Care for the Critically Ill COVID-19 Patient

Institute for Critical Care Medicine
and
Department of Anesthesiology, Perioperative and Pain Medicine

Icahn School of Medicine at Mount Sinai
The Mount Sinai Hospital
• Outline

- COVID-19 basics
- Recognition and care of patient who is
  - Critically ill / decompensating
  - Hypotensive
  - In acute respiratory failure
  - Mechanically ventilated
- COVID-19 unit workflow
- Assessing patients respiratory status
  - Signs and symptoms
  - Basics of blood gas analysis
  - Choice of support device: Nasal cannula (NC), Non-rebreather (NRB), High flow nasal cannula (HFNC), Non-invasive ventilation (NIV), Mechanical Ventilation (MV)
  - Escalation pathway
- Ventilator Basics
  - Intro to ventilator and settings
  - Lung protective ventilation initiation and management
  - Troubleshooting a ventilator
COVID-19 Basics

❑ **Level of Care:**
  - Lower threshold for ICU transfer
  - Patients with confirmed COVID-19 with rapidly increasing O2 requirements, non-rebreather, or NIV should be transferred to Intermediate / ICU level of care

❑ **PPE (PUI & COVID-19 positive):**
  - All common areas:
  - In patient room: surgical facemask¹, face shield, isolation gown, gloves
  - N95 (instead of surgical facemask) is used for (1) aerosol-generating procedures (e.g., intubations, cardiac arrest, chest physiotherapy) and (2) in rooms with PUI/COVID+ patients on HFNC/bipap
  - 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), will need 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
  - Encourage patients to communicate with family / friends using their own personal communication devices

❑ **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
  - No HFNC or BIPAP
  - Intubated patients should be transported on the ventilator with filter (no BMV)
  - Staff transporting patient should wear a mask
  - The receiving department should be informed that enhanced droplet and contact precautions are required

❑ **Mobility:**
  - Standard care. No ambulation outside room.

❑ **Personal clothing & Equipment:**
  - Use ONLY disposable stethoscopes
  - Clean personal devices (phone, pager, etc) frequently with rubbing alcohol
COVID-19 Basics

LABORATORY TESTING
- Inpatient testing must be approved by Infection Prevention (x89450)
- Obtain procalcitonin, LFTs, EKG in addition to routine testing
- A negative result in a symptomatic patient who is not improving and with a high suspicion for COVID-19 may represent a false negative. Consider discussing with Infection Prevention and continuing isolation in meantime
- In critically ill, consider arterial line to aid ABGs, blood draws, BP monitoring with less 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., sputum induction, nebulized medications)
- Use MDI instead of nebulized medications
- Supplemental oxygen if SpO2 <92%
  - Nasal cannula and non-rebreather masks may be used as usual
  - Avoid Venti masks due to risk of aerosolization
  - A brief and carefully monitored trial of HFNC (if unavailable, BIPAP with filter on exhalation port) is acceptable. Patient needs to be in airborne isolation room and HCP need to use N95 (instead of surgical masks) for PPE
  - If BIPAP must be used, use closed circuit V840 ventilator with a filter on exhalation port
COVID-19 Basics

INTUBATION:
- Have a low threshold for early intubation in order to avoid emergent intubations. 3 COVID-19 patients can deteriorate rapidly.
- N95 (instead of surgical mask), face shield, double gloves, blue plastic gown, hat must be used
- Plan for rapid sequence intubation by most experienced physician. Ideally 2 people (max 3) in room during intubation. (see Intubation Guidelines in APPENDIX for details)

VENTILATOR MANAGEMENT:
- Initiate all patients on low tidal volume ventilation immediately (4-6cc/kg IBW)
- Goal SpO2 no higher than 96%
- Moderate to severe ARDS (P/F<200)
- Consider high PEEP (16-22 cm H2O, plateau <30 cm H2O) strategy
- Recruitment maneuver: Pressure Control Ventilation 15 cmH2O above PEEP 30-40 cmH2O x 20 seconds; leave at higher PEEP than where you started, caution if hypovolemic - monitor for hypotension
- Sedate to RASS -4/-5
- If persistent ventilator dyssynchrony, prone ventilation, persistently high Pplateau, consider neuromuscular blocking agents (bolus preferred over continuous infusion; if no improvement, infusion x 4 - 48hr)
- Severe ARDS
- Consider early proning and consulting ECMO team (Proning Guidelines forthcoming)
- Consider inhaled epoprostenol (prefer over iNO) as a bridge to proning / ECMO
- ECMO team should be consulted when proning is being considered so team can be mobilized quickly if the patient declines. (see ECMO Guidelines in APPENDIX for details)
- MV with FiO2 >90% with: P/F < 50 for > 3h or P/F < 80 for > 6h

SEDATION:
- Keep more sedated (e.g., RASS -2 to -3, instead of 0 to -1) because of risk of self-extubation
- Daily Spontaneous Awakening Trials with HCP in room
COVID-19 Basics

OTHER PROCEDURES
- Consider (1) arterial line to facilitate blood draws and reduce contact time, (2) central line if requiring pressors / difficult veins, (3) NGT at time of intubation to assess placement using same CXR
- Procedures should be performed by an experienced physician in order to minimize clinician time spent in close proximity to patient
- 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 green 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 w/ cardiac dysfunction despite IVF and levophed, add dobutamine
- 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
- Diuresis per FACCT-Lite strategy if off vasopressors >12 hours and not clinically hypovolemic
COVID-19 Basics

PHARMACOLOGIC TREATMENT (see TREATMENT guidelines in APPENDIX)

- Acetaminophen for fever (no clear evidence that ibuprofen can make COVID-19 worse, can avoid if concerned)
- **Bacterial co-infection may occur**, and treatment of bacterial pneumonia (CAP or HCAP as appropriate) should be initiated upon initial presentation. Consider stopping antibiotics after 48-72 hours if micro data is negative, there is no neutrophilia/bandemia, purulent sputum or lobar infiltrate
- **Viral co-infection is rare**, but may occur. If a patient tests positive for an additional respiratory viruses, the result should not be presumed to be false positives.
- **Nebulized medications must be avoided** whenever possible; use MDI instead
- Steroids can be used for refractory shock, COPD/asthma exacerbation
- Moderate Disease: **Hospitalized COVID-19 Patient with SpO2 <94%**
  - Hydroxychloroquine: 400 mg po q12 hr x 2 doses, then 400mg po daily x 5-10 days, may add azithromycin
- Severe disease with respiratory failure with OR without other end organ damage
  - Hydroxychloroquine: 400 mg po q12 hr x 2 doses, then 400mg po daily x 5-10 days, may add azithromycin
  - Consider Tocilizumab or sarilumab clinical trial
- Evidence of cytokine release syndrome
  - May be eligible for Tocilizumab or sarilumab clinical trial

CARDIAC ARREST

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

- **Engage** donning coach
- Perform **hand hygiene**
- Don **yellow gown**
- Coach makes sure gown covers your back
- Tie straps on the **side** of your body
- Put on **mask**
- Do not cross straps
- **Pinch** nose to ensure tight fit

- 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**
- **N95 instead of mask for aerosolizing procedures**
- **OR**
- if patient is COVID-19+ or PUI and on HFNC or bipap
Doffing PPE

Remember front of gown / face shield / mask can be contaminated, so don't touch the front

If ante-room
  • doff all PPE in ante-room
If no ante-room
  • Doff all PPE except face mask inside room (at least 6 feet away from patient)
  • Exit room, perform hand hygiene, then doff face mask and perform hand hygiene again

Method 1 – Gloves, then Gown Removal
1. Engage doffing coach
2. Remove gloves using non-touch technique
3. Perform hand hygiene
4. Remove face shield
   • Leaning forward, lift head band at the back of your head, pull away from your face and discard
5. Grasp inner neck of gown, break apart
   • Pull gown off and away from shoulders
   • As you go, turn gown inside-out and roll into inside-out bundle
   • discard
6. Perform hand hygiene
7. Remove mask* by grasping individual straps at back of head
   • Leaning forward, first remove bottom strap, then remove top strap and discard
8. Perform hand hygiene
9. If any breach is noted, perform hand hygiene immediately. Record breach on Breach Log

Method 2 – Simultaneous Gown and Glove Removal
1. Engage doffing coach
2. Untie gown
   • Roll off gown inside out into a bundle, peeling off gloves inside out at the same time
   • Bare hands only touch inside of bundle. Discard.
3. Perform hand hygiene
4. Remove face shield
   • Leaning forward, lift head band at the back of your head, pull away from your face and discard
5. Remove mask* by grasping individual straps at back of head
   • Leaning forward, first remove bottom strap, then remove top strap and discard
6. Perform hand hygiene
7. If any breach is noted, perform hand hygiene immediately. Record breach on Breach Log

*N95 instead of mask for aerosolizing procedures, or if patient is COVID+ or PUI and on HFNC or bipap
# COVID-19 Directed Treatments

## Mount Sinai Health System Treatment Guidelines for SARS-CoV-2 Infection (COVID-19)

<table>
<thead>
<tr>
<th>Patient group</th>
<th>Current Potential Therapy Options</th>
<th>Notes</th>
</tr>
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<tbody>
<tr>
<td><strong>Mild disease:</strong>&lt;br&gt;Not requiring hospitalization OR&lt;br&gt;Hospitalized patient with (SPO2 &gt; 94%), and NO radiographic evidence of pneumonia</td>
<td>Not hospitalized: Supportive care  Hospitalized: Start Hydroxychloroquine  400 mg PO q 12 hrs x 2 doses then 12 hours later start 400 mg PO q 24 hrs for 5 days total  ***May add azithromycin 500 mg PO x 1 dose then 24 hours later start 250 mg PO q 24 hours x 4 doses for a total of 5 days OR 500 mg PO q 24 hours for 3 days  If discharged, discontinue hydroxychloroquine and azithromycin.</td>
<td>- Infectious Diseases consult required for all hospitalized patients with confirmed COVID19  - Check ECG prior to hydroxychloroquine initiation for QT prolongation. Risk is increased when used with other QT prolonging drugs  - Follow QT monitoring algorithm below  - Review potential medication interactions and other possible side effects  ***Combination Azithromycin and Hydroxychloroquine: contraindicated in persons with known WPW and prolonged QT</td>
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<tr>
<td><strong>Moderate disease:</strong>&lt;br&gt;Hospitalized patients with hypoxia (SPO2 ≤ 94 %) OR&lt;br&gt;Radiographic evidence of pneumonia</td>
<td>Start Hydroxychloroquine  400 mg PO q 12 hrs x 2 doses then 12 hours later start 400 mg PO q 24 hrs for 5 days total  ***May add azithromycin 500 mg PO x 1 dose then 24 hours later start 250 mg PO q 24 hours x 4 doses for a total of 5 days OR 500 mg PO q 24 hours for 3 days  If discharged, discontinue hydroxychloroquine and azithromycin.</td>
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<td><strong>Severe disease with respiratory failure but no other end organ damage:</strong>&lt;br&gt;Patient requiring high flow, NRB, BIPAP or mechanical ventilation AND Not on pressors, CrCl &gt; 30 ml/min, ALT &lt; 5x upper limit of normal</td>
<td>Start Hydroxychloroquine:  400 mg PO q 12 hrs x 2 doses then 12 hours later start 400 mg PO q 24 hrs for 5 days total  ***May add azithromycin 500 mg PO x 1 dose then 24 hours later start 250 mg PO q 24 hours x 4 doses for a total of 5 days OR 500 mg PO q 24 hours for 3 days  Consider Tocilizumab or sarilumab clinical trial.  If discharged, discontinue hydroxychloroquine and azithromycin.</td>
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Updated: March 23, 2019
COVID-19 Directed Treatments

**Severe disease with respiratory failure and other end organ damage:**
- Patient requiring mechanical ventilation
- AND
- Requiring pressors or CrCl < 30 ml/min or receiving HD or CVVH or ALT > 5x upper limit of normal

Start Hydroxychloroquine:
- 400 mg PO q 12 hrs x 2 dose then 12 hours later start
- 400 mg PO q 24 hrs for 5 days total

***May add azithromycin
- 500 mg PO x 1 dose then 24 hours later start
- 250 mg PO q 24 hours x 4 doses for a total of 5 days
- OR
- 500 mg PO q 24 hours for 3 days

Consider Tocilizumab or sarilumab clinical trial.
- If discharged, discontinue hydroxychloroquine and azithromycin.

**Evidence of cytokine release syndrome**
- Worsening of respiratory function with evidence of CRS including elevations of IL-6, ferritin, d-dimer, CRP

Consider Tocilizumab or sarilumab clinical trial.

**Infectious Diseases consult required for all hospitalized patients with confirmed COVID-19**
- Check ECG prior to hydroxychloroquine initiation for QT prolongation. Risk is increased when used with other QT prolonging drugs.
- Follow QT monitoring algorithm below.
- Review potential medication interactions and other possible side effects.
- Combination AZ and HCQ contraindicated in persons with known WPW and prolonged QT.

**Obtain Baseline ECG**
- A: If not on any QT prolonging agents, K/Mg within normal limits, and most recent ECG is within 30 days, a new ECG may not be necessary.
- B: Ideally, discontinue QT prolonging agents.

**Normal Baseline QT**
- QTc < 470 ms
- QTc < 500 ms in wide QRS patient
- Administer Hydroxychloroquine
- Obtain ECG 2 hours after 2nd dose (of 400 mg)
- If QTc increases by > 50 ms and absolute QTc is < 500 ms (or < 500 ms in wide QRS), then can continue recommended regimen.

**Marginal Baseline QT**
- QTc > 470 ms
- QTc > 500 ms in wide QRS patient
- Caution Required

**Abnormal Baseline QT**
- QTc > 500 ms
- QTc > 550 ms in wide QRS patient
- Do not start Hydroxychloroquine
- Discuss risk/benefit pre-initiation

**Notes:**
- High risk patients for development of Torse de Pointes, who should be considered for continuous telemetry monitoring include those with LV dysfunction (LV EF <40%) and Wide QRS defined as > 120 ms
- Must discontinue drug for any evidence of Torsade de Pointes

*Version 1.0 (March 31, 2020)*

*Credit: Dr. Valentin Fuster and Dr. Vivek Reddy*

Updated: March 23, 2019
<table>
<thead>
<tr>
<th>Agents NOT recommended at this time for the treatment of COVID-19</th>
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<tr>
<td><strong>ACE inhibitors and ARBs</strong>&lt;sup&gt;13&lt;/sup&gt;</td>
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<tr>
<td>Patients should NOT be started on an ACE inhibitor or an ARB for the treatment of COVID-19. It is strongly recommended that those patients prescribed ACE inhibitors and ARBs for preexisting conditions should be continued on their ACE inhibitor and ARB therapy. Currently, there is no scientific or clinical evidence that taking ACE inhibitors or ARBs increases the risk of acquiring COVID-19 or that use may increase the severity of illness for those acquiring infections.</td>
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<td><strong>Corticosteroids</strong>&lt;sup&gt;13&lt;/sup&gt;</td>
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<tr>
<td>Per WHO guidelines, given the lack of effectiveness and possible harm, especially delayed viral clearance, routine corticosteroids should be avoided unless they are indicated for other reasons such as exacerbation of asthma, COPD and refractory septic shock.</td>
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<tr>
<td><strong>Lopinavir/ritonavir (Kaletra)</strong>&lt;sup&gt;15-16&lt;/sup&gt;</td>
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<tr>
<td>Lopinavir inhibits the protease activity of coronavirus in SARS. Two retrospective matched cohorts of lopinavir/ritonavir (used in combination with ribavirin and corticosteroids) in SARS demonstrated a potential role in clinical outcomes, especially when used in the early stages of diseases. Due to risk of adverse events and drug-drug interactions, along with lack of data in SARS-CoV-2 at present time, not currently recommended.</td>
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<tr>
<td><strong>Darunavir/cobicistat (Prezobix)</strong></td>
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<tr>
<td>Currently being evaluated in a clinical trial but no in vitro or in vivo data exist to support use at this time.</td>
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<tr>
<td><strong>Oseltamivir</strong></td>
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<tr>
<td>SARS-CoV-2, the virus that causes COVID-19, does not use neuraminidase as part of the viral replication cycle so oseltamivir is unlikely to be of therapeutic value, and supplies of the drug should be preserved for patients with influenza.</td>
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<tr>
<td><strong>IVIG</strong></td>
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<tr>
<td>IVIG remains on critical national shortage. The benefit in patients with COVID-19 is unclear.</td>
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<tr>
<td><strong>Ribavirin</strong></td>
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<tr>
<td>Role unclear, doses required for optimal antiviral activity often exceed limit of patient tolerability. Risk of toxicity likely outweighs potential clinical benefit.</td>
</tr>
<tr>
<td><strong>Nitazoxanide</strong>&lt;sup&gt;17&lt;/sup&gt;</td>
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<td>Displays inhibitory activity against the virus in vitro however no clinical data in humans exists.</td>
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COVID-19 Unit Workflow

- Think of the common workspace as being effectively cross contaminated and routinely bleach/wipe your workstations.
- Remember that your safety is paramount and even in a crash scenario, you should NEVER enter a room without donning appropriate PPE.
- On admission:
  - Use COVID-19-order set
  - New admissions- perform a medication reconciliation of home meds (using collateral from family/nursing homes/outpatient pharmacies/prior discharge meds
  - Identify the health-care proxy and/or surrogates and confirm accurate phone numbers- make sure this is documented in the advanced care planning tab and also an advanced care planning note
  - Confirm code status with patient or with NOK/HCP/surrogate if pt is incapacitated
  - Consult ID to discuss treatment/clinical trial options
## COVID-19 Orderset

### COVID-19 Test and Isolation Precautions Panel
- COVID Testing
- Transmission Based Precautions

### Respiratory Interventions
#### Respiratory Orders

For patients on BiPAP/CPAP or on Highflow Nasal Cannula, providers must wear a N95 mask.

- Nasal Cannula Oxygen
- Non Rebreather Mask Oxygen (Delivers > 80%)
  - Routine, CONTINUOUS
- High Flow Nasal Cannula
- CPAP
- BiPAP
- Mechanical Ventilation
<table>
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<tr>
<th>Lab</th>
<th>STAT, ONCE, First occurrence today at 1640</th>
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<tr>
<td>CBC+ Platelet+ Differential</td>
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<tr>
<td>Comprehensive Metabolic Panel</td>
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<tr>
<td>PT/INR and APTT</td>
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<tr>
<td>Type And Screen</td>
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<tr>
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<td>Fibrin Degrad-Dimer</td>
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</tbody>
</table>
# COVID-19 Orderset

## EKG
- **Electrocardiogram, Tracing**
  - Routine, ONCE, First occurrence today at 1640

## Labs to Trend
- **CBC+Platelet+Differential**
  - Routine, ONCE AM DRAW, First occurrence tomorrow at 0600, Last occurrence tomorrow at 0600, for 1 occurrence
- **Comprehensive Metabolic Panel**
  - Routine, ONCE AM DRAW, First occurrence tomorrow at 0600, Last occurrence tomorrow at 0600, for 1 occurrence
- **ICU Venous Panel**
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- **Troponin I**
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- **C Reactive Protein**
  - Routine, ONCE AM DRAW, First occurrence tomorrow at 0600, Last occurrence tomorrow at 0600, for 1 occurrence
- **Ferritin**
  - Routine, ONCE AM DRAW, First occurrence tomorrow at 0600, Last occurrence tomorrow at 0600, for 1 occurrence
- **LDH-Bld**
  - Routine, ONCE AM DRAW, First occurrence tomorrow at 0600, Last occurrence tomorrow at 0600, for 1 occurrence
- **Procalcitonin Serum**
  - Routine, ONCE AM DRAW, First occurrence tomorrow at 0600, Last occurrence on Fri 3/27 at 0600, for 2 occurrences
- **Fibrin Degrad-Dimer**
  - Routine, ONCE AM DRAW, First occurrence tomorrow at 0600, Last occurrence tomorrow at 0600, for 1 occurrence
COVID-19 Orderset

**Medications**

**SARS-CoV-2 (COVID-19) Treatment**

The following treatment options are for CONFIRMED COVID-19 CASES ONLY. All COVID-19 cases require Infectious Disease Consultation.

- **Mild Disease** (Hospitalized patient without hypoxia (SpO2 greater than 94%) and NO radiographic evidence of pneumonia.)
- **Moderate Disease** (Hospitalized patients with hypoxia (SpO2 less than or equal to 94%) OR radiographic evidence of pneumonia.)
- **Severe Disease with respiratory failure but NO other end organ damage** (Patient requiring mechanical ventilation AND all of the following: not currently on pressors, CrCl > 30 mL/min, and ALT < 5x upper limit of normal.)
- **Severe Disease with respiratory failure and other end organ damage** (Patient requiring mechanical ventilation AND at least one of the following: requiring pressors, CrCl < 30 ml/min, receiving HD or CVVH, ALT > 5x upper limit of normal.)

**Pneumonia Antibiotics**

**Empiric antibiotics for Community acquired pneumonia (CAP)**

- Mild-moderate CAP (inpatient and RETU) and Severe CAP (ICU or stepdown level of care and/or pneumonia with severe sepsis)
- If Severe beta lactam allergy
- If resident in long term nursing facility / history of MDR / recent use of broad spectrum antibiotics

**Antibiotics - Hospital acquired pneumonia**

- If onset of symptoms is >= 2 but < 5 days following admission and without other risk factors
- If onset of symptoms is >= 5 days following admission
- If colonized/infected with an ESBL organism within past 90 days
- If colonized with a multi drug resistant organism

**Ventilator associated pneumonia**

- Ventilator associated Pneumonia- onset >48 hours after intubation
- If colonized/infected with an ESBL organism within past 90 days
- If colonized with a multi drug resistant organism
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, gtts/rates, blood gas/lactate and vent support required, new microbiology data, ins/outs
- Step 3: see patients (either from door) or call patients as needed. Minimize exposure, in/out. A physical exam is NOT necessary for routine care of COVID-19 patients and is extremely discouraged.
Sample Presentation for Rounds

- Overnight events
- Vitals: Tmax, HR, BP (specify pressors/doses), SpO2 or PaO2 (in context of ventilator settings or O2 support)
- Drips: Sedation and doses, other pertinent drips
- Medications: antibiotics (day x of y), COVID-19 directed treatment
- Example: "Tmax is 102.4 over 24 hours, with HR in the 70s, and blood pressure systolics 90s on Levophed at 18 mcg and vasopressin at 1.8. The pt is saturating in the mid-90s on Volume-Control with an FiO2 of 70% and PEEP of 19 with the most recent ABG as 7.35, pCO2 50, and paO2 of 67. Current gtts include propofol at 50mcg, fentanyl at 100 mcg."

- Work of the day:
  - Consults
  - Orders
  - Titration of meds/drips/vent settings
  - Updating family- should occur on a daily basis
7. MSHS COVID-19 AIRWAY MANAGEMENT GUIDE

Preparation:
1. Respiratory Therapy should prepare the ventilator in the room prior to intubation
2. Take only the things that you need with you into the room, but make sure to take everything you need
3. Prepare medications and intubation equipment outside of the patient’s room
4. Suggested hypoxic agent and sucralfate saline 1-1.5 mg/kg, or miconazole 1.2 mg/kg
5. Verify intravenous access
6. See equipment checklist
7. Have a dedicated provider outside the room not in PPE to hand additional equipment/medications that may be needed and to come in to assist if needed

Airway Management:
We recommend starting supplemental O2 for SpO2 < 92% and aim for maintaining a SpO2 of no higher than 96%. There should be a low threshold for early intubation for adult patients. Consider discussions with pediatric critical care team for children unless patient is unstable. Patients with worsening respiratory failure should be intubated early. A short trial of High Flow Nasal Cannula (HFNC) can be used on COVID-19 patients, ideally in a negative pressure room with a surgical mask over the HFNC. If HFNC not available, non-invasive ventilation with BiPAP with a filter on the exhalation port can be considered for a short trial.

Personnel:
1. The provider on the team with the most intubation experience should intubate the patient
2. The Difficult Airway Response plan should be activated in the event of a difficult airway following the standard protocol
3. There should be no more than 3 people, ideally 2 people in the room during intubation
4. Designate a person outside the room to help with supplies if needed, and to monitor for breaches of PPE

Pre-intubation:
1. Ventilator should ideally be set up prior to intubation
2. Advance planning and clear communication are paramount
3. If patient is not in a single patient room, separate from other patients by 6 feet using curtains or screens
4. Set up and confirm ETCO2 waveform for oxygen is working
5. Minimize personnel
6. All equipment/medications that are needed should be setup and brought into the room prior to the start of the procedure. See intubation checklist.
7. Don PPE (gown, gloves, N95 respirator, eye protection, hair cover) outside of the patient’s room

Intubation:
1. Prolonged pre-oxygenation for more than 5 minutes with 100% FIO2 non-rebreather (caution: expiratory ports may aerosolize secretions)
2. Most experienced provider should intubate, second provider should push medications and assist
3. Goal is Rapid Sequence Intubation (RSI)
4. Can use push dose vasopressors for post intubation hypotension if needed
5. If manual ventilation is needed, use 2 hands to provide good seal, slip filter between mask and bag, and deliver small tidal volumes.
6. Do not use non-invasive ventilation if it can be avoided
7. Preferred use of video laryngoscope (using the device that the intubator is most experienced with and hand held device if available) to increase the distance
8. Inflate cuff immediately after intubation
9. Doff outer gloves after intubation and prior to touching other equipment
10. Attach filter to ETT, then the rest of the system
11. Institute mechanical ventilation on volume control mode at 6-8cc/kg BW in the ARDS setting
12. Use disposable stethoscope to auscultate from the patient’s side
13. Avoid awake intubation (risk of aerosolizing the virus during localization and coughing)
14. Avoid oral/otracheal airway (LOMA) ventilation, unless warranted for a difficult airway

Post-intubation:
1. Connect the patient to the ventilator and secure the tube
2. If needed to disconnect the patient from the ventilator, cut it in standard fashion
3. Dispose used and all disposable items that were brought into the room in trash in the room
4. Video Laryngoscope thoroughly wipe all surfaces with peroxide wipe prior to donning PPE making sure to fully saturate the surface following standard droplet cleaning protocols
5. Doff PPE, ideally in anteroom if available (can remove all pieces including N95, and wash hands) but if anteroom is not present, then doff in patient’s room (at least 6 feet away from the patient), except for the N95 mask, which is removed outside of the room. Hand hygiene.
6. Wipe Video Laryngoscope again with peroxide wipe after donning PPE. After this it is ready for next patient use and can be returned to its storage location
Intubation Check List:

- Working IV (ideally two IVs)
- BVM (± PEEP Valve) on Oxygen
- Waveform Capnograph on BVM
- Video Laryngoscope
- Backup Laryngoscope
- ET tube the size your plan to use and 1 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
Assessing Patient's Respiratory Status

When asked to consider patient's respiratory status assess the following:

- Vitals: Heart Rate, Respiratory rate, SpO2
- Physical exam and appearance: grimacing, using abdominal and accessory muscles, or tachypnea without distress
- Arterial blood gas analysis: pH / pCO2 / pO2 / lactate

Warning Signs of Respiratory Decompensation

- Rapidly escalating O2 requirement (eg RA--> 6L NC--> NRM in short period of time, eg minutes to hours)
- Inability to maintain sats in the 90s on escalated O2 therapy
- Respiratory distress including: tachypnea, accessory muscle use, inability to speak in full sentences
- Note that patients with COVID-19 often feel very little dyspnea despite being profoundly hypoxemic, for unclear reasons.

Note that these patients have very little reserve and decompensate QUICKLY and PROFOUNDLY. BE VIGILANT AND ESCALATE YOUR CONCERNS EARLY
**Oxygenation**

- Generally speaking, most patients who require O2 escalation will escalate from NC---> NRM---> intubation
- Trial of HFNC is acceptable but the patient must be in a NEGATIVE PRESSURE ROOM and patient should wear a surgical mask to minimize aerosolization
- Trial of BIPAP is acceptable as long as the pt is connected to the VENTILATOR (not stand alone BIPAP) with a filter on the expiratory port

If the pt is desaturating on 6l NC, place the pt on a non-rebreather and discuss with your attending whether a trial of HFNC/BIPAP are appropriate or if intubation is the next step
Ventilator Basics

- Goal: Support both oxygenation and ventilation of patient by improving pO2/SpO2 and removing CO2
- Most commonly patients will be on Volume control or VC mode
  - In this mode, ventilation is by setting the Tidal Volume (Vt), Flow, and Respiratory rate
  - Oxygenation is controlled by setting the FiO2 and PEEP

Basic Ventilator Settings: Lung-Protective ARDS Settings

- Tidal Volume Selection. Multiply Ideal Body Weight (IBW) x 6cc/kg (eg. Pt with 60kg IBW would get a tidal volume of 360).
- Respiratory Rate: will need to be titrated based on the pt's blood gas-increasing rate blows off more CO2 which is needed if the pt is acidemic (pH < 7.4, pCO2 > 40)
- FiO2: Start with 100% and back-down slowly
- PEEP: Recommended to titrate for high PEEP ladder from the ARDSnet protocol
- Most patients will need high vent settings (eg 100% FIO2 and PEEP >10) up-front
- GOAL: Achieve oxygen saturations over 90% and a pH > 7.3, while minimizing ventilator induced lung injury
Basic Ventilator Settings: Lung-Protective ARDS Settings

- **Tidal Volume Selection.** Multiply Ideal Body Weight (IBW) x 6cc/kg (e.g., pt with 60kg IBW would get a tidal volume of 360).

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- **Most patients will need high vent settings (eg 100% FIO2 and PEEP >10) up-front**

- **Goal:** Achieve oxygen saturations over 90% and a pH > 7.3, while minimizing ventilator induced lung injury
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

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

- SpO2 in the 90s
- PaO2 on ABG minimum of 55
- Can wean vent settings (FiO2 or PEEP) if oxygenation is much better than that
- Remember that we will preferentially wean FiO2 before we wean PEEP, per the ARDS Network High PEEP ladder (In other words, FiO2 decreases to 50% before you begin to wean PEEP)

Management of Refractory Hypoxemia

- As ventilator settings become very high, you may discuss with your attending if there is an appropriate role for:
  - Nimbex, a medicine that will paralyze the patient so they can rest their lungs completely
  - Prone ventilation (rolling the pt to a facedown position)
  - Inhaled flolan or inhaled NO therapy
  - ECMO
Desaturating Intubated Patient

- Confirm a good SpO2 waveform, make sure vent is connected
- Increase FiO2 to 100%
- Check peak/plateau pressure
- Performing a lung ultrasound to evaluate for lung sliding and other pathology
- **DO NOT REMOVE THE PT FROM THE VENT CIRCUIT. IF YOU ABSOLUTELY MUST, THE ETT MUST BE CONNECTED TO A FILTER BEFORE BVM and YOU MUST BE IN N95 AS IT IS CONSIDERED AEROSOLIZING**
Shock

- Can trial a small boluses PRN (250cc at a time)
- However most patients need vasopressors. Recommend:
  - Levophed as the first line agent.
    - Discuss with attending about adding 2nd vasopressor
    - Add vasopressin when levophed > 15 mcg/min
  - Avoid dopamine as it predisposes to arrhythmias
  - Some pts develop cardiogenic shock/myocarditis --> inotrope (dobutamine) would be helpful
- If levophed dose >15mcg/min, stress dose steroids may be added, discuss with your attending:
- Hydrocortisone 100mg bolus followed by 50mg q6h
- +/- Fludricortisone
Sedation of Intubated COVID-19 patients

- To prevent accidental extubation
  - Recommend sedating heavily (RASS –4/-5) for patients on high ventilator settings (anything greater than PEEP > 8 and FiO2 >50%)
- Sedation can be weaned when oxygenation improves and patient is a candidate for spontaneous breathing trials (SBT).
- Propofol
  - Recommended unless pt is in high shock state, as it can cause profound hypotension
- Opiates: Fentanyl/Dilaudid
- When getting ready for SBT --> consider dexmedetomidine (Precedex)
- Benzodiazepines
  - Versed- least preferred due to delirium, however may be needed for adjunctive therapy in critically ill patients to tolerate the ventilator
9. PUI / COVID-19 POSITIVE CARDIAC ARREST guide (for floor / ICU codes)

**Important Things to Consider Before ACLS**
- Enter the room after donning PPE - use N95 mask, face shield, hat, gown, double gloves, and other equipment as indicated.
- Minimize staff and throughput within the room. Do not enter the room if you are not needed.
- Use automated external compression device (LUCAS) if available.
- If patient is already intubated, perform CPR on the ventilator VC mode and FiO2 100%.
- If the patient is not intubated, utilize a non-rebreather for oxygenation during CPR with a face mask under the non-rebreather.
- The airway should be prioritized once the intubation team arrives.
- Chest compressions must be held during endotracheal intubation to minimize aerosolization.
- The room door should be closed all the time.
- Review advanced directives and explore goals of care as appropriate before and during ACLS.

**Follow standard ACLS protocol**

Intubating during code:
Because the most likely cause of the cardiac arrest in these patients would be a hypoxic respiratory failure, we recommend inserting an endotracheal tube as soon as possible (Follow the Mount Sinai Health System Airway Management Guide: Appendix 1):

- A Respiratory therapist is required in the room only if the patient requires endotracheal intubation.
- Do not perform endotracheal intubation during active chest compressions. When ready to intubate, chest compressions must be held.
  1. Intubate using a video-laryngoscope
  2. Inflate the balloon
  3. Place a HEPA filter between ETT and vent.
  4. Directly connect patient to the ventilator. If a ventilator is not available, attach endotracheal tube with a filter to an BVM.

**Post-CPR:**
- Exit room
- DoFF PPE
- Debrief

Team Members (max 5) in room, all wearing PPE:
1. Cardiac Arrest Leader
2. RN M1: Medication administration and recording.
3. RN or MD: CPR
4. RN or MD: CPR (If not using LUCAS)
5. Respiratory therapist: Only if the patient requires intubation, Use ONLY two person bag mask ventilation technique to ensure a seal. Ventilate with a Bag Valve Mask (BVM) with a HEPA filter.

Team Members (2) outside room, not wearing PPE:
1. MD, RN or PA: Remains outside the room. Wearing PPE. Supplies medications and hands off materials as well as observes for breach in PPE of providers inside the room.

ACLS Process
1. The person who identifies patient in cardiac arrest (already in the room wearing PPE)
   a. Activate Cardiac Arrest notification (e.g. press “code blue button”)
   b. Start chest compressions
2. 2nd person to arrive
   a. Bring cardiac arrest cart and intubation box outside the room
   b. Don PPE and enter the room
   c. Place backboard
   d. Bring defibrillator into the room and Place Zoll pads
   e. check appropriate IV access
3. 3rd person to arrive:
   a. Don PPE
   b. Assist critical care MD in setting up intubation equipment (if the patient is not already intubated).
   c. Brings ACLS medications into the room per code leader
   d. Consider: epinephrine x 5, bicarb x 2, calcium x 1; flushes x 10
   e. Assist with CPR, if LUCAS is not available
4. 1st Critical Care MD to arrive

Note: If the patient requires ventilation during the intubation process only use a 2 person ventilation technique with the BVM and a HEPA filter. One person uses both hands around the mask to develop a seal with the patients face and the other person squeezes the bag. This will ensure a proper seal and minimize aerosolization.

Adapted from protocol by Dr. Miguel Merillo, ICMI, 3/24/20

Updated 3/25/20
Jean Hrush
Aside from Vents, Pressors, Sedation

- The hallmark of good critical care medicine is attention to preventable harms, which include:
  - DVT ppx with SQH
  - GI ppx with h2 blocker or PPI for vented patients
  - Discussing antibiotic de-escalation
  - Providing early enteral nutrition with tube feeds and glycemic control
  - Ensuring things like: bowel movements, preventing hypernatremia, attempting to maintain an even or net negative fluid balance
Treatment of Hyperkalemia

- Use Hyperkalemia orderset in Epic
  - Calcium Chloride or Calcium Gluconate
  - Insulin and glucose (be careful in patients with renal failure)
  - Sodium bicarbonate
  - Inhaled $\beta_2$-agonists (avoid nebs in COVID-19 patients not through the vent)
  - Lasix
  - Sodium polystyrene sulfonate
  - Dialysis
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