
April 15, 2020

Adopted from primary sources:

a. Brigham and Women’s and Massachusetts General Hospital Departments of Emergency medicine.


d. American College of Emergency Physicians Covid 19 Field Guide. ICU Care in the Emergency Department. Jamie Allen, DO and Susan R. Wilcox, MD, FACEP,

**Background:** Since the outbreak of the Covid-19 Corona Virus Pandemic, approximately 80% of confirmed cases have resulted in mild febrile illness, however 17% of patients have required hospitalization with less than 3% requiring mechanical ventilation. For those patients who suffer from respiratory failure, the percentage of complications resulting from intubation, sedation, and mechanical ventilation have been adjusted to upwards of 80% mortality. When diagnosing Covid-19 common signs, vitals, and clinical findings have also been adjusted to include not only signs and symptoms of respiratory distress and failure, but also a litany of sequelae that target the multiple organ systems including not only respiratory, but cardiovascular, gastrointestinal, renal among others. This review will address primarily the risk and sequela around the spectrum of illness surrounding the compromise and potential collapse of the critical respiratory system. As providers who will encounter this population of patients with respiratory compromise, it is imperative that our management matches the recommendations that other inpatient hospitals and critical care transport teams are utilizing. To this end, there have been a variety of sources that have made recommendations around the airway management of these critical patients.

The current literature notes that the transmission of Covid-19 is primarily through droplet spread (approximately 6 feet). These droplets not only can be aerosolized, but also contaminate surrounding surfaces. There is some concern that the virus travels further and thus airborne precautions are utilized in high risk procedures. Thus, it is the goal of the information below to provide vital information for staff to protect themselves as well as the patient during high risk encounters. LifeFlight of Maine has developed specific recommendations around personal protective equipment (PPE) and subsequent cleaning procedures. Please refer to these guidelines concurrently for additional information on these specific topics.

When providing airway management or other invasive procedures (including needle decompression or tube thoracostomy), it is imperative that providers are aware of events that generate contaminated aerosols. Additionally, crews must be aware that contaminants can remain active on surfaces, fomites, and PPE for a prolonged period of time. Lastly, as the critical teams resuscitate critically ill patients with COVID -19, we must be aware of procedures that can further generate conditions that will exacerbate the spread of aerosols (See Table 1. Risks for Healthcare providers (Adopted directly from SAS Consensus statement).
Table 1. Risks for Healthcare providers (Adopted directly from SAS Consensus statement).

<table>
<thead>
<tr>
<th>Aerosol generating Events</th>
<th>Procedures vulnerable to aerosol generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coughing or sneezing</td>
<td>Laryngoscopy</td>
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<tr>
<td>Non-invasive or positive pressure ventilation with inadequate seal</td>
<td>Endotracheal intubation</td>
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<td>High flow nasal cannula oxygen (HFNO)</td>
<td>Bronchoscopy/ gastroscopy</td>
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<tr>
<td>Delivery of nebulized medications via simple face mask</td>
<td>Front of neck Airway procedures including tracheostomy and cricothyrotomy</td>
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<tr>
<td>Cardiopulmonary resuscitation (Prior to intubation)</td>
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<tr>
<td>Tracheal suctioning without a close system</td>
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<tr>
<td>Tracheal extubation</td>
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Note: The reliability of a seal is greatest with the endotracheal tube > Supraglottic airway > facemask

**Guiding Principles.**

There is no reason to develop new airway protocols around management. New checklists and procedures cause confusion around a procedure that staff have a familiarity and comfort. Rather, it is appropriate to insert some additional guiding principles that will help minimize contamination of staff while maintaining the safety of the patient. Initially, the LifeFlight of Maine team of medical directors and leadership staff have been working to diligently develop further resources for which crews can refer to enable a safe response. In this packet, three appendices will be included to enhance the respiratory management of these patients.

These include the following appendices:

a. **Appendix 1. The treatment of patients with COVID 19 experiencing respiratory distress.**

b. **Appendix 2. Rapid Sequence Intubation Checklist Special Respiratory Precautions.**

c. **Appendix 3. Ventilatory Management of patients with COVID 19.**

Overall, the principles of managing patients with respiratory compromise can be outlined as follows to ensure the safety of the critical care transport teams. In the course of providing respiratory care to this population of patients, it is the goal to complete the following:

1. Reduce virus aerosolization.
2. Maximize efficient airway management.

I. **Reduction of Virus Aerosolization**

1. Complete airway management and invasive procedures in a negative pressure room *if available and feasible* and avoid nebulized medications whenever possible.

2. If there is an option to use disposable equipment, this is always preferred over reusable equipment.

3. Early endotracheal Intubation vs. Primary management with BiPAP or High Flow Nasal Cannula (HFNO).

   a. If oxygenation and ventilation support is needed, *early endotracheal intubation* is recommended instead of attempts to primarily manage with BiPAP or HFNO. NIPPV may be used in the facility in a safe closed-circuit manner, however, with the challenges of transport medicine, it is NOT feasible to use NIPPV in the out-of-hospital environment.
b. Prior SARS experience showed that BiPAP and manual bag valve mask ventilation both increase the risk of airborne viral particles and > 90% of patients ultimately failed trials of non-invasive positive pressure ventilation.

c. Patients suspected of having COVID-19 that require positive pressure ventilation and helicopter emergency medical transport should be transported with endotracheal intubation (versus non-invasive ventilation). Because of the risk of aerosolization, non-invasive ventilation (NIPPV) should and will NOT be used on patients with suspected COVID-19 during aeromedical transport or ground transport without consult with LFOM Medical Director.

4. **Rapid sequence intubation is the preferred method.** Use awake intubation only when absolutely indicated because of the potential for viral spread due to coughing during application of topical anesthesia and laryngoscopy.

5. The use of heated and / or humidified high flow oxygen is only used with appropriate forms of mitigation due to risk of aerosolization (Refer to Appendix 1 The treatment of patients with COVID 19 experiencing respiratory distress).

6. During RSI, use high-dose neuromuscular blocking agents (NMBA) for faster and more complete apnea and no residual cough. Even with high-dose NMBA use, **respect the NMBA onset time.**
   a. Rocuronium 1.5mg/kg IBW

7. Ambient pressure pre-oxygenation whenever possible
   a. **Manual bag valve ventilation and PPV only if clinically required.**
   b. Use a low volume and higher frequency approach if manual ventilation is required. Ensure a well-sealed mask in place. A PEEP valve should also be used.
   c. **Place a HEPA filter** between the ETT and BVM (this can be with the same filter used on the ventilator).
   d. Expect precipitous drops in oxygen saturations during intubations.

8. Limit ventilator disconnects
   a. If working with sending and receiving staff, communicate often with Respiratory Therapist (RT) regarding need for ventilator checks and disconnects.
   b. If disconnects are required (i.e. transition from room to portable ventilator) do so quickly and at end-expiration.
   c. **Place a HEPA filter** between ETT and ventilator.
   d. Consider clamping the endotracheal tube during transfer of ventilators to maintain recruitment and limit aerosolized exposure.

II. **Maximize efficient airway management** – This will reduce the need for bag valve mask ventilation between attempts.

1. The most experienced and proficient available clinician should manage the airway first.

2. **Focus on robust pre-oxygenation.**
   a. Oxygen can be administered via nasal cannula with the general principle that the higher the flow, the higher the risk for aerosolization (Typical NC flow is less than 6L/min).
b. This will provide more time for a first-attempt intubation success. Benefits of pre-oxygenation must be weighed against the risk of aerosolized viral particles however patient safety is paramount. Intubating a hypoxic patient who will desaturate rapidly after RSI meds are given puts them at risk of death during the procedure.

c. Preoxygenate with 3-5 minutes of tidal breathing on NRB mask at 15 L/min flow with upright positioning AND Place low flow nasal cannula at 5 L/min to be left in place for apneic oxygenation. A surgical mask on top may reduce aerosolization.

d. We are not recommending starting with “flush-flow” rate facemask pre-oxygenation for these patients. This might result in excess L/min flow which would leak out of the mask margin.

e. Intubate in a negative pressure room and ensure all providers pay extreme attention to personal protective equipment (PPE). As noted above, precipitous drops in oxygen saturations have occurred with many patients with COVID 19.

3. The video laryngoscope allows for safer provider / patient distancing by using the screen and not looking directly in the oropharynx.

   a. There is increased first attempt success with video laryngoscopy (VL) compared to direct laryngoscopy (DL)

4. Have all required disposable airway equipment at the bedside.

   a. ETTs, bougie (use pre-loaded or have as an adjunct), syringe (with immediate balloon-up after tube placement), lube, ETCO₂, VL with multiple blade sizes/shapes, single-use Mac/Miller set-up, cric kit.

5. If staff are in a facility with multiple resources including providers, respiratory therapists, NIPPV with an exceptional seal can be considered for the intubation if there is significant hypoxia prior to the intubation. However, there is currently debate in this maneuver’s effectiveness and safety. Ensure a tight-fitting mask to minimize aerosolization. Providers may have to hold the mask manually to ensure a tight seal and reduce leak around the margin of the mask.

   a. Continue positive pressure ventilation until the patient is apneic and then suspend the ventilator before removing mask as intubation proceeds.

   b. There is no role for NIPPV in the out-of-hospital setting.

6. The other LifeFlight of Maine donned provider should be in the room with anticipated difficulty or need for complex airway maneuver.

III. Minimize Personnel Exposure

1. Enhanced droplet and airborne PPE

   a. Please refer to the LifeFlight of Maine Covid-19 SOP for further details about appropriate PPE. At minimum, for airway management and invasive procedures

      i. PAPR or N-95 mask with surgical mask on top

      ii. Gown, Tyvek suit or equivalent

      iii. Face Shield and/ or Goggles

      iv. Double gloves
2. Follow all **donning and doffing procedures with observer-ensured compliance and hand hygiene.**

3. Minimize number of clinicians in the room needed to complete the airway management or invasive procedure situation.
   a. SARS experience revealed that cross contamination was highest when > 3 people were in the room.

4. Complete all procedures that the patient requires sequentially to avoid additional staff exposures (i.e. IV access, airway management, OG/NG tube placement, Foley catheter, etc)

5. Wash hands **IMMEDIATELY** before and after completing the necessary procedures.

6. Consider debriefing with the care team after each resuscitation.

7. Follow LifeFlight of Maine SOP for post-flight cleaning procedures of aircraft, ambulance and equipment.

Summary:

In an effort to minimize exposures to healthcare staff and ensure quality resuscitation of patients with suspected or confirmed COVID-19 coronavirus disease, it is essential to follow these three pillars of care:

I. Minimize virus aerosolization.

II. Maximize efficient airway management.

III. Minimize personnel exposure by wearing appropriate personal protective equipment and following infection control procedures.

References


Appendix 1.
LifeFlight of Maine
The treatment of patients with respiratory distress with COVID 19

Supplemental Oxygen Support

1. Goals of therapy:
   a. Maintain target \( \text{SPO}_2 \) 92% to 96%
      i. Target \( \text{SPO}_2 \) 88% to 94% in patients with oxygen dependent chronic obstructive pulmonary disease.
   b. Maintain stable work of breathing
      i. Goal respiratory rate less than 24 breaths per minute
      ii. Target normal respiratory effort (no sign of accessory muscle use or obvious increased respiratory work).

2. Supplemental oxygen support
   a. Initial oxygen delivery should be nasal cannula to titrate from 1 L to 6 L per minute to meet goals of therapy.
      i. A surgical mask should be placed over the nasal cannula
   b. If goals of therapy are not met at 6 L per minute nasal cannula, then advance to either:
      i. Oxymizer
         1. Initiate at 6 L per minute.
         2. Titrate to a maximum of 12 L per minute to meet goals of therapy.
         3. A surgical mask should be placed over the oxymizer.
      ii. Venturi mask
         1. Initiate at 12 L per minute and with FiO\(_2\) of 40%
         2. Titrate to a maximum of an FiO\(_2\) of 60%
         3. A surgical mask should be placed over the Venturi Mask

3. Considerations during oxygen support escalation
   a. Clarify goals of care and appropriateness of ICU hospitalization prior to escalating transfer of patient and pursuing definitive airway placement.
   b. Be aware that clinicians may use a form of awake proning in selected patients.
   c. Consider the rate of change of oxygen escalation as well as pre-existing cardio pulmonary disease in determining threshold for interfacility transfer (i.e. a patient with chronic obstructive pulmonary disease with a baseline supplemental oxygen requirement).
   d. If the \( \text{SPO}_2 \) is less than 92% or there is unstable work of breathing on an oxymizer at 12 L per minute or Venturi mask with an FiO\(_2\) of 60%, consider intubation:
      i. Discuss with sending and receiving clinicians.
      ii. If there is any disagreement in the management of the patient in respiratory distress, consider discussion with LifeFlight of Maine Medical Director.
      iii. Referred to appendix 2: RSI checklist for patients with special respiratory precautions.

Note: Adopted from Brigham and Women’s Hospital Covid 19 Management Guidelines.
Appendix 2. Modified LifeFlight of Maine RSI Checklist for Special Respiratory Precautions (SRP)

**GOALS:** minimize aerosolization, maximize efficient airway management, minimize personnel exposure

**PLAN**

**Premedication**
Confirm medications and doses. Draw into appropriately labeled syringes.

**Induction agent & Muscle Relaxant**
Confirm medications and doses. Draw into appropriately labeled syringes.

*Note: Rocuronium dosing is 1.5mg/kg IBW*

**Post-intubation medications**
Confirm appropriate analgesic and sedative medications and draw into labeled syringes.

**Failed Airway plan**
Verbalize have equipment in appropriate location with assistant.

**Team roles**
Clarify as a crew & out of room resource person designated with limited staff.

**PREPARATION**

**Preoxygenation & Denitrogenation**
Non-rebreather mas (keep mask snug) at 15lpm with nasal cannula with flow up to 5lpm. Place surgical mask to minimize aerosolization. At minimum, 3-5 min preoxygenation is required. If additional time is available, consider further additional time with supplemental oxygen. BVM with HEPA filter **ONLY** if clinically required with low volume with higher rate, ensure good seal with two-handed technique/non-vented BiPAP mask. Ensure PEEP valve is in place.

**Reliable IV access**
IV fluids and appropriate pressors prepared.

**Assess for dentures**
check

**HELP position/c-spine plan**
check

**SpO2/monitor visible**
check

**Suction tested**
check

**EQUIPMENT**

**To go into the room**
Functioning CMAC and blade with functioning BVM for post procedure BVM w/PEEP valve (consider BiPAP mask). ETT w/bougie and 10ml syringe. Viral filter (May be the same as used for both BVM and ventilator). Non-rebreather mask and nasal cannula. Digital EtCO2 detector
Clamp for Endotracheal tube.
Commercial endotracheal tube securing device

Note: Ventilator set up: Ballard > HEPA filter > EtCO2 > Vent circuit > viral filter > ventilator in standby mode.

Set up in non-contaminated space:
Backup Direct laryngoscopy device and second endotracheal tube
Backup BLS airways including OPA’s and NPA’s
Supraglottic airway devices.
Cricothyrotomy kit

**SRP RSI Procedure**

**PLAN**
- Consider early RSI intubation in high risk patients, minimize personnel in room
- If available, consider negative pressure room/keep door closed in regular room
- Maximize first pass success and brief backup plans
- Assistant with PPE outside door with additional equipment ready
- Complete procedures sequentially to minimize exposure risks
- Discuss CPR plan; consider prioritizing ABC. Start CPR with NRB only, stop compressions ASAP and intubate, proceed with ACLS
- PPE: PAPR/N95 with surgical mask on top, gown/suit, face shield and/or goggles, double gloves

**PROCEDURE**
- Preoxygenate in progression as required by clinical condition, aim for 3-5 minutes
  - NRB at 15L/m and NC at 5L/m with superimposed surgical mask if possible.
  - BVM with HEPA filter and PEEP valve only if clinically required, with lower volume breaths at higher frequency.
  - Consider two-hand mask technique or a non-vented BiPAP mask, ensure tight-fit.
- If able avoid manual ventilations after induction. Expect desaturation. Allow adequate time for NMBA onset
- Consider VL on first attempt with most experienced clinician.
- Anticipate that the patient may become hypoxic briefly during intubation procedure.
- Inflate cuff prior to ventilation
- Confirm tube placement with EtCO2
- Limit disconnects, time at end-expiration and have ventilator on standby until connection verified.
  - Consider clamping the ETT during the transfer from the bag valve mask to the ventilator.
- If unable to intubate with ETT, SGA device is a marginal alternative. Be sure to cover the OG port if there is one on the device.
- Sanitize and change outer gloves immediately post procedure
- Be prepared to dial PEEP quickly to facilitate alveolar recruitment. Many patients are ultimately require levels greater than 10 with concurrent elevated levels of FiO2.
- Avoid nebulized medications and opt for MDI if available
Appendix 3
LifeFlight of Maine

Ventilatory Management of patients with COVID 19.

Note: There has been significant discussion around the exact strategy around ventilation of patients diagnosed with respiratory failure secondary to Covid-19. Although there are a variety of hypothesis on the ideal strategy to use on this population of patients, local tertiary care systems in Maine and New England are still applying that of the ARDSnet protocol. For this reason, LifeFlight of Maine will continue to utilize this ventilation strategy until both the literature has demonstrated that other options optimize patient care and the local healthcare intensive care providers adopt different care plans.

Initial ARDS ventilation settings

1. Set mode to volume control (AC/VC)
2. Set initial tidal volume (Vt):
   a. VT equals 6 ML/KG (based upon ideal body weight from ARDSnet table, see below).
      i. IBW men (kg) = 50 + 2.3 (height in inches - 60)
      ii. IBW women (kg) = 45.5 + 2.3 (height in inches - 60)

<table>
<thead>
<tr>
<th>MALES</th>
<th>FEMALES</th>
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<tbody>
<tr>
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3. Set initial respiratory rate
   a. Typical starting rates will be 16 to 24 breaths per minute titrated to goal minute ventilation of 5 to 8 L per minute
   b. Consider starting rate of 24 to 28 breaths per minute titrated to goal minute ventilation of 8 to 12 L per minute in setting of acidosis (pH less than 7.25) pre-intubation
4. Set an initial pEEP based upon BMI empirically chosen targets
   a. BMI less than 35: PEEP of 5
   b. BMI greater than or equal to 35: PEEP of 10
5. Initial FiO₂: 100% on the intubation then rapidly ween SPO₂ to 92–96% (Barrot et al, N Engl J Med, 2020)

Determining PEEP and mechanics
1. Titrate FiO₂ and PEEP for oxygenation
2. Initiate PEEP based upon BMI then titrate PEEP for FiO₂ to target oxygenation SPO₂ 92–96% per the following guidelines.
   a. BMI less than 35: titrate pEEP and FiO₂ per the ARDSnet low BMI table

<table>
<thead>
<tr>
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<th>0.4</th>
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<td>16</td>
<td>18</td>
<td>18-24</td>
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   b. BMI greater than or equal to 35: titrate PEEP and FiO₂ as per the ARDSnet high PEEP table.

<table>
<thead>
<tr>
<th>FiO₂</th>
<th>0.3</th>
<th>0.3</th>
<th>0.3</th>
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<table>
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<td>20</td>
<td>22</td>
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3. If SPO₂ is less than 96% or greater than 96%, then titrate PEEP an FiO₂ to according to High PEEP ARDSnet that table as per BMI.
4. Special consideration: anecdotal reports of COVID-19 patients describe a compliant, higher PEEP dependent phenotype in which people management may not strictly adhere to specified ARDSnet tables (i.e., The FiO₂ 0.4 to 0.5, but does not tolerate PEEP less than 10)
5. Avoid elevated plateau pressures (with goal less than or equal to 30), particularly if using higher PEEP table.
6. Obtain respiratory mechanics:
   a. Plateau pressure
   b. Static compliance
Sedation and ventilator synchrony

1. Treat pain, agitation and delirium
2. The LifeFlight of Maine CCTTP protocols as outlined in:
   a. CCTTP 2.5: Post intubation sedation, pain control, and muscle relaxants
3. Strategies include “pain first” approach (both assessment and treatment).
4. Use the lowest dose that can achieve the desired effect.
5. Note: Many preferred medications may change as drug availability and shortages exist.
   a. In general, bolus strategy of benzodiazepines and opiates are preferred to continuous infusions.
   b. Discuss with sending and receiving clinicians to determine if a bolus strategy or infusion strategy is indicated for medications.
6. If the patient is on a continuous infusion, buses should be administered prior to starting the infusion as well as when infusions are titrated up
7. Achieve ventilator synchrony in order to reduce ventilator induced lung injury
   a. Following rapid sequence intubation, ensure analgesia and sedation is started as paramedics may be active to target a RASS score of -2 to -3.
   b. After paralytics are metabolize, assess patient synchrony with the ventilator (evidence of breast stacking, double triggering, and other ventilator alarms
   c. If synchronous, Layton sedation to lowest levels that maintain synchrony, ideally RASS score of zero to -1
   d. If not synchronous, escalate sedation as needed to achieve synchrony regardless of RASS score
   e. If the patient remains disinterest despite deep sedation (RASS score of -4 to -5), initiate paralytic and continue neuromuscular blockade to ventilator synchrony.

Medications:

1. Analgesics
   a. Refer to CCTTP 2.5 Post intubation sedation, pain control, and muscle relaxants
2. Sedation
   a. Refer to CCTTP 2.5 Post intubation sedation, pain control, and muscle relaxants
3. Muscle Relaxants
   a. Refer to CCTTP 2.5 Post intubation sedation, pain control, and muscle relaxants
   b. Additional reference for clinicians for noted alternative muscle relaxants that staff may encounter with patients with Covid-19
## Types of Muscle relaxants / Paralytics with associated Pharmacokinetics

<table>
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<th>Cisatracurium</th>
<th>Vecuronium</th>
<th>Rocuronium</th>
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<td><strong>Duration/recovery</strong></td>
<td>80-180</td>
<td>30-60</td>
<td>20-30</td>
</tr>
<tr>
<td><strong>Renal excretion (%)</strong></td>
<td>Hoffman Elimination</td>
<td>50</td>
<td>20-30</td>
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<td><strong>Effect renal failure</strong></td>
<td>No change</td>
<td>Increased, especially metabolites</td>
<td>Minimal</td>
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<tr>
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<td>Hoffman Elimination</td>
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<td>&lt;75</td>
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<td>Moderate</td>
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<tr>
<td><strong>Histamine release</strong></td>
<td>No</td>
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</table>

**Note:** Adopted from Brigham and Women’s Hospital Covid 19 Management Guidelines.