Care for the Critically Ill COVID-19 Patient

Institute for Critical Care Medicine
Division of Pulmonary, Critical Care and Sleep Medicine
Mount Sinai Hospital
Outline

- COVID-19 basics
- PPE donning / doffing
- COVID-19 unit workflow
- Recognizing / managing respiratory failure
- Shock / sedation management
- Cardiac arrest
COVID-19 Basics

- **Level of Care:**
  - Patients with confirmed COVID-19 with rapidly increasing O₂ requirements, non-rebreather, or NIV should be carefully monitored

- **PPE (PUI & COVID-19 patients):**
  - In patient room: surgical facemask, face shield / goggles, isolation gown, gloves
  - N95 (instead of surgical facemask) is used for aerosol-generating procedures (e.g., intubations, cardiac arrest, chest physiotherapy) and also in rooms with PUI/COVID+ patients on HFNC/BiPAP/mechanical ventilator
  - Isolation gown: offers full protection against droplets; same gown can be worn when interacting with COVID-19 patients in isolation cohort (discard if visibly ripped or soiled)

- **Patient Room:**
  - Isolation designation: special droplet + contact precautions
  - If requiring frequent aerosolized procedures (e.g., HFNC, BiPAP), transfer to negative pressure room if available
  - Cohorting is allowed for COVID-19 positive patients; NOT allowed for PUI (must be single room)

- **Patient Visitors:**
  - No visitors
  - Patients can video chat with family and friends using hospital smart tablets
  - Daily phone calls to families by critical care team to provide medical updates

- **Patient Transport:**
  - Necessity should be confirmed by MD prior to transport
  - Non-intubated patients should wear a facemask, nasal cannula under facemask, or nonrebreather during transport
  - Intubated patients should be transported with viral filter
  - Staff transporting patient should wear a mask

- **Personal clothing & equipment:**
  - Use ONLY disposable stethoscopes
  - Clean personal devices, phone, pager frequently with rubbing alcohol
COVID-19 Basics

LABORATORY TESTING
- Obtain procalcitonin, LDH, CRP, ferritin in addition to routine testing
- In critically ill patients, consider arterial line to aid ABGs, blood draws, BP monitoring, minimize staff exposure

IMAGING
- Consider utility of bedside and other imaging/diagnostic studies in context of personnel exposure and potential for equipment contamination
- Batch indications for CXR together (i.e., intubation, central line, NGT)
- Consider use of bedside ultrasound for evaluation of lung pathology and assessment for cardiomyopathy
- Limit use of CT scans when possible

RESPIRATORY SUPPORT
- Limit use of aerosol-generating modalities whenever possible (e.g., nebulized medications)
- Use MDI instead of nebulized medications
- Supplemental oxygen if SpO₂ <92%
  - Nasal cannula and non-rebreather masks may be used as usual
  - A monitored trial of Non-Invasive Ventilation (HFNC & BiPAP with filter on exhalation port). Patient ideally would be in an airborne isolation room and HCP would use N95 instead of surgical mask for PPE
  - BiPAP should have a HEPA filter on exhalation port
COVID-19 Basics

**INTUBATION:**
- N95 instead of surgical mask, face shield, double gloves, gown, and hat
- Plan for rapid sequence intubation by experienced physician
- Minimize people in room during intubation to limit exposure

**VENTILATOR MANAGEMENT**
- Initiate all patients on low tidal volume ventilation immediately (4-6cc/kg IBW)
- Goal SpO2 no higher than 94%
- Consider moderate to high PEEP (minimize plateau) strategy
- If ventilator dyssynchrony or persistent high plateau pressures
  - Increase sedation to goal RASS -4/-5, then consider neuromuscular blockade
- If P/F <100: consider early prone position ventilation; Consider inhaled epoprostenol if persistently hypoxemic despite neuromuscular blockade
- ECMO team should be consulted when proning is being considered so team can be mobilized quickly if the patient declines

**SEDATION:**
- May require more sedation (slower response because of donning PPE)
- Daily Spontaneous Awakening Trials with HCP in room
OTHER PROCEDURES

- Consider
  - NGT at time of intubation to assess placement using same CXR
  - Arterial line to facilitate blood draws and reduce contact time
  - Central line if requiring pressors / difficult veins
- Procedures should be performed by an experienced physician (to minimize exposure)
- 2 providers (2 MDs or MD + RN) should be in the patient’s room for the duration of the procedure
- If increased risk of aerosolization, use N95
- Non-disposable equipment (e.g. ultrasound) should be wiped down with hydrogen peroxide wipes in the room (>2min contact time). Repeat after exiting room.
- Avoid bronchoscopy unless absolutely necessary (high risk of aerosolization)

HEMODYNAMIC MANAGEMENT

- Use multimodal assessment strategy (skin temp, capillary refill, lactate) to guide fluid resuscitation
- Conservative fluid strategy, keep net negative, avoid maintenance fluids
- Prefer buffered crystalloids over colloids/unbalanced crystalloids
- Target MAP 60-65 using levophed as first-line agent, and vasopressin if 2nd agent needed
- If shock with cardiac dysfunction despite IVF and levophed, add dobutamine or epinephrine
- If refractory shock or chronic steroid use, consider stress dose steroids (hydrocortisone 50mg q6h)
- Be mindful of the potential for development of cardiomyopathy in COVID-19 patients
PHARMACOLOGIC TREATMENT

- Acetaminophen for **fever** (no clear evidence that ibuprofen can make COVID-19 worse, can avoid if concerned)
- **Bacterial co-infection may occur**, treatment of bacterial pneumonia should be based on clinical suspicion (CAP or HCAP as appropriate). Consider stopping antibiotics after 48-72 hours if no evidence of infection
- **Viral co-infection is rare**, but may occur.
- **Nebulized medications** should be avoided whenever possible; use MDI instead
- Multiple clinical trials for experimental COVID-19 treatments, discuss with ID team

CARDIAC ARREST

- Don PPE before entering room, **N95**, eye protection, **hat**, gown, **double** gloves; room door remains closed
- If patient is already intubated, perform CPR on VC mode with FiO2 100%
- Use automated external compression device (LUCAS) if available
- **Hold compressions during intubation** to minimize aerosolization
PPE
Donning PPE

- Perform **hand hygiene**
- Don **yellow gown**
- Tie straps on the **side** of your body
- Put on **mask**
- *Pinch* nose to ensure tight fit

If aerosolizing procedures or patient is intubated or on HFNC or BiPAP, use N95 instead of surgical mask

- Put on **eye protection** (face shield or goggles)
- Put on **gloves**
  - Make sure thumbs are in gown thumb hole
  - Gloves *over* yellow gown so **no skin exposed**

*Remember that your safety is paramount*  
*Even in a crash scenario, you should NEVER enter a room without appropriate PPE*
1. Untie gown
2. Roll off gown **inside-out** into a bundle, peeling off **gloves at the same time**. (bare hands touch only the inside of gown)
3. Discard
4. Perform hand hygiene
COVID-19 Unit Workflow
COVID-19 Unit Admission

- Medication reconciliation of home meds
  - collateral from family/nursing homes/outpatient pharmacies/prior discharge meds

- Identify the health-care proxy and/or surrogates
  - confirm accurate phone numbers
  - obtain advance directives (if patient is incapacitated)
  - Document in an Advanced Care Planning note in the Advanced Care Planning Tab
Pre-Rounding / Rounding in the COVID-19 unit

- **Step 1:**
  - Get **signout** from the overnight team on new admissions and major overnight events

- **Step 2:**
  - EPIC **pre-rounding** for vitals, labs, drips, blood gas, vent support required, new microbiology data, in’s/out’s
  - Make note of **trends** (e.g., increasing pressor or FiO2 requirement)

- **Step 3**
  - **Examine** patients
Sample Presentation for Rounds

1. Overnight events
2. Vital signs: blood pressure and oxygenation should be reported in context of pressor dose and ventilator settings
3. Drips: vasopressors, sedatives, increasing/decreasing dose
4. Medications: antibiotics (day x of y), COVID-19 directed treatment

Example:
"Levophed increased to 18 mcg and vasopressin added to maintain MAP 65. Ventilator settings are unchanged from yesterday (VC FiO2 70%, PEEP 14), maintaining similar oxygenation SpO2 92%; ABG 7.35, pCO2 50, PaO2 67. Propofol increased to 40mcg/hr to achieve RASS -4 for ventilator synchrony"
Recognizing and Managing Acute Hypoxemic Respiratory Failure
Recognizing Acute Hypoxemic Respiratory Failure

Assessing Patient's Respiratory Status

- Vitals: Heart Rate, Respiratory Rate, SpO2
- Physical exam: grimacing, abdominal / accessory muscle use, tachypnea
- ABG: pH / pCO2 / pO2 / lactate, contextualize with amount of O2 support

Warning Signs of Respiratory Decompensation

- Rapidly escalating O2 needs (e.g., room air --> 6L NC--> NRM over a few hours)
- Hypoxemia despite escalating O2 therapy
- Respiratory distress: tachypnea, accessory muscle use, short sentences

Non-invasive ventilation support

- A trial of Non-Invasive Ventilation (HFNC and BiPAP) can be given with close monitoring for lack of clinical improvement
- Patients with increased work of breathing or persistent hypoxia despite high level of non-invasive support should be intubated

Note that these patients have very little reserve and can decompensate QUICKLY
BE VIGILANT AND ESCALATE YOUR CONCERNS EARLY
General Intubation Principles

- Minimize exposure / aerosolization
  - Rapid Sequence Intubation by the most experienced provider
  - Minimal number of providers in the room (should be 2-3 at most)
  - Avoid: awake intubation, LMA use

- If possible, optimize patient / room before intubating
  - Pre-oxygenate
  - Ensure patient has reliable IV access, suction
  - RT sets up ventilator in room before intubation
  - Prepare medications and intubation equipment outside of room. Only bring in what is necessary
Intubation Check List:
- Working IV, ideally two
- BVM (± PEEP Valve) on oxygen
- Waveform Capnograph on BVM
- Video Laryngoscope
- Backup Laryngoscope
- ET tube the size your plan to use and one size smaller
- ET tube stylet
- Oral airway
- Bougie
- LMA sized for the patient
- Suction
- NRB for pre-oxygenation
- Nasal Cannula for Apneic Oxygenation
- Paralytic (succinylcholine 1-1.5 mg/kg or rocuronium 1.2 mg /kg)
- Induction Agent (suggest ketamine 1-2mg/kg or etomidate)
- Flushes
- Post intubation sedation (hydromorphone or midazolam) (setup on PCA or pump)
- Orogastric tube
- Norepinephrine on pump only if needed
- Bolus dose of phenylephrine
Ventilator Basics

- Goal: Support oxygenation and ventilation by improving O2 & removing CO2
- Most patients will be on Volume Control (i.e., VC mode)
  - Oxygenation controlled by setting the FiO2, PEEP
  - Ventilation controlled by Tidal Volume (Vt), Flow, Respiratory Rate

Lung-Protective Ventilation Settings

- GOAL: SpO2 > 90%, pH > 7.3, while minimizing ventilator induced lung injury
- **Low Tidal Volume**: Ideal Body Weight (IBW) x 6cc/kg
  - e.g., 60kg IBW → tidal volume of 360cc
- **Respiratory Rate**: titrate based on pH / PCO2.
  - e.g., if acidemic → increase RR to blow off CO2
- **FiO2**: Start with 100% and slowly wean down
- **PEEP**: Start with highest PEEP tolerated for plateau pressure ~30
- **Most patients will need to start at high vent settings**
  - e.g., 100% FIO2 and PEEP >10

<table>
<thead>
<tr>
<th>FiO2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
<th>0.5</th>
<th>0.6</th>
<th>0.7</th>
<th>0.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP</td>
<td>5</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FiO2</th>
<th>0.7</th>
<th>0.8</th>
<th>0.9</th>
<th>0.9</th>
<th>0.9</th>
<th>1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEEP</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>16</td>
<td>18</td>
<td>18-24</td>
</tr>
</tbody>
</table>
A close-up look…

Actual output as measured by the ventilator. This is what the patient is doing.

Pressure-time and flow-time curves

Vent settings:
f = respiratory rate
Vt = Tidal volume
Vmax = Flow in Liters per minute

Inspiratory and expiratory hold buttons
Inspiratory pause measures plateau pressures
Expiratory pause measure autoPEEP
Oxygenation Goals

- SpO2 88-94%, PaO2 ≥ 55
- Preferentially wean FiO2 before weaning PEEP, per the ARDS Network PEEP ladder
- e.g., FiO2 must decrease to 50% before you can wean PEEP down to 8

Management of Refractory Hypoxemia

- Neuromuscular blockade to rest their lungs completely
- P/F <100: Prone position ventilation
- P/F < 80: ECMO evaluation
- Inhaled epoprostenol or inhaled nitric oxide therapy
Evaluating / managing a desaturating intubated patient

- Confirm a good SpO2 waveform
- Make sure vent is connected
- Increase FiO2 to 100%
- Check peak inspiratory pressure / plateau pressure
- Lung ultrasound to evaluate for lung sliding and other pathology
- If decide to bag valve mask:
  - Endotracheal tube must be connected to a HEPA filter
  - You must be use N95 respirator
Shock & Sedation
Shock

- Adequate volume resuscitation?
  - If net negative: assess fluid responsiveness with small bolus (e.g., 250cc)

- If MAP<65 despite adequate resuscitation → vasopressor
  - First line: Norepinephrine
  - Second line: Vasopressin (e.g., norepinephrine > 20 mcg/min)
  - Avoid dopamine – increase risk of arrhythmias

- If norepinephrine dose >15mcg/min, can add stress dose steroids
  - Hydrocortisone 100mg bolus, then 50mg q6h
  - +/- Fludrocortisone
Sedation of Intubated COVID-19 patients

- If having ventilator dyssynchrony +/- hypoxemic
  - Sedate heavily (goal RASS -4/-5)
  - When oxygenation improves and patient is a candidate for spontaneous breathing trials (SBT) → lighten goal RASS to -1 to 0 (alert awake)

- Sedatives
  - Propofol
  - Opiates: Fentanyl/Dilaudid

- If agitated delirium during SBT --> consider dexmedetomidine (Precedex)

- Avoid if possible: Benzodiazepines
  - Versed is least preferred due to delirium, however may be needed for adjunctive therapy if propofol / dilaudid is insufficient or having adverse reaction from either
The hallmark of good critical care medicine is attention to preventable harms, which include:

- **DVT prophylaxis**
  - lovenox or subcutaneous heparin
- **GI prophylaxis for patients on mechanical ventilation**
  - H2 blocker or PPI
- Antibiotic, lines, catheter de-escalation – consider daily
- Early enteral nutrition with tube feeds
- Glycemic control (goal FSG 120-180)
- Net even or net negative fluid balance once adequately volume resuscitated
- Bowel movements on opioids
Cardiac Arrest
Cardiac Arrest of the COVID-19 patient

- Assign code team roles at the beginning of the shift
- Do not enter room until donned in proper PPE
  - **N95**, eye protection, gown, hat, gloves
- Minimize number of staff in room (up to 5 total)
  - Code leader: MD
  - Medication administrator/log keeper: RN
  - If no LUCAS, chest compressions: 2 RN or MD’s
  - If patient requires intubation: RT
- Outside room
  - Two staff members to retrieve medications/supplies, observe for PPE breach
- Airway
  - If already intubated: put on VC mode, FiO2 100%
  - If not intubated:
    - BVM: ensure proper seal, must have HEPA filter
    - hold compressions during intubation to minimize exposure
Ventricular Fibrillation

- Start CPR immediately
- Defibrillate as soon as possible
- Epinephrine, 1 mg Q3 min
- Antiarrhythmic agents-Amiodarone 300 mg followed by 150 mg

Pulseless Electrical Activity and Asystole

- Search for reversible causes H’s and T’s
- Epinephrine, 1 mg Q3 min
Bradycardia

- Transthoracic/Transvenous pacing
- Atropine
- Epinephrine

Stable Narrow Complex Tachycardia

- Vagal maneuvers
- Adenosine
- Diltiazem
- β-Blocker
Unstable Tachycardia

- Initiate immediate cardioversion if the patient is unstable
- Use synchronized mode
- Premedicate if possible

Stable Wide Complex Tachycardia

- Amiodarone
- Magnesium (for torsades)
- Cardioversion