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Anaesthetic Induction and Intubation of Critically Unwell Child CoMET Guideline

This guideline is for use by healthcare staff, at CoMET undertaking critical care retrieval, transport and stabilization of children, and young adults.

CoMET is a Paediatric Critical Care Transport service and is hosted by the University Hospitals of Leicester NHS trust working in partnership with the Nottingham University Hospitals NHS Trust.

The guidance supports decision making by individual healthcare professionals and to make decisions in the best interest of the individual patient.

This guideline represents the view of CoMET, and is produced to be used mainly by healthcare staff working for CoMET, although, professionals, working in similar field will find it useful for easy reference at the bedside.

We are grateful to the many existing paediatric critical care transport services, whose advice and current guidelines have been referred to for preparing this document. Thank You.

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Approved By:	**Policy & Guidelines Committee**
Date of Latest Approval:	
Version:	**(1)**
Next Review Date:	**Month, Year**

Education and Training

1. Annual Transport team update training days

2. Workshops delivered in Regional Transport Study days/ Outreach

Monitoring Compliance

What will be measured to monitor compliance	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Incident reporting	Review related Datix	Abi Hill – Lead Transport Nurse abi.hill@uhl-tr.nhs.uk	Monthly	CoMET Lead Governance Meeting
Documentation Compliance	Documentation Audit	Abi Hill – Lead Transport Nurse abi.hill@uhl-tr.nhs.uk	3 Monthly	CoMET Lead Governance Meeting

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Anaesthetic Induction and Intubation of Critically Unwell Child

1. Assessment

→ **Haemodynamic instability**
Optimise with fluids and early inotropes (peripheral adrenaline infusion is preferred)

2. Preparation

→ **Difficult airway concerns**
Follow Paediatric DAS Guideline (See Appendix)

→ **Complete Intubation LocSSIP (See Appendix)**

3. Selection of drugs

→ **a. Induction agent**

Ketamine only induction (for all patients), dose 1-2 milligram/kg
Or
Fentanyl only induction in neonates, dose 2-5microgm/kg
Or
Co-induction in cardiac patients and/or severe haemodynamic compromise e.g. severe sepsis
Fentanyl 1-2 microgram/kg and **Ketamine** 1-2 milligram/kg

→ **b. Neuromuscular blockade**

Rocuronium 1milligram/kg

Intubate

→ **Management of unanticipated difficult airway (See Appendix)**

4. Ongoing sedation

→ **Morphine**
10 – 40 micrograms/kg/hr
+/-
Midazolam
50 – 250 microgram/kg/hr
(Discuss with CoMET consultant for midazolam use <1 year)
NB: Bolus 50microgm/kg before starting morphine +/- midazolam infusion.

NB:
Propofol is best used in elective situations. Not recommended in unwell children as unpredictable and profound cardiovascular compromise could occur.

A critically unwell child requires,
Early review by senior clinician (local paediatric and/or ED consultant)
Early review by anaesthetic team – local anaesthetic consultant should be involved in discussions
Discussion with CoMET consultant for advice as needed

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A Practical Approach to Intubation of Critically Unwell Children (including unanticipated difficult airway)

If unable to ventilate or oxygenate at any time, move to next plan. Please ensure senior help is sought early on. Call for specialist anaesthetic +/- ENT assistance early on.

Plan A

Patient appropriately positioned (shoulder roll <2yr / neutral head position >2yr)
Pre-oxygenate - PEEP +/- OPA
Apnoeic oxygenation in sick children
Administer induction agent + NMB
BVM ventilation
Direct / Video laryngoscopy

ETT passed →

Confirm ET intubation with continuous EtCO2 trace / colorimetric capnography (NB - if in doubt, consider taking ETT out and repeat steps)
Confirm chest rise / auscultation
Cuff pressure, keep <20mm H2O via manometer
Secure ETT (Modified Melbourne strapping)
Connect to pre-set ventilator adjust ventilation as needed subsequently using clinical and blood gas parameters
Ongoing sedation and analgesia +/- paralysis
Post intubation CXR / blood gas

↓ **Difficult view / failed intubation**

Revise intubation plan based on findings from first attempt
Call for senior help, if not done already
Reposition patient, as needed
Check whether induction / paralysis adequate
Consider different blade / video laryngoscope if not used already / stylet / bougie, as appropriate
Maximum 2 attempts at laryngoscopy by non-airway trained physicians (including the first one)
Change operator (airway trained physicians) —>> Repeat steps - maximum attempts at laryngoscopy 3+1

↓ **Falling SpO2 / difficult view / failed intubation**

Plan B

Oxygenate and ventilate - two person bag and mask technique / OPA
Aspirate NG tube to relieve gastric distension
Introduce SAD (e.g. LMA, iGel, intubating LMA)

Oxygenation / Ventilation achieved →

Consider waking up the patient, if clinically safe
Consider keeping LMA / iGel in situ
D/W consultants - Anaesthetics / ENT
D/W CoMET consultant
Consider intubating via SAD (intubating LMA), if available
Consider fibre optic, if available
Following multiple intubation attempts, consider airway trauma

↓ **Falling SpO2 / difficult view / failed intubation**

Plan C

If ENT not available, perform percutaneous cricothyrodotomy +/- front of neck access

If ENT available, perform rigid bronchoscopy +/- surgical tracheostomy

NB: All these procedures could have serious complications and require training, should only be considered in life threatening situations.

Discuss with CoMET Consultant

For all practical purposes, paediatric emergency intubation should be considered as a modified rapid sequence induction.

The important steps in the induction and intubation process are:

Assessment:

Two important aspects to consider: difficult airway and haemodynamic instability.

If the child is in a DGH, it is important that the local anaesthetic team review is sought early and not at the time of extremis and decompensation. This will provide the anaesthetic team enough time for preparation and an opportunity to discuss with CoMET consultants if needed.

Similarly, in case a difficult airway is anticipated, the consultant anaesthetist should be involved and consider moving the child to theatres or another suitable area with appropriate equipment and staffing. Approach all intubations with caution as it is often not possible to exclude difficulty by examination. Local guidance may be in place and should be followed accordingly.

Some pointers towards difficult airway in children: History of previous difficult intubation, large tongue/tonsils/tumour, restricted jaw/neck movement, prominent upper teeth, small receding chin, syndrome / diagnosis associated with difficult airway e.g. Pierre Robin syndrome, Hurler's syndrome. Consider involving the ENT team early if difficulty is anticipated.

If a difficult airway is encountered guidelines from the Difficult Airway Society (DAS) - Paediatric Difficult Airway Guidelines (See Appendix) should be followed. These guidelines could also be downloaded from:
https://database.das.uk.com/guidelines/paediatric-difficult-airway-guidelines

A practical approach to the intubation process in children who are critically unwell is attached. This also includes unanticipated difficult airway.

Acutely unwell children often have cardiovascular instability that deteriorates at induction of anaesthesia. This should be minimized by using appropriate anaesthetic agents at the minimum effective dose and a plan made for fluid and inotrope support if required. Peripheral adrenaline infusion before induction and intubation is suggested in children without central venous access (e.g. portacth, tunnelled Hickman/Broviac lines); however, in exceptional circumstances, push dose adrenaline could be used too.

Please refer to UHL Intubation LocSSIP prior to proceeding to intubation – attached as appendix.

Preparation:

Preparation is the key to a successful intubation. Administering a general anaesthetic should be a two doctor/ACP (advanced clinical practitioner) procedure. Especially for CoMET, referring hospital is an unfamiliar environment and involving a local anaesthetist is very important.

Selection of drugs (induction agent and neuromuscular blockade/muscle paralysis):

Induction agent:

For single agent induction, Ketamine is the agent of choice across all age groups, dose 1-2 milligram/kg.

Fentanyl may be used as co-induction agent in children with

- congenital or acquired cardiac pathologies (e.g. single ventricle physiology, myocarditis, cardiomyopathy etc) and/or
- children with haemodynamic instability, e.g. severe sepsis

The co-induction dose is 1-2microgram/kg.

In some unstable neonates, **fentanyl could also be used as single agent for opiate only technique**, dose is 2-5microgram/kg.

It is advised for sequential increments in doses rather than a larger dose at the start as it is often unpredictable how an unwell child would respond.

There is enough evidence for use of ketamine (1-2milligram/kg) as a safe induction agent in cases of raised ICP e.g. prolonged status epilepticus, meningitis/meningoencephalitis, traumatic brain injury or space occupying lesion. Multiple studies have demonstrated that ketamine does not cause any significant rise in intracranial pressure.

Propofol may be used for induction but should be avoided in critically unwell children with haemodynamic compromise as they can lead to vasodilatation and subsequent profound hypotension, further potentiating haemodynamic compromise; best used for well children coming to the theatres for elective procedures. Dose ranges from 1-4milligram/kg and are titrated to effect.

Thiopentone (2-5milligram/kg) may be used in children with status epilepticus however Ketamine has largely replaced this. Thiopentone can precipitate cardiovascular instability. Consideration should be given to the patient's haemodynamic status as prolonged status is well known to cause multi organ dysfunction and haemodynamic compromise.

Please discuss with CoMET consultant re choice of preferred induction agents as needed.

Neuromuscular blockade/muscle relaxation:

Rocuronium is the preferred neuromuscular blocker across all age groups irrespective of the underlying cause for intubation. A dose of 1mg/kg provides neuromuscular blockade within 30-45 seconds and duration of action 30-40 mins.

Sugammadex is used for the reversal of neuromuscular blockade of rocuronium, usually available in the theatres. For immediate reversal, e.g., can't intubated/can't ventilate a 16milligram/kg dose should be used. If reversal is needed in the next few minutes, a 2-4milligram/kg/dose is recommended.

Subsequent muscle relaxation can be achieved with Atracurium 0.5-1milligram/kg.

Post intubation management of sedation +/- paralysis:

Morphine +/- midazolam infusions are to be started once intubated. Midazolam may cause/potentiate hypotension in children with haemodynamic instability, and its use should be discussed with a CoMET consultant especially in children <1yr of age.

Need for ongoing paralysis to be discussed with CoMET consultant prior to commencement.

Prolonged propofol infusion is not recommended in children, neither are the volatile gases.

General aspects:

- Every attempt should be made to minimise the number of intubation attempts.
- Routine usage of microcuff ETT is recommended for all paediatric patients.
- Uncuffed ETT is recommended in recent airway surgery/balloon dilatation, suspected subglottic stenosis, slide tracheoplasty patients.
- Consider uncuffed ETT with history of stridor this admission or previous admission after extubation.
- APLS Guidance should be followed for sizing and depth of ETT inserted.
- Length of the ETT (DO NOT PRECUT)
    - Recommended length of the ETT post intubation is at least 3 cm of ETT free length after ETT position is confirmed on CXR, and after strapping is applied.
- Aim to keep cuff pressures less then 20cmH20 on tracheal cuff pressure manometer - recommended upper limit of intracuff pressure is 30cmH2O.
- Strapping of the ETT
    - Modified Melbourne strapping is recommended for securing the ETT - refer to CoMET guideline for securing ETT.
- Post intubation CXR is mandatory for confirmation of endotracheal tube depth - tube tip should be at the level of T2 thoracic vertebra.
- ETT suctioning should be limited to the length of the ETT in situ.
- Continuous ETCO2 monitoring is mandatory
    - During endotracheal intubation and tracheostomy (all areas)
    - Peri-operatively
    - For all ventilated patients during inter-hospital or intra-hospital transfer
- Changing of the ETT strapping
    - A bolus of sedation together with a bolus of muscle relaxant is highly recommended.
    - Cuff should always be deflated prior to re-positioning of ETT

Peripheral Adrenaline:

When central access is not present (e.g. portacath, tunnelled Hickman/Broviac lines), peripheral adrenaline infusion is recommended; however, push dose of adrenaline may be used in an emergency while waiting for the peripheral infusion to be ready.

For central and peripheral adrenaline infusion preparation guide, refer to CoMET's infusion monograph (follow the link)
https://www.eastmidlandscomettransport.nhs.uk/medical-professionals/infusion-monograph

Push dose adrenaline:

Preparation PICU physicians prefer - resuscitation dose of adrenaline (0.1 mL/kg of 1:10,000 solution), dilute up to 10mls with 0.9% sodium chloride, 0.5-1ml of this preparation is administered every 2-5mins titrated to target BP (much easier to prepare, personalised to the patient's weight).

Alternative Preparation: 1 ml of solution from cardiac adrenaline ampule (1:10,000 strength), diluted to 10 ml with 0.9% sodium chloride, 0.5-1 ml of this preparation is administered every 2-5mins titrated to target BP.

Please discuss with CoMET consultant if there is need for further advice / discussion.

Reference:

1. Paediatric difficult airway guidelines. Difficult Airway Society. **https://das.uk.com/guidelines/paediatric-difficult-airway-guidelines**
2. Weingart S. Push-dose pressors for immediate blood pressure control. Clin Exp Emerg Med. 2015 Jun 30;2(2):131-132. doi: 10.15441/ceem.15.010. PMID: 27752585; PMCID: PMC5052865
3. Intubation and Bronchoscopy(s) Children's Critical Care Standard Operating Procedure UHL Paediatric Intensive Care Unit (PICU)(LocSSIPs) https://secure.library.leicestershospitals.nhs.uk/PAGL/Shared%20Documents/Intubation%20and%20Bronchoscopy(s)%20Standard%20Operating%20Procedure%20UHL%20Paediatric%20Intensive%20Care%20LocSSIP.pdf
4. Endotracheal Tube Management UHL Childrens Intensive Care Guideline C116/2016

   https://secure.library.leicestershospitals.nhs.uk/PAGL/Shared%20Documents/Endotracheal%20Tube%20Management%20UHL%20Childrens%20Intensive%20Care%20Guideline.pdf

Document Amendment Record:

Version	Issue Date	Author(s)	Description
1	February 2024	Bedangshu Saikia Chris Cairns David Marriott	Original document

Appendix 1a: Intubation LocSSIP (Local Safety Standards for Invasive Procedures)

PATIENT STICKER

Invasive Procedure Safety Checklist: PICU Intubation

Leicester Children's Hospital — East Midlands Congenital Heart Centre

Procedure date:	Operator:	Level of Supervision:	SpR/ANP:	Consultant:
Time:	Observer:			
Known Allergies:	Assistant:			

1. BEFORE THE PROCEDURE

PREPARATION		
Have all members of the team introduced themselves?	YES ☐	NO ☐
Is patient position optimised?	YES ☐	NO ☐
Has the appropriate sized mask been selected?	YES ☐	NO ☐
Has the appropriate sized bagging circuit been selected and made ready for use?	YES ☐	NO ☐
Has cricoid pressure been considered?	YES ☐	NO ☐
Has the feed been stopped and NG aspirated?	YES ☐	NO ☐
Preoxygenate on maximum individualised level of oxygen for 3 minutes?	YES ☐	NO ☐
EQUIPMENT & DRUGS		
Is monitoring attached? (ECG, Spo2 plus pulse alarm on, BP on regular cycling, EtCO2)	YES ☐	NO ☐
Is suction ready?	YES ☐	NO ☐
Are working laryngoscopes +/- video laryngoscope ready for use with appropriate sized blade?	YES ☐	NO ☐
Are endotracheal tubes ready?	YES ☐	NO ☐
Are oropharyngeal airways, bougies and iGels available?	YES ☐	NO ☐
Difficult airway anticipated? If yes follow SOP for managing difficult paediatric airway on PICU	YES ☐	NO ☐
Is adequate venous access in place?	YES ☐	NO ☐
Are intubation and resuscitation drugs available?	YES ☐	NO ☐
PPE precautions required?	YES ☐	NO ☐
TEAM		
Is Consultant aware of intubation?	YES ☐	NO ☐
Is the Consultant required to be present?	YES ☐	NO ☐
Is role allocation clear? (Intubator, Assistant, Drugs, Cricoid, MILS)	YES ☐	NO ☐

2. TIME OUT

Verbal confirmation between team members before start of Procedure

Difficult airway plans discussed?	YES ☐	NO ☐
Is senior help needed?	YES ☐	NO ☐
Is role allocation clear? (intubator, drugs, assistant, cricoid, MILS)	YES ☐	NO ☐
Any concerns about procedure?	YES ☐	NO ☐

If you had any concerns about the procedure, how were these mitigated?

3. SIGN OUT

Endotracheal position confirmed (EtCO2 trace)?	YES ☐	NO ☐
Tube depth checked (B/L Air entry)?	YES ☐	NO ☐
ETT secured and cuff pressure checked?	YES ☐	NO ☐
Previous respiratory support removed?	YES ☐	NO ☐
Appropriate ventilator settings confirmed?	YES ☐	NO ☐
Analgesia and sedation started?	YES ☐	NO ☐
ICP optimisation required?	YES ☐	NO ☐
Chest X-Ray performed?	YES ☐	NO ☐
Hand over to nursing staff?	YES ☐	NO ☐
Procedure Documentation (overleaf) completed?	YES ☐	NO ☐

Signature of responsible clinician completing the form:

PICU Intubation 03/20

Appendix 1b: Intubation LocSSIP (Local Safety Standards for Invasive Procedures)

PATIENT STICKER

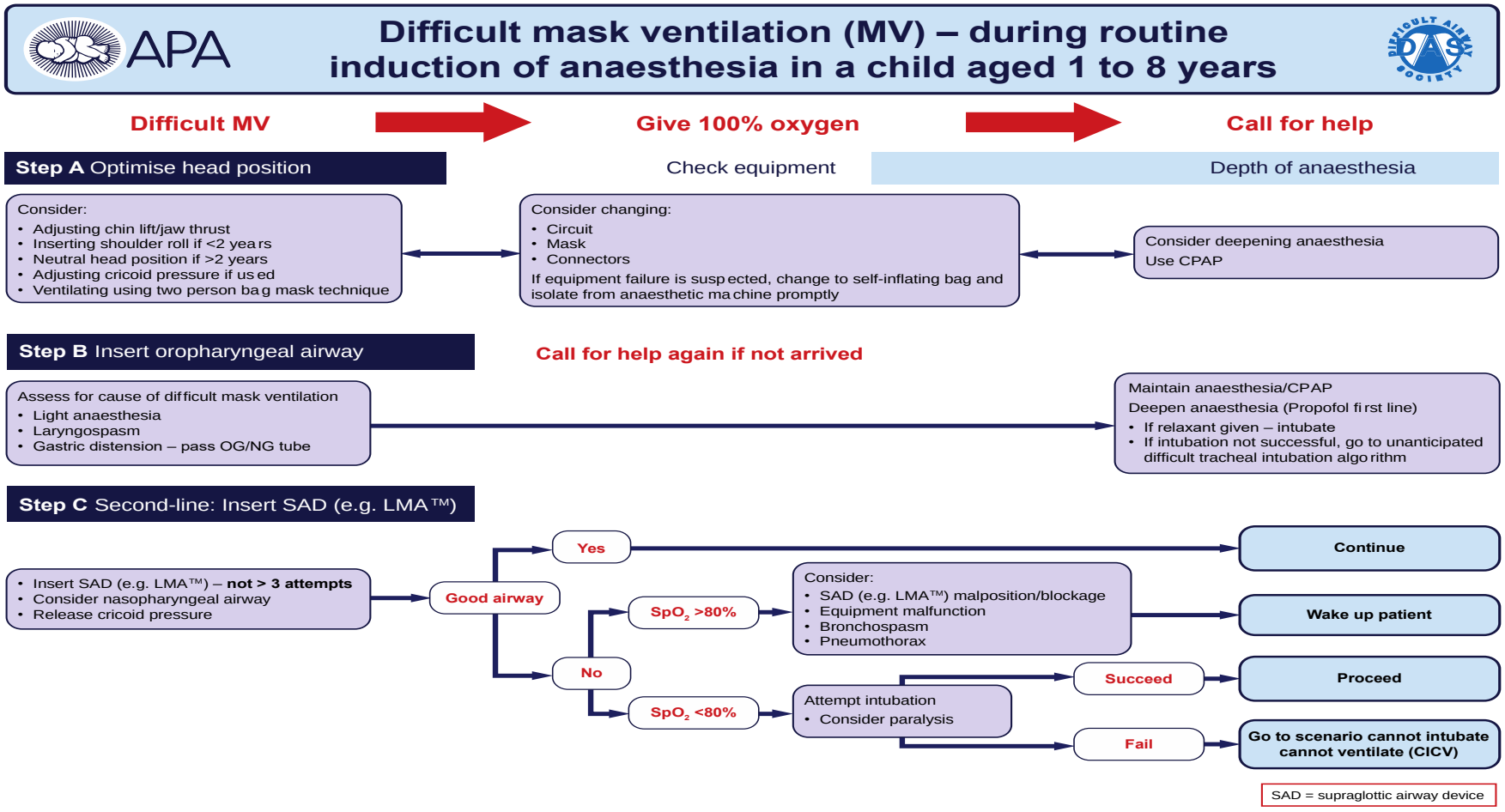
Leicester Children's Hospital
East Midlands Congenital Heart Centre

Procedure Documentation

Number of attempts		
ETT	ORAL ☐	NASAL ☐
Size ETT		
Length fixed at lips/nose		
Adjuncts used-Type?		
Laryngoscopy grade		
Laryngoscope used		
Video Laryngoscope used? Type? Blade size		
Video Laryngoscope decontaminated using the Tristel triple wipe system		YES ☐
Number of attempts	YES ☐	NO ☐
McGrath audit form completed?	YES ☐	NO ☐

PICU Intubation 03/20

Appendix 2: Difficult Mask Ventilation (Paediatric Difficult Airway Guidelines)



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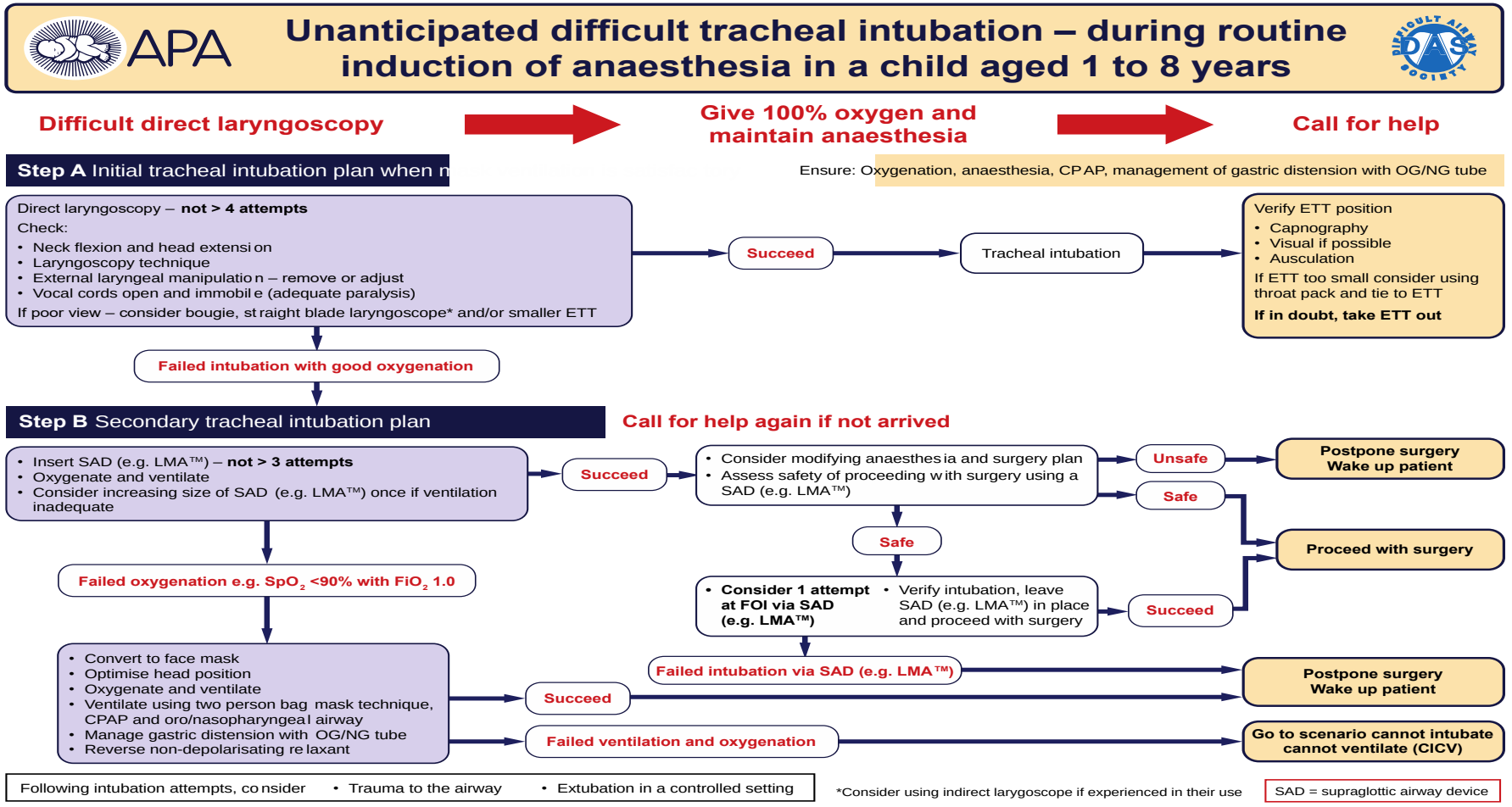
Appendix 3: Unanticipated Difficult Tracheal Intubation (Paediatric Difficult Airway Guidelines)



Appendix 4: Cannot Intubate and Cannot Ventilate (Paediatric Difficult Airway Guidelines)