ICU Care Guidelines for Patients With COVID-19

Purpose
This document was created by the fellows and faculty of Northwestern University Feinberg School of Medicine Division of Pulmonary and Critical Care Medicine, and the Northwestern Memorial Hospital Medical Intensive Care Unit (MICU) interprofessional team to provide general guidelines and describe current practices for the care of critically ill patients with COVID-19.

Editors
Jacqueline Kruser, MD
James (Mac) Walter, MD (contact for updates/questions: james.walter@northwestern.edu)
Ben Singer, MD (contact for updates/questions: benjamin-singer@northwestern.edu)
Richard Wunderink, MD
Scott Budinger, MD

Important notes
- This document will be continuously revised and updated as care practices and policies change.
- Some information may only apply to Northwestern Memorial Hospital (NMH) or to Northwestern Medicine (NM) system practices, and some links may only be accessible from NM Interactive (NMI).
- This document sets out guidelines, but exceptions will be made on an individual patient basis.
- Care practices can change quickly and may not be fully reflected below.

Table of contents
1. Intensive Care Unit (ICU) Triage
2. Personal Protective Equipment (PPE)
3. Patient/Family Engagement and Visitation, Palliative Care and End-of-Life Care
4. Cardiopulmonary Resuscitation
5. Diagnostics
6. Biomarkers and Monitoring
7. VTE Prophylaxis and Transfusion Guidelines
8. Treatment Options and Clinical Trials
9. High-Flow Nasal Cannula, Non-invasive Ventilation and Airway Clearance Therapies
10. Peri-intubation Management
11. General Ventilator Management and Extracorporeal Support
12. Prone Positioning
13. Respiratory ECMO Service Structure
14. Sedation Management
15. Bowel Regimen while Using High-dose Opioids or Phenobarbital
16. Neurocritical Care Consultation
17. Lines, Tubes and Procedures
18. Echocardiography and Point-of-Care Ultrasound
19. Optimizing the Electronic Health Record (Epic)
20. The Logistics of Rounding

Last Modified: April 20, 2020
Chronology of updates to guidelines

- March 30, 2020
  - New: CPR policy, HFNC/NIV/Airway clearance, logistics of rounding
  - Updated: Ultrasound cleaning recommendations
- April 5, 2020
  - New: VTE prophylaxis and transfusion guidelines
  - Updated: ICU procedures, including pulmonary and central venous access procedure services
- April 8, 2020
  - New: Link to NMH formal prone positioning protocol
  - Updated: Revised recommendations for use of HFNC in confirmed or high pre-test probability COVID infections
- April 16, 2020
  - New: Respiratory ECMO service structure, neurocritical care consult guidelines, bowel regimen while on opioids or phenobarbital
  - Revised: CPR policy, VTE prophylaxis dosing, extensive expansion to sedation guidelines
Section 1: ICU Triage

**NMH Dedicated COVID-19 ICU Triage Pager: Page 19075/Look-up “COVID-MICU Triage”**

**Note:** Other NM hospitals will have alternate triage pagers/phones.

We recommend clear, early communication with the patient or surrogate about patient preferences for life-sustaining treatment. Communications should include the range of expected outcomes (including the potential for death) for all patients with high-risk features (see below) or decompensating respiratory status requiring ICU triage.

**Call COVID-19 MICU triage pager** for all patients with confirmed COVID-19 infection (or persons under investigation, or PUI) and:

- Impending respiratory failure requiring intubation
  - Note: Intubation is a highly aerosolizing procedure. Given the risk to providers, attempts should be made to enact transfer to a negative pressure room prior to intubation.
- Persistent hypoxemia (SpO$_2$ < 90%, PaO$_2$ < 65 or P/F < 300) despite FiO$_2$ 0.50 or 4-6L NC
  - Note: Non-symptomatic hypoxemia has been reported as a feature of COVID-19, especially in the elderly.
- Rapid increase in supplemental O$_2$ requirement
- Acidosis
  - ABG with pH < 7.3 or PCO$_2$ > 50 or above patient’s baseline
  - Lactate > 2
- Persistent hypotension after appropriate volume challenge
- Currently intubated with need for assistance with vent management
  - **Note:** At this time, all external transfer requests must be routed to MICU leadership.
- Other standard indications for ICU admission/triage may also apply in the patient population with COVID-19 and PUI

**Consider paging COVID-19 MICU triage** for patients who are COVID-19 positive or PUI patients with >1 high-risk features (or any other concern for clinical deterioration):

- **Clinical**
  - Age > 60
  - Hx of DM, CKD, CAD, Cardiomyopathy, Chronic Lung Dz
  - Immunosuppression/transplant
  - HIV+ regardless of CD4 count
  - Altered mental status
- **Vitals**
  - RR > 24
  - HR > 125
  - SpO$_2$ < 90% on ambient air
  - Persistent/high fevers associated with altered mental status or elevated CK

(continued next page)
• Labs
  o D-dimer > 1000 ng/mL
  o CRP > 20
  o CPK > twice upper limit of normal
  o Ferritin > 300 ng/mL
  o ALT > 24 IU/L
  o LDH > 245
  o Lymphocytes < 0.7
  o High Sensitivity Troponin I > 28 pg/mL

**Triage requests to transfer to COVID-19 unit from other (non-COVID-19) ICUs**

• Non-COVID-19 ICU team (e.g., SICU) will call COVID-19 ID pager (pager number 26651, **not** the COVID-19 MICU triage pager).
• ID team will review patient and inform the ICU team to place the patient in droplet-contact isolation pending assessment.
• ID team will determine if testing is needed.
• Patients can remain in current ICU pending results; if positive, they will transition to COVID-19 unit.
Section 2: Personal Protective Equipment in the ICU

Purpose/scope
To outline recommendations for the use of PPE in the care of patients with confirmed COVID-19 and PUI. The information presented in the document is based on the current guidelines from Northwestern Medicine, the Centers for Disease Control and Prevention, and the World Health Organization. PPE recommendations are subject to change. For the most up-to-date information, review the PPE resources page on Physician Forum.

Persons affected
All healthcare providers caring for patients with known or suspected COVID-19 in the ICU

General principles
- Ensure you are up to date on N95 fit testing.
- Do not participate in the care of patients with COVID-19 without first familiarizing yourself with proper PPE donning and doffing. Guidelines are available on the PPE resources page on Physician Forum.
- Have a team member observe PPE donning and doffing to ensure you are following correct technique.
- Minimize the number of personnel in patient rooms, limit time, and try to avoid repeatedly entering the room.
- Ensure you have all supplies needed prior to entering a patient room for any procedure.
- Conserve PPE.
- Follow guidelines on reuse of N95 respirators:
  - An N95 respirator may be used continuously beyond one patient as long as it is not soiled, wet or torn, and it is donned and doffed properly to avoid contamination.
  - Follow the sign on the door to determine which mask/respirator to use. If you perform an aerosol-generating procedure, discard the respirator. Otherwise, you may extend use until the respirator is soiled, wet or damaged.
  - You may wish to wear a face shield over the N95 respirator to avoid contamination of the respirator and to provide eye protection.
  - N95 respirators may be worn continuously by the same healthcare worker through one shift and stored in a brown paper bag or other clean location.
  - Procedure masks may be worn continuously to see multiple patients if not removed between encounters.
  - If mask is removed from the face, it can be re-applied with care per guidelines.
  - Each time an N95 respirator is applied, perform a user seal check.
  - Any mask may NOT be pulled down and worn below the nose and mouth.
  - Replace respirator if it becomes contaminated, soiled, damaged/torn, wet and/or hard to breathe through.
  - Perform hand hygiene before and after touching N95 respirators.
  - Replace n95 respirators after any aerosol-generating procedure including bronchoscopy.
- Powered air-purifying respirators (PAPRs):
  - PAPRs are limited throughout the organization and restricted to providers who are performing high-risk aerosolizing procedures and who are unable to wear an N95 respirator due to facial reconstruction, extreme weight loss/gain, braces or dentures.
  - Facial hair should be shaved to fit an N95 respirator. Only those who obtain a religious exemption to shaving will be considered for a PAPR.

(continued on next page)
• PAPR hoods may be worn continuously by the same healthcare worker for multiple patients and multiple shifts, and must be stored in a large plastic bag or another clean location.
  ▪ Individuals should identify their hood by writing their name on it with a marker.
  ▪ Hoods should be replaced if any damage is detected.
  ▪ Hoods should be wiped down after each use with hospital-approved disinfecting wipes.
  ▪ Hand hygiene should be performed before and after touching PAPR hoods.
• Every effort should be made to bundle procedures (e.g., central line, arterial line) to prevent repeatedly entering the patient’s room.

**PPE use in the ICU for suspected or confirmed patients with COVID-19**
• Follow airborne precautions: Use an N95 respirator at all times.
• Follow contact precautions: Gown and gloves must be worn.
• Wear eye protection: goggles or face shield.
  o Perform hand hygiene before and after touching eye protection.
  o Eye protection may be worn continuously.
  o Clean goggles/face shield per instructions (hospital-grade wipes). Allow surface of eye protection to dry.
  o Dispose of eye protection if it is no longer clear, or if it is cracked or damaged.
• All people entering the room must wear the appropriate PPE.
• Additional considerations to prevent the spread of infection:
  o Designate a workstation for each provider. Try to work in a physically distant space from other team members (i.e. a call room or separate office).
  o Clean high-touch surfaces (keyboard, mouse, door handles, phone, pager, telephone) frequently.
  o Do not share food.
  o Consider covering your hair to avoid contamination.
  o For physicians who prefer to wear hospital-laundered scrubs, change into scrubs for shift and change out of scrubs before going home.
    ▪ The scrub machine and locker room are on the sixth floor of Feinberg Pavilion at NMH.
    ▪ If you do not already have scrub access, go through your department/division administrators.

**Personal cell phone devices or nursing phones**
• Restrict use of any personal or nursing phones when in a room with a patient with COVID-19.
• If a member of the team needs something when in a patient room, knock on the door to get the attention of another clinician or use the room phone to call the nursing station.
• If it’s absolutely necessary to use your phone in a patient room, it must be cleaned with a purple wipe upon exiting the room (when cleaning goggles).

**Special PPE circumstances**
• Endotracheal intubation: PPE recommendations during airway management can be found in the [Airway Management Guideline for Known or Suspected COVID-19 Patients](#).
• Tracheostomy: Guidelines are in progress.
• Cardiac arrest:
  o In the event of an arrest where CPR will be provided, **under no circumstances should CPR be performed until full PPE is donned (including N95 respirator).**
  o The number of CPR providers in the room should be kept at a minimum.
Section 3: Patient/Family Engagement and Visitation, Palliative Care and End-of-Life Care

Visitor policy (subject to change; see NMI policy on visitation for full details)
The most up-to-date visitor policy is here.

- No visitors are allowed to visit critically ill patients with COVID-19, with the exception of end-of-life care.
- At end-of-life, exceptions will be made only when other methods of communication and support (phone and video) have been attempted and do not meet the needs of the patient.
- For patients who are near the end of life (imminently dying, expected within a day), the physician and nurse manager/charge nurse may make the decision to allow an exception; the evening administrator can also determine with charge nurse if physician is not available.
  - Visitor exceptions should usually be only for immediate family, such as spouse, children, siblings or parents. If dying patient identifies one different preferred visitor, such as a close friend rather than family, this may be honored.
  - Please limit to one visitor at a time in ICU.
    - Exceptions are at the discretion of unit manager/charge nurse and physician and/or evening administrator.
    - Consult evening/weekend administrator for assistance in considering exceptions.
  - Visitors under age 18 are strongly discouraged.
    - Younger children are supported with video visits rather than brought to the unit.
  - Visitors are screened for temperature/symptoms at entry to the building. Any positive screening will exclude them from visiting. Visitors known to have COVID-19 will not be permitted.
  - PPE use for visitors:
    - Visitors are masked at entry to building. They should don full PPE when entering patient room.
    - Visitors are instructed to perform frequent hand hygiene.
  - Visits should be limited to 30 to 60 minutes.

Surrogate decision-makers and family communication

- Identify (per standard practice) HCPOA agent or surrogate decision-maker, and review existing advance directives upon ICU admission.
- Always ensure a secondary agent is identified in the event that the primary decision-maker is ill or otherwise unavailable.
- Designate a single contact person per patient that will be updated daily by the team. This individual should be default to the HCPOA agent or legally appointed surrogate decision-maker unless there are exceptional circumstances.
  - Contact person(s) should be informed that they will be contacted once per day in the afternoon by a member of the medical team for an update.
- In this context, at the clinician’s discretion, FaceTime or other video chat platforms on a personal device may be used to facilitate communication between the family and the care team.
- Hospital-supplied iPads will likely be available to support video chat in the near future.
- A summative family meeting via video conference (or telephone if necessary) should be conducted for all critically ill patients with COVID-19 by the third day of their ICU stay and at least weekly thereafter.

Last Modified: April 20, 2020
• Refer to this consistently updated resource from VitalTalk with COVID-19-specific communication tips (exactly what to say and when).
• It is recommended to use framework of time-limited trials of critical care or specific life-sustaining treatments.
  o Identify clear benchmarks for success and failure, and plan a timeline to meet again to discuss next steps.
• For patients or families who do not speak English, use of the language line translation services and video translation for all communication is required.

Clinician support for family communication
• **COVID-19 communication facilitators** with clinical backgrounds have been embedded into the COVID-19 teams since March 22 to serve as a liaison between the clinical team and family members to support telephone communication.
• **Chaplains** reach out daily to COVID-19 ICU CCs to identify families in need of support and actively screen census as able.
  o NMH ICU teams can contact chaplains at 312.695.2028 (pager); this number can also be provided to families.
  o Chaplain-family interactions will be documented in Epic.
• **Social Work** will support families, patients and clinicians.
  o Social Work also has instituted a proactive process to ascertain or complete HCPOA paperwork for all PUI and patients with COVID-19 on the general floors and in the ICU, when patients are able.
• The Psychiatry consult liaison team is available to help clinicians make a plan for families experiencing extreme distress.
Ethics and allocation of scarce resources

- If the primary team reaches a point at which decisions must be made for allocation of resources among two or more people who could benefit, consult the NM Allocation Decision-Making Team at ethics@nm.org or pager 312.921.3343.
- This is to minimize conflicts of commitment whenever possible. An independent decision-making team rather than bedside clinicians is an ethically justified, established practice in the context of scarce resources, e.g. UNOS and local transplant decision-making committees for allocation of organs for transplant.

Respiratory support in patients who are DNR/DNI and COVID-19 positive or rule out COVID

- Use high-flow nasal cannula with heated humidity.

End-of-life care and withdrawal of mechanical ventilation

- See above visitor section for exceptions to visitation policy.
- Withdrawal of mechanical ventilation near end of life (prior to death):
  1. Prepare all necessary medications for end-of-life symptom management (typically opioid and benzodiazepine infusions) and titrate as necessary per standard practice and protocols.
  2. Stop all airflow (turn off mechanical ventilator) prior to disconnecting endotracheal tube from circuit.
  3. Disconnect endotracheal tube from circuit, but do not extubate patient.
  4. Place filter cap/holster over end of endotracheal tube, which will allow patient to breathe through endotracheal tube while minimizing aerosolization.
  5. To avoid aerosolization, do not remove endotracheal tube from patient until after death.
  6. Continue symptom-directed, end-of-life care per standard practice, including dyspnea management.
- After death:
  1. Call medical examiner (ME) for all deaths in COVID-19 positive patients (in Cook County: 312.666.0500).
     - Record case number and employee number, and document in death note.
  2. If the patient is an ME case, follow instructions per ME, which will likely include leaving endotracheal tube in place.
  3. If the patient is NOT an ME case, remove endotracheal tube while wearing appropriate PPE (including N95 respirator) and use the following precautions to reduce aerosolization:
     - If ventilator is not already disconnected, turn off airflow.
     - Clamp endotracheal tube before disconnecting it from the ventilator circuit, then cap.
     - Place a clear plastic bag (e.g., patient belongings bag) over the patient’s face.
     - When the bag is covering the patient’s face, remove the endotracheal tube into the bag.
     - Then, remove bag from the patient’s head, and dispose of bag and endotracheal tube.
  4. Funeral home guidelines are available from the Illinois Department of Public Health (Social Work and HOA can provide if needed).

Role of specialty Palliative Care consultation

- The decision to consult palliative care is based on ICU team discretion.

(continued on next page)
• Specific scenarios that may prompt a specialty Palliative Care consultation:
  o Patients with complex symptom control needs
  o Patients already followed by a Palliative Care specialist
  o Patients whose symptoms have not been adequately controlled by standardized protocols
  o Seriously ill patients who have been denied life-sustaining treatment because of the triage system
  o Younger adults, particularly those with no significant medical history, who are parents and providers for young children
• When direct consultation with a Palliative Care specialist is not possible, telephone or telemedicine systems should be used.
Section 4: Cardiopulmonary Resuscitation

Scope
- This document provides general guidelines on CPR in COVID-19 positive patients and is not a replacement for the clinical judgment of individual providers at the bedside. Guidance is related to whether or not the cardiac arrest is expected:
  - **Unexpected cardiac arrest**: sudden development of cardiac failure, often in setting of improving/stabilized pulmonary disease
  - **Expected cardiac arrest**: progressive hemodynamic deterioration, clear that CPR has no reasonable chance of success

#1 CPR should be performed for unexpected cardiac arrests in COVID-19 infected individuals if consistent with patient preferences/code status
- Additional provider precautions during CPR are essential even if they impact the performance of the code
- During code status discussions, patients and surrogates should be informed that these provider safety measures (e.g. donning personal protective equipment) will cause necessary delay in the initiation of CPR

#2 CPR should NOT be performed for expected cardiac arrest due to progressive clinical deterioration from COVID-19 refractory to maximal intensive care.
- Such decisions should be made on a case-by-case basis only after an assessment of whether restoring circulatory function can likely be achieved and a thorough analysis of the other potential risks and benefits, including whether it is impracticable to mitigate further exposure to staff.*
  - Document why CPR will have no reasonable chance of success in the medical record
  - Notify the family that CPR will not be performed and document this discussion
  - Enter a DNR order
  - The consent of the patient’s family or surrogates to write a DNR order is not required when CPR attempts have no reasonable chance of success and are not medically indicated
  - If the surrogate will not agree to a DNR, the patient’s attending shall request evaluation by another attending (who has not cared for patient if possible). If the second attending agrees that CPR does not have a reasonable chance of success, the DNR should be entered over the objection of the surrogate. This consultation shall be documented in the medical record.
  - The local ethics committee or the Allocation Decision Making Team may be consulted for support.

#3 Cardiac arrest secondary to COVID-19 infection is not an indication for Extracorporeal Cardiopulmonary Resuscitation (ECPR)*

Please note these guidelines are **only** intended for adult patients with documented positive COVID-19 or persons under investigation (PUI) with high clinical probability of infection. **We strongly recommend that provider address code status and goals of care at the time of hospitalization and again with any major change in clinical status such as transfer to an ICU.**

(continued on next page)
Decisions regarding whether to perform CPR must be non-discriminatory and may not be based on the race, gender, age, religion, citizenship, sexual orientation, disability unrelated to medical diagnosis, or socioeconomic status of the patient, including that patient’s ability to pay. Such decisions are not to be based on judgments about patient’s anticipated quality of life or social value.

*This recommendation is not to limit CPR or Extracorporeal Membrane Oxygenation (ECMO) for all patients with COVID-19 based solely on their diagnosis. Clinical care and assessments will remain individualized based on the relative risks and benefits to the patient and the health care providers and staff involved in the patient’s care. Evaluation of each individual patient is necessary to determine whether CPR or ECMO is likely to achieve its intended goal of restoring circulatory function and can be provided safely. It is ethically justifiable to factor in concerns about staff safety when making decisions about the care that will be offered to patients with COVID-19.


*Recommended documentation in addition to DNR order (available with a dot phrase in Epic)*

.COVIDnoCPR

**Attending decision for No CPR Decision in COVID-19 patient**

As the patient’s attending physician, having reviewed all current clinical information and having consulted with another attending (PHYSICIAN NAME), who reviewed all current pertinent clinical information, I have concluded that there is no reasonable chance that CPR would be successful for following reason(s): [embed multi-select list]

- Will not restore circulatory function
- Will not allow patient survival to discharge
- Will cause more harm by the intervention than benefit to patient’s desired outcome
- The physiological abnormalities that will lead to cardiac arrest are irreversible
- The medical impact of acute and chronic illnesses are inconsistent with survival to hospital discharge

I have informed patient’s surrogate/POAHC in a detailed discussion of these reasons that there is no reasonable change that CPR will be successful. Therefore, a DNR order will be entered and we will not perform CPR when/if the patient experiences cardiac arrest.

Surrogate/POA expressed [understanding and consent to placement of DNR order] or [desire for CPR, and that request was denied with a full explanation that the intervention would not be beneficial]. [Hospital Ethics Service or Allocation Decision Making Team] was consulted and concurs with the appropriateness of this decision.
Section 5: Diagnostics

When to test
- Known contact of any COVID-19 positive patient but without symptoms > no test
- Fever and respiratory symptoms > test
- Special populations:
  - Transplant or stem cell transplant patients with fever and no known source > test
  - Transplant or stem cell transplant patients with cough but no fever > test
- A positive respiratory pathogen panel (RPP) is NOT adequate for ruling out the presence of a SARS-CoV-2 infection (see below in the section regarding co-infection).
- A history of recent travel is not required to proceed with testing for SARS-CoV-2.
- The COVID-19 ID pager needs to be notified regarding every patient who is tested so that they may be tracked by Infection Prevention.
- A lower respiratory sample (usually BAL) should be considered in a high-risk intubated patient with a negative nasopharyngeal swab.

How to test
- Order in Epic: Search for “COVID-19 order panel”
  - Select both Respiratory Pathogen Panel and the Coronavirus (Covid 2019) tests. Select the appropriate specimen source.

(continued on next page)
• Nasopharyngeal swab
  o Proper sample collection technique is critical for ensuring accurate results.
  o In non-intubated patients, an NP swab should cause discomfort. If the patient does not describe this, suspect incorrect technique.

• See a full NEJM video here: youtube.com/watch?v=DVJNWefmHjE
• Bronchoalveolar lavage (BAL)
  o This test requires bronchoscopic sampling of fluid from the lower respiratory tract/lungs.
  o This should only be ordered/performed at the discretion of ICU attending based on risk/benefit consideration (see Section 14: Lines, Tubes and Procedures).

Co-infection
• Available data suggests that the presence of an alternative infection does not rule out co-infection with COVID-19.
• Co-infection rates have been reported to be as high as 22.4% in adults in non-peer-reviewed, pre-print publications.
  o medium.com/@nigam/higher-co-infection-rates-in-covid19-b24965088333
  o medrxiv.org/content/10.1101/2020.02.13.20022673v1
Section 6: Biomarkers and Lab Monitoring

Note: All specimens must be walked down to the lab and not sent through the tube system.

Recommended daily labs (consider decreasing frequency if stable or severe anemia)
- CBC with differential
- CMP and magnesium
- ABG (if clinically indicated for worsening respiratory physiology or changes to mechanical ventilation settings other than FiO2)
- DIC labs
- Mixed venous oxygen saturation (if hemodynamically unstable and has central access)
- UA daily if receiving remdesivir

Recommended baseline labs for risk stratification and prognostic value (consider repeating for monitoring)
- Troponin (monitor for myocarditis/CM)
- LFTs
- LDH
- CRP (tracks with IL-6 levels)
- D-dimer (appears to be prognostic marker)
- PT
- CK and aldolase (consider repeating to evaluate for inflammatory, possibly viral, myopathy in patients who are slow to liberate from mechanical ventilation)
- Ferritin
- Procalcitonin

Infectious workup (consider each test individually if clinically indicated based on pre-test probability)
- Blood cultures (2 sets)
- S. pneumoniae/legionella urinary antigen

For immunocompromised patients or other specific risk factors, consider:
- Blastomycosis/histoplasma urinary antigen
- Serum B-d glucan and aspergillus galactomannan
- BAL PJP DFA, galactomannan, AFB culture (note AFB culture requires entire residual BAL)

For initial bronchoscopy and BAL and any subsequent BAL sampling, especially before starting IL6r blockade:
- Respiratory culture
- Cell count and differential
- Amylase – aspiration in COVID patient may have different prognosis than viral pneumonia
- Lower respiratory tract panel (NAT) (this is the name for a newly available BioFire Pneumonia Panel, now available by Epic order), includes respiratory pathogen panel (RPP) and MRSA PCR
  - Alternative is RPP and MRSA PCR
- Coronavirus (Covid 2019) test (even if NP swab is positive to define alternate cause of respiratory failure; particularly important on subsequent BALs in order to take patient out of isolation)
**Imaging/cardiology (consider risks and benefits for each patient; see upcoming Cardiac Management section for details)**

- Upon admission (or after intubation and central line placement), obtain CXR; minimize CXR as possible.
- **Limited TTE** (limited protocol for LV/RV function, and valvular disease screening) should be performed instead of standard TTE order.
- Patients with severe valve disease, prosthetic valves or other comprehensive cardiac disease requiring a full echo should be ordered as a "2D echo with Doppler" in Epic.
Section 7: VTE Prophylaxis and Transfusion Guidelines

VTE prophylaxis

- COVID-19 may be associated with a hypercoagulable state, especially in patients with more severe disease. As such, the following VTE prophylaxis recommendations propose a more aggressive VTE prophylactic regimen.
- The treating team may decide to follow less aggressive dosing strategies based on individual patient factors (hemoglobin trend, bleeding risk, etc.).
- In general, prophylaxis is recommended unless active bleeding or a platelet count < 25 x 10^9/L.
- For patients on direct oral anticoagulants or warfarin for Afib or VTE, transition to full dose anticoagulation with LMWH or unfractionated heparin is advised, based on renal function and/or clinical scenario.

<table>
<thead>
<tr>
<th>Renal Function &gt;30 mL/min</th>
<th>Renal Function &lt;30 mL/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI &lt;40</td>
<td>Enox 30 mg Q12H*</td>
</tr>
<tr>
<td>BMI &gt;40</td>
<td>40 mg Q12H</td>
</tr>
<tr>
<td>BMI &gt;50</td>
<td>60 mg Q12H</td>
</tr>
</tbody>
</table>

| CrCl 15-30 mL/min, BMI <40, Age <75 | Consider Enox 30 QD or SQH 5000 TID based on bleeding risk |
| CrCl <30, BMI >40 | SQH 7500 TID |
| CrCl <15, BMI <40 | SQH 5000 BID/TID |
| CrCl <15, BMI >40 | SQH 7500 TID** |

* PharmD to consider of AXA monitoring for goal 0.2-0.5 w/ adjustments by 10 mg BID as appropriate (low level rec)
** PharmD to consider aPTT monitoring to possibly up to 10,000 TID for Large BMIs >50-60 (low level rec)

Transfusion guidelines

- Critically ill patient without bleeding
  - Platelet count > 20 x 10^9/L
  - Fibrinogen > 150mg/dl
- If bleeding is present
  - Platelet count > 50 x 10^9/L
  - Fibrinogen > 200mg/dl
  - PT ratio < 1.5
- In the event of cryoprecipitate shortage, use of fibrinogen concentrates may be advised by hematology/transfusion medicine

Last Modified: April 20, 2020
Section 8: Treatment Options and Clinical Trials

Currently available treatment options
(adapted from NM ASP Evidence Review for Inpatient Treatment Options document)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Evidence</th>
<th>Monitoring/Adverse Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydroxychloroquine</td>
<td>Dose: 400mg BID x 1 followed by 200mg TID x 4-10 days (various durations in this range have been reported)</td>
<td>RCT 36 hosp COVID pt; improved virological clearance, also has been studied with azithro [Gautret 2020]</td>
<td>QT prolongation (monitor) &lt;br&gt; CBC (rare pancytopenia) &lt;br&gt; Hypoglycemia &lt;br&gt; No renal function dose adjustments necessary</td>
</tr>
<tr>
<td>Chloroquine (not currently available, may change in future)</td>
<td>Dose: 500mg q 12h x 10 days</td>
<td></td>
<td>QT prolongation (monitor) &lt;br&gt; CBC (pancytopenia) &lt;br&gt; Hypoglycemia &lt;br&gt; Renal function dose adjustment</td>
</tr>
<tr>
<td>Remdesivir Antiviral</td>
<td>200mg IV x 1 (day 1) then 100mg IV daily for 10 days</td>
<td>Case reports of patient response [Holshue NEJM 2020]</td>
<td>Abnormal LFTs &lt;br&gt; Abnormal INR, PT/PTT &lt;br&gt; Reversible kidney injury &lt;br&gt; Nausea, vomiting, diarrhea &lt;br&gt; Headache</td>
</tr>
</tbody>
</table>

Contraindications for compassionate use: use of vasopressors and same-day administration of tocilizumab
<table>
<thead>
<tr>
<th>Drug</th>
<th>Evidence to Date</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Empiric Antibiotics</strong></td>
<td>Standard guidelines for treatment of community-acquired or hospital-acquired pneumonia apply.</td>
<td>Empiric therapy with ceftriaxone/azithromycin (CAP coverage) Consider de-escalation of antibiotics if no evidence of bacterial superinfection Consider HAP coverage only if patient otherwise meets HAP criteria</td>
</tr>
</tbody>
</table>
| **Corticosteroids**  | Wu C et al, JAMA. 3/13/2020  
• Retrospective review, 201 pts  
• Patients who developed ARDS were 49% more likely to have been treated w/steroids compared to patients who did not develop ARDS.  
• Patients with ARDS who were treated with steroids had decreased risk of death compared to ARDS patients who were not treated with steroids.  
• Limitations of data: retrospective, single center, steroid use was confounded by indication | We do not recommend use of steroids for treatment of respiratory failure in patients with COVID-19. Can consider steroid replacement for patients with refractory shock Consider use of steroids for other indications when present |
<table>
<thead>
<tr>
<th><strong>ACE Inhibitors and ARBs</strong></th>
<th><strong>Angiotensin II</strong></th>
<th><strong>We do not recommend initiation or cessation of ACE inhibitors or ARBs to treat COVID-19.</strong>&lt;br&gt;May adjust use for other indication, i.e. AKI, hypotension</th>
<th><strong>We recommend use of angiotensin II as a second line agent for distributive shock.</strong>&lt;br&gt;May adjust use for other indication, i.e. AKI, hypotension</th>
</tr>
</thead>
</table>
| • ACEi in vitro may upregulate expression of ACE2 receptor  
• No clinical or experimental data suggesting use of ACEi/ARB affects outcomes in COVID-19 | • No clinical or experimental data suggesting use of ACEi/ARB affects outcomes in COVID-19 |  |

**Active COVID-19 clinical trials at NMH**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Study Design</th>
<th>Intervention</th>
<th>Inclusion Criteria</th>
<th>Key Exclusion Criteria</th>
<th>How to Enroll Patient</th>
</tr>
</thead>
</table>
| **Remdesivir**  
*(Nucleotide analog)* | • Adaptive  
• Randomized 1:1  
• Placebo controlled  
• Double blind | • Day 1: 200mg  
• Day 2-9: 100mg | • Hospitalized, non-ICU and ICU  
• COVID-19 positive within 72 hours of randomization  
• Infiltrate on chest imaging  
• Supplemental oxygen or intubated  
• Female patients must agree to contraception during study | • ALT or AST > 5x ULN  
• eGFR < 50 or hemodialysis  
• Breast feeding  
• On other clinical trial  
• Hormonal contraception | COVID-19 ID pager  
Compassionate use remdesivir only available for pregnant patients while trial is ongoing (see Current Treatment Options table) |
| **Sarilumab**  
*(IL6 receptor antagonist)* | • Randomized  
• Double blind | • 200mg IV x 1 or  
• 400mg IV x 1 or  
• Placebo | • Hospitalized  
• COVID positive  
• Documented fever  
• Infiltrate on chest imaging | • Bacterial infection  
• Fungal infection  
• TB  
• Immunosuppression w/in past 5 months  
• ALT or AST > 5x ULN | Research pager 59285 |
Section 9: High-Flow Nasal Cannula, Non-invasive Ventilation and Airway Clearance Therapies

General recommendations

- **Bronchodilators**
  - Bronchodilators may be administered when clinically indicated via either metered dose inhaler (MDI) with a spacer or nebulizer.
    - Use of nebulized therapy requires providers in the room to wear an N95 mask.

- **Airway clearance for mechanically ventilated patients**
  - Patients frequently develop thick secretions after 5 days of invasive mechanical ventilation.
  - Airway clearance with a vest, sport bed or handheld percussive device is recommended to aid secretion clearance.

- **Confirmed or high pre-test probability COVID patients**
  - Prior to the need for mechanical ventilation
    - Favor early intubation if any of the following are met:
      - Acute persistent desaturations
      - Need for > 6 L NC to maintain SpO₂ > 90%
    - Consider trial of high-flow nasal cannula (HFNC) with heated humidity especially in the following situations:
      - Immunocompetent patients < 70 years of age with minimal comorbidities, and
      - Able to maintain SpO₂ > 90% on HFNC ≤ 50% FiO₂ and 50 L/min flow rate.
If a patient is to be transported from the ED to a COVID inpatient unit on HFNC, 30 minutes of clinical stability on HFNC should be documented prior to transfer.

- **Post-extubation**
  - Favor HFNC with heated humidity for immediate post-extubation oxygen supplementation.
  - **Acceptable to trial noninvasive ventilation (NIV)** with a full face mask and a filtered exhalation port in select cases where NIV may be particularly efficacious (e.g., chronic obstructive pulmonary disease).
  - For patients with a tracheostomy:
    - Trach collar with in-line suction or filtered heat moisture exchanger can be used.
    - Avoid open suctioning until the patient has documented clearance of detectable virus unless emergently required.

- **Rule out COVID patients**
  - Favor HFNC with heated humidity and nebulizer treatments (if clinically indicated).
  - **Acceptable to trial NIV** with filtered exhalation port to minimize aerosol generation in select cases where NIV may be particularly efficacious (e.g., exacerbations of chronic obstructive pulmonary disease or congestive heart failure).

---

**Approach to patients who require chronic NIV**

- **Scope and unique patient characteristics:**
  - Chronic NIV refers to the long-term use of devices that use modes including, but not limited to, CPAP, BiPAP, BPAP, AVAPS and PC.
  - Unlike patients who use CPAP for obstructive sleep apnea (OSA), **patients who require chronic NIV use NIV as a life support device. It is NOT safe to withhold NIV in these patients.**
  - Examples of patients using NIV for chronic life support include those with neuromuscular disorders, kyphoscoliosis and chronic hypercapnic respiratory failure.
  - These patients are at **high risk of clinical deterioration with infection,** regardless of their baseline pulmonary function.
  - There have been documented deaths when these patients are given supplemental oxygen via nasal cannula rather than NIV, as this approach masks the risk of CO₂ retention in this vulnerable population.

- **Recommendations for when a patient who requires chronic NIV presents to the ED or hospital:**
  - Confirm if a patient is on CPAP for OSA or in fact use NIV for chronic respiratory failure.
  - Patients on chronic NIV should be placed in a negative pressure room and continued on their home NIV machine pending clinical assessment.
  - Patients with chronic respiratory failure on NIV should be tested for COVID-19 rapidly if any compatible symptoms are present and if they are expected to stay in the hospital.
  - The Pulmonary Consult service should be consulted for management, in particular to evaluate if NIV should be continued pending COVID testing.
Section 10: Peri-intubation Management

[View/download the below document for easier viewing.]
<table>
<thead>
<tr>
<th>Physician/APP</th>
<th>COVID/PCR Resident/APP</th>
<th>Anesthesia Physician</th>
<th>Nursing</th>
<th>MICU COVID Unit MD</th>
<th>MICU COVID Unit Charge RN</th>
<th>MICU COVID Unit BRN</th>
<th>MICU COVID Unit RT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor MD</td>
<td>Floor RN</td>
<td>RRT RN</td>
<td>MICU COVID Unit MD</td>
<td>MICU COVID Unit BRN</td>
<td>MICU COVID Unit RT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>event’s course</td>
<td>present patient information</td>
<td>patient transfer &amp; notification</td>
<td>maintain status</td>
<td>patient &amp; family education</td>
<td>patient education</td>
<td>patient education</td>
<td>patient education</td>
</tr>
<tr>
<td>Not a line of plants here.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*This document was developed with the assistance of representatives from the Department of Anesthesia-Critical Care, Respiratory Therapy, the Division of Pulmonary and Critical Care, the Internal Medicine Residency, and MICU Nursing.*

**Last Modified: April 20, 2020**
Section 11: General Ventilator Management and Extracorporeal Support

**Suggested COVID + ARDS Ventilator Management**

- Low tidal volume ventilation
  - May tolerate higher $V_t$ if $P_{aw} < 30$ cmH$_2$O and/or $DP < 15$ cmH$_2$O as many pts have compliant lungs early in course
- High PEEP strategy
  - See PROSEVA table below
- Conservative fluid strategy

**Flowchart**

- **P/F > 150?**
  - Yes: Continue current management
  - No: Contraindications to prone positioning?
    - Yes: Absolute contraindications to ECMO?
      - Yes: Care per MICU team
      - No: Lung Rescue call
    - No: Manual prone positioning
- Failure of prone positioning?
  - Yes: Absolute contraindications to ECMO?
    - Yes: Lung Rescue call
    - No: Care per MICU team

**Notes**
- Neuromuscular blockade (NMB) can be used at the discretion of the MICU team for severe ventilator dyssynchrony or to facilitate proning. Use of NMB is not required for proning.
- Use of nitric oxide should not be viewed as necessary before considering proning or ECMO.
- Early discussion of prognosis and range of expected outcomes with surrogate decision makers and family is essential.
- Consider early involvement of ethics and/or palliative care.

**Absolute contraindications to ECMO**
- Severe chronic disease leading to disability (metastic cancer, end-stage dementia, etc)
- Low probability of recovery (assessed by pulmonologist and surgeon)
- Irreversible failure of three or more organ systems

**Contraindications to prone positioning**
- Ventral body surface burns/open wounds
- Spinal instability
- Open chest or central ECLS
- Refractory shock (MAP < 65 mm Hg on vasopressors)
- Unstable arrhythmia
- Third trimester pregnancy
- Increased intracranial pressure
- Increased intraocular pressure
- Recent cardiac arrest
- Single anterior chest tube with active air leak

**Failure of prone positioning**
- Moderate or large-volume hemoptysis
- While proned with NMB, $SpO_2 < 85\%$ or $PaO_2 < 55$ mmHg on FIO2 0.8 sustained for > 15 minutes
- While proned with NMB, $pH < 7.20$ with a $PaCO_2 > 60$ mmHg for 3 hrs
- While proned with NMB, $Pplt > 35$ cmH$_2$O sustained for > 30 minutes after addressing reversible etiologies (e.g. mucus plug) and optimizing PEEP
- Unstable arrhythmia
- Need for 3 or more vasopressors to maintain a MAP > 65 mmHg or addition of 2 new vasopressors while proned

**Suggested PEEP Table (from PROSEVA)**

<table>
<thead>
<tr>
<th>PEEP (cm H$_2$O)</th>
<th>5</th>
<th>5</th>
<th>8</th>
<th>8</th>
<th>10</th>
<th>10</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>14</th>
<th>16</th>
<th>16</th>
<th>18</th>
<th>18-24</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIO$_2$</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
<td>0.6</td>
<td>0.6</td>
<td>0.7</td>
<td>0.7</td>
<td>0.8</td>
<td>0.8</td>
<td>0.9</td>
<td>0.9</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Lung Rescue call: Dial 5-5555**

Last Modified: April 20, 2020
Section 12: Prone Positioning

Northwestern Memorial Hospital’s approved protocol for the use of prone positioning in acute respiratory distress syndrome can be found here.
Section 13: Respiratory ECMO Service Structure

Purpose

- As we move to establish VV ECMO as a procedure to support patients with COVID-19 induced respiratory failure in our Medical Intensive Care Units, it is important that we establish clear guidelines for service line responsibilities. This is analogous to other supportive care services in the Medical ICU that require service-specific expertise for management (e.g., hemodialysis and plasmapheresis).

Multidisciplinary rounds

- Team members from Pulmonary and Critical Care Medicine (PCCM) including PCCM attending and Thoracic Surgery along with the bedside ECMO specialist should round together daily in the COVID-ICU at 7:30 AM on all cannulated patients.
- The goal of these rounds should be to collaboratively discuss specific components of ICU management including but not limited to
  - ECMO support
  - Mechanical ventilation
  - Need for and timing of tracheostomy
  - Analgesia/sedation
  - Anticoagulation
  - Mobilization

Service-specific responsibilities

- Pulmonary Critical Care Service
  - Management of all orders save changes to ECMO. Importantly, PCCM service will not change ECMO settings without explicit approval from thoracic surgery service.

- Thoracic Surgery
  - All changes to sweep gas and ECMO RPMs
  - Timing and need for oxygenator exchanges
  - ECMO cannula management including cannula repositioning and management of access site bleeding
  - Collaborative interactions to manage anticoagulation
  - The Thoracic Surgery Service note will document plans for these components of care on a daily basis
  - The Thoracic Surgery Service will provide 24-hour call coverage to troubleshoot issues with ECMO or to make urgent changes to ECMO settings.
Section 14: Sedation Management

Protocol Introduction

- This guidance applies to the unique scenario of sedation in critically ill COVID-19 patients. This guidance should not be extrapolated to other populations where standard sedation protocols and order sets should be used.
- COVID-19 ICU illness is divided into three phases to guide sedation management: active, transition, and convalescent. Features of these phases are provided below.
- Agents are listed in the preferred order of escalation during the active phase.
- Active phase additions are intended to be stepwise and synergistic. Earlier agents should be continued, or dose adjusted, if their toxicities are not adequately tolerated.
- During the transition phase of COVID-19 ICU illness, adjunctive agents are added in preparation for weaning of anesthetic agents during the convalescent phase of COVID-19 ICU illness.
- The sedation goal for early critical care therapy is RASS 0 to -2. RASS -2 to -4 may be required in select patients at increased risk for self-extubation or ventilator dyssynchrony. Deeper sedation goals (RASS -4 to -5) are required for neuromuscular blockade and may be required during select procedures to reduce the extent of aerosolization of secretions (such as bronchoscopy, proning, line placements, tracheostomy, transition to transport ventilators).
- Guidance for neurocritical care consultation is provided in Section 16 of this guidelines.
- Consider psychiatry consultation for those with underlying substance abuse disorder, psychiatric history on home medications, or persistent delirium during the transition and convalescent phases.

COVID ICU Disease Phases

- Phase 1 – Active ICU phase
  - Characterized by
    - Fever, often high and persistent
    - Rising inflammatory markers including D-dimer, CRP, and ferritin (this may be mitigated by use of IL-6 blocking agents)
    - Rising CPK
    - Acute agitation
    - Worsening oxygenation - high levels of PEEP are needed
    - Development of other organ system involvement including shock, acute kidney injury, transaminitis, cardiomyopathy and hypercoagulable states
  - During this phase, sedation requirements are high to combat agitation and to allow for patient ventilator synchrony which may require paralysis, prone ventilation, and bronchoscopy.
  - Temperature management with a goal of 34 – 36 °C may have multifactorial benefits including for inflammatory conditions that may be driving sedation needs. Some agitation control is required prior to initiation of targeted temperature management.
- Phase 2 – Transition ICU phase
  - Characterized by
    - Improving fevers
    - Resolving shock
    - Inflammatory markers stabilize and may trend down
    - Improving CPK levels
    - Improving LFTs
- Oxygenation may improve allowing a decrease in the FiO₂ though PEEP should be maintained
- May see improvement in other non-pulmonary organ function as well although established organ failures will take longer to resolve.
  - During this phase, start to prepare to back down on high dose sedation by considering addition of adjunctive agents to facilitate weaning of anesthetic sedatives. The clinician must make preparations for aggressive weans during the convalescent phase

- Phase 3 – Convalescent ICU phase
  - Characterized by
    - Ventilator settings that have been/are being weaned back and patients are ready to start spontaneous breathing trials once other ICU issues have been addressed
    - Inflammatory markers are now down other than D-dimer which lags
    - Fevers have resolved
    - AKI starts to resolve
  - Delirium and agitation are likely to be due to drugs and ICU interventions though select groups may have COVID-19 CNS involvement or inflammatory CNS conditions contributing to agitation and encephalopathy. Agitation may be multifactorial.
  - If sedation has not been successfully weaned by now, other strategies, including psychiatry and neurocritical care consultation, are needed.

Agent Initiation and Titration Recommendations

- Active Phase - Phase I
  1. Propofol
    - Propofol infusion: initiate at a rate of 10mcg/kg/min and increase q2min prn by 5-10 mcg/kg/min to goal RASS.
      - Maximum infusion rate of 65 mcg/kg/min. Notify provider if the patient is not at goal despite maximum infusion rate.
      - Under physician supervision, higher infusion rates may be used temporarily during bedside procedures.
      - With infusions of 40-65 mcg/kg/min, propofol infusion syndrome monitoring labs should be initiated and monitored q24 hours. Monitoring labs include: ABG/VBG, lactate, CK, creatinine, LFTs, triglycerides, serum potassium.
      - Increasing vasopressor requirements should trigger the clinician to consider the possibility of propofol infusion syndrome or possible sepsis and not be attributed to sedation-mediated hypotension alone.
      - Vasopressor support may be required with higher doses of propofol. An alternative sedation strategy should be considered if more than one vasopressor needs to be added in order to tolerate propofol dosing.
    - Consider starting fentanyl infusion (25-50 mcg/hr) concurrent with propofol when propofol dose exceeds 20 mcg/kg/min.
      - Hourly bolus doses of fentanyl (25-50 mcg) as needed may be used rather than infusions for the elderly (≥70 years old), those lethargic at the time of intubation, or those in whom propofol 20 mcg/kg/min or less provides sufficient sedation but intermittent pain control is needed.
• Need for frequent hourly boluses should trigger conversion to infusion in order to minimize nurse entry to the room.
  ▪ Plan to transition off of (or dose reduce) propofol to an alternative agent when serum triglycerides exceed 500 mg/dL
  ▪ If the clinician believes pain is the predominant cause of agitation, then a strategy of opioid initiation before propofol may be considered.

2. Fentanyl and hydromorphone (morphine if supply shortages occur)
  ▪ Fentanyl infusion should be attempted prior to hydromorphone infusion
  ▪ A bowel regimen should be initiated when IV opioids are initiated for analgesia and sedation. See Section 15
  ▪ Fentanyl infusion: infusion rate ranges from 25-150mcg/hr. Titrate fentanyl infusion by 25-50mcg/hr q15minutes. Each infusion rate increase should be accompanied by a bolus dose of 25-50 mcg.
    ▪ For the elderly (≥70 years old), fentanyl boluses may be trialed prior to infusion fentanyl. Provide 25-100 mcg IV push q15min PRN CPOT ≥3. Increase each push by 25mcg if repeated pushes are needed for breakthrough pain or sedation control.
    ▪ If the patient requires hourly boluses, then convert to infusion in order to minimize nursing entry into the room.
    ▪ For patients with pre-morbid opiate exposure, fentanyl up to 300 mcg/hr (or hydromorphone over 5mg/hr) may be required.
    ▪ Serotonin toxicity should be routinely assessed for by the clinical team when fentanyl infusions exceed 150 mcg/hr, particularly in those exposed to multiple serotonergic agents (such as SSRIs, SNRI, Triptans, MAOIs, anti-emetics, linezolid). Nursing staff should inform the physician team when fentanyl dose exceeds 150 mcg/hr. Development of myoclonus, stereotyped movements, or rigidity should trigger consideration for holding fentanyl while seeking neurocritical care consultation. Serotonin toxicity can manifest as worsening agitation despite escalating fentanyl doses.
    ▪ Patients developing signs of serotonin toxicity should be converted from fentanyl to hydromorphone if continued opioid therapy is needed. If opioid therapy in excess of fentanyl 300mcg/hr is indicated, then conversion to hydromorphone can be discussed in consultation with pharmacy. Fentanyl to hydromorphone is 100mcg fentanyl IV = 1mg hydromorphone IV.
      ▪ Hydromorphone infusion: Standard infusion ranges from 0.5-5mg/hr. Titrate hydromorphone infusion by 0.5mg q15minutes. Each infusion rate increase should be accompanied by a bolus dose of 0.5mg.
      ▪ Morphine infusion: Morphine infusion may be used in the case of supply chain shortages affecting fentanyl and hydromorphone. Infusion ranges from 1-10mg/hr. Titrate IV infusion by 1mg/hr q30 minutes with a bolus of 2-4mg IV push. Additional intermittent boluses of morphine may be given as 2-4mg IV push q1H as needed.

3. Haloperidol, quetiapine or olanzapine (listed in preferential order)
  ▪ Note that antipsychotics will be most effective for agitation rather than providing sedation. If the primary need is sedation, then move to item 4.
  ▪ Scheduled dosing is preferred over as needed dosing to avoid additional need for nursing to enter the room.
- **Haloperidol**: 2-5 mg PO/IM/IV q6-8h scheduled with additional 2-5mg prn once for a maximum daily dose of 20mg.
- **Quetiapine**: 100 mg PO/Per tube BID. Titrate daily by 25-50 mg/day to a maximum of 400 mg PO/Per tube divided BID
- **Olanzapine**: 5-10 mg PO/IM/SL daily-BID. Titrate to a maximum daily dose of 20 mg daily (alternative to quetiapine).
- Avoid these agents if the patient has evidence of COVID-19 associated cardiomyopathy, arrhythmia, or QTc prolongation. Rhythm strip assessment is recommended after initiation and dose escalation.
- Divided dosing is less likely to prolong QTc. QTc should be checked by rhythm strip after initiation and titration.

4. **Low-dose midazolam**
   - **Midazolam infusion**: Rate ranges from 5-25mg/hr, should be titrated every 30 minutes by increments of 5mg/hr with a 5mg bolus.
     - Vasopressor support may be required with higher doses of midazolam. An alternative sedation strategy should be considered if more than one vasopressor needs to be added in order to tolerate midazolam dosing. Additional work-up of hypotension should be pursued whenever vasopressor requirements change significantly after remaining on stable dose of midazolam infusion for 24 hrs.

5. **Lorazepam (as an alternative to midazolam if midazolam supplies are depleted)**
   - Due to the risk of toxicity from the propylene glycol diluent, midazolam is the preferred benzodiazepine sedative when available.
   - **Lorazepam infusion**: infusion rate ranges from 2-10 mg. Lorazepam should be titrated every 30 minutes by increments of 2mg/hr with a 2mg bolus.
     - **Lorazepam dose should not exceed 10mg/hr** and the clinician should begin monitoring for propylene glycol toxicity (anion gap metabolic acidosis) at doses exceeding 6mg/hr, particularly when patients are receiving other IV formulations with propylene glycol (phenobarbital and phenytoin IV).
     - Bioequivalent doses of diazepam may be used as an alternative to lorazepam when midazolam or lorazepam supplies are depleted. 5mg diazepam = 1mg lorazepam IV

6. **Low-dose (benzo-opioid synergistic) ketamine**
   - **Ketamine infusion**: rate ranges from 2.5-5 mcg/kg/min, titrate after 30 minutes if needed by providing a 0.2-0.5 mg/kg bolus and increasing the rate by 2.5 mcg/kg/min.
     - Agitation can occur with emergence from ketamine, particularly at higher and more prolonged doses. The reported incidence varies from 0 - 30% with most cases being mild. Pre-medication with benzodiazepines reduces the incidence of emergence reactions and benzodiazepines can be used to treat emergence reactions.

7. **High-dose midazolam**
   - **Midazolam titration**: 1 mg/kg/hr ideal body weight, titrate every 15-30 minutes by providing a 10mg bolus and increasing the infusion by 10mg.
     - In the elderly (≥70 years old), slower titration (5mg bolus every 15-30 minutes and increase infusion by 5mg) to 0.75-1.0 mg/kg/hr ideal body weight may be used in an attempt to minimize benzodiazepine exposure.
• Anticipate the need for vasopressor support at doses approaching 80mg/hr. An alternative sedation strategy should be considered if more than one vasopressor needs to be added in order to tolerate midazolam dosing.
• Doses of versed up to 3mg/kg/hr ideal body weight have been reported for sustained use but should only be pursued after consultation with pharmacology and neurocritical care.

8. **High-dose ketamine**
   • **Ketamine infusion:** Rate ranges from 5-30 mcg/kg/min, titrate every 30 minutes by providing a 0.2-0.5 mg/kg bolus and increasing the rate by 2.5-5 mcg/kg/min
   • Consult neurocritical care if infusion dose exceeds 30 mcg/kg/min
   • Sustained doses up to 160 mcg/kg/min have been tolerated in the literature
   • Agitation can occur with emergence from ketamine, particularly at higher and more prolonged doses. The reported incidence varies widely from 0-30% with most cases being mild. Pre-medication with benzodiazepines reduces the incidence of emergence reactions and benzodiazepines can be used to treat emergence reactions.

9. **Phenobarbital (consult neurocritical care and psychiatry prior to starting)**
   • Due to significant morbidity when used in critically ill patients at risk for multi-system organ failure, phenobarbital for sedation should be last line in the active phase of COVID illness after other approaches have been exhausted.
   • **Phenobarbital loading:** Initiate with a load of 10mg/kg given no faster than 60mg/min to avoid hypotension
   • **Phenobarbital maintenance:** dose of 1-2mg/kg/day divided twice daily by IV or enterally
   • Phenobarbital breakthrough agitation dosing: 65-130mg IV push q1-2hours prn
   • Routine, serial drug level monitoring may not be necessary but may be clinically useful in cases of increased metabolism. Consider initially targeting trough levels of 10-15 mcg/mL for agitation control if other agents are also being used. Trough levels of phenobarbital should only exceed 25 mcg/mL with caution as high-dose phenobarbital may produce prolonged over-sedation, ileus, and cardiogenic/vasodilatory shock, contributing to prolonged ICU stay.
   • Use caution and target lower doses if the patient has evidence of COVID-19 associated cardiomyopathy

• **Transition Phase - Phase II**
   Adjunctive agents should be added in this phase to facilitate sedative wean. Initially, start with one adjunctive agent while beginning a slow sedative wean. Add additional agents as needed to further facilitate sedative wean. Of note, COVID-19 patients may not tolerate acute spontaneous awakening trials. Adjuncts are listed in order of preference.

1. **Haloperidol, quetiapine, or olanzapine**
   • These agents are recommended if not already utilized in phase 1
   • Scheduled quetiapine, olanzapine, or haloperidol may be initiated. Scheduled dosing is preferred to avoid additional need for nursing to enter the room.
   • **Haloperidol:** 2-5 mg PO/IM/IV q6-8h scheduled with additional 2-5mg prn once for a maximum daily dose of 20mg.

Last Modified: April 20, 2020
- **Quetiapine**: 100 mg PO/Per tube BID. Titrate daily by 25-50 mg/day to a maximum of 400 mg PO/per tube divided BID
- **Olanzapine**: 5-10 mg PO/IM/SL daily-BID. Titrate to a maximum daily dose of 20 mg daily (alternative to quetiapine).
- Avoid these agents if the patient has evidence of COVID-19 associated cardiomyopathy, arrhythmia, or QTc prolongation. Rhythm strip assessment is recommended after initiation and dose escalation.
- Divided dosing is less likely to prolong QTc. QTc should be checked by rhythm strip after initiation and titration

2. **Dexmedetomidine, clonidine, or guanfacine**
   - Dexmedetomidine can be initiated if the patient is not bradycardic or hypotensive. Clonidine can be initiated if the patient is not hypotensive (bradycardia can occur with clonidine but tends to be milder than with dexmedetomidine)
   - **Dexmedetomidine infusion**: Rate ranges from 0.2-1.5 mcg/kg/hr, titrate by 0.1 mcg/kg/hr q 30 min to maintain RASS 0 to -2 while weaning other sedative agents.
   - **Clonidine**: Initiated as 0.1mg TID per tube and titrated q8H up to 0.3mg TID. Clonidine patches should be avoided while the patient is critically ill and in the obese, where pharmacokinetics may be unpredictable.
   - **Guanfacine**: As immediate release 1mg twice daily. May titrate to maximum 4mg per day.
     - Consider guanfacine if the patient has been unable to tolerate clonidine or dexmedetomidine. Guanfacine has central alpha-2 agonist properties with potentially less tendency towards bradycardia or hypotension.
   - Use of both dexmedetomidine and clonidine/guanfacine is not recommended unless clonidine/guanfacine is being used to wean the patient off dexmedetomidine.

3. **Propofol**
   - If triglycerides have improved (<400 mg/dL) then propofol may be re-introduced to facilitate sedative weaning. Propofol may have particular benefits in facilitating wean from benzodiazepines and barbiturates and may be preferred over dexmedetomidine or clonidine if high doses of benzodiazepines or barbiturates have been used.
   - **Propofol infusion**: Initiate at a rate of 10mcg/kg/min and increase q2min prn by 5-10 mcg/kg/min to goal RASS.
     - Maximum infusion rate of 65 mcg/kg/min.

4. **Valproic acid**
   - Avoid this agent if the patient is known to be hyperammonemic, significantly thrombocytopenic, has severe liver injury or pancreatitis, or has significant hypertriglyceridemia. Valproic acid can be initiated if the patient is on propofol provided they have not demonstrated significant hypertriglyceridemia from propofol.
   - **Valproic Acid Loading dose**: 20-30mg/kg total body weight over 1 hour for agitation
   - **Valproic Acid Maintenance dose**: 500-750mg every 6 hours. Higher maintenance doses may be needed for patients with increased metabolism.
   - Concurrently with valproic acid initiation, load levocarnitine 50mg/kg IV once and start maintenance levocarnitine 990mg PO every 8 hours. In addition, start thiamine 500mg IVPB every 8 hours for three days and then continue 100mg PO or IV daily while critically ill. Monitor daily ammonia levels. Ammonia levels up to 100 are tolerable in most patients.
• Drug Levels: Routine monitoring may not be necessary. Consider titrating to clinical effect and maintaining trough levels below 100 mcg/mL. Free drug levels may be elevated disproportionately if serum albumen is low, which may contribute to drug toxicity.
• Valproic acid should be used as a short-term therapy to facilitate sedative wean. Consider discontinuation if INR increases above 1.7 or AST/ALT exceed 5 times the upper limit of normal.

5. Trazadone
• Trazodone may be initiated if patients appear to have “sundowning.” Doses should start at 50mg qHS and can be increased to 150mg qHS. Trazodone may facilitate entrainment of the circadian rhythm but can also be used as 50mg q8prn for agitation. Trazodone should be avoided in patients on multiple serotonergic agents due to the risk of serotonin syndrome.

6. Gabapentin
• Gabapentin: 600mg every 8 hours titrated to maximum of 900mg every 6 hours. Dose adjustment is needed for renal insufficiency (consult with pharmacy). It may have particular benefit if patients have a history of neuropathic pain, autonomic dysregulation, or concern for alcohol or benzodiazepine withdrawal. Slowly taper for those on high or prolonged dosing.

7. Phenobarbital (consult neurocritical care and psychiatry prior to initiation)
• If the patient has been on benzodiazepines for greater than 72 hours and has required 3 or more sedative infusions, then the addition of low dose phenobarbital should be considered if not already initiated, otherwise alternative adjunctive agents should be pursued.
• Phenobarbital loading: Initiate with a load of 5-10mg/kg given no faster than 60mg/min to avoid hypotension
• Phenobarbital maintenance: Dose of 1-2mg/kg/day divided twice daily by IV or enterally
• Phenobarbital breakthrough agitation dosing: 65-130mg IV push q1-2hours prn
• Routine drug level monitoring may not be necessary, and the drug can be titrated to clinical effect as an adjunct for weaning. If drug level targets are used, consider initially targeting trough levels of 10-15 mcg/mL and avoid levels exceeding 20 mcg/mL given risk of morbidity in critically ill patients.

• Convalescent phase - Phase III

Agents are listed in suggested order of wean

1. Weaning high-dose ketamine
• Due to the risk of emergence reactions with high doses and prolonged use of ketamine, adjunctive agents or benzodiazepines should be in place with a plan for sedation if emergence reactions occur. Trial reducing ketamine dose by 20% every 6 hours and monitor for tolerance. Concurrent benzodiazepines have been shown to reduce the risk of emergence reactions.

2. Weaning benzodiazepines
• With prolonged use of midazolam, active benzodiazepine metabolites accumulate and can facilitate weaning (“self-weans”). Lorazepam also leads to metabolite accumulation with prolonged use but likely represents a higher risk of withdrawal symptoms than midazolam. As a precaution, benzodiazepine infusions should be reduced by 25% every 4 to 6 hours while monitoring for symptoms of withdrawal. If withdrawal is suspected than lorazepam 2mg or clonazepam 1mg can be given as needed in response to withdrawal symptoms.
Benzodiazepine and opiate withdrawal may have similar features though fever and tremor are more likely to occur with benzodiazepine withdrawal while diarrhea, lacrimation, and rhinorrhea are suggestive of opiate withdrawal.

3. Weaning opioids
   - Consider initiation of a scheduled opioid to reduce withdrawal symptoms as infusions are reduced. Approaches such as fentanyl pushes (25-50 q4-6H) or scheduled IV/enteral oxycodone or hydromorphone (for example, 2-10 mg q6H depending on peak infusion dose) as maintenance opioid can be considered to reduce withdrawal symptoms. Trial reducing opioid continuous infusions by 20% every 6-12 hours and monitor for tolerance to refine the rate of wean.
   - Benzodiazepine and opiate withdrawal may have similar features though fever and tremor are more likely to occur with benzodiazepine withdrawal while diarrhea, lacrimation, and rhinorrhea are suggestive of opiate withdrawal.
   - Due to the possibility of opioid supply chain shortages, opioids should be transitioned to PO or per tube dosing as soon as feasible. Dosing options include
     - Oxycodone 5-20mg PO q4-6 hours scheduled with additional q4-6 hour boluses as needed
     - Hydromorphone 2-4mg PO q4-6 hours scheduled with additional q4-6 hour boluses as needed
     - Morphine 5-30mg PO q4 hour scheduled with additional q4 hour boluses as needed.

4. Weaning propofol
   - Propofol infusion may be reduced by 10 mcg/kg/min every 1-2 hours while monitoring for tolerance.

5. Dexmedetomidine to facilitate ventilator wean and extubation
   - Dexmedetomidine can be used to facilitate extubation in agitated patients who are otherwise appropriate for extubation. Consider weaning dexmedetomidine dose to 1 mcg/kg/hr and extubating while dexmedetomidine is infusing. The infusion may be continued for a short period of time after extubation to facilitate the peri-extubation period.

6. Ketamine reintroduction (optional) for extubation
   - If an agent is required to facilitate extubation then re-introduction of low dose ketamine could be considered

7. Weaning adjunctive agents
   - Remaining adjunctive agents can likely be weaned on a general medicine unit over the course of days. Phenobarbital can be weaned by reducing maintenance dose q48H.
Active and Transitional Phase COVID-19 Sedation Guidance Figure

**ACTIVE PHASE**

- **Propofol**
  - Infusion: 10 mcg/kg/min, titrated by 5-10 mcg/kg/min q2min
  - HyperT, PRN, Renal failure
  - Vent dysynchrony/ agitation

- **Midazolam (low dose)**
  - Intermittent: 1-5 mg IV push q15min prn
  - Infusion: 5-25 mg/hr titrated by 5 mg/hr q30min (with bolus)

- **Morphine bolus + infusion**
  - Intermittent: 0.5-2 mg IV push q15min prn
  - Infusion: 0.5-5 mg/hr titrated by 0.5 mg/hr q15min (with bolus)

- **Antipsychotics**
  - Haloperidol 2.5 mg PO/IV q6-8h plus 2-5 mg PRN, Max 20mg/day
  - Quetiapine 100 mg PO BID, Max 400 mg/day
  - Olanzapine 5-10 mg PO/IM/SL OD-BID, Max 20 mg/day

**TRANSITION PHASE**

- **Antipsychotics**
  - Haloperidol 2.5 mg PO/IV q6-8h plus 2-5 mg PRN, Max 20mg/day
  - Quetiapine 100 mg PO BID, Max 400 mg/day
  - Olanzapine 5-10 mg PO/IM/SL OD-BID, Max 20 mg/day

- **Propofol**
  - Infusion: 10 mcg/kg/min, titrated by 5-10 mcg/kg/min q2min
  - Clonidine 0.1 mg PO/PT TID divided QID
  - Guanfacine 1 mg PO/PT BID, Max 3 mg/day

- **Valproic Acid**
  - Load IV: 20-30 mg/kg
  - Maintenance PO/IV: 500-750 mg q8h

- **Phenoxybutiltal**
  - Load IV: 5-10 mg/kg
  - Maintenance IV/PO: 1-2 mg/kg/day divided BID
  - Breakthrough: 65-130 mg IV push q1-2hrs

- **Gabapentin**
  - 600 mg PO/PT TID

- **Trazodone**
  - 50 mg PO/PT qHS for sunsetting or

- **Oxycodone**
  - 5-20 mg PO q4-6hr +/- PRN

- **Hydromorphone**
  - 2-4 mg IV push q1hr

- **Morphine**
  - 5-30 mg PO q4hr +/- PRN

**When adjunctive agents are initiated and titrated up, the previous sedation infusions should be titrated down.**

For additional details regarding agent selection, titration parameters, contraindications, and monitoring, refer to COVID-19 Sedation Initiation and Weaning Guidance.
Section 15: Bowel Regimen While Using High-dose Opioids or Phenobarbital

Routine bowel regimens

- Should be started upon initiation of analgesia/sedation
- Docusate/senna 2 tablets PO/per tube BID
- Polyethylene glycol PO/per tube BID

Adjunctive regimens

- Magnesium citrate 300 ml PO/per tube x1
- Bisacodyl PO/Rectal daily or daily PRN
- Fleet Enema/tap water enema PR x1
- Lactulose 20 g (30ml) PO/per tube daily- BID
- Naloxone 3-12 mg PO TiD (48-hour trial recommended)

Refractory

- Methylnaltrexone (weight based, renally adjusted): 8-12 mg SQ every other day
Section 16: Neurocritical Care Consultation

Indications for Neurocritical Care Consultation

• Encephalopathy without focal motor or cranial nerve features*
  o Non-intubated patient with oxygen saturation >92%, serum (venous or arterial) pH>7.3, MAP >65mmHg
    ▪ Consult if GCS 12 or less
  o Intubated patient with PaO2 >60mmHg, serum pH >7.25, MAP >65mmHg
    ▪ Consult if GCS is 8T or less and patient is off sedatives besides moderate-dose dexmedetomidine
      • Propofol held 1 hour, fentanyl or benzodiazepines held 6 hours if sedatives used <72
        hours or 8 hours if sedatives used more than 72 hours)
    ▪ Consult if agitation or ventilator synchrony prevent complete cessation of sedatives but GCS is
      8T and no neurologic improvement is appreciated with a trial of sedative dose reduction
      (consider 25-50% reduction)
  o If oxygen saturation, serum pH, or MAP are below the noted cutoffs then attempt to address these
    derangements prior to consultation.
• Focal motor or cranial nerve features* not known to be present prior to acute COVID-19 infection or explained
  by past medical history
• Sustained or intermittent stereotyped motor movement or “spells” during which the patient would not respond
  purposefully to the examiner by verbal or tactile stimuli or the patient would not demonstrate bilateral
  purposeful movements (such as purposefully pulling against restraints or reaching for lines/tubes).
• Severe agitation (RAAS 3-4) disproportionate to level of stimulation or in setting of extensive sedative use (i.e.
  use of greater than three separate sedative agents, midazolam greater than 1mg/kg/hr, or ketamine greater
  than 30 mcg/kg/min)
• Patients with “recovered” COVID-19 infections should receive neurological consultation according to standard
  clinical practice

*excludes anisocoria (unequal pupils), which has a high prevalence in the normal population, without other motor or
cranial nerve findings
Section 17: Lines, Tubes and Procedures

General guidelines for all procedures performed on COVID-19 positive or suspected patients

- All efforts should be made to minimize exposure to healthcare workers. Safety procedures, including donning and doffing of PPE, shall not be altered no matter how emergent the situation.
- PPE, including N95 respirator, gloves, goggles or face shield, and gown, are mandatory for all providers present for any procedure.
- Limit the number of healthcare providers in the room during the procedure.
- Procedures should be performed by the most experienced provider available.
- If multiple procedures are required, providers should make every effort to coordinate and batch these procedures to minimize trips in and out of the patient’s room and use of PPE.
- Careful preparation outside the room is strongly recommended. All necessary supplies should be gathered and checked prior to entering the room. Suggested supply lists for common ICU procedures are listed in the following sections.
- An outside the room time out, including a review of necessary supplies, should be performed.
- Clear lines of communication, possibly via white board, should be maintained through the window to a runner outside the room.

Pulmonary procedure service

- During the COVID-19 pandemic, there will be need for increased pulmonary procedures, especially for patients in the COVID ICUs. The Interventional Pulmonology (IP) team will provide two attendings, a fellow and a PA to perform bronchoscopy, pleural procedures and percutaneous tracheostomy. The procedure service is also available to assist with procedures for the non-COVID MICU and the Pulmonary Consult service.
- The IP team will be available at 8 am to review COVID ICU patients who may need pulmonary procedures. The COVID ICU teams may also page the IP service as needed to discuss patients. Bronchoscopy and pleural procedures can be arranged for the same day with immediate notice, but tracheostomy procedures will require notification at least 24 hours in advance. Tracheostomy procedures require coordination with ancillary services, including RT and Anesthesia, and will therefore be done within business hours Monday through Friday. Please see separate Tracheostomy Protocol Procedure for details.

Central venous access service

A central venous access service is available to assist with central line placement. This service can be contacted at pager 57557 (COVID Line Team).
Endotracheal intubation

- Review the Intubation and Airway Management Guidelines for known or suspected patients with COVID-19.
- An abbreviated summary of this guideline is provided below:
  - Limit the number of HCPs in the room where the patient is to be intubated.
    - Recommendation: Two anesthesia providers in the room with an additional provider (runner) outside the room. The ventilator can be set up by respiratory therapist prior to intubation (if not an emergency) or after intubation.
  - The most experienced anesthetist available should perform intubation, if possible.
  - Standard monitoring, IV access, instruments, drugs, ventilator and suction should be checked prior to the procedure. Do not bring the anesthesiology airway emergency supply bag or respiratory therapy airway emergency supply bag into the patient’s room.
  - Avoid all awake intubations unless specifically indicated. Atomized local anesthetic might aerosolize the virus.
  - Consider rapid sequence induction and intubation (RSI).
  - Give 5 minutes of preoxygenation with oxygen 100% and perform RSI in order to avoid manual ventilation of patient’s lungs and potential aerosolization of virus from the airways.
  - Ensure that a high-efficiency hydrophobic filter (i.e., viral filter) is interposed between the face mask and the breathing circuit, or between face mask and manual resuscitation bag. The viral filter should be placed as close to the patient as possible (i.e., immediately distal to the ETT).
  - Intubate and confirm the correct position of tracheal tube. Use of videolaryngoscope provides distance between provider and patient’s mouth as well as minimization of intubation attempts. The colorimetric capnometer used to confirm ETT position should be placed between the viral filter and the manual resuscitation bag. Use the patient’s in-room disposable stethoscope to auscultate bilateral lung fields.
  - Institute mechanical ventilation and stabilize the patient.
  - Any disconnection of the patient from the ventilator circuit (i.e., placement of in-line suction device) must be preceded by clamping the ETT prior to circuit disconnection. A viral filter should always be placed between the ETT and the manual resuscitation bag when the manual resuscitation bag is used.
  - All reusable airway equipment must be decontaminated and disinfected according to appropriate hospital policies.

Bronchoscopy

- ICU bronchoscopy
  - Bronchoscopy in the ICU will be performed for diagnostic and therapeutic purposes, including
    - Diagnostic evaluation of newly intubated patient, including COVID rule-out testing
    - Evaluation of possible VAP
    - Airway clearance
  - Bronchoscopy can be performed at the discretion of the ICU attending, but generally policy will be that off-hour bronchoscopy performed by a fellow without an attending should be limited to emergent situations such as mucous plugging. The following protocol will be used for bronchoscopy and will be performed by 1 to 2 member(s) of the procedure service or the COVID ICU attending. The COVID ICU fellow will participate if willing and available (per fellow’s preference). The nurse will help with pre-
procedural sedation but can then leave the room. RT should assemble the following materials but does not need to enter the room.
- Ambu scope and monitor
- Lubricant
- Slip tip 60 mL syringes x 4
- Normal saline 500 cc bottle
- Lukens trap x 2
- Bronchoscopy adapter for ETT
- Bag mask and PEEP valve
- Container for research BAL specimen
- Clamp for ETT (verify that one is already in the room)
  ○ Steps for bronchoscopy:
    - Continue/adjust ICU sedation for goal RASS -4, then dose cisatracurium 0.1 mg/kg.
    - Increase FiO₂ to 100%.
    - Clamp ETT, temporarily disconnect inspiratory limb from the vent distal to the filter, place adapter, unclamp, reconnect ventilator and allow patient to re-equilibrate.
    - Clamp the tube, disconnect the inspiratory limb from the ventilator, open the bronch adapter port and insert bronchoscope through adapter, then unclamp the tube and reconnect the inspiratory limb.
    - Toilet secretions, and wedge into target lobe.
    - Perform BAL with 120 – 240 cc saline with goal 30+ cc BAL return. Would discard an initial sample that is pulled into the syringe as toileting was performed prior to BAL, in an effort to minimize a false positive bacterial PNA result.
    - Clamp ETT, disconnect the inspiratory limb from the vent distal to the filter, remove the bronchoscope and adapter, unclamp and re-connect to ventilator to restart mechanical ventilation.
    - All disposables will be placed in double biohazard red bags for disposal.
    - The bronchoscopy monitor and pole will be wiped down before leaving room.
  ○ Special circumstances:
    - Prone positioning can continue with standard procedure as outlined above.
  ○ Specimens:
    - We encourage the managing team to place bronch order set. Routinely send BAL for cell count with differential, bacterial culture, viral panel (if no previous negative RVP), COVID19 PCR, MRSA PCR, and Amylase (mainly on initial sample and/or if aspiration event suspected). COVID-19 testing should be performed on all BALs until we get better data on time to clearance of the virus. If any additional testing is requested, please inform the procedural team of the additional testing that is needed.
    - 10 mL or more should also be saved for research purposes in a separate container and a patient label should be placed in the specimen bag with the sample. The MICU research team can be contacted by phone at 62752 or by pager at 59285. If they are not readily available to pick up the specimen, it can be left in the specimen fridge in the dirty utility room in the 9th floor MICU.
• Non-ICU bronchoscopy
  o For patients who require a COVID rule-out bronchoscopy but do not require ICU level care, their bronchoscopy will be performed by the procedure service in the Feinberg 9th floor MICU procedure room, which is negative pressure. Nursing staff will be from the bronchoscopy suite. **These cases should be scheduled by contacting Rebekah Werner** who can be paged. Or, use the dot phrase .covidbronchrequest in Epic, which will generate a form to complete, prompt you to place an order for the bronchoscopy to be scheduled, and allow you to specify an appropriate and requested timeframe.
  o Patients in COVID rule out status will be brought to the Feinberg 9th floor MICU procedure room using standard precautions of such patients during transport. In the procedure room, N95 masks will be worn by all personnel, and disposable bronchoscopes will be used. The patient will be recovered in this procedure room by the staff. The room will be left empty once the patient leaves for 70 minutes per hospital protocol. Samples will be double-bagged. All disposables will be placed in double biohazard red bags for disposal.

**Central venous access**

• Recommended staff: physician, registered nurse
• Most COVID-19 positive patients in our center have required vasopressors in the immediate peri-intubation period. This should be anticipated and prepared for by the care team with a plan for immediate placement of IJ catheter once airway is secured.
• To limit exposure of PICC placement providers, triple lumen catheters are preferred as a first line for vasopressor administration. PICCs should be considered if vasopressor requirement is expected to last for longer than 10 days or long-term central IV access is needed for other indications. Please indicate in IR orders that placement is on a COVID-19 positive patient.
• Unless there are contraindications, the internal jugular is preferred for central venous access.
  o Consider dialysis line if underlying CKD or severe AKI with anticipated renal replacement therapy.
• I/O lines are also an option for emergent needs. If I/O is placed, plan immediately to gain more long-term central access; do not wait the 24 hours until I/O is expired.
• As with other procedures, bolus NMB can be considered to facilitate CVC placement.
• Reminder shopping list to help minimize entering and exiting rooms:
  o Ultrasound
  o Chloraprep x 3
  o Multi-Lumen Central Venous Catheterization Kit
  o Triple Lumen Insertion with Thyroid Kit (contains thyroid drape and sterile dressing)
  o If placing line other than TLC, get the appropriate kit (e.g., cordis, trialysis, dual lumen dialysis catheter, etc). Note what is in these kits very carefully before entering room: Many do not have suture or gauze; if angiocath is desired, bring separately.
  o Blue caps for TLC
  o Sterile ultrasound probe cover
  o Sterile saline
  o Sterile bowl
  o Sterile gloves, gown, bouffant
  o Additional sterile gauze
Arterial lines

- Recommended staff: physician, registered nurse
- Most COVID-19 positive patients who require intubation can be expected to require serial arterial blood gas assessment to guide management of their respiratory failure. Therefore, arterial line placement is recommended in patients with respiratory failure to avoid repeated provider exposure drawing blood gases.
- Reminder shopping list to help minimize entering and exiting rooms:
  - Ultrasound
  - Chlorapreps x 3
  - Arrow kit x 3
  - Sterile ultrasound probe cover
  - Sterile towels
  - Thyroid drape
  - Sterile gloves
  - Bouffant caps

Extubation

- Recommended staff: registered nurse, respiratory therapist (RT) (policy review pending)
- Evaluation for extubation should be done with pressure support trials on the ventilator. T-piece is contraindicated given aerosolization risks.
- Secretion management should be a major consideration when assessing patient for extubation, as traditional airway clearance technology may not be readily available for COVID-19 positive patients.
- During the extubation procedure, the RT should leave the ET tube connected to the ventilator circuit for as long as possible.
- Before extubation, cross clamp the ET tube and apply a viral filter to the end of the ET tube.
- Deep oropharyngeal suctioning is required during most extubation procedures, but creates a significant risk for aerosol generation. Healthcare team should plan for this and limit members of the healthcare team present during suctioning.

Tracheostomy

- Identifying patients and multidisciplinary discussion
  - The COVID ICU and Lung Rescue teams, including the ECMO team, will meet routinely to discuss COVID patients with respiratory failure.
  - There will be multidisciplinary discussion about patient selection, timing and technique for tracheostomy.
  - Patient selection and timing will be at the discretion of the primary teams.
  - Patients’ families will be approached early in their course about the potential need for tracheostomy, so that goals of care can be addressed early.
  - Efforts will be made to perform tracheostomy procedures at the bedside in order to minimize transporting patients and exposing other environments.
  - Open tracheostomy will be reserved for patients in whom anatomic considerations are deemed unsafe for percutaneous tracheostomy.
• Percutaneous tracheostomy
  o Step 1: Pre-procedural preparation
    ▪ The day prior to procedure, contact OR scheduling to request Anesthesia support or RT supervisor to request RT support.
    ▪ The day of the planned procedure, the following procedural items will be assembled outside the room by the nursing staff and Respiratory Therapy:
      • Cook Medical BlueRhino or Blue Dolphin Tracheostomy Tray
      • Shiley 6 and Shiley 6 XLT tracheostomy tubes with cuffs
      • Bronch adapter
      • Sterile basin
      • Two packages of sterile OR towels
      • Package of OR lap sponges
      • Vaginal packs x 2 from the OR
      • Clamp for ventilator circuit
      • Bag-mask device with PEEP valve
      • One 20 cc bottle of 1% lidocaine with epinephrine
      • Bottle of saline and sterile bowl
      • One medium size duoderm
      • Ultrasound machine
      • Disposable bronchoscope with monitor
      • Medications, including continuous ICU sedatives, phenylephrine and cisatracurium
      • 2 biohazard bags
    ▪ The following PPE items will also be assembled outside the room by nursing staff and respiratory therapy:
      • Four PAPRs with hoods
      • Four sets of sterile surgical gloves, with sizes at the discretion of operators
      • Four sterile gowns
      • Four non-sterile regular PPE gowns
      • Four foot/boot covers
      • Two red biohazard bags
    ▪ The tracheostomy team will be notified, and the following team members assembled:
      • COVID ICU attending, nurse and RT
      • On-call/designated Anesthesia attending or fellow
      • On-call/designated Interventional Pulmonology attending
      • On-call/designated surgeon, either ENT or Thoracic Surgery attending
    ▪ In case Anesthesia is not requested and RT is requested, sedation and paralytics will be administered under the direction of the provider performing the procedure if they have privileges to administer sedation. Medications will be initiated by the nursing staff who can leave the room prior to the start of procedure. However, every effort will be made to limit personnel in the room, as this is a high aerosol-generating procedure. Every effort will also be made to be consistent in how this procedure is performed, regardless of the procedural team.
Step 2: Procedural setup

- Once all materials have been assembled outside the room, team members will meet for a sign-in and procedural pause outside the room. The patient’s medical history, vital signs, labs (including CBC, INR, ABG), imaging, medications, IV infusions, allergies, ventilator settings and code status will be reviewed. Consent will have already been obtained by the COVID ICU team, and the consent form will be reviewed. Assembled tracheostomy team members will decide upon designated roles: bronchoscopist, anesthesiologist and operator(s). Ideally only these three or four people will enter the room with standard PPE precautions as well as PAPR devices and maximal body coverage, including non-sterile gowns, gloves, eye protection and foot covering.

- **Role 1: Bronchoscopist.** This person will be responsible for airway management, including bronchoscopy and possible need for flexible intubation. They will stand at the head of the bed and help position the head. They will be responsible for managing the airway during the procedure, including positioning of the endotracheal tube, packing the nose and mouth, and deflating the cuff at the appropriate time.

- **Role 2: Anesthesiologist.** This person stands at the left side of the patient and is responsible for managing the ventilator and medications during the procedure. They will manage IV sedation and give the dose of paralytic (traditionally 0.1 mg/kg cisatracurium) at the designated time (traditionally just before incision). They will monitor hemodynamics and provide vasoactive medications at their discretion. They will increase the FiO₂ on the ventilator to 100% and consider a recruit maneuver (PEEP or breath-hold) before the procedure. They will be responsible for ventilator tube management, including clamping and bagging as described below.

- **Role 3: Respiratory Therapist.** They will increase the FiO₂ on the ventilator to 100% and consider a recruit maneuver (PEEP or breath-hold) before the procedure. They will be responsible for ventilator tube management, including clamping and bagging as described below. They will assist with ventilator setup after the procedure.

- **Role 4: Operator (may need two people for this role).** This person(s) will stand at the right side of the patient and perform the tracheostomy. They will position and examine the neck to decide upon the most appropriate technique (i.e., percutaneous or open). They will open supplies and trays, put on sterile materials and prepare the tracheostomy tube.

Step 3: Tracheostomy procedure (percutaneous). The following steps describe a modified percutaneous tracheostomy approach that minimizes exposure to aerosols. If the operators feel that this cannot be performed safely because of anatomy, then skip this step and proceed to Step 5 for open/surgical tracheostomy.

- The operator will position the patient in the standard position and examine the neck (palpation +/- ultrasound to identify anatomy). They will cleanse neck once with chlorhexidine and then put on sterile gowns and gloves. They will drape the neck and body. Care should be taken so that ventilator and IV tubing is easily accessible to anesthesia.

- The bronchoscopist will cover and pack nose and mouth with towels, vaginal packs or sponges to minimize exposure to secretions or aerosols.

- The anesthesiologist or RT will pause the ventilator, clamp the ETT, disconnect the ventilator tubing, and place the bag-mask device with PEEP valve and 100% oxygen flowing. A bronchoscope adapter will also be attached to the ETT at this time. Unclamp the ETT and begin manual ventilation.
The bronchoscopist will place scope through the ETT, toilet secretions, deflate the cuff, and draw back the tube to the level of the subglottic space. Care should be taken so that the connections with the adaptor are tight, and then the adaptor and tube can be covered with towels.

The operator will again cleanse with chlorhexidine and then instill lidocaine into the dermis and down to the tracheal rings. A 10 mm dermal incision will be made, and an angiocatheter placed through the incision and down to the trachea.

The angiocatheter will enter the trachea guided by direct visualization by the scope. Ideal placement will be between the 2nd and 3rd or between the 3rd and 4th rings, and the needle should enter between the 10:00 and 2:00 positions of the trachea as viewed by the scope.

The needle will be removed, and the catheter advanced. Finger occlusion will be performed until a guidewire can be placed, and then the catheter is removed. A wet lap sponge will be used around the incision site to minimize aerosol.

The anesthesiologist/RT will hold ventilation. A 14Fr dilator is placed over the wire and used to dilate down to the trachea. Dilation is performed twice. Once the dilator is removed, wet gauze should be applied around the wire to minimize leak of aerosols. The anesthesiologist/RT can resume ventilation at their discretion.

The anesthesiologist/RT will again hold ventilation once the operator is ready with the next dilator. The Rhino or Dolphin dilator will be placed over the wire and into the trachea with direct visualization of the appropriate-sized black lines in the airway by the scope. The Rhino or Dolphin dilator will be removed, and further packing will be applied around the fresh stoma. The anesthesiologist/RT can resume ventilation at their discretion.

The anesthesiologist/RT will hold ventilation. The tracheostomy introducer and tube will be placed over the wire and into the airway. The wire is removed, and the cuff of the tracheostomy tube will be inflated.

The anesthesiologist/RT will hold manual ventilation and attach the regular ventilator tubing to the tracheostomy tube. Mechanical ventilation can be resumed through the tracheostomy tube. The bag-mask device does not need to be removed from the ETT.

The bronchoscope will be used to ensure proper positioning of the tracheostomy tube. The scope and ETT can then be removed.

The tracheostomy tube can then be secured in the routine fashion with padding, sutures and tracheostomy ties.

Non-reusable materials will be placed into red biohazard bags (doubled). Sharps will be discarded per routine. PAPR devices will be cleansed per routine.

Doffing: The gloves and gowns will be removed in the room and discarded within the biohazard bags. The operators will then leave the room, with PAPR’s in place. An assistant will wipe down the PAPR using SANI-WIPES per Infection Prevention protocol and will help remove the PAPR hoods. Hand-washing and disposal of any other PPE will then be performed.
• **Tracheostomy procedure (open/surgical)**
  
  o If this is deemed necessary, every effort will be made to perform the procedure at bedside, but this may require transporting the patient to the OR with the COVID-19 OR protocol in place. Every effort will be made to delay these procedures and extubate the patient rather than transporting to the OR for an open/surgical tracheostomy.
  
  o **Timing**
    - Sign-out between COVID ICU and designated personnel in the OR (attending anesthesiologist designated for the procedure and OR nursing) before transfer is initiated from COVID ICU to expedite transfer to assigned room.
    - All open/surgical tracheostomy procedures will be performed during regular working hours when nursing personnel trained in this procedure are available.
  
  o **Personnel**
    - **Nursing:** 1 scrub nurse, 1 circulating nurse. Both must be ENT/thoracic trained and experienced in performance of tracheostomy procedure.
    - **Anesthesia:** Personnel must be experienced with tracheostomy procedure and comfortable with COVID-19 protocols.
    - **Surgery:** Attending otolaryngologist or thoracic surgeon, 1 resident PGY4/5.
  
  o **Pretransfer huddle**
    - All members of the above team will huddle to ensure readiness (of anesthesia and surgical equipment, and checklist of necessary PPE) before the attending anesthesiologist can perform a sign-out with COVID ICU to initiate transfer.
  
  o **PPE checklist**
    - PAPRs with hoods x 5
    - N95 masks x 5
    - Sterile surgical gloves
    - Sterile impermeable gowns x 3 (for 2 surgeons and 1 scrub nurse)
    - Non-sterile regular PPE gowns x 2 (for anesthesiologist and circulating nurse)
    - Impermeable boot covers
    - Red biohazard bags
  
  o Perform a time out: Include COVID-19 specific language for positive patients; include buddy checks for PPE; include check of tracheostomy surgical equipment and choice of tracheotomy tube/s.

• **Surgical procedure**
  
  o Perform standard prepping of neck and draping of patient.
  o Inject trach site with 1% lidocaine with 1:100,000 epinephrine solution (at surgeon’s discretion).
  o Make a horizontal incision using Bovie cautery. Make sure fume evacuator is present and deployed.
  o Dissect down to trachea quickly using vertical dissection, strictly keeping to the midline and retracting. Divide thyroid isthmus only if needed to expedite procedure.
  o Stop ventilation and paralyze the patient. Communicate with attending anesthesiologist about anticipated time of stopping ventilation, as some of these patients will have poor reserve.
  o Make a vertical or horizontal incision in the tracheal wall (surgeon’s discretion). Make a Bjork flap if needed (as open tracheostomy will only be performed for anatomically unfavorable patients).
  o Remove endotracheal tube and insert tracheotomy tube. Dispose of the endotracheal tube safely (in a double biohazard bag).
  o Inflate the cuff on tracheostomy tube and connect to ventilator.
  o Follow NMH protocol for donning.
Section 18: Echocardiography and Point-of-Care Ultrasound

Goals
- Obtain the diagnostic testing necessary to guide the care of critically ill patients.
- Minimize the risk of exposure to clinicians and sonographers.
- Guide the utilization of a potentially limited resource during a time of unprecedented stress on the healthcare system.

Transthoracic echocardiography (TTE)
- Goal-directed qualitative point of care ultrasound (POCUS) by trained clinicians already caring for COVID-19 positive patients is encouraged to limit the number of TTEs ordered.
- Suggested indications for TTE:
  - Clinical concern for acute cardiac pathology (e.g., rising troponins, dynamic EKG changes, unstable arrhythmias, undifferentiated or suspected cardiogenic shock).
  - Clinical deterioration in a patient with preexisting complex cardiac disease.
  - Consideration of mechanical circulatory support.
- Ordering a TTE:
  - For patients with severe valvular heart disease, prosthetic valves or other complex cardiac diseases, order “2D Echo with Doppler” in Epic.
  - All other TTEs should be ordered as “Limited Echo,” which will follow a focused COVID-19 TTE protocol.
  - This protocol provides information about left and right ventricular function as well as a screen for valvular disease.
  - If assessment of diastolic function or cardiac output is required, add this request in the comments section.
- Infection prevention with point of care ultrasound:
  - Attempts should be made to limit entering COVID-19 positive patient rooms. POCUS should only be performed when there is a specific clinical question for which POCUS is likely to change management.
  - Leave excess/additional probes outside of patient rooms when not in use.

Designate 1 portable ultrasound to be used solely for COVID+ patients

Disinfect machine before and after entering the room, including the probe, cord, keyboard and monitor using Grey Top Sani-Cloths

Don and Doff appropriate PPE including gown, gloves, N95 mask and goggles FACE shield per NM guidelines
Point of care cardiac ultrasound

- Indications
  - Shock
  - Suspected new heart failure
  - Rising troponin
  - Recommend against POCUS for frequent assessment of volume responsiveness (favor pulse pressure variation and/or clinical response to small fluid boluses to limit exposure)

- Probe
  - Phased array

- Preset
  - Cardiac

- Views
  - Parasternal long axis
  - Parasternal short axis (mid papillary level)
  - Subcostal four chamber
  - Inferior vena cava

- Notable cardiac disease pattern
  - Acute cardiac injury
    - Incidence 7% – 22%
    - Troponin and/or EKG changes
    - Acute coronary syndrome
    - Incidence unknown
    - May see regional wall motion abnormalities
  - Fulminant myocarditis
    - Case reports
    - Globally reduced LV function + -troponin
  - Arrhythmias
    - Incidence ~ 50% in ICU patients including VT/VF late in course
Point of care lung ultrasound

- Indications
  - Peak pressure alarm (rule out pneumothorax)
  - Progressive hypoxemia
- Probe
  - Phased array
  - Linear probe may be used if solely ruling out pneumothorax
- Preset
  - Abdominal (for phased array)
- Views
  - Anterior chest – Ultrasound 4 lung zones on each side (see picture)
  - Posterior chest – Ultrasound 1 lung zone on each side

- Notable disease patterns
  - B-line pattern indicating interstitial edema
  - Consolidation with air bronchograms
Section 19: Optimizing the Electronic Health Record (Epic)

- Patients can be identified as positive for COVID-19 in the StoryBoard in Epic:
• COVID-19 test results populate separate from the Respiratory Pathogen Panel. The official test result name is Coronavirus Covid-19.

Common COVID-19 orders
• COVID-19 Order Panel is the orderset for ordering both an RPP and COVID-19 testing.
• Indwelling Urinary Catheter Orders (search ‘Foley’)
• Standard ICU ordersets that would be helpful to use:
  o Ventilator management
  o Sedation/analgesia for ICU patients

Dot phrases
• Several members of the team have developed dot phrases that are helpful when writing notes.
• Note: There are several standard COVID-19 dot phrases that start with .COVID. These are mostly focused for patient education.
• They are all shareable from Theresa Lombardo’s list and will need to be copied to your SmartPhrases.
  o General dot phrases:
    ▪ TLBCDIFF
    ▪ TLBMP
    ▪ TLLFT
    ▪ TLDIC
    ▪ TLVENTVC – for patients on VC – pulls in settings as well as peak and plateau pressures
    ▪ TLVENTPC – for patients on PC – pulls in settings as well as measured tidal volumes
    ▪ TLPF – pulls in last documented P/F ratio
COVID-19-specific dot phrases:

- TLCOVIDLABS — lists all inflammatory markers in table form
- COVIDSIGNOUT — short sign-out list with important patient details (content below)

  Confirmed/Rule Out: route/date/time
  Intubated?: yes/no
  Lines:
  Pressors:
  Remdesivir: yes/no
  Other abx: yes/no
  Other systems failing?
  Consulting services:

- COVID19PNA — a detailed plan section for progress notes (content below)

# COVID-19 Pneumonia

Demographics

- Status: ***confirmed/rule out; ***date test sent: ***
- Travel history: ***
- Known positive exposure: ***yes/no
- Symptoms: ***

Objective Data:

- Imaging findings: ***
- Infectious workup: ***
- FiO2 Trend: ***

Treatment:

- Antibiotics: ***
- Lung protective ventilation ***
- COVID-19 team updated; anesthesia updated
- Intubate if O2 requirements approaching <90 on 5LNC; daily P/F ratios
- Compassionate use Remdesivir if approved: 200 mg IV day 1 (**), 100 mg IV daily day 2-10 (EOT ***)
- Inhaled colistin 150 mg q8h

Monitoring:

- Labs: daily CBC, CMP, Mg, coags, troponin, LDH, CRP, D Dimer, ABG if intubated***, SVO2 if central line***, UA***if on Remdesivir; PM BMP and Mg
- Avoid nebulized treatments, HFNC, and BIPAP; MDIs through circuit only***if intubated
- Electrolyte goal: replete K >4.0, Mg >2.0 (high risk of unspecified cardiomyopathy later in course)
- No visitors allowed in hospital: update families 1-2x per day
- Strict airborne/contact precautions: N95 mask, faceshield/goggles, gown, gloves
Tips from clinical documentation specialists

- **Documenting work-up**
  - As people are being ruled out, consider using the terms “suspect, being ruled out, possible.”

- When culture results are received, please clarify the diagnosis using the following guidelines
  - Documenting negative/ruled out for COVID-19 (examples):
    - COVID-19 ruled out
    - Exposure to COVID-19; ruled out
  - Documenting positive COVID-19
    - It will remain important to link a patient’s presenting symptoms to COVID-19, when appropriate.
    - Examples:
      - Pneumonia due to COVID-19
      - COVID-19 pneumonia
      - Acute hypoxic respiratory failure due to COVID-19
      - Sepsis 2/2 COVID-19
      - Viral sepsis 2/2 COVID-19
      - Severe sepsis due to COVID-19 (when appropriate)
      - Acute bronchitis d/t COVID-19
      - ARDS related to COVID-19
Section 20: The Logistics of Rounding

- Daytime rounding teams are typically made up of attending, fellow, and 2 residents or APPs.
  - Interprofessional team members should join for relevant patients.
  - Interprofessional team includes bedside nurse, RT and pharmacist (if available).
- Morning rounds typically start at 730 every day, or at the discretion of the attending.
- “Bedside” interprofessional rounds are conducted in front of each patient’s room.
  - If nursing is present, they should present patient’s up-to-date vitals, drips, lines, vent settings and other objective data using the MICU rounding guide.
- Team does not enter room after discussion.
  - If any vent changes or drip changes need to be made and there is a nurse or RT in the room, please communicate through the door to minimize personnel entering and using PPE.
  - Nursing can make any vent changes you need if they are in the room or about to enter the room.
  - After developing plan, please communicate clearly with nursing about any changes in drips, vent changes or lab draws so nurses only have to enter the room once.
- Examination of patients occurs after rounding on all patients.
  - In an effort to conserve PPE, patients should be examined once daily by either the fellow or attending.
  - Residents may need to enter the room at other times during the day, but are not expected to physically see the patients when they pre-round or just to conduct a routine/daily exam.
- All examinations and procedures are bundled to reduce traffic in and out of room.
- Disposable stethoscopes are in every room. If using your personal stethoscope, please ensure you clean it before stepping out using the wipes from the purple bottle.