

Consensus guidelines for managing the airway in children with COVID-19; Highlighting differences in practice from adult guidelines

Guidelines from the Association of Anaesthetists, the Difficult Airway Society, the Intensive Care Society, the Faculty of Intensive Care Medicine and the Royal College of Anaesthetists, Paediatric Intensive Care Society, Association of Paediatric Anaesthetists

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Summary

Airway management of patients with COVID-19 is high risk to staff and patients. Guidance has been published directed at adult practice. The vast majority of this guidance is also applicable to paediatric patients. This consensus statement provides advice for anaesthetists who undertake airway management in paediatric patients suspected or confirmed to have COVID-19 and seeks to provide clarity where that guidance differs for paediatric patients. It is not directly relevant to neonatal practice in neonatal ICUs (NICUs). This document does not stand alone as advice but should be read with the adult advice [1] at <https://icmanaesthesiacovid-19.org/covid-19-airway-management-principles>

It is important to recognise that globally there have been very few children admitted to critical care units with COVID-19. This has several implications: firstly, there is less published literature relating to paediatric practice, and guidance is therefore inevitably extrapolated from adult practice; secondly, the likelihood if one is called to intubate a child who meets the case definition for COVID-19 is that the patient will prove to be COVID-19 negative. However, we urge that this should not in any way detract from the necessity for strict adherence to appropriate use of personal protective equipment (PPE) and infection control procedures outlined in this guidance and elsewhere [2].

Due to the necessary speed in which this guidance has been drawn up in, it is likely incomplete but it aims to provide an overview of principles. It does not aim to propose or promote individual devices. The advice is designed to be adapted in line with local workplace policies. This document does not discuss when to intubate patients, the ethics of complex decision-making around escalation of care or indemnity for staff necessarily working outside their normal areas of expertise. Where the guidance in children is the same as for adults the adult consensus documents are signposted.

COVID-19: the need for airway interventions and risks to airway managers – see [1]

Staff safety – see [1]

Aerosol-generating procedures – see [1]

High-flow nasal oxygen (HFNO) in paediatric practice

This is discussed in general terms in the adult document [1]. HFNO should be treated as an aerosol generating procedure (AGP) and airborne PPE precautions are recommended, but it is likely to be at the lower end of the risk scale in terms of AGPs. HFNO is widely used in paediatric practice and as most children who need it are likely not to have COVID-19, and its removal may precipitate the need for intubation, our advice is not to change current practice.

We do not recommend HFNO is started solely for preoxygenation before tracheal intubation. If a child is already receiving HFNO it is acceptable practice to leave it on during preoxygenation and intubation but if it is safe to remove it and preoxygenate with other methods this is also acceptable practice.

Low flow nasal oxygen (<5 L/min) is unlikely to be aerosol generating. It may be used during intubation to reduce the likelihood and severity of hypoxaemia.

Systems to prevent contamination of healthcare workers, including PPE – see [1, 2].

Engagement of parents

There are several considerations in relation to having parents present during the intubation process: the availability of appropriate PPE, the protection of staff from transmission of infection either from the child or the parents, and the needs of the child. The PPE that is suitable before intubation is that which protects against droplet and contact transmission. Airway management involves aerosol generating procedures (AGPs) and the level of PPE required rises to 'airborne protection' for all those in the room, which includes a fit-tested FFP3 mask.

A pragmatic approach is recommended. If parents are with the child and already wearing appropriate (droplet and contact level) PPE they can be allowed to stay until induction drugs are injected. However, before any further airway management is undertaken parents should be taken from the room into a separate room for decontamination.

Tracheal intubation of the critically ill – see [1]

Note - This is a high-risk procedure: around 16% of children intubated in a paediatric ICU setting develop adverse events, 6.6% are severe (cardiac arrest, oesophageal intubation with delayed recognition, witnessed

aspiration, hypotension requiring intervention, laryngospasm, malignant hyperthermia, air-leak or airway injury) [3]. When intubating the critically ill child in a district general hospital setting, the risk of severe adverse events may be even higher (13.8%), with cardiac arrest occurring in nearly 2% of cases [4].

Delivering care in non-standard environments and by or with staff less trained in critical care – see [1]

Note that during the epidemic children may need to be cared for in locations that differ from normal practice. This includes children who might otherwise have been transferred to tertiary centres being treated in the secondary care setting and care of older children in adult ICUs or smaller babies in NICUs. These alterations should be avoided where possible and early discussion with a tertiary centre is strongly advised to seek the best solution for each child.

Monitoring should adhere to Association of Anaesthetists standards and in particular, continuous waveform capnography should be used for every tracheal intubation and in all patients dependent on mechanical ventilation unless this is impossible. Note that even in cardiac arrest during lung ventilation, there will be a capnograph trace – a flat trace indicates oesophageal intubation and should be managed as such, until proven otherwise ('no trace- wrong place') [1, 5].

During the escalation there may be necessity for staff who do not usually manage children to manage their care. Due to the high-risk nature of paediatric airway management in the critically ill, except where this is impossible the service should be provided by staff who routinely work with children and have the appropriate, current skills and experience. At its extreme peak, care may also be delivered by retired staff and medical students. Because of the high consequence nature of airway management in these patients, both for the patient and staff, it is recommended that these staff do not routinely take part in airway management of children with COVID-19.

The most appropriate airway manager – see [1]

Staff who should avoid involvement in airway management – see [1]

Simulation – see [1]

Single vs. reusable equipment – see [1]

When to intubate the critically ill COVID-19 patient – see [1]

Fundamentals of airway management for a patient with suspected or confirmed COVID-19 and the process of tracheal intubation – see [1] (Figure 1 and 2)

Note

- As the MACOCHA score advocated for use in adults is not validated in children its use is not recommended.
- Weigh the patient. Where this is impractical carefully estimate their weight.
- Prepare drugs based on known or estimated weight. Use a calculator where necessary.

- Prepared drugs may include atropine in smaller infants to aid management of hypoxia induced bradycardia,
- Cognitive aids are advised to aid in checking drug doses and equipment sizes. All regions have their own and are encouraged to use them.
- During preparation it is particularly important in children that the right size equipment is used. Select equipment that maximises the chances of first-time airway management success.
- In the critically ill child, early recourse to intraosseous access is suitable when intravenous access is difficult or fails.
- An Ayres' T-piece breathing circuit with HME filter attached is an alternative to other circuits for preoxygenation in children weighing < 20 kg, but only for those experienced with its use.
- Use of a cuffed tracheal tube is to avoid airway leak and to reduce the need for re-intubations. Use a microcuff tracheal tube for patients aged under 6 years and a standard cuffed tracheal tube for patients over 6 years. Use of an intubation stylet is recommended.
- Intubate orally with a tracheal tube of an appropriate size to the age of the child:

Size of microcuff ETT	Recommended age
3.0 mm	Term > 3 kg and up to <8 months
3.5 mm	8 months to <2 years
4.0 mm	2 to < 4 years
4.5 mm	4 to < 6 years

- Sizing standard cuffed ETT = $\text{age}/4 + 3.5$
- At tracheal intubation during videolaryngoscopy, place the tracheal tube, without losing sight of it on the screen, and pass it to the anticipated length for the age of the child.
- Inflate the tracheal tube cuff to 20 cmH₂O initially, immediately after tracheal intubation and before connection to the ventilator. This pressure may need to be increased if there is a leak or high airway pressures are required.
- Use an in-line suction catheter that is of an appropriate size for the tracheal tube used.
- When a supraglottic airway (SGA) is used in children second generation devices are less readily available and may not be available for the smallest children. A first generation SGA may be substituted in this circumstance. Staff should use an SGA they are familiar with.

Unexpected difficulty and predicted difficult airway– see [1]

Note, the principles are applicable to children, but the specific equipment and techniques used may differ according to the patient size, equipment availability and experience with its use. Practitioners can adhere to the Vortex approach when unexpected difficulty is encountered (Figure 3). The Association of Paediatric Anaesthetists and the Difficult Airways Society have published an algorithm for the 'Cannot intubate cannot

ventilate' (Cannot intubate cannot oxygenate) situation' [8] (Figure 4). Above the age of 8 years the adult algorithm may be used.

Airway management after tracheal intubation and trouble shooting – see [1]

Note: children may be more prone to accidental airway displacement and blockage than in adult practice. Great care should be taken to ensure the tracheal tube is secured and that it remains patent. Monitoring that the airway remains in the trachea and is patent is best achieved by continuous waveform capnography.

Risk of blockage of a heat and moisture exchange filters – see [1]

Tracheal extubation – see [1]

Note: minor complications at extubation are more frequent in children compared to adults, and particularly in those under 10 kg. Local protocols are suitable, but anaesthesia care should be planned and conducted meticulously to avoid emergence laryngospasm, coughing and the need for reintubation.

Tracheal tube exchange

Routine exchange of oral tracheal tube for nasal tracheal tube in a child with COVID-19 is not recommended.

Airway management during cardiac arrest – see [1]

Airway management for anaesthesia – see [1]

Conclusions

The management of children with known or suspected COVID-19 requires specific consideration to safety for staff and patients. As in adults, accuracy is critical, and clinicians should avoid unreliable, unfamiliar or repeated techniques during airway management, thus enabling it to be safe, accurate and swift. The basic principles of airway management of children for anaesthesia and critical care are not changed by the presence of COVID-19 but require careful adaptation and application to maintain patient and staff safety.

Refs

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EMERGENCY TRACHEAL INTUBATION OF THE CHILD WITH COVID-19

- Tracheal intubation of the patient with COVID-19 is a high-risk procedure for staff, irrespective of the clinical severity of disease. In severe COVID-19 it is also a high-risk procedure for the child.
- Children are much less likely to have COVID-19 than adults. However, guidance recommends airborne level PPE precautions for all practitioners called to intubate a child who meets the clinical case definition for COVID-19.
- Limit staff present at tracheal intubation: one intubator; one assistant; and one to administer drugs and monitor the patient. A runner should be outside the room.
- Weigh the child or estimate weight carefully.
- Parents, if in suitable PPE, may stay until induction drugs are administered but should leave before airway management, as this is an aerosol generating procedure (AGP) requiring 'airborne' PPE precautions.
- Wear full personal protective equipment (PPE) at all times. Consider double gloving. Defog goggles and/or eye wear if possible. Touch as little as possible in the room to avoid fomites.
- Intubate in a negative pressure room with > 12 air changes per hour whenever possible.
- Know and communicate the plan before entering the room; use a checklist to achieve this.
- Take the algorithm or cognitive aid you plan to use into the room or display it there.
- Prepare and check weight/size appropriate equipment and drugs outside the room. Use a kit dump mat.
- Plan how to communicate before entering the room.
- The best skilled airway manager present should manage the airway to maximise the first pass success.
- Be safe, accurate and swift. Aim to succeed at the first attempt because multiple attempts increase risk to sick patients and staff. Do not rush but make each attempt the best it can be.
- Use reliable techniques that work, including when difficulty is encountered. The chosen technique may differ according to local practices and equipment. With prior training and availability this is likely to include:
 - Pre-oxygenation for 3–5 minutes with a well-fitting mask. Use a circuit that is age appropriate and with which you are familiar: eg Mapleson C ('Waters') with HME or Ayres' T piece with HME in children <20 kg.
 - Videolaryngoscopy for tracheal intubation;
 - Consider 2-person, 2-handed mask ventilation with a VE-grip to improve seal;
 - A second generation supraglottic airway device for airway rescue where available, also to improve seal.
- Place an HME filter between the catheter mount and the circuit at all times. Keep it dry to avoid blocking.
- Avoid AGPs such as non-invasive ventilation, bronchoscopy and tracheal suction without an in-line suction system in place. Do not start HFNO just for preoxygenation. Low flow (<5 L/min) nasal oxygen may be used.
- Use full monitoring: including continuous waveform capnography including after tracheal intubation.
- Use RSI / cricoid force if you normally would and a trained assistant can apply it. Take it off if it causes difficulty.
- To avoid cardiovascular collapse, consider induction with ketamine 1–2 mg.kg⁻¹
- Paralyse with rocuronium 1.2 mg.kg⁻¹. Ensure full neuromuscular blockade before attempting tracheal intubation
- Have a vasopressor for bolus or infusion immediately available for managing hypotension.
- Do not face mask ventilate unless needed, and use a 2-person, low flow, low pressure technique if required.
- Once neuromuscular blockade ensured, intubate with an appropriately sized cuffed tracheal tube.
- Pass the tracheal tube to a predetermined appropriate length and inflate the tracheal tube cuff to seal the airway before starting ventilation. Note and record depth.
- Auscultation is difficult wearing PPE: confirm tracheal intubation with continuous waveform capnography – which is present even during cardiac arrest.
- Consider passing a nasogastric tube to aid gastric decompression which may make lung ventilation more difficult.
- Avoid circuit disconnection - push twist all connections. Clamp the tube during disconnections.
- Use a standard failed tracheal intubation algorithm with a cognitive aid if difficulty arises.
- Communicate clearly: simple instructions; closed-loop communication; adequate volume without shouting.
- If COVID-19 status not already confirmed take a deep tracheal aspirate for virology using closed suction.
- Discard disposable equipment safely after use. Decontaminate reusable equipment fully and according to manufacturer's instructions. After leaving the room ensure doffing of PPE is meticulous. Clean the room 20 minutes after tracheal intubation (or last AGP).
- A visual record of ease of tracheal intubation should be prominently visible in the patient's room. If airway difficulty occurs the subsequent plan should be displayed in the room and communicated between shifts.

Figure 2 Checklist

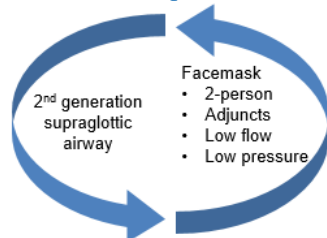
Personal Protective Equipment	Prepare Equipment	Prepare for Difficulty	In the Room	Post-procedure and Safety
OUTSIDE ROOM			INSIDE ROOM	AFTER AND LEAVING
<p>PPE – be thorough, don't rush</p> <ul style="list-style-type: none"> <input type="checkbox"/> Wash hands <input type="checkbox"/> Buddy with checklist <input type="checkbox"/> Put on PPE <ul style="list-style-type: none"> <input type="checkbox"/> Long sleeved gown <input type="checkbox"/> FFP3 (or equivalent) mask <input type="checkbox"/> Gloves <input type="checkbox"/> Eyewear <input type="checkbox"/> Headwear and wipeable shoes as per local protocol <input type="checkbox"/> Final buddy check <input type="checkbox"/> Names on visors <p><input type="checkbox"/> Allocate roles:</p> <ul style="list-style-type: none"> A: Team leader and intubator B: Cricoid force and intubator's assistant C: Drugs, monitor, timer D: Runner (outside) <p>Decide who will do eFONA</p> <p><input type="checkbox"/> How does runner contact further help if required?</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Weight – drugs and equipment appropriate to child size <input type="checkbox"/> Check kit (kit dump) <ul style="list-style-type: none"> <input type="checkbox"/> Mapleson C (or Ayres' T piece) with HME attached (preferred to BVM) <input type="checkbox"/> Catheter mount <input type="checkbox"/> Guedel airways <input type="checkbox"/> Working suction <input type="checkbox"/> Videolaryngoscope (if trained) <input type="checkbox"/> Bougie/stylet <input type="checkbox"/> Tracheal tubes x2 <input type="checkbox"/> Tapes and syringe <input type="checkbox"/> In-line suction ready <input type="checkbox"/> Tube clamp <input type="checkbox"/> 2nd generation SGA <input type="checkbox"/> eFONA set available <input type="checkbox"/> Do you have all the drugs required? <ul style="list-style-type: none"> <input type="checkbox"/> Ketamine (or other) <input type="checkbox"/> Muscle relaxant (Rocuronium/Other) <input type="checkbox"/> Fluid/Vasopressor/inotrope <input type="checkbox"/> Maintenance sedation <input type="checkbox"/> Allergies? 	<ul style="list-style-type: none"> <input type="checkbox"/> If the airway is difficult, could we wake the patient up? <input type="checkbox"/> VERBALISE the plan for a difficult intubation? <ul style="list-style-type: none"> Plan A: RSI Plan B/C: 2-handed 2-person mask ventilation & 2nd generation SGA <div style="text-align: center;">  <p>Facemask</p> <ul style="list-style-type: none"> • 2-person • Adjuncts • Low flow • Low pressure </div> <p>Plan D: Front of neck airway: scalpel bougie tube</p> <ul style="list-style-type: none"> <input type="checkbox"/> Confirm agreed plan <input type="checkbox"/> Does anyone have any concerns? 	<ul style="list-style-type: none"> <input type="checkbox"/> Airway assessment <ul style="list-style-type: none"> <input type="checkbox"/> Identify cricothyroid membrane <input type="checkbox"/> Apply monitors <ul style="list-style-type: none"> <input type="checkbox"/> Waveform capnography <input type="checkbox"/> SpO₂ <input type="checkbox"/> ECG <input type="checkbox"/> Blood pressure <input type="checkbox"/> Checked i.v or i.o. access (x2) <input type="checkbox"/> Optimise position <ul style="list-style-type: none"> <input type="checkbox"/> Firm mattress <input type="checkbox"/> Optimal pre-oxygenation <ul style="list-style-type: none"> <input type="checkbox"/> 3-5 min, use low flow oxygen (do not start NIV or HFNO) <input type="checkbox"/> Optimise patient condition before tracheal intubation <ul style="list-style-type: none"> <input type="checkbox"/> Fluid/vasopressor/inotrope <input type="checkbox"/> Delayed sequence induction? <input type="checkbox"/> Now proceed 	<ul style="list-style-type: none"> <input type="checkbox"/> Airway management <ul style="list-style-type: none"> <input type="checkbox"/> Inflate cuff before any ventilation <input type="checkbox"/> Check waveform capnography <input type="checkbox"/> Push/twist connections <input type="checkbox"/> Clamp tracheal tube before any disconnection <input type="checkbox"/> Avoid unnecessary disconnections <input type="checkbox"/> Consider orogastric tube to decompress stomach <input type="checkbox"/> Other <ul style="list-style-type: none"> <input type="checkbox"/> Insert nasogastric tube <input type="checkbox"/> Consider deep tracheal viral sample <input type="checkbox"/> Careful equipment disposal <input type="checkbox"/> Decontamination of reusable equipment <input type="checkbox"/> Complete and display intubation form <input type="checkbox"/> Remove PPE <ul style="list-style-type: none"> <input type="checkbox"/> Observed by buddy <input type="checkbox"/> Use checklist <input type="checkbox"/> Meticulous disposal <input type="checkbox"/> Wash hands <input type="checkbox"/> Clean room after 20 minutes

Figure 3 Vortex approach. Reproduced with permission of Dr N Chrimes.

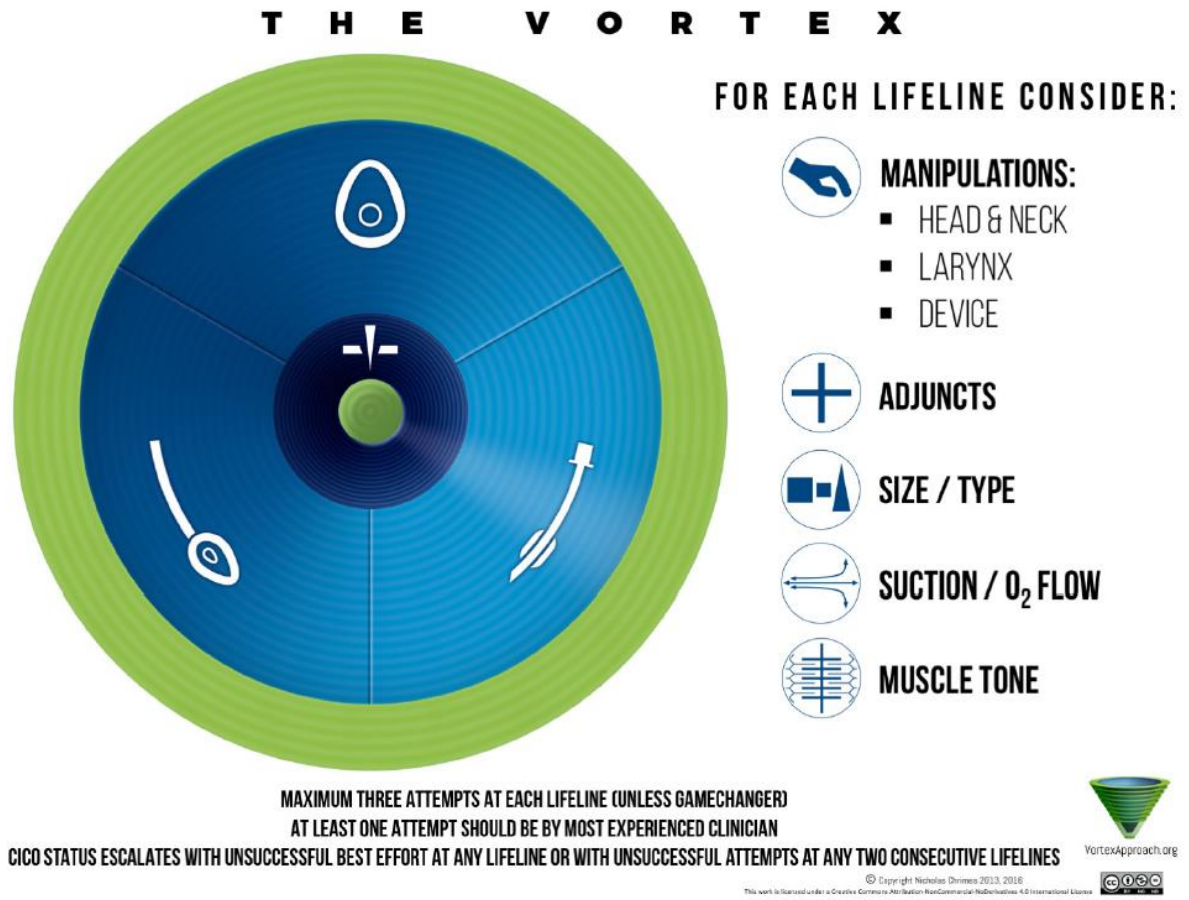


Figure 4 Association of Anaesthetists and Difficult Airway Society algorithm for management of the Cannot Intubate Cannot Ventilate (Cannot intubate Cannot Oxygenate) situation. Reproduced with permission of Difficult Airway Society

