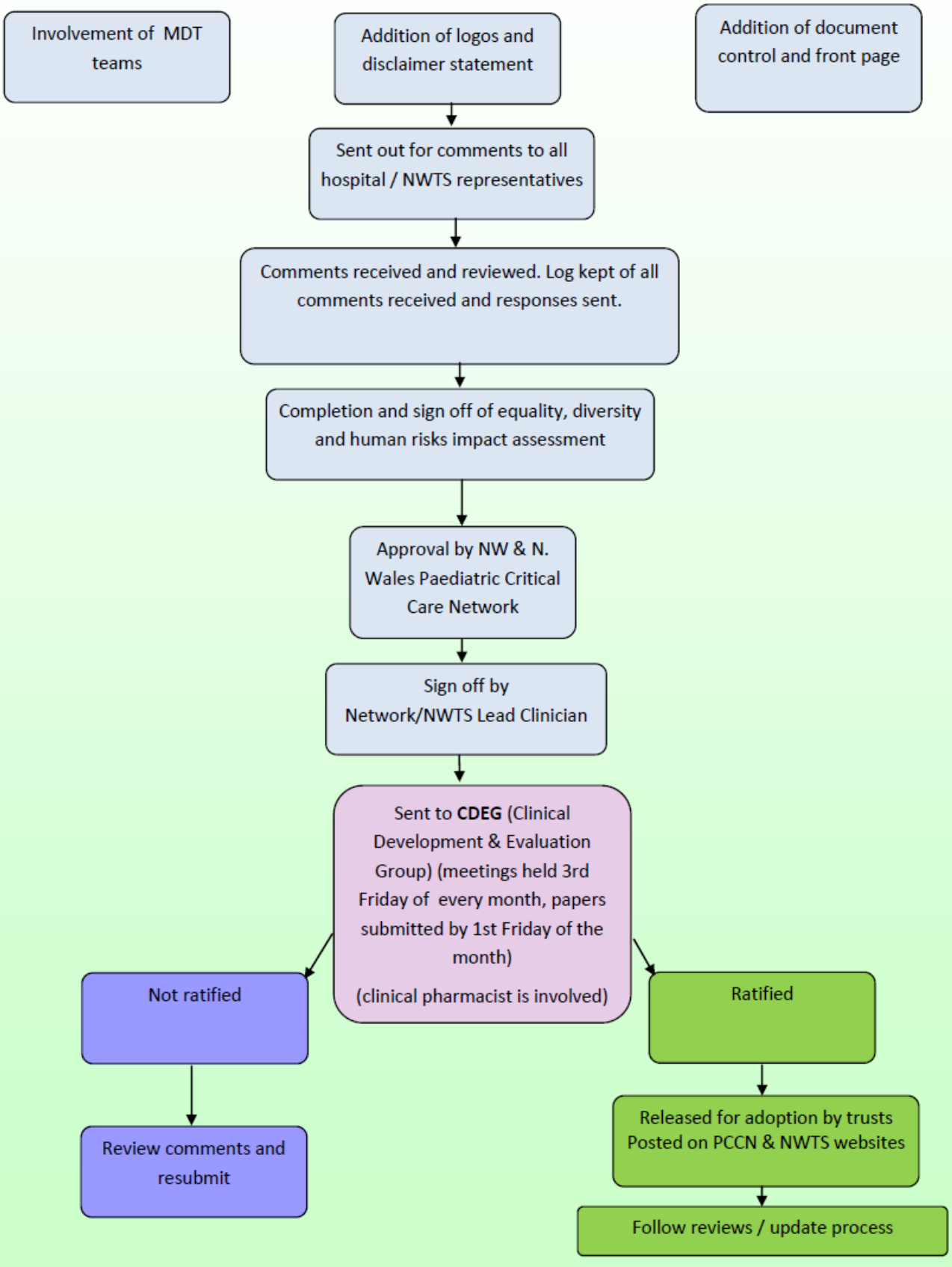
Ratification of Guidelines with Host Organisation (CMFT)



Appendix 1 continued

Alder Hey Children's NHS Foundation Trust | North West & North Wales Paediatric Critical Care Network | Central Manchester University Hospitals NHS Foundation Trust

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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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

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