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# Pediatric Airway Management in COVID-19 patients – Consensus Guidelines from the Society for Pediatric Anesthesia's Pediatric Difficult Intubation Collaborative and the Canadian Pediatric Anesthesia Society

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**Abstract**

The severe acute respiratory syndrome coronavirus 2 (COVID-19) pandemic has challenged medical systems and clinicians globally to unforeseen levels. COVID-19's rapid spread has forced clinicians to care for patients with a highly contagious disease without evidence-based guidelines. Using a virtual modified nominal group technique, the Pediatric Difficult Intubation Collaborative (PeDI-C), which currently includes 35 hospitals from six countries, generated consensus guidelines on airway management in pediatric anesthesia based on expert opinion and early data about the disease. The PeDI-C identified overarching goals during care, including minimizing aerosolized respiratory secretions, minimizing the number of clinicians in contact with a patient, and recognizing that undiagnosed asymptomatic patients may shed the virus and infect healthcare workers. Recommendations include administering anxiolytic medications, intravenous anesthetic inductions, tracheal intubation using video laryngoscopes and cuffed tracheal tubes, use of in-line suction catheters, and modifying workflow to recover patients from anesthesia in the operating room. Importantly, the PeDI-C recommends that anesthesiologists consider using appropriate personal protective equipment when performing aerosol-generating medical procedures in asymptomatic children, in addition to known or suspected children with COVID-19. Airway procedures should be done in negative pressure rooms when available. Adequate time should be allowed for operating room cleaning and air filtration between surgical cases. Research using rigorous study designs is urgently needed to inform safe practices during the COVID-19 pandemic. Until further information is available, the PeDI-C advises that clinicians consider these guidelines to enhance the safety of health care workers during airway management when performing aerosol-generating medical procedures. These guidelines have been endorsed by the Society for Pediatric Anesthesia and the Canadian Pediatric Anesthesia Society.

**Keywords:** 2019 novel coronavirus infection, COVID-19, pediatric anesthesia, airway, sarscov2, aerosol generating medical procedures

**Glossary of Terms**

N95 = N95 mask (respirator)

AGMP = Aerosol generating medical procedure

COVID-19 = Coronavirus disease

HCW = Health care worker

PAPR = powered, air-purifying respirator

PeDI-C = the Pediatric Difficult Intubation Collaborative

SARS-CoV2 = severe acute respiratory syndrome coronavirus 2

**Abbreviated title:** COVID-19 pandemic and pediatric anesthesia

## Introduction

Coronavirus disease 2019 (COVID-19), a pandemic infection caused by a positive-sense RNA virus named the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has strained health care systems, ignited fear, and dramatically changed the daily lives of people around the world. Clinicians must care for patients with a highly communicable disease while protecting themselves from a potentially lethal disease. Anesthesiologists are at a particularly high risk of being exposed to SARS-CoV-2 because airway management, particularly tracheal intubation, positive pressure ventilation through a mask, and management of tracheostomy tubes, causes widespread aerosolization of virus (Table 1).[1,2] Though the virus appears to have its most damaging clinical effects in adult patients, infection does occur in children.[3-6] Indeed, in the Chinese experience, asymptomatic transmission of the virus from children to health care workers (HCW) emerged as a significant risk.[4,5] How to manage the pediatric airway in patients who may or may not be symptomatic is the focus of this report. Further many routine pre-COVID-19 practices, such as mask induction of general anesthesia in anxious, crying, and agitated children or carrying them into the operating room may be less desirable because of the risk of viral exposure to the clinical staff.

Robust, evidence-based research to advise safe airway practices during the COVID-19 pandemic are not yet available. Therefore, we sought to develop consensus guidelines from airway experts in pediatric anesthesiology. The Pediatric Difficult Intubation Collaborative (PeDI-C) [pediregistry.org] is a special interest group of the Society for Pediatric Anesthesia (pedsanesthesia.org). The mission of PeDI-C is to advance the safety of pediatric airway management by facilitating multicenter research, quality improvement, and education. PeDI-C has led several multicenter studies on pediatric airway management.[7-10] The Collaborative currently includes 35 hospitals from six countries and ten additional hospitals that are being

onboarded. The more than 100 PeDI-C members include many internationally recognized experts in pediatric airway management. The PeDI-C hosts biannual in-person meetings and communicates year-round using an online active chat group on WhatsApp™ (https://www.whatsapp.com). Members discuss real-time management of difficult intubation cases and disseminate clinical best practices through the forum. Average messages increased from 4 per day in March 2019 to 77 per day during March 2020. The surge in messaging highlighted the global need for guidance about airway management during this COVID-19 pandemic. To help address this need, the PeDI-C leadership organized a webinar to generate consensus guidelines about airway management during AGMPs in pediatric anesthesia.

**Methodology**

On March 23, 2020, the PeDI-C members on the WhatsApp™ forum hosted a webinar to discuss and identify themes and formulate best practice guidelines for AGMPs during the COVID-19 pandemic based on expert opinion. We used a modified nominal group technique (NGT). The classic NGT technique yields prompt results but requires a face to face meeting.[11] Due to the travel restrictions and requirement for social distancing during the unfolding COVID-19 pandemic, the Collaborative held a virtual NGT. The PeDI-C leadership advertised the virtual meeting on the Collaborative's WhatsApp™ channel. Participation was voluntary and open to all members. We used Zoom™ (https://www.zoom.us), an online video conferencing service for the virtual NGT, allowing members to interact using audio and video. JEF moderated the session. Preplanned topics for discussion included appropriate use of PPE, conduct of anesthesia, and management of at-risk care teams. Forty-four pediatric anesthesiologists and one otolaryngologist from 33 institutions attended the virtual NGT (Supplemental Digital Content 1, Material 1, http://links.lww.com/AA/D84). We analyzed the audio, chat messages, and video recordings to identify themes and compared these themes to notes taken in real-time during the

meeting by three PeDI-C members (JEF, PEC, CTM). We summarized the identified themes and shared them with the PeDI-C membership for review, further input, and refinement (Table 2). Additionally, investigators (CTM) conducted a literature search using Ovid Medline, PubMed, and Google on March 24, and 25th 2020 using the search teams "COVID-19," "SARS-CoV-2," "children," AND "pediatrics." to identify publications relevant to airway management in children with COVID-19.

## Results

### Literature search

We identified thirty articles from the literature search (Supplemental Digital Content 1, Material 2, http://links.lww.com/AA/D84), none of which provided details on airway management during AGMPs.

### Training and context-sensitive simulation

As COVID-19 continues to spread all over the world, many organizations have implemented simulation sessions to train clinicians on basic donning and doffing of PPE. This training is commendable; however, the PeDI-C identified the need for context-specific simulation, i.e., simulation that reflects their specific role in the health care team.[12,13] For example, anesthesia clinicians should design simulation sessions focused on intubating and extubating COVID-19 patients in full appropriate personal protective equipment while minimizing exposure to and spread of the virus in the perioperative environment. Similarly, otolaryngologists would simulate performing an aerosolizing procedure with a clinical team while also minimizing operating room exposure using various barrier techniques and personal protective equipment.

### Protecting Clinicians

The Collaborative agreed that clinicians who are at higher risk of morbidity and mortality from COVID-19 should be protected from clinical exposure.[14] Some suggestions included delegating

these at-risk clinicians to staff telemedicine clinics or contribute to scholarly and administrative tasks while maintaining adequate physical distancing. The Collaborative discussed the importance of PPE for anesthesia clinicians; specifically, there was consensus that airway manipulation, such as endotracheal intubation or extubation, are AGMPs and therefore require maximum protection.[1,15-19] The group also acknowledged that during times of crisis, such as the current pandemic, institutions might have PPE shortages. Several members emphasized that although equipment shortages are essential to consider, the highest priority should be the safety of care teams. Prioritizing the safety of health care workers can maximize the delivery of care for patients during a pandemic. PPE supplies are becoming available from manufacturers, donations, and release from national strategic stockpiles; however, clinicians are impossible to replace if quarantined, severely ill, or, worse yet, dead. The collaborative felt centers should err on the side of overprotection rather than under protection. Almost 10% of HCW in Italy and 14% in Spain have contracted COVID-19 with associated morbidity and mortality.[20] Inadequate PPE, deeper lung penetration of aerosolized viral particles and a high burden of exposure may contribute to these infections. In centers with limited PPE supplies, the collaborative felt teams should be pared down to the minimum necessary, and cases should be consolidated into the fewest possible rooms to conserve PPE.

The PeDI-C recognized that children infected with SARS-CoV-2 could shed virus asymptomatically, even in stool, and infect others.[21-24] A case report of an asymptomatic well infant reported high viral loads for 16 days.[5] Anywhere from 18% to 31% of COVID-19 positive passengers (mostly adults) isolated on the Diamond Cruise ship never developed symptoms. Early periods of SARS-CoV-2 can lead to lower levels of sensitivity on screening tests.[25] Therefore, the PEDI-C recommends appropriate PPE (N95 and Face Shield & PAPR) for AGMPs in all children in areas with high community spread. The Collaborative also recognized

the importance of balancing the need for ideal PPE for AGMPs against the current global shortage of PPE. A PPE coach should be available to ensure correct donning and doffing of PPE. The CDC offers educational videos of proper donning and doffing technique at https://www.cdc.gov/vhf/ebola/hcp/ppe-training/index.html.

**Cognitive Aids**

The Collaborative identified the need for cognitive aids to support clinical care and workflow during the pandemic.[26] PeDI-C encourages the creation and sharing of such cognitive aids for current and future pandemics. Careful attention must be paid to the design and composition of these aids so that they are easily readable and comprehensible. Figure 1 demonstrates an example of a cognitive aid for managing COVID-19 pediatric patients. Cognitive aids (e.g., checklists). should be printed, laminated and mounted in care locations.

**Case preparation**

All drugs and equipment should be prepared and readily available before starting an anesthetic. This preparation reduces the need for clinicians to reach into the anesthesia workstation drawers and bins once the patient has entered the procedure room. Trash cans and sharps containers should be readily available and open to avoid dropping equipment on the floor, which increases viral dispersion. For anesthesia drug dispensing workstations that require touching the screen, a plastic shield should be placed over the screen to minimize contamination. Clinicians should leave badges, keys, cell phones, pagers, and pens outside the operating room. Emergency phones may be kept in sealed bags to facilitate communication with other clinicians.

**Premedication**

Clinicians should consider the routine use of preprocedural sedatives to reduce anxiety and increase compliance when an IV is placed awake. Additionally, premedication may reduce the risk of vigorous crying and the need for physical restraints during inhalational inductions. Nasal

administration of premedication is undesirable because of the potential for high viral loads and the risk of coughing and sneezing. The PeDI-C did not recommend parental presence for the induction of anesthesia in order to conserve PPE and reduce clinician exposure to SARS-CoV-2. However, this will depend on the local infrastructure and practice especially in areas where PPE shortages are not of concern.

**Intravenous placement and Induction of Anesthesia**

Because inhalational induction may increase exposure to respiratory droplets and aerosols, the Collaborative members agreed that intravenous induction is preferred. However, clinicians should assess the child's disposition to intravenous catheter placement as struggling to place a catheter may result in higher exposure to respiratory droplets if the child cries. The PeDI-C recommended rapid sequence induction or modified rapid sequence to reduce the risk of reflex airway activation during intubation with associated aerosolization. Rapid Sequence Induction may not be feasible without severe hypoxemia in small children and patients with severe lung pathology. These patients should receive gentle positive pressure ventilation with the goal of using just enough tidal volume to achieve chest rise while maintaining a tight mask seal.

**Mask Induction if required**

Clinicians should induce anesthesia with the lowest possible flow rates and maintain a tight mask seal. The Collaborative recommended avoiding bag-mask ventilation if feasible to reduce aerosolization. Several collaborative members recommended mask induction and direct laryngoscopy and video laryngoscopy-assisted intubation (Figure 2), using a transparent plastic barrier around the anesthesia elbow to minimize extensive contamination of the operating room. A simulation using a three-layer transparent plastic technique with a simulated cough with particles of similar size to the SARS-COV-2 virus indicates that this barrier may trap virus under the plastic drape creating a hot zone around the patient but reducing the exposure of clinicians.[27]

The WHO guide for rational use of PPE encourages the use of "physical barriers to reduce exposure to COVID-19 virus."[28]

**Airway device placement**

The PeDI-C agreed that a cuffed tracheal tube was the ideal device to secure the airway in children with COVID-19. The Collaborative recommends using video laryngoscopy for all intubations, if available, to reduce the laryngoscopist's proximity to the patient's airway.[29] The most experienced laryngoscopist should attempt tracheal intubation to minimize laryngoscopy time and the number of attempts. Open suctioning may create aerosols, and an in-line closed suction system is preferred.[1,17,30] If clinically appropriate, patients in the ICU should be intubated in the ICU (preferably in a negative pressure room) before transfer to the operating room (OR). The PeDI-C felt a supraglottic airway device with a good seal was acceptable in some cases. A simulated cough in a manikin model with a supraglottic airway device in place showed minimal aerosol dispersion (Supplemental Digital Content 2, Video 1, http://links.lww.com/AA/D85). Second generation supraglottic airway devices have higher leak pressures than first-generation masks and should be considered.[31] The PeDI-C agreed that the least desirable approaches were high or low flow nasal cannula or bag-mask ventilation, though these techniques may be unavoidable at times. A simple oxygen mask placed on top of a nasal cannula may reduce the risk of aerosol dispersion (Supplemental Digital Content 3, Video 2, http://links.lww.com/AA/D86). The Collaborative recommended avoiding techniques that bring the clinician's face or stethoscope near the patient to verify leak pressures for ETT and SGA. Clinicians can use the ventilator's measurements of expired and inspired tidal volume and handheld manometers to titrate cuff inflation. Wireless Stethoscopes and point of care ultrasound can be used to confirm bilateral ventilation of the lungs. A "high quality" viral filter should be

placed between the breathing circuit and the patient's airway and another one at the end of the expiratory limb at the connection to the anesthesia machine as illustrated at https://www.apsf.org/faq-on-anesthesia-machine-use-protection-and-decontamination-during-the-covid-19-pandemic/#machine

**Maintenance of Anesthesia**

The PeDI-C recommended that clinicians use full PPE during the entire operative case given the risk of accidental ventilator circuit disconnection, accidental extubation, and unquantified aerosolization from the procedure, especially airway, laparoscopic, and endoscopic procedures. The PeDI-C recommended a transparent barrier over the airway device and patient's head to trap any aerosolized virus. Others have used wet towels and gauze for the same purpose.[32]

**Emergence and Extubation**

If available, the clinician should use closed in-line suction to minimize aerosolization during tracheal tube suctioning (Figure 3A). Clinicians should consider deep extubation using techniques that minimize coughing and bucking during emergence, such as total intravenous anesthesia or dexmedetomidine. [33,34] Still, patients may cough during the subsequent emergence and recovery. Protective barriers can be helpful in all phases of care, and the World Health Organization has recommended using them to reduce viral dispersion.[35] Supplemental Digital Content 4, Video 3, http://links.lww.com/AA/D87, demonstrates an example of transparent barrier techniques used by PeDI-C members during extubation.[27] In addition, The PeDI-C agreed clinicians should consider placing a suction device under the barrier to create a negative pressure microenvironment which may scavenge droplets and aerosolized materials.

The Collaborative recommends emerging and recovering COVID-19 patients and patients under investigation for COVID-19 in the operating room, followed by direct transfer of the patient to the inpatient ward bypassing the Post Anesthesia Care Unit if possible. This change

in workflow minimizes the number of exposed HCW and nearby patients. For patients being admitted to the ICU postoperatively, consider extubating in the ICU.

Pediatric anesthesiologists may be called upon to assist with the extubation of critically ill COVID-19 patients in the intensive care unit. Advanced planning of workflows and procedures for emergent intubations outside the operating room is critical and should include representatives from anesthesiology, critical care, respiratory therapists, hospitalists and nursing and respiratory therapists.

**Prepare for Adult care**

Pediatric anesthesiologists may be involved in providing care to adults using anesthesia ventilators. The Anesthesia Patient Safety Foundation and the American Society of Anesthesiologists have provided detailed guidance on how to repurpose anesthesia ventilators for ICU care.[36] In preparation for this possibility, we encourage anesthesiologists to familiarize themselves with these processes in collaboration with other key stakeholders.

**Transporting Intubated Patients**

Mechanically ventilated children with COVID-19 should be transported with a ventilator with viral filters on the patient side of the y-piece and the expiratory limb of the breathing circuit (Figure 3).[36] If a transport ventilator is not available, a viral filter should be placed on the tracheal tube during transport with the caveat that they increase the dead space in the circuit which may be significant in small children. Figure 4 demonstrates two positions of the viral filter with this consideration in mind. Tracheal intubation should be confirmed with capnography and visual observation of bilateral chest rise. Samples lines for capnography should be placed after viral filters. In some cases, viral filters can be removed from the anesthesia circuit and repurposed as a viral filter for a manual transport circuit (Figure 3A). Before transport, clinicians

should weigh the risks and benefits of administering additional sedation or neuromuscular blockade to prevent coughing and bucking.

**Infrastructure**

The use of a negative pressure operating room for AGMPs is recommended for all proven or suspected COVID-19 patients if feasible. Ensure adequate air exchange and filtration time of the operating rooms used for patients with COVID-19 and suspected cases before cleaning and preparing for the next case.[37] A chart of time needed for adequate air exchange is available at https://www.cdc.gov/infectioncontrol/guidelines/environmental/appendix/air.html#tableb1 (scroll down to table B1). If negative pressure ORs are not available, use high-efficiency particulate air (HEPA) filters that sufficiently filter the operating room's square footage. Also, try to avoid rooms with connected ventilation systems.

**Difficult Airways**

The PeDI-C members identified the unique challenges involved in managing difficult airways in patients with known or suspected COVID-19. Many of the recommendations described above for tracheal intubation of normal airways apply to difficult airways as well. An airway team should be assembled, and all equipment should be set-up in the operating room and checked. The team should consider a just-in-time review before beginning airway management. The clinician with the most experience with the selected airway device should perform the tracheal intubation. The collaborative ranked difficult airway management approaches as follows: video laryngoscopy as the primary technique followed by fiberoptic intubation through a supraglottic airway device, combined video laryngoscopy and fiberoptic bronchoscopy and finally freehand fiberoptic. Oral fiberoptic intubation is preferred over nasal fiberoptic intubation and minimize passive oxygenation as tolerated. Hypoxia can be addressed with intermittent two-hand mask ventilation to maintain a good seal and low tidal volumes. If safe to do so, consider administering a

neuromuscular blocking agent after intravenous induction. Sugammadex should be immediately available to antagonise the neuromuscular blocking agent if needed. If warranted, perform mask ventilation with low tidal volumes using a two-person technique to maintain a good seal. If nasal fiberoptic intubation is required, consider using an endoscopy mask (Supplemental Digital Content 1, Material 3, http://links.lww.com/AA/D84). Endoscopy masks have a diaphragm that seals around the fiberoptic scope but allows the tracheal tube to be advanced into the airway. It may be prudent to call early for personnel and equipment for a surgical airway. Prolonged attempts at intubation may be associated with increased aerosolization of the virus.

## Discussion

The PeDI-C generated consensus guidelines for multiple aspects of pediatric anesthesia care during the COVID-19 pandemic. Our literature search yielded no articles investigating pediatric airway management in patients known or suspected of having COVID-19, further supporting the need for such guidelines. Additionally, rigorous studies of COVID-19 patients may be challenging, given the high infectivity of the disease.

The PeDI-C identified the critical importance of protecting HCWs. SARS-CoV-2 infected 3300 HCW in China and 20% of Italian HCW with associated morbidity and mortality.[19,20,38] The PeDI-C recommendations regarding the use of PPE for all AGMPs are in line with consensus guidelines from the American Society of Anesthesiologists, Anesthesia Patient Safety Foundation, American Academy of Anesthesiologist Assistants, and the Association of Nurse Anesthetists.[39] The Collaborative recognized that many institutions are already facing inadequate PPE supplies, and need to balance PPE use for routine care in asymptomatic patients with future demand for COVID-19 patients.[40] Some have argued that a surgical facemask and standard universal precautions are sufficient in asymptomatic untested patients for AGMPs and cite published literature to support this practice. One study compared

the efficacy of N95 respirators to medical masks in preventing HCW from acquiring influenza and other viral respiratory infections. They randomly assigned 2862 HCW to N95 or a medical mask and found no difference in lab-confirmed influenza infections between the two groups, 207 (8.2%) in the N95 group and 193 (7.2%) in the medical mask group (difference, 1% [95% CI, -0.5% to 2.5%]; *P = 0.18*).[41] Clinicians should not extrapolate these data to COVID-19 for two reasons. First, the SARS-CoV-2 virus is more contagious than influenza. The R0, also known as the basic reproductive number, is a measure of how contagious an infectious disease is and indicates the expected number of people who will get the disease from an infected individual. The R0 of influenza is 1.2, while that of COVID-19 is estimated to be between 2 and 3.[42] Secondly, SARS-CoV-2 may aerosolize more readily than influenza and remain airborne longer.[43] Clinicians should err on the side of overprotection in asymptomatic patients until more rigorous data is available in children. Fortunately, new data from Italy and China suggests that the pediatric burden of the disease might be low (2,4). Data from the Virtual PICU systems (www.myvps.org), a collaboration of 135 North American Pediatric Intensive Care Units, indicates that of 609 patients tested, 30 were COVID-19 positive as of March 29$^{th}$, 2020. These data should be considered in the context of limited testing and exponential spread, which means a low disease prevalence can change rapidly. We caution clinicians not to lower their guard because of a perceived low burden of disease in children.

There remain areas of controversy and need for future exploration, including the value of pre-procedural testing for COVID-19, and ethical and legal considerations for the use of innovative but unapproved PPE. Some centers use COVID-19 screening tests to determine the type of PPE for AGMPs, reserving N95 masks for COVID-19 patients and standard surgical masks for negative patients. Using RT-PCR testing for COVID-19 to determine PPE use in a limited resource setting makes sense. However, sensitivity for detection of COVID-19 can vary

based on how the sample was obtained, the duration from infection to testing, and how the laboratory performed the test. Further, the potential for false negatives should be recognized and clinicians should not be falsely reassured by a negative test. If high sensitivity testing for COVID-19 is negative in the child, PPE may not be required. Another area of concern is the potential for asymptomatic spread of SARS-CoV-2 from HCW to patients. It may become necessary for all HCW to undergo COVID-19 testing to prevent nosocomial infection.

We acknowledge several limitations. The guidelines outlined in this document are based on expert opinions from a diverse group of clinicians. Supportive evidence is referenced when available, however there are few rigorous studies given the novelty of this disease. Although we searched multiple online repositories and search engines for manuscripts, publication delays could have made some reports unavailable to us at the time of this writing, and not all manuscripts from the global medical community are available in the repositories we queried. Information is evolving quickly during this pandemic, and the Collaborative recognizes that an update to this document may be warranted as we learn more. Most importantly, each hospital will need to adapt these guidelines based on local regulations, availability of equipment, and the prevalence of the disease. These guidelines are meant to help clinicians deliver care that is safe for children as well as staff.

## Conclusions

The Society for Pediatric Anesthesia's PeDI-C developed consensus guidelines based on expert opinion and the limited available data to guide pediatric airway management during the COVID-19 pandemic. Pandemics of this magnitude are rare. We hope that these guidelines will support clinical care, workflow, and decision-making that maintain patient-centered care while protecting HCW, our most valuable resource to fight the pandemic. Finally, the PeDI-C hopes that these guidelines help prepare clinicians to safely and effectively fight this pandemic.

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**Figure Legends**

Figure 1. A cognitive aid summarizing the recommendations of the PeDI-C for airway management of pediatric patients during the COVID-19 pandemic.

Figure 2. A depiction of transparent drapes being used as an aerosolization barrier during (A) mask induction in a patient; (B) video laryngoscopy intubation in a manikin; (C) direct laryngoscopy in a real patient; (D) three-drape technique using an anesthesia elbow and suction under the transparent drapes.

Figure 3. (A). Standard viral filters (red circle) present on inspiratory and expiratory limbs of an anesthesia circuit depending on manufacturer, can removed and used as a viral filter for a transport circuit for patient transport. (B) Viral filter (red circle) removed from anesthesia circuit and inserted between the endotracheal tube adapter and transport circuit.

Figure 4. (A) A Mapleson D breathing circuit with an In-line suction catheter. (B) A Mapleson D breathing circuit with a viral filter at the distal end. Not suitable for infants, neonates, and small children because of the dead space of the filter and potential rebreathing. (C) A Mapleson D breathing circuit with a viral filter proximal to the fresh gas flow. Preferred in infants, neonates, and small children.

**Supplemental Materials**

Supplemental Material 1. List of institutions participating in virtual Nominal Group Technique session

Supplemental Material 2. List of publications reviewed for this article.

Supplemental Material 3. An endoscopy mask.

Supplemental Video File 1. Video depicting laryngeal mask airway and cough simulation

Supplemental Video File 2. Video depicting High flow nasal canullae aerosolization simulation

Supplemental Video File 3. Video depicting three-layer drape technique for extubation

**Tables**

Table 1. Risk of transmission of SARS-CoV1 to healthcare workers exposed and not exposed to aerosol generating procedures during the 2003 SARS outbreak.[1]

| Aerosol generating medical procedure | Odds Ratio |
|---|---|
| Tracheal Intubation | 6.6 |
| Tracheostomy | 4.2 |
| Suction before intubation | 3.5 |
| Non-invasive ventilation | 3.1 |
| Manual ventilation before intubation | 2.8 |
| Chest compression/defibrillation | 2.5 |
| Bronchoscopy | 1.9 |

Table 2. PeDI Collaborative's recommendations for airway management in the pediatric patient during the COVID-19 pandemic

| Theme | Recommendations | Example comments |
|---|---|---|
| Training | Context sensitive simulation | Pediatric patients, needs to be relevant to the perioperative and out of operating room procedures |
| Cognitive Aids | Develop, test and share | Need to address challenges related to processes, workflows and clinical management. Development and testing should include nurses and other stakeholders |
| Patient Safety and Clinical Management | Use of sedation | Coughing and crying can increase aerosolization |
| | Parental Present at Induction of Anesthesia | Should be avoided or minimized |
| | IV induction | Should minimize coughing and crying |
| | Use of neuromuscular blockers for intubations | |
| | Exubation | Should be smooth and under clear plastic is needed |

| | | |
|---|---|---|
| | Avoid nasal prongs | They can cause aerosolization but a simple oxygen mask covering may prevent or reduce dispersion |
| Staff Safety | Personal Protection Equipment | Needs to protect health care workers who are a scarce resource |
| | Minimizing Staff in the room | Should work for the context of the operating room |
| | Continued use of personal protection equipment during for high risk procedures or patients | |
| | High risk staff (Age, Immunodeficiency, Pregnancy) | |
| | Anesthesia Trainees | |

Figure 1

Figure 2

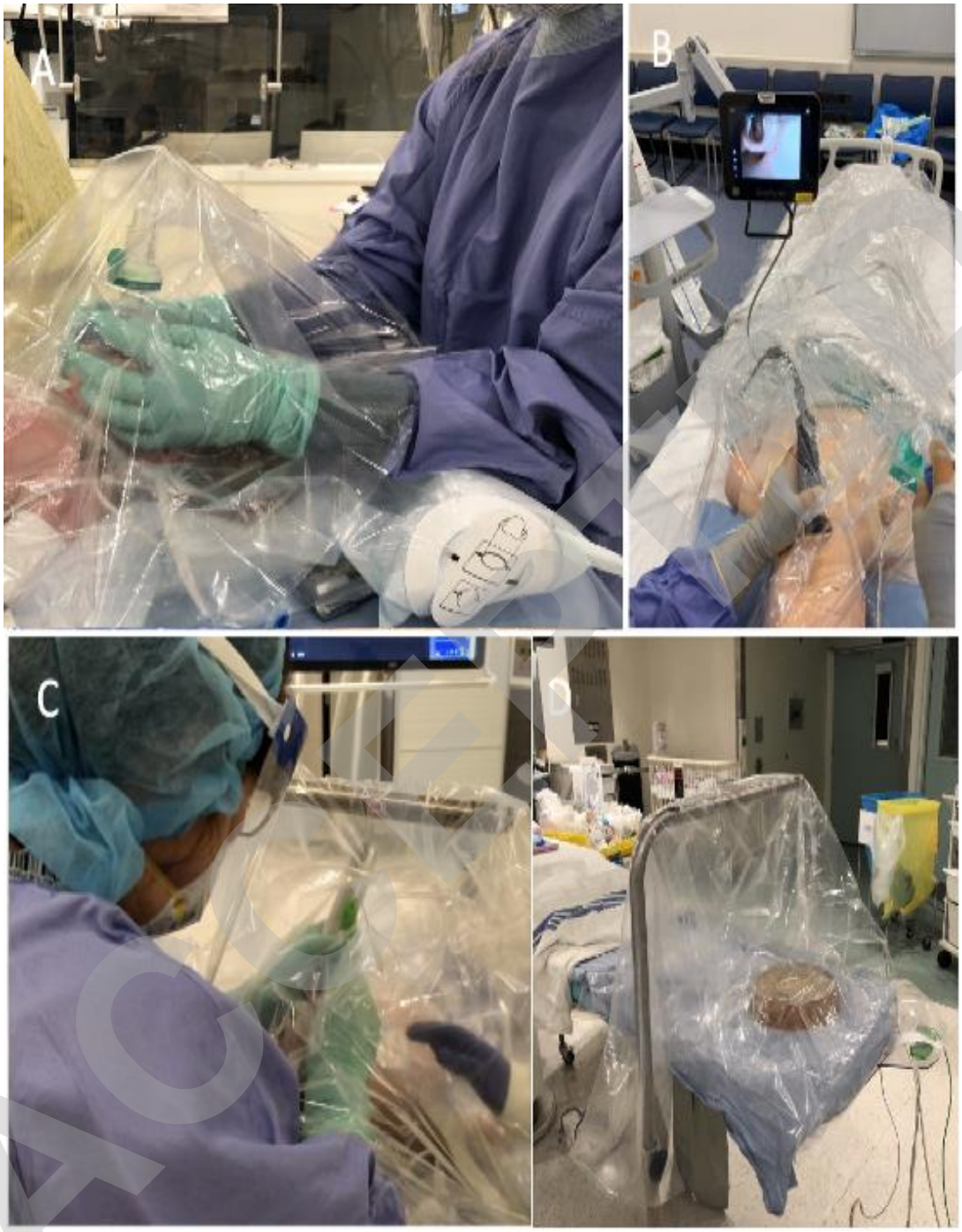

Figure 3

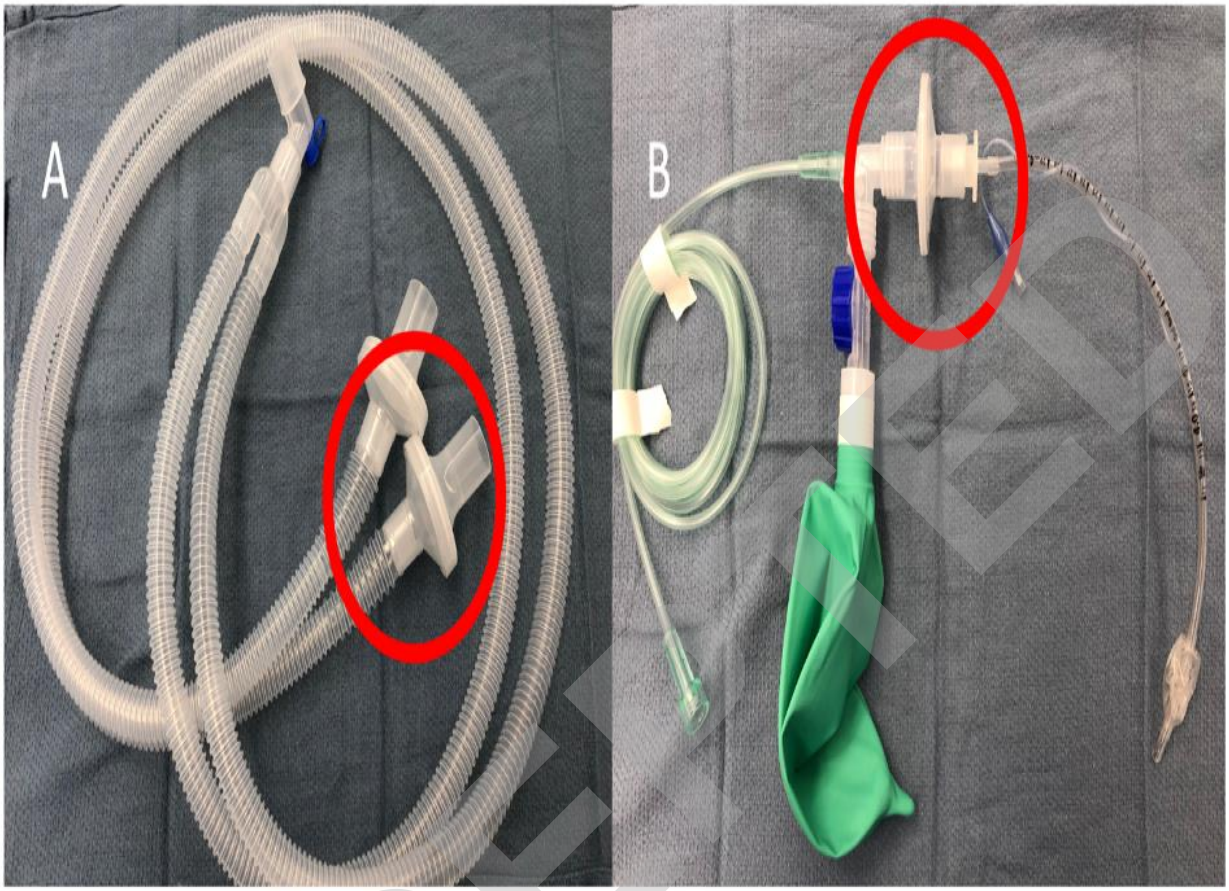

Figure 4