COVID – 19

Critical Care Primer
This document is intended to serve as a cursory guide and reference for non-ICU providers who, in the context of relative austerity, are tasked with the management of patients in need of ICU level care. It’s focus is on the management of patients afflicted with COVID-19 who require mechanical ventilation. It is in no way intended to establish policy.
Please remember to protect yourself

On-line Resources
(available only on UPHS network)
- PPE Video
- PAPR & PPE Checklist
- N95 Appropriate Use
COVID-19 Background

- **Non-Severe**: Asymptomatic, mild disease
- **Severe**: Hypoxemia, dyspnea
- **Critical**: Respiratory Failure, shock

- 81% Non-Severe
- 14% Severe
- 5% Critical
COVID-19 Background

- Older patients and those with comorbidities (i.e. cardiovascular disease, pulmonary disease, diabetes mellitus) are at high risk for severe disease, rapid progression / deterioration, and mortality. Yet this is not a disease exclusive to these groups.

- Evidence shows that pulmonary compliance may be normal (> 40 mL/cmH₂O)

- However, hypoxemia can be profound requiring PEEP titration

- Patients may develop myocarditis
COVID-19 Background

Symptoms:

- Cough: 60-85%
- Fever: 43-98%
- Dyspnea: 20 – 40%
- GI: 10%

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Coronavirus*(COVID-19)</th>
<th>Cold</th>
<th>Flu</th>
<th>Seasonal Allergies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of symptoms</td>
<td>7-25 days</td>
<td>Less than 14 days</td>
<td>7-14 days</td>
<td>Several weeks</td>
</tr>
<tr>
<td>Cough</td>
<td>Common (usually dry)</td>
<td>Common (mild)</td>
<td>Common (usually dry)</td>
<td>Rare (usually dry unless it triggers asthma)</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>Sometimes</td>
<td>No**</td>
<td>No**</td>
<td>No**</td>
</tr>
<tr>
<td>Sneezing</td>
<td>No</td>
<td>Common</td>
<td>No</td>
<td>Common</td>
</tr>
<tr>
<td>Runny or stuffy nose</td>
<td>Rare</td>
<td>Common</td>
<td>Sometimes</td>
<td>Common</td>
</tr>
<tr>
<td>Sore throat</td>
<td>Sometimes</td>
<td>Common</td>
<td>Sometimes</td>
<td>Sometimes (usually mild)</td>
</tr>
<tr>
<td>Fever</td>
<td>Common</td>
<td>Short fever period</td>
<td>Common</td>
<td>No</td>
</tr>
<tr>
<td>Feeling tired</td>
<td>Sometimes</td>
<td>Sometimes</td>
<td>Common</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Headaches</td>
<td>Sometimes</td>
<td>Rare</td>
<td>Common</td>
<td>Sometimes (related to sinus pain)</td>
</tr>
<tr>
<td>Body aches and pains</td>
<td>Sometimes</td>
<td>Common</td>
<td>Common</td>
<td>No</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>Rare</td>
<td>No</td>
<td>Sometimes for children</td>
<td>No</td>
</tr>
</tbody>
</table>

*Information is still evolving. **Allergies, cold, and flu can all trigger asthma, which can lead to shortness of breath. COVID-19 is the only one associated with shortness of breath on its own. Sources: Asthma and Allergy Foundation of America, World Health Organization, Centers for Disease Control and Prevention
COVID-19 Background

- Labs: 80% with leukopenia / lymphopenia, elevated BUN/Scr, and elevated AST/ALT/Tbili
- CXR: hazy bilateral, peripheral opacities
- CT: ground glass opacities, consolidation
  - Rarely unilateral
- Lung Ultrasound (POCUS): numerous B lines, pleural line thickening, consolidation with air bronchograms
Epic banner
Initial Management (Levels of PPE)

Droplet / Contact

• “Golden Ticket to Test” / “Under Investigation”

Airborne / Contact

• Confirmed COVID-19 (“Presumptive Positive”)
• High risk procedure
  • Intubation
  • NIPPV
  • Bronchoscopy
Initial Management

- Focus on protecting the team due to the risk of aerosolization with respiratory interventions!
- Refer to UPHS ICU and Respiratory Care Guidelines
- In general, intubation if $\text{SpO}_2 < 92\%$ on 6 L NC and e/o of dyspnea
- Avoid nebulizers, pulmonary vasodilators
- Minimize NIPPV and bronchoscopy

Intubate early (Overhead anesthesia STAT for all intubations)

- Anticipate the extra time required for anesthesia to don PPE
- Have PPE ready for anesthesia
- Ideally perform in a negative pressure room
Initial Management

**MONITOR**

Monitor for deterioration focus on:

- SpO₂ (resp rate not always raised to compensate)
- Mental state
- Hemodynamic deterioration
- Trial of CPAP/BIPAP in negative pressure rooms only

**EARLY INTUBATION**

- Early intubation if SpO₂ < 92% on 6L O₂
- NIV or high-flow nasal cannula only in negative pressure rooms. Time-limited trials (1-2 hrs) reasonable, but may not avoid ultimate intubation
- Call anesthesia as soon as possible
- Controlled intubation with appropriate PPE in negative pressure room (if patient can tolerate being moved)
- Use colorimetric CO₂ detector
- Anesthesia team should place orogastric tube
Intubation Guidelines for Patients with known or suspected COVID-19 disease

Please review the material and use appropriate isolation precautions. Plan ahead as it takes time to apply all the barrier precautions.

**BEFORE**

1. **Prior to intubation**: Review and practice donning and doffing the appropriate respiratory protection, gloves, face shield, and clothing. Pay close attention to avoid self-contamination.
2. **Before and after all procedures**: Practice appropriate hand hygiene.

**DURING**

3. **Clothing**: Wear gown, gloves, and a PAPR or fit-tested N95 respirator + face protector such as a shield.
   *PAPR: powered air-purifying respirator*
4. **Staffing**: Limit the number of healthcare providers in the room where the patient is to be intubated.
5. **Monitoring**: Check standards, i.e., access, instruments, drugs, ventilator and suction.
6. **Considerations**: Avoid awake fiberoptic intubation unless specifically indicated. Atomized local anesthetic might aerosolize the virus. Consider using a video laryngoscope.
7. **Plan for rapid sequence induction (RSI)**: RSI may need to be modified, if patient has very high alveolar-arterial gradient and is unable to tolerate 30 s of apnea, or has a contraindication to succinylcholine. If manual ventilation is anticipated, small tidal volumes should be applied.
8. **Oxygenation**: 5 minutes of preoxygenation with oxygen 100% and RSI to avoid manual ventilation of patient's lungs and potential aerosolization of virus from airways.
9. **Check filter**: Ensure bacterial/viral high efficiency hydrophobic filter placed between facemask and breathing circuit or between facemask and resuscitation bag.
10. **Intubate**: Intubate and confirm correct position of tracheal tube.
11. **Ventilate**: Institute mechanical ventilation and stabilize patient.

**AFTER**

12. **Clean equipment**: All airway equipment must be decontaminated and disinfected according to appropriate hospital policies.
13. **Remove protective equipment**: Avoid touching hair or face before washing hands.
14. **Before and after all procedures**: Practice appropriate hand hygiene.
Bacterial and viral filter

- Place Bacterial/Viral filter between BVM and mask or ETT
- Pictured: Hudson RCI Bacteria/Viral Filter (REF: 1605)

- If this product is not used, please ensure you are using a product with the following: Bacteria Filtration Efficiency (BFE): 99.999+% and Viral Filtration Efficiency (VFE) 99.99+%
**Pulmonary Goals on Mechanical Ventilation**

**Oxygenation**
- \( \text{SpO}_2 \) 90 – 95%
- \( \text{PaO}_2 \) 60 – 80 mmHg (though limit lab draws)

**Airway pressure**
- \( \text{pPLAT} \leq 30 \text{ cmH}_2\text{O} \)

**pH goals**
- 7.20 – 7.45
Key Ventilator Terms

- **AC/VC**: Assist control ventilation. This is the mode of ventilation most commonly used. The provider sets rate, tidal volume (VT), PEEP, and FiO₂. If there is respiratory effort the patient receives the set VT with every initiated breath.

- **Compliance** (pulmonary compliance): Describes the degree of flexibility of the lungs and thoracic cavity. A more compliant lung can tolerate higher volumes without dangerous increases in pressure. COVID-19 lungs generally have normal compliance.

- **FiO₂**: Fraction of inspired oxygen. The percentage of oxygen you set the vent to deliver.

- **Minute Ventilation**: The amount of gas in liters moved in a minute. Increasing minute ventilation by increasing rate or VT will generally improve CO₂ clearance.

- **NIPPV**: CPAP / BIPAP. Forms of mechanical ventilation that do not require intubation. These have high risk of provider exposure to COVID-19. At this time, we are not favoring their use for hypoxemia/respiratory distress related to COVID-19.

- **PEEP**: Positive end expiratory pressure. The ventilator will hold this set amount of pressure after expiratory flow has stopped. Increasing PEEP helps recruit lung and can help with impaired oxygenation by increasing mean airway pressure. COVID-19 patients generally tolerate and benefit from higher levels of PEEP. Start around 12. “Normal” is around 5. Caution: High PEEP may provoke hypotension especially in those who are intra-vascular volume deplete.

- **Plateau Pressure** (Pplat): The pressure measured during an inspiratory pause. This is most reflective of the distending force being applied to the lung by the delivered VT. A Pplat > 30 incurs greater risk of barotrauma (injury to the lung as a result of pressure).

- **Tidal Volume**: VT. The amount of gas you set the vent to deliver. Best practice is to set this between 6 – 8 cc/kg ideal body weight.
Initial Ventilator Settings

Mode: AC / VC
Rate: 16-20
Tidal volume: 6 cc/kg IBW
PEEP: 10-14 cmH₂O
FiO₂: 100%
Oxygenation

If not meeting oxygenation goals

Rescue Moves

Starting Point
- Increase FiO₂ (by 10%)
- Recruitment (PEEP 30 for 30 sec)
- Increase PEEP (by 2 following recruitment)

Advanced
- Neuromuscular blockade
- Prone positioning
- ECMO

ICU provider call triggers
- PaO₂/FiO₂ < 150, need for PEEP > 14 cmH₂O
Plateau Pressure

Airway pressure goal

- \( p_{PLAT} \leq 30 \text{ cmH}_2\text{O} \)

Rescue Moves

Independent

- \( P_{plat} > 30 \) ↓ \( V_T \) in 1 mL/kg steps
  - Limit: \( V_T = 4 \) mL/kg
- \( P_{plat} < 25 \) & \( V_T < 6 \) mL/kg ↑ \( V_T \) 1mL/kg steps
  - Limit: \( P_{plat} > 25 \) or \( V_T = 6 \) mL/kg
- \( P_{plat} < 30 \) & dys-synchrony ↑ \( V_T \) 1 mL/kg steps
  - Limit: \( P_{plat} > 30 \) or 8 mL/kg \( V_T \)

ICU provider call triggers

- \( P_{plat} > 30 \) & \( V_T \leq 5 \) mL/kg
- Persistent ventilator dys-synchrony, need for paralysis

Monitor q4 or with each ▲ PEEP or VT
RT or ICU provider to measure
Peak and Plateau Airway Pressures

Pressure through airways

Pressure in alveoli

Peak pressure
Airway Resistance Pressure
Plateau pressure
Alveolar Compliance Pressure
Positive End-Expiratory Pressure

All pressure above atmospheric pressure is positive airway pressure
pH

**pH goals**
- 7.20 – 7.45

**Rescue Moves**

**Independent**
- pH < 7.20 ↑ RR to 35 (monitor auto-PEEP with expiratory hold)
- pH still < 7.20 ↑ VT in 1 mL/kg steps
  - Limit: Pplat > 30 or pH > 7.25
- pH still < 7.20 give 1 amp NaHCO₃
- pH > 7.45 ↓ RR

**Advanced**
- Exceed Pplat 30

**ICU provider call triggers**
- Persistent acidemia
Hemodynamics Management

- Central line & arterial line if intubated
  - Ipsilateral access (L > R) for potential proning
- Early resuscitation in initial phase, assess with U/S, PPV, CVP
- Norepinephrine (1st line)
  - Start early / hang on standby
  - MAP goal > 65
  - Start at 2 – 4 mcg/min
- Vasopressin (2nd line)
  - Start 0.04 U/h if Norepinephrine > 10 mcg/min
- Consider myocarditis if clinical decline
  - EKG, Troponin

ICU Provider Call Triggers

- Escalating vasopressor requirement
  - ↑ Norepinephrine of > 10 mcg/min
- Concern for shock (e.g. new or worsening lactic acidosis)
- Acute clinical decline

STABILIZATION
- Insert arterial line and central line for vasopressors and blood draws as soon as possible (keep lines on one side to facilitate proning)
- Obtain norepinephrine so it can be readily started & escalated
- Assess intravascular volume to guide fluid management
- Early enteral nutrition is important
Sedation / analgesia

Management

▪ Initial sedation strategy
  ▪ Propofol:
    – Initial dose: 10 mcg/kg/min
    – Monitor triglycerides (initial then qod)
    – The downside of propofol is hypotension. Hold for profound refractory hypotension
  ▪ Fentanyl:
    – Initial dose: 25 mcg/h
  ▪ Initial goal is ventilator synchrony

Neuromuscular blockade

▪ If persistent dyssynchrony
▪ Sedate to BIS 40 – 60
▪ If no BIS sedate to RASS -4 prior to blockade
▪ Titrate to 1-2 / 4 twitches

ICU Provider Call Triggers

▪ Persistent agitation or vent dyssynchrony
▪ Triglycerides > 300
▪ Hypotension
# RASS

<table>
<thead>
<tr>
<th>Scale</th>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td>Combative</td>
<td>Violent, immediate danger to staff</td>
</tr>
<tr>
<td>+3</td>
<td>Very agitated</td>
<td>Pulls or removes tube(s) or catheter(s); aggressive</td>
</tr>
<tr>
<td>+2</td>
<td>Agitated</td>
<td>Frequent non-purposeful movement, fights ventilator</td>
</tr>
<tr>
<td>+1</td>
<td>Restless</td>
<td>Anxious but movements not aggressive, vigorous</td>
</tr>
<tr>
<td>0</td>
<td>Alert and calm</td>
<td>Spontaneously pays attention to care giver</td>
</tr>
<tr>
<td>-1</td>
<td>Drowsy</td>
<td>Not fully alert, but has sustained awakening (eye-opening/eye contact) to voice (&gt;10 seconds)</td>
</tr>
<tr>
<td>-2</td>
<td>Light sedation</td>
<td>Briefly awakens with eye contact to voice (&lt;10 seconds)</td>
</tr>
<tr>
<td>-3</td>
<td>Moderate sedation</td>
<td>Movement or eye opening to voice (but no eye contact)</td>
</tr>
<tr>
<td>-4</td>
<td>Deep sedation</td>
<td>No response to voice, but movement or eye opening to physical stimulation</td>
</tr>
<tr>
<td>-5</td>
<td>Unarousable</td>
<td>No response to voice or physical stimulation</td>
</tr>
</tbody>
</table>
Other considerations

- Other access: foley, OGT (avoid small bore due to potential drug incompatibility)
- Early Nutrition: TEN
  - Daily GI prophylaxis with lansoprazole
  - Bowel regimen, once daily
- DVT prophylaxis preferentially with daily enoxaparin
  - If contraindicated, use heparin
- Use subcutaneous insulin for hyperglycemia
  - Finger sticks every 6 hours as able
- Antipyretics for fever
- ID consult mandatory

MEDICATION ORDERS

- Antiviral medications incompatible with Dobhoff tube; orogastric Salem sump tubes preferred
- When ordering, decrease frequency where possible to decrease contacts:
  - Daily enoxaparin preferred for DVT prophylaxis; SQ heparin at Q12 hours instead of Q8 hours
  - Daily stress ulcer prophylaxis, not Q12 hours
  - Limit insulin infusions (use Q6 hour SSI)
- Order MDIs instead of nebs
Other considerations

<table>
<thead>
<tr>
<th>COMMUNICATION</th>
<th>CARE PRINCIPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Engage Penn E-Lert early (215-893-7310)</td>
<td>• Limit healthcare worker contact</td>
</tr>
<tr>
<td>• Place a telephone with speakerphone capabilities in the patient’s room, post telephone # on wall (visible by Penn E-Lert and window)</td>
<td>• Limit CXR / EKG / diagnostic testing</td>
</tr>
<tr>
<td>• Consider using a handheld dry erase board inside &amp; outside the room (visible from window)</td>
<td>• Use a “go bag” - pre-packaged bag with necessary disposable items that can easily be passed into the room (contains arterial &amp; central line kits, OG tube)</td>
</tr>
</tbody>
</table>
# Laboratory Guidance

<table>
<thead>
<tr>
<th>Lab</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Blood Gas (ABG)</td>
<td>On admission, then with clinical change or event</td>
</tr>
<tr>
<td>BMP, Mg, Phos</td>
<td>On admission then daily</td>
</tr>
<tr>
<td>CBC</td>
<td>On admission then daily</td>
</tr>
<tr>
<td>LFT</td>
<td>On admission then daily</td>
</tr>
<tr>
<td>PT/PTT/INR</td>
<td>On admission then daily</td>
</tr>
<tr>
<td>Troponin / EKG</td>
<td>On admission then QOD if negative</td>
</tr>
<tr>
<td>COVID-19 Rapid</td>
<td>On ID approval, Paper requisition (Golden Ticket)</td>
</tr>
<tr>
<td>Blood cultures</td>
<td>On admission then as indicated for fever &gt; 101.5 F</td>
</tr>
<tr>
<td>UA</td>
<td>On admission then as indicated for fever &gt; 101.5</td>
</tr>
<tr>
<td>Respiratory Viral Panel</td>
<td>On admission</td>
</tr>
</tbody>
</table>
Epic Tidbits
Epic setup

- Change login context to “HUP Critical Care Medicine MD Virtual”
- Summary Tab -> search Critical Care Rounds-> click wrench then click accept
  - Includes best practice advisories, isolation information, hemodynamic variables, respiratory monitoring, active medications, infectious trends, ins and outs, among others
Summary tab

Isolation Updates Required: Airborne, Contact, Droplet

- **Airborne**
  - Place patient in an Airborne Infection Isolation Room (negative pressure ventilation room) that meets the current guidelines
  - Verify that room is in negative pressure every shift
  - Keep doors and windows closed at all times
  - Wear NIOSH-Approved N95 mask when entering room
  - Hand hygiene must be performed before entering and leaving room
  - Prior to transport, ensure patient is wearing surgical mask and any lesions are covered
  - Provide patient and family education regarding isolation
  - For complete guidelines, please refer to the isolation protocols on the intranet.

- **Contact**
  - Place patient in a Private Room
  - Wear gown and gloves when entering room
  - Hand hygiene with soap and water when possible or use alcohol hand sanitizer before and after glove use
  - Prior to transport, notify receiving department of precautions
  - Provide patient and family education regarding isolation
  - For complete guidelines, please refer to the isolation protocols on the intranet.

- **Droplet**
  - Place patient in a Private Room
  - For complete guidelines, please refer to the isolation protocols on the intranet.
Critical care rounds
Add to summary tab
Summary

- **Airway**
  - Early and with bacterial/viral filter

- **Ventilator**
  - Volume control, 6cc/kg, PEEP \( \geq 12 \), spo2 > 88-95%

- **Hemodynamics**
  - MAP > 65, norepinephrine 1\(^{st}\)
  - Even to negative fluid balance after initial resuscitation

- **Sedation**
  - Propofol-fentanyl for ventilator synchrony until oxygenation improves
  - BIS monitoring if paralysis

- **Access**
  - Central line, arterial line, GI access (OGT), foley
Oxygenation

PaO₂ > 60 mmHg
SaO₂ > 90%

PaO₂ > 80 mmHg
SaO₂ > 95%

Yes

No

Consider Wean
↓FiO₂ 10% (min: 30%)
↓PEEP 2 (min: 10)

No

Change

Yes

No

FiO₂ > 80%
PEEP > 14
PaO₂ / FiO₂ < 150

Yes

No

Recruit:
PEEP 30 for 30
Then ↑ PEEP by 2
(CAUTION HYPOTENSION)

Call ICU Provider

↓FiO₂ 10% (min: 30%
↓PEEP 2 (min: 10)
Pplat < 30

Yes

Dys-synchrony

Yes

V_T ≥ 8cc/kg IBW

Yes

Call ICU Provider

No

Change

↑ V_T 1cc/kg IBW steps

No

No

V_T = 4 cc/kg IBW

Yes

Call ICU Provider

↓ V_T 1cc/kg IBW steps

No
pH

pH < 7.20

RR ≥ 35

Yes

Pplat > 30

Yes

↑ V_T 1cc/kg IBW steps

Give HCO₃
& Call ICU Provider

No

↑ RR to 35
(Monitor for auto PEEP/ Hypotension)

↓ RR

pH > 7.45

Yes

↓ RR

No

Monitor

No