Colleagues,

The simulation team along with our infection control and occupational health teams have been conducting in situ-simulation activities in preparation for a COVID-19 patient requiring intubation in our ED and ICU. Our simulations have been an instructive exercises and I'd like to share our findings. I would also like to share what I've gathered from ongoing literature review, social media and conversations with other airway enthusiasts. In the interest of expediency, this paper has not been thoroughly peer reviewed nor approved by my hospital or any of the other courses, agencies or universities with which I am affiliated. The opinions expressed may not reflect the opinions of any of those organizations. There is a vulnerability in sharing a document in this way, but I have been encouraged by others who have shared their documents however imperfect in the hopes they may be helpful. Take from this what you wish and discard that you do not. This document will serve as a discussion paper to provide food for thought as you consider your own approach to the COVID-19 airway. I have produced a separate clinical reference that can be used at the bedside should you find yourself needing to intubate a COVID-19 patient. These documents are constantly being updated and the most current version can be found at https://www.scorecme.com. I'm also keen to hear your feedback and will incorporate it into this living document.

Jesse Guscott MD CFPC (FPA)
FP-Anesthetist
Hospitalist
Simulationist

Caveats and Assumptions

This document is derived for use here in Collingwood. It's applicability to other hospitals will be variable. I am not an infection control specialist nor a public health specialist. I've based this summary on current recommendations by Ontario public health, consensus opinion, expert opinion and personal opinion in that order. This is not a binding protocol and as individual clinicians we need to decide what we believe is best for our patients, ourselves and our families. Particularly with respect to PPE, please think through your personal approach and make decisions ahead of time about what you plan to use. Practice and commit.

I have not gone into detail about airway plans, backup plans etc as that is outside of my scope here. The assumption is that you have made plans for intubation with backup plans for oxygenation via BMV, Supraglottic airway and Front of the Neck Access and that you feel the patient is an appropriate candidate for RSI and that you are the most experienced available intubator.

Key Findings and Suggestions

- **PPE requires some practice and definitely requires a donning and doffing coach using a written checklist**
- **PPE is HOT. Make equipment and drug preparations and detailed airway plan before donning PPE so that once you are in PPE you can quickly enter the patient room and proceed to intubation**
- **The intubation team should don together so that one person is not left overheating while the rest are getting dressed**
- **Rooms 8/9 are adequate for the required procedure, the ICU negative pressure room may be preferable if available.**
- **We recommend a team of 1 MD, 1 RN and 1 RT in the room during intubation with the primary RN and ER MD (if an anesthetist is available) stepping into the anteroom to act as an equipment runner/passer and backup.**
- **In some situations it may be beneficial to have 2 MDs in the room if available. For example, patients with anticipated difficult laryngoscopy or those with profound hypoxia, a second MD can add to the situational awareness and can double setup for FONA.**
- **The period between intubation and connection of BMV is crucial. Plan and prepare the sequence of cuff inflation, connection of the BVM with filter and CO2 monitor inline, prior to entering the room.**
- **We experimented with attaching the ETT immediately to the ventilator post intubation. This sequence does confer some advantages however the costs were either loss of wave form capnography or added complexity in quickly changing the sampling tubing over. On the balance of risks and benefits we suggest first connecting the BVM to confirm tube placement, reoxygenate the patient and then plan a transition to the ventilator in a controlled fashion with clamping of the tube.**
- **All of the literature suggests that the most experienced available airway person attempt intubation. Our anesthetists anticipate getting called for these cases and unless otherwise occupied by patient care, will plan to attend.**

PPE

COVID-19 is thought to be primarily spread through large droplets. Most agencies and experts including Ontario's Public Health agency recommend surgical masks, isolation gowns,eye protection and gloves for routine patient care.

Intubation is considered an Aerosol Generating Procedure (AGP/AGMP) and as such a higher level of PPE is recommended. After reviewing many agencies' recommendations and testing available equipment we make the following recommendation for PPE for AGPs in our facility.

- **2 sets of gloves, 1 under the gown, and one over top of the gown (consider long cuffed gloves over the gown).**
- **Impervious gowns such as our standard OR gowns**
- **fit tested N95 respirators**
- **goggles**
- **face shield**
- **head covering (bouffant or hood)**
- **shoe covers if desired**

2 issues arose with respect to available PPE

1) Some groups have expressed concerns about neck exposure with this type of setup. You can consider a “surgeon’s hood” type head gear which offers some neck coverage but it is incomplete and extra care must be taken to remove it without contaminating one’s face. In this picture, I am wearing a bouffant and Jessica and Greg are wearing hoods.
2) Available boot covers may be too small for those of us with bigger feet and the doffing of tight boot covers was also identified as concern for potential contamination. You may consider removing your shoes to fit into the covers recognizing this brings a risk of stepping on a sharp or other hazardous item.

We are working with Infection Control and Occupational Health to ensure that everyone is getting the opportunity to practice donning and doffing under supervision. You can watch this video https://youtu.be/syh5UnC6G2k for details of donning and doffing though our sequence will look a bit different.

There is no consensus on exactly what PPE should be worn. A balance needs to be struck between protection and usability. Further, multiple layers of PPE used incorrectly are probably more likely to foster contamination then less layers worn correctly. During the SARS outbreak, Health Care Workers (HCWs) wearing airborne PPE were infected with a cluster likely occurring during intubation. Lack of fit testing and lack of training in proper techniques were identified as likely contributory causes. Conversely, a recent case report from Singapore describes a total of 41 Health Care Workers with exposure to AGPs in a COVID patient not yet identified as such. Only 15% of these HCWs wore N95s as the patient was under contact precautions only. Despite at least 10 minutes within 6 feet of the patient during AGPs, none of these HCWs developed symptoms or positive PCR on serial testing.

My approach will be to assume that even with the most vigilant PPE, some contamination may occur particularly around the neck and I will try to get into a shower with soap and water as soon as is feasible. It is reassuring to hear that Health Care Workers with appropriate PPE do not seem to be getting infected at high rates.

Our most current version of the donning and doffing checklist is included in the Clinical Reference Document. I cannot recommend strongly enough that donning and doffing be done in the presence of a spotter/coach using the written checklist. Check boxes should be physically checked to avoid errors. Disposable markers are included in the kits. Particularly when stressed, the sequence can be challenging to remember and spotter can watch for inadvertent contamination. PPE removal is the crucial step.

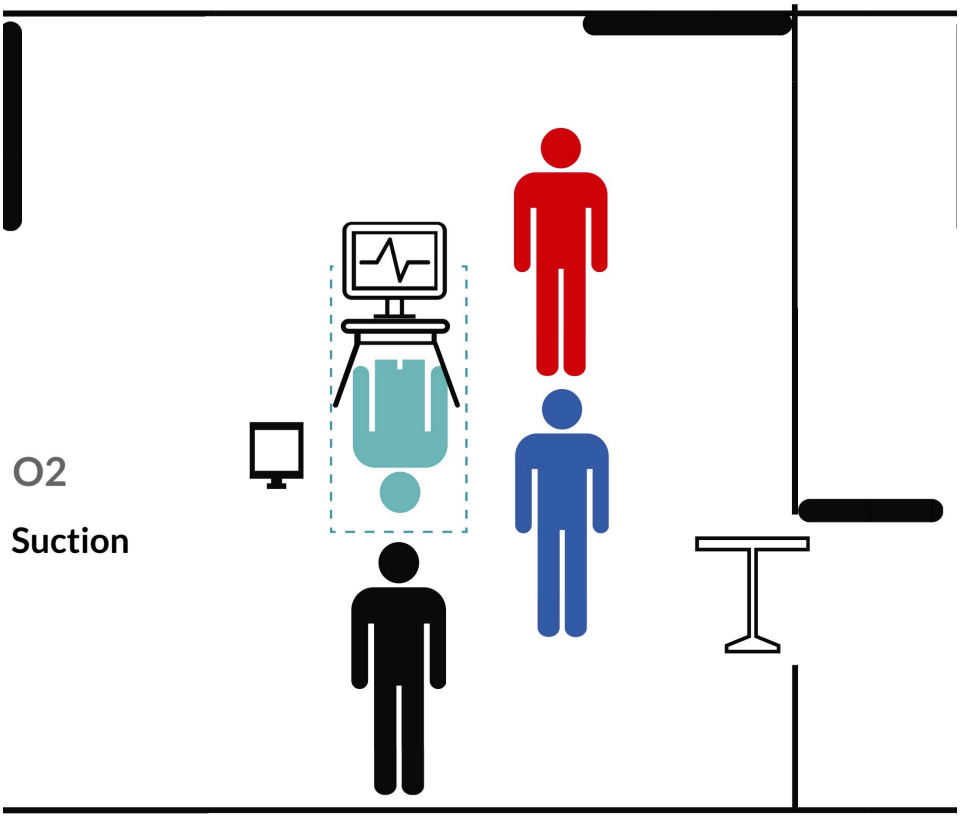
Personnel

We recommend a 3 person intubation team with the most experienced available MD available to intubate, an RN and an RT. In some instances such as a profoundly hypoxic patient or an anticipated difficult intubation with FONA double setup, it may be advisable to add a second MD if available. In the ED, we anticipate that the primary nurse and attending ED doc are caring for the patient while the intubation team is preparing. The intubation team needs to be dressed in Airborne PPE while the care team is in droplet PPE. The intubation team should prepare the equipment and review the plan before donning and entering the room. When the intubation team is ready they would receive handover from the care team who would then step into the anteroom. We believe given our negative Air Changes/Hour (ACH) rates of our negative pressure rooms that the room should be considered aerosolized for at least 30 minutes.

Equipment

As room 8 is not typically a monitored bed with resuscitation equipment, one of our aims was to test the feasibility of bringing the necessary equipment to room 8. The same principals can be applied to other non traditional resuscitation spaces. With the appropriate room setup, we found the space adequate for the necessary equipment. With the goal of thorough preparation and minimizing entry and exit from both the patient room and the anteroom, the Clinical Reference document include a checklist for equipment preparation. The same checklist can be used in the ICU though you would not require the monitor.

I have provided a schematic of the physical arrangement we found ideal. With the intubator at the head of the bed, an RT on their right with the Glidescope screen positioned on the left where they can both visualize it. The RN should be positioned nearest the IV being used and with a view of the monitor. We put a tray table at the entrance to the washroom to hold the intubation equipment/tray and put the monitor on a tray table over the patient's lower extremities.



Preoxygenation

Our competing goals are to minimize the generation of aerosols while maximizing patient oxygenation to extend safe apnea time. High gas flows, CPAP, High Flow Nasal Oxygen, BiPap and bag mask ventilation are variably thought to generate aerosols. The relative contraindication of their use in COVID is debated. It appears that HFNO in particular can be considered as a treatment for COVID related hypoxia but is not recommended as a means of preoxygenating for intubation.

Preoxygenating and/or reoxygenating a hypoxic patient with COVID will pose challenges. Based on expert opinion, in particular EMcrit and personal communication with Canadian airway experts, we have assembled the following setup.

This setup consists of
1.Mask (either NIPPV mask with straps or Cuff Seal Mask)
2.HFE (filter) with EtCO2 Sampling line connected
3.T-piece connected to O2 source at 4L
4. BVM with PEEP valve set at 5-15 connected to wall O2 at 15L/min

With a good mask seal, patients are exhaling directly into the filter which may confer advantages over nasal prongs or traditional non-rebreather masks. Our BMVs have 1 way valves, therefore forward flow is limited to the period of patient's inspiration. The 15L/min flow is flowing forward and is therefore not generating aerosol.

Choice of mask will depend on the length of time that you anticipate using this O2 delivery setup. Use of the NIPPV masks with straps confers the benefit of hands free setup. It can be applied in advance of anticipated intubation and in particular during team donning, preparation and planning. We recommend switching to the cuff seal mask just prior to induction. During our simulations, we found this conferred a simplicity advantage. Negotiating and removing the straps post induction and switching to the cuff seal mask in the event that rescue BVM was required were two instances where additional steps contributed unwanted complexity.

Like with BiPap, resistance through the mask on inspiration and PEEP valve on exhalation may cause some patients to feel uncomfortable. Small doses of ketamine may be useful in this instance.

Care should be taken to ensure that all connections are tight, the most important being the connections between the filter and the mask.

Technique

- **Use the most experienced available intubator in order to maximize the likelihood of first pass success**
- **Try to avoid Bag Mask Ventilation, Bipap, Highflow Nasal Oxygen (HFNO) and apneic oxygenation if not required.**
- **Avoid active bagging in the spontaneously breathing patient as asynchronous breaths may promote aerosol generation**
- **The patient should be at least 45 degrees upright during preoxygenation and intubation to maximize oxygenation**
- **Configure waveform capnography during the preoxygenation period.**
- **Ensure a viral filter is in place at all times**
- **Videolaryngoscopy with the Glidescope will allow the intubator to maintain a greater distance from the patients face, reducing the risk of contamination. The intubator should consider whatever intubation technique is most likely to result in rapid first pass success.**
- **If VL is used, especially with a hyperangulated blade, remember to employ a deliberately restricted "50:50" view to decrease the time taken to deliver the ETT.**
- **Rapid Sequence Intubation using an induction agent with high dose rocuronium (1.2-1.5 mg/kg) will decrease the risk of patient coughing and will ensure tone is not regained during airway management.**
- **There is a timer on the Zoll as well as the Glidescope which can be used to time medications.**
- **Be prepared for post intubation cardiovascular collapse with push pressors and/or vasopressor infusion hanging.**
- **Re-oxygenate with BVM or LMA with a viral filter and EtCO2 if dangerous desaturation occurs during intubation attempt. Use two handed BVM technique with low flow, low pressure, low tidal volumes. Use waveform capnography to confirm adequacy of ventilation as you can anticipate a lag in spO2 recovery and you will instinctively hyperventilate.**
- **Visualization of the tube markings through the cords combined with waveform capnography are preferred to auscultation in order to decrease risk of contamination.**
- **The period between intubation and connection of BMV is crucial. Plan and prepare the sequence of cuff inflation, connection of the BVM with filter and CO2 monitor inline, prior to entering the room.**
- **Ensure cuff is inflated and filter is inline before bagging the patient.Cover or dispose of laryngoscope blade immediately after use.**
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Post Intubation

- **We experimented with attaching the ETT immediately to the ventilator post intubation. This sequence does confer some advantages however the costs were either loss of wave form capnography or added complexity in quickly changing the sampling tubing over. On the balance of risks and benefits we suggest first connecting the BVM to confirm tube placement, reoxygenate the patient and then plan a transition to the ventilator in a controlled fashion with clamping of the tube.**
- **At all times the ETT should be connected to a filter, clamped or both.**
- **To transition to the ventilator with inline suction on the patient side of the filter, the tube will need to be clamped.**
- **Ventilation parameters will be ARDS goals. Tidal volume of 6-8 ml/kg of ideal body weight. ARDSnet guides are included in the clinical resource document.**
- **Plan and provide post intubation sedation and paralysis.**
- **Place a gastric tube**

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