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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.

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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.

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Chronology of updates to guidelines

- November, 2020
    - Major updates to medications and trials
    - Decommissioning of previous COVID CPR policy
    - Clearing patients of COVID status
    - Minor updates to all sections
- January, 2021
    - Update to steroid and other therapeutics recommendations
    - Small administrative updates
    - Updates to Section 4 by Dr. Neely
- December 2021
    - Updates to therapeutics and logistics

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Section 1: ICU Triage

All COVID MICU triage is currently going through the MICU admitting pager 58806

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.

Page MICU for all patients with confirmed COVID-19 infection or persons under investigation (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
- Other standard indications for ICU admission/triage also apply in the patient population with COVID-19 and PUI

Consider paging MICU 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
    - Escalating oxygen requirements
    - Persistent/high fevers associated with altered mental status
- Labs
    - D-dimer > 1000 ng/mL
    - CRP > 20
    - CPK > twice upper limit of normal
    - Ferritin > 300 ng/mL
    - ALT > 24 IU/L
    - LDH > 245
    - Lymphocytes < 0.7
    - High Sensitivity Troponin I > 28 pg/mL

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, **providers should review the NMI COVID-19 site.**

Persons affected

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

General principles

- All healthcare providers should wear masks at all times and maintain physical distance.
- Eating and drinking should be limited to designated areas that allow isolation from co-workers.
- Ensure you are up to date on N95 fit testing or elastomeric respirator 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 NMI COVID-19 site.
- Have a team member observe PPE donning and doffing to ensure you are following the 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. The mask should be discarded at the end of the shift.
    - 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, plastic biohazard bag, or other clean location.
    - Procedure masks may be worn continuously to see multiple patients if not removed between encounters.
    - If the 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; if N95 is covered by a surgical mask during AGP, the surgical mask may instead be discarded
- 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.

    - 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 or elastomeric respirator at all times.
- Follow contact precautions: Gown and gloves must be worn.
- Wear eye protection: goggles or face shield.
    - Perform hand hygiene before and after touching eye protection.
    - Eye protection may be worn continuously.
    - Clean goggles/face shield per instructions (hospital-grade wipes). Allow the surface of eye protection to dry.
    - 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:
    - 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).
    - Clean high-touch surfaces (keyboard, mouse, door handles, phone, pager, telephone) frequently.
    - Do not share food.
    - Consider covering your hair to avoid contamination.
    - 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 is 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 as below
- Cardiac arrest:
    - 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 or elastomeric respirator)**.
    - 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

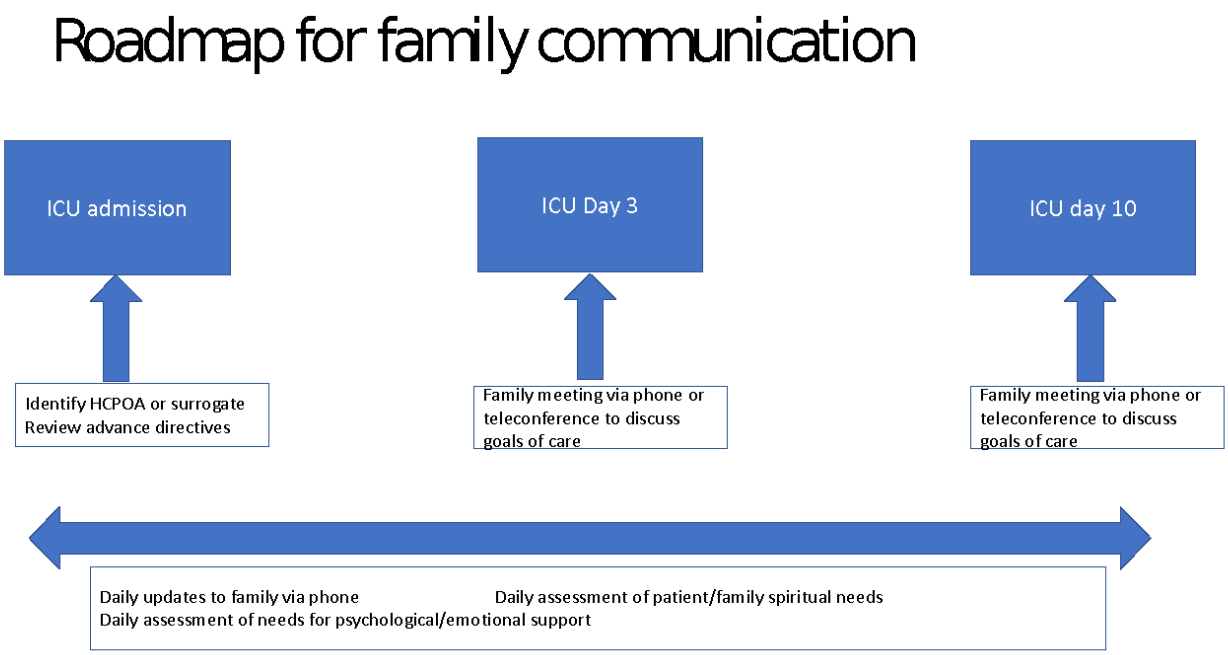
Inpatient Visitor Policy is subject to change; the most up-to-date visitor policies for each hospital can be found **here.**

Check with unit management for most recent visitor guidelines to the COVID patients, especially regarding end of life care or goals of care conversations.

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 are available to support video chat.
- Establish patient preferences for CPR ("code status") on ICU admission and as necessary during ICU stay
- 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.
- All meetings should be documented in Epic using the Family Meeting Note smarttext. Search 'Family Meeting Note' for the template.
- Refer to **this** resource from VitalTalk with COVID-19-specific communication tips (exactly what to say and when).

- 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** will be assigned to the COVID ICU service when available to serve as a liaison between the clinical team and family members to support telephone communication.
- **Chaplains** are available to support the ICU teams, families, and patients
    - NMH ICU teams can contact chaplains at 312.695.2028 (pager); this number can also be provided to families.
    - Chaplain-family interactions will be documented in Epic progress notes
- **Social Work** will support families, patients and clinicians.
    - 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

- Acceptable to use high-flow nasal cannula with heated humidity if aligned with patient preferences for life-sustaining treatments

Procedure for withdrawal of mechanical ventilation and at end of life:

- 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. If plan to remove from ventilator:
        - Stop all airflow (turn off mechanical ventilator) prior to disconnecting the endotracheal tube from the circuit.
        - Disconnect the endotracheal tube from the circuit, but do not extubate the patient.
        - Place a filter cap/holster over the end of the endotracheal tube, which will allow the patient to breathe through the endotracheal tube while minimizing aerosolization.
        - To avoid aerosolization, do not remove the endotracheal tube from the patient until after death.
    3. Alternate option (if family present or if priority to reduce aerosolization):
        - set ventilator to press support mode, PS of 5 with PEEP of 5; FiO2 21%
        - Maintain ventilator circuit until after death (see below)
    4. Continue symptom-directed, end-of-life care per standard practice, including dyspnea management.

- After death:
    1. At NM central, all deaths in COVID-19 positive patients must be called to the Medical Examiner (in Cook County: 312.666.0200).
        - Record employee name and badge number, and document in death note.
        - The ME will need a copy of certain parts of the patient's medical record. Email the following information to Medical Records (himexpiration@nm.org) and the medical records will be sent to the ME office. This is available 24/7.
            - Patient:
            - Floor/Room:
            - MRN:
            - DOB:
            - DOD/TOD:
            - Autopsy y/n:
            - ME y/n:
            - Chart and documents tubed to 125 or 908 y/n: upon paperwork review
            - Death Certificate signed by physician y/n: (name of physician)
            - Funeral Home has not been designated y/n (list name and contact phone)
        - After the ME receives the patient medical records a case number will be assigned.
    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).

Palliative Care consultation

- Which patients to consider for Palliative Care involvement
    - Expected poor prognosis
        - Age>70
        - Significant comorbidities
        - Poor functional status pre-illness
        - Declining clinical status despite continued intensive care
    - Families struggling with decisions
    - Families in need of emotional support
    - Difficult-to-control symptoms
    - Patients we have followed on the floor or as outpatients
- How to Consult Palliative Care
    - Page the Palliative COVID team directly (57393)
- Introducing Palliative Care to Families
    - "Having a loved one in the hospital can be stressful and anxiety provoking, especially when diagnosed with COVID-19. Our palliative care team is skillful at helping patients and families cope with a serious medical illness such as you are currently facing. A member of the team will be reaching out to you (and/or your family) to get to know you and how best they can support you through this hospital stay."
- Palliative Care Role
    - Clarify patient goals of care
        - Help patients/families identify goals/values, weigh trade-offs and make treatment decisions.
        - Collaborate with the ICU and families to establish time-limited trials of different interventions.
    - Relieve physical, psychological, spiritual and practical suffering using the Palliative Care Interdisciplinary Team (physician, nurse, chaplain, social worker)
    - Complex symptom management
    - Spiritual support
    - Emotional support
    - Practical support (e.g. social work)
    - Support the ICU Team
        - Check in with the teams as needed in person or by phone.
        - Unburden the team by helping with longer family meetings, defining goals and supporting families.
        - Provide coaching where desired on how to discuss difficult topics.
        - Join the ICU team on calls for family meetings to discuss high-stakes decisions.
        - Debrief with the ICU team after difficult conversations/situations.

Section 4: Medically Inappropriate or Non-beneficial Treatment

Under ordinary circumstances, when adequate resources exist to meet patient need, attending physicians, teams and consultants exercise clinical judgment within recognized standards of care to recommend interventions aligned the patient's preferences and values. Determining which medical interventions will and will not provide benefit is integral to this process. Characteristics of "non-beneficial" or "medically inappropriate" treatment [1] include:

1. Highly unlikely to achieve its stated goals; and/or

2. Disproportionately burdensome in human and other resources; and/or

3. Is intended to achieve a goal of questionable realism or value.

When uncertainty arises regarding purported non-beneficial treatments, local NM hospital ethics resources and palliative care teams can illuminate and clarify medical decision-making. On the occasions that the patient/legal substitute decision-maker (LSDM) does not agree with the care team that an intervention is non-beneficial, NM hospitals provide a fair process to allow the patient/LSDM to be heard by a third party (such as an ethics consultant or committee) and/or to request a transfer to another healthcare institution for a second opinion.

Under circumstances of impending scarcity imposed by the COVID pandemic, patient care resources must be carefully stewarded. Healthcare providers must therefore engage in proactive, shared decision-making processes that address goals of care, especially for any patient (COVID + or otherwise) who is at risk of decompensating. Withdrawing and withholding of life-sustaining medical interventions (e.g., pressors, dialysis, mechanical ventilation, ECMO) are understood as ethically equivalent. Therefore, such interventions should be offered within a well-planned and well-communicated time-limited trial with explicit objective outcomes. Beginning with initial evaluation, this approach should frame every consideration of escalating interventions. Only when the offered intervention achieves the objective outcomes will providers continue treatment at this level of care.

Should a pandemic reach a stage where resources are severely constrained, NM leadership will initiate Crisis Standards of Care (CSC). Then, the ethical framework for decision-making shifts from honoring patient autonomy toward a CSC goal of achieving the most good for the most people. To navigate complex, uncertain cases under CSC or for assistance in applying CSC allocation guidelines to a specific patient or population (e.g., patients with advanced metastatic cancer), care providers can call upon the NM Allocation Decision Making Team (ADMT). The ADMT assists with decisions to limit or withdraw interventions, and also helps in preparing for communication with patients and families impacted by these challenging decisions.

Decisions regarding allocation of scarce medical resources must be non-discriminatory and may not be based on the race, gender, 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 a patient's anticipated quality of life or social value.

Illustrative example

Frail patient aged 85 presents to the Emergency Department from home with advanced dementia of several years' standing, CHF comorbidity, with pneumonia of likely COVID-19 etiology. Medical team evaluates **success** as relatively unlikely, **resource use** (ICU) as disproportionately burdensome relative to benefit, and surrogate stated **goal** of return to

independent living as highly unrealistic based on both underlying dementia and CHF, and new onset pneumonia. Patient is moved to a medical unit with DNR order and comfort care.

[1] Bosslet GT et al. An Official ATS/AACN/ACCP/ESICM/SCCM Policy Statement: Responding to Requests for Potentially Inappropriate Treatments in Intensive Care Units. 2015. Am J Respir Crit Care Med (191) 1318–1330.

Illinois Department of Public Health Guidelines on Emergency Preparedness for Hospitals During COVID19, April 18, 2020

Section 5: Cardiopulmonary Resuscitation

As per standard practice, patient preferences and limitations on life-sustaining treatment (including limitations on cardiopulmonary resuscitation, “code status”) should be discussed with the patient/family on admission to the ICU and as necessary throughout ICU stay..

CPR should be performed for cardiac arrests in COVID-19 infected individuals if consistent with patient preferences/code status

- 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 or elastomeric respirator)**.
- The number of CPR providers in the room should be kept at a minimum.
- 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

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 the patient’s anticipated quality of life or social value.

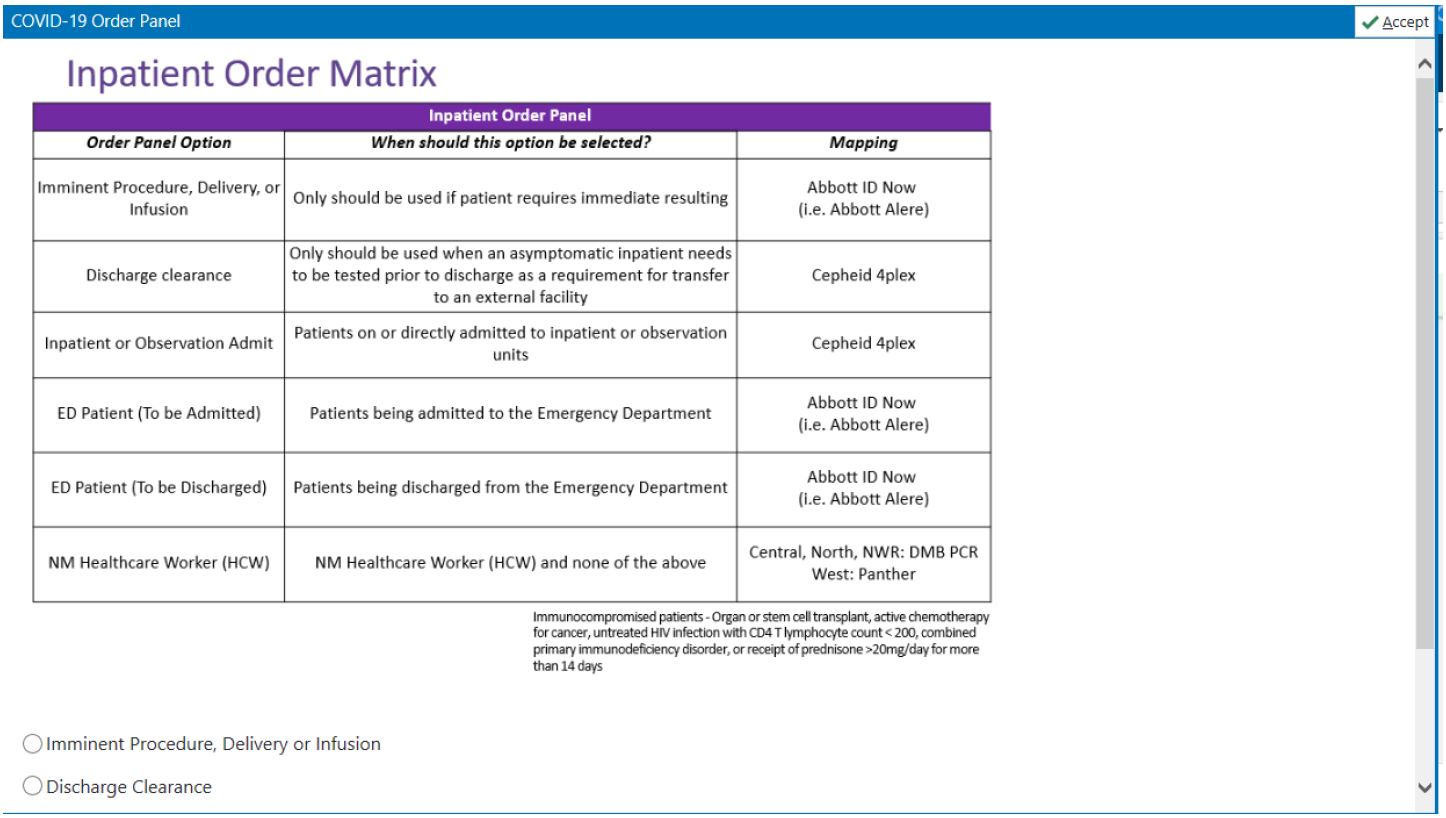
Section 6: COVID-19 Testing/ Diagnostics

When to test

- The threshold to test new admissions to the ICU for SARS-COV-2 should be low, even in patients with recent negative tests.
- In general, it is reasonable to test all newly critically ill patients with signs or symptoms of systemic infection or respiratory failure (excluding patients with known COVID-19).
- A lower respiratory sample (usually BAL) should be considered in a high-suspicion intubated patient with a negative nasopharyngeal swab.

How to test

- Order in Epic: Search for "COVID-19 order panel"


COVID-19 Order Panel

Accept

Inpatient Order Matrix

Inpatient Order Panel		
Order Panel Option	***When should this option be selected?***	***Mapping***
Imminent Procedure, Delivery, or Infusion	Only should be used if patient requires immediate resulting	Abbott ID Now (i.e. Abbott Alere)
Discharge clearance	Only should be used when an asymptomatic inpatient needs to be tested prior to discharge as a requirement for transfer to an external facility	Cepheid 4plex
Inpatient or Observation Admit	Patients on or directly admitted to inpatient or observation units	Cepheid 4plex
ED Patient (To be Admitted)	Patients being admitted to the Emergency Department	Abbott ID Now (i.e. Abbott Alere)
ED Patient (To be Discharged)	Patients being discharged from the Emergency Department	Abbott ID Now (i.e. Abbott Alere)
NM Healthcare Worker (HCW)	NM Healthcare Worker (HCW) and none of the above	Central, North, NWR: DMB PCR West: Panther

Immunocompromised patients - Organ or stem cell transplant, active chemotherapy for cancer, untreated HIV infection with CD4 T lymphocyte count < 200, combined primary immunodeficiency disorder, or receipt of prednisone >20mg/day for more than 14 days

Imminent Procedure, Delivery or Infusion

Discharge Clearance

- Nasopharyngeal swab
    - Proper sample collection technique is critical for ensuring accurate results.
    - 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)
    - This test requires bronchoscopic sampling of fluid from the lower respiratory tract/lungs.
    - Consider performing immediately after intubation to take advantage of neuromuscular paralysis, or early after intubation to rule in/out bacterial super-infection

Section 7: Other Biomarkers and Lab/Diagnostic Monitoring

Note: please double-bag all specimens.

ICU Admission Diagnostics (see section 6 for COVID testing):

- Inflammatory and other biomarkers
    - CRP
    - D-dimer
    - ferritin
    - troponin
    - procalcitonin
    - CK
    - LDH
- Evaluation of organ dysfunction (and for therapeutics candidacy):
    - CMP with magnesium
    - UA
    - CBC with differential
    - ABG
    - Lactate
    - DIC labs
    - Central venous oxygen saturation (if hemodynamically unstable and has central access)
    - Type & Screen
- Co-Infection evaluation (consider each test individually if clinically indicated based on pre-test probability):
    - Respiratory pathogen panel
    - Urine legionella and strep antigens
    - Blood cultures
    - Sputum culture
    - If/when intubated:
        - 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) - (does NOT include SARS-CoV-2; does include MecA for MRSA)
        - Respiratory Pathogen Panel (now includes SARS-CoV-2 PCR as well)
        - SARS-CoV-2 Coronavirus (Covid 2019) PCR test (even if NP swab is positive to define alternate cause of respiratory failure; particularly important on subsequent BALs in order to clear patients from an isolation and visitor limitation perspective)
        - Galactomannan
    - For immunocompromised patients or other specific risk factors, consider:
        - Blastomycosis/histoplasma urinary antigen
        - Serum B-D glucan and aspergillus galactomannan
        - If intubated, BAL PJP DFA, galactomannan, AFB culture (note AFB culture requires entire residual BAL)

Recommended serial labs and frequencies (consider decreasing frequency if stable or severe anemia)

- Inflammatory/ other biomarkers (no more than Q48 scheduled labs; can order as needed based on clinical indications)
    - CRP
    - D-dimer
    - Consider (case-by-case): ferritin, troponin, procalcitonin, CK, LDH
- Evaluation of organ dysfunction (daily scheduled labs; can order as needed based on clinical indications)
    - ABG
    - BMP with magnesium
    - CBC with differential
    - Consider (case-by-case): transaminases, lactate, central venous oxygen saturation, DIC evaluation

Imaging/cardiology (consider risks and benefits for each patient)

Upon admission (or after intubation and central line placement), obtain CXR; minimize the use of routine repeated chest films as per usual ICU guidelines.

- **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 8: 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.
- In critically ill patients with COVID-19, an initial strategy of therapeutic dose anticoagulation did not result in greater probability of survival to hospital discharge or number of days free of cardiovascular or respiratory organ support (https://www.nejm.org/doi/full/10.1056/NEJMoa2103417, REMAP-CAP ACTIV-4a, ATTACC)

● **Renal Function >30 mL/min**	
BMI <40	Enox 30 mg Q12H*
BMI >40	40 mg Q12H
BMI >50	60 mg Q12H
Renal Function <30 mL/min	
CrCl 15-30 mL/min, BMI <40, Age <75	Consider Enox 30 QD or SQH 5000 TID based off 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 < 10 x 10^9/L
  - Fibrinogen < 100mg/dl
  - Hgb < 7
- If bleeding is present
  - Platelet count < 50 x 10^9/L
  - Fibrinogen < 200mg/dl
  - INR < 1.5
- In the event of cryoprecipitate shortage, use of fibrinogen concentrates may be advised by hematology/transfusion medicine

Section 9: Treatment Options and Clinical Trials

Drug	Recommendation	Evidence	Monitoring/Adverse Effects
Dexamethasone	Give (strong recommendation)	RECOVERY trial: https://www.nejm.org/doi/full/10.1056/NEJMoa2021436 - dexamethasone 6mg x 10 days improves mortality for those needing oxygen Amongst others: meta-analysis: https://jamanetwork.com/journals/jama/fullarticle/2770279	Hyperglycemia Infection Delirium

Detailed Recommendations on the use of Dexamethasone for Patients with COVID-19

The following are recommendations from a multidisciplinary working group which met on 6/25/2020 with revisions 1/13/21

1. Recommend FOR the use of dexamethasone when the following criteria are met
   a. Patients who require admission to the intensive care unit AND
   b. > 7 days from symptom onset AND
   c. Need for either high-flow nasal cannula, non-invasive ventilation, or invasive mechanical ventilation for worsening hypoxemia AND
   d. After prioritizing enrollment in a clinical trial
2. Recommend FOR the use of corticosteroids for patients with other indications (e.g. acute exacerbations of obstructive lung disease).
3. Recommend AGAINST the use of dexamethasone for patients who do not require supplemental oxygen given the reported increased mortality with steroids in this population.
4. Recommend that the decision to give steroids for hospitalized patients who require supplemental oxygen outside of the intensive care unit should be an individualized patient-centered decision.
5. Recommend that the decision to give steroids for hospitalized patients early in the course of their illness (< 7 days from symptom onset) should be an individualized patient-centered decision.
6. Recommend AGAINST the routine use of dexamethasone (or other steroids) for patients with ARDS of > 14 days duration. Steroids can be considered for post-infectious or cryptogenic organizing pneumonia or fibroproliferative ARDS in patients with worsening lung compliance that is not responsive to recruitment maneuvers. These entities usually have measurable responses to high-dose corticosteroids within 72 hours. If no response to a therapeutic trial occurs after that time, steroids should be rapidly tapered.

Recommended steroid dosing for COVID-19-specific treatment:

- Dexamethasone 6mg daily for up to 10 days (do not continue on discharge)
- For patients who require steroids for both COVID-19 and another indication (e.g. exacerbations of obstructive lung disease), recommend discussing optimal agent and dose with pharmacy.

- Steroid dosing and duration for COP/fibroproliferation is beyond the scope of these recommendations and should be determined by the treating clinician.
- there is no clear benefit to a higher dose of 12mg/day in terms of increasing the days alive without life support (https://jamanetwork.com/journals/jama/fullarticle/2785529, COVID STEROID 2)

Other therapeutic considerations for COVID-19

Drug	Evidence	Recommendation	Adverse Effects
Tocilizumab	MOA: IL-6R Inhibitor Key Trials 1.EMPACTA in NEJM - trend towards less intubation 2.REMAP-CAP (NEJM) – Patients receiving Toci had decreased mortality and increased days free of CV & Pulm support 3.RECOVERY Trial (Lancet) - with weight based dosing, mortality benefit in the Toci group References: Association Between Administration of IL-6 Antagonists and Mortality Among Patients Hospitalized for COVID-19: A Meta-analysis | Critical Care Medicine | JAMA | JAMA Network https://emcrit.org/pulmcrit/tocilizumab/	Consider administration if following inclusion criteria are met : 1.<10 days symptom onset 2.<24-48 hours hospital admission 3.<48-72 hours ICU admission 4.CRP >75 5.Not on mechanical ventilation 6.Not on any immunosuppressed (Prednisone >40mg, MMF, tacrolimus or highly suppressive agents) 7.Not a Solid Organ Transplant or stem cell transplant patients	1.Studies suggest no increased rates of infection, although absolute rates (<1%) were lower than in our population. 2. Monitor for transaminase elevation
Baricitinib (JAK inhibitor)	JAK- inhibitor Key Trials 1.ACTT-2 trial in NEJM: Baricitinib faster time to recovery (7 vs 8 days P0.03), similar mortality 2.COV-Barrier Trial: No difference in disease progression, however decreased mortality in the HFNC/BiPAP groups 3.COV-Barrier – Substudy: Possible benefit in patients that are on ECMO References: Baricitinib plus Remdesivir for Hospitalized Adults with Covid-19 | NEJM	Consider administration if following inclusion criterias are met : 1.<10 days symptom onset 2.<24-48 hours hospital admission 3.<48-72 hours ICU admission 4.On HFNC/NIPPV patients 5.CRP >65 6.Crcl >30 7.Not on any immunosuppressed (Prednisone >40mg, MMF, tacrolimus or highly suppressive agents) 8.Non-neutropenic, ALT/AST <x5 ULN	1. Increased rates of thromboembolic events (FDA Black Box Warning) 2. Studies suggest no increase rates of infection

	https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(21)00331-3/fulltext https://www.medrxiv.org/content/10.1101/2021.10.11.21263897v1 PulmCrit - Baricitinib for COVID-19: The rise of the jakinibs (emcrit.org)	9. Not Solid Organ Transplant or stem cell transplant patients 10.Pregnancy 11.Lymphopenia 12.No acute VTE or PE	
Remdesivir	Key Trials: 1. Wang et al. May 2020: No difference to time for clinical improvement or mortality 2.ACTT-1 trial – Final Report: Faster time to clinical recovery in the remdesivir arm, the benefit is lost if started >10 days from symptom onset. No mortality benefit 3.WHO SOLIDARITY trial : No difference in mortality, ventilation, time to discharge, or LOS benefit in hospitalized patients; trend towards harm in intubated patients References: https://www.idsociety.org/covid-19-real-time-learning-network/therapeutics-and-interventions/remdesivir/#key	1.No strong evidence of benefit in critically ill patients; a.Consider in HFNC or BIPAP patients b.Consider NOT administering in intubated patients 2.No Benefit in extending past 5 days. 3.May administer in AKI, iHD or CVVHDF	1.Abnormal LFTs (avoid in patients with ALT >10ULN) 2.May cause bradycardia 3.Nausea, vomiting, diarrhea & headache
Convalescent plasma	Numerous trials, nice summary by Farkas: https://emcrit.org/pulmcrit/convalescent-plasma/ PLACID trial in BMJ - may improve symptom resolution PLASMAR in NEJM - no difference in outcomes INFANT-COVID in NEJM - given <72hrs upon symptom onset to older adults, less deterioration RECOVERY - stopped early for futility, awaiting full data	No recommendation to give in those already critically ill.	Blood production infection reactions, complications
Non-targeted therapy:			
Empiric Antibiotics	Empiric therapy with ceftriaxone/azithromycin (CAP coverage)	Standard guidelines for treatment of community-	Increased resistance C.diff

	Consider discontinuation of antibiotics if there is no evidence of bacterial superinfection on bronchoscopy. Consider narrowing of antibiotics in patients with an identified co-infection from analysis of BAL fluid. Clinical decisions about antibiotics should not be based on the results of endotracheal aspirates Consider HAP coverage only if patient otherwise meets HAP criteria	acquired or hospital-acquired pneumonia apply. Our local experience suggests antibiotics can be safely discontinued or modified based on the results of the BioFire Pneumonia Panel ('Lower respiratory tract panel' in Epic) and quantitative culture of BAL fluid.	

Not recommended:

Drug	Evidence to Date	Recommendation
Bamlanivimab	ACTIV-3 in NEJM - no benefit in hospitalized patients https://www.nejm.org/doi/full/10.1056/NEJMoa2033130	Do not recommend in patients hospitalized with COVID-19
Hydroxychloroquine	Numerous studies showing no benefit - RECOVERY https://www.nejm.org/doi/full/10.1056/NEJMoa2022926	Do not recommend
Lopinavir-ritonavir	No benefit in RECOVERY trial - https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)32013-4/fulltext	Do not recommend
Ivermectin		Do not recommend

Active COVID-19 clinical trials at NMH

See https://www.feinberg.northwestern.edu/sites/covid-19/covid-19-clinical-trials.html

To add a trial to the website, contact Abby Cosentino-Boehm <a-cosentino-boehm@northwestern.edu>.

Can reach out to the MICU Research team pager 59285 (or search 'Study' in the Web Paging Site)

Section 10: 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 or elastomeric respirator.

- **High-flow nasal cannula (HFNC) and Non-invasive ventilation (NIV)**
  - Both HFNC and NIV are acceptable for use in patients with COVID-19 although N95 mask or elastomeric respiratory are required for any staff entering a room with a patient using these devices (COVID confirmed or not).
  - HFNC is typically preferred for oxygenation support in acute hypoxemic respiratory failure
  - NIV (with filtered exhalation port to minimize aerosol generation) should be considered particularly in patients in whom NIV is known to have benefit (e.g., exacerbations of chronic obstructive pulmonary disease or congestive heart failure).

- **Indications for Invasive Mechanical Ventilation (IMV)**
  - Standard indications for IMV apply to patients with COVID-19
  - For patients with *potential or impending need for IMV,* contact anesthesia/clinician performing intubation early to allow for additional time for preparation (PPE, etc.)

- **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. Use of metaneb for airway clearance is currently being studied and is reserved for research purposes only at this time.

- **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 if possible until the patient has documented clearance of detectable virus unless emergently required.

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 CO_2 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 11: Peri-intubation Management

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 the 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.
    - Rapid sequence intubation (RSI) should be performed in all cases and ventilation after induction of anesthesia avoided.
    - 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).
    - If a patient was being pre-oxygenated with BIPAP or HFNC, flows should be turned off immediately after the patient is asleep and paralyzed and before laryngoscopy.
    - Intubate and confirm the correct position of the 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. Ensure oxygen flows to ambubag are discontinued and ETT clamped prior to disconnecting Ambag and attaching patient to ventilator circuit.
    - 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.

Section 12: General Ventilator Management and Extracorporeal Support

Presentation on management of COVID-19 patients: Zoom Conference: https://northwestern.zoom.us/rec/share/wG-eRoxJF2AWkbMPp_zPcBhzhlDSuTTK6Xw6XqCqyzWJcaQIZ09IAE1Z1tLDxYkj.UT0jeKbfrnTQDLVR + slides: https://northwestern.box.com/s/4dqzbvhbofq5696lk6mp7jlw0jxv1guz

Basic Principles:

- Patients with COVID-19 who require invasive mechanical ventilation should receive evidence-based strategies for ARDS.
- The ARDSnet Pocketcard (http://www.ardsnet.org/files/ventilator_protocol_2008-07.pdf) can be printed out and used as a reminder for ventilator titration and physiologic targets.
- Lung-protective ventilation
    - Low-tidal-volume ventilation
        - Starting Vt of 8 mL/kg **PREDICTED BODY WEIGHT** with a goal of 6 mL/kg PBW
        - The Vt is lowered step-wise in 1 mL/kg intervals until 6 mL/kg is reached. The respiratory rate is typically raised concurrent with this step-wise lowering of Vt to avoid severe acidemia
    - Low distending pressures
        - Goal plateau pressure (Pplt) < 30 cmH2O (Pplt is measured during an inspiratory hold maneuver)
        - A Pplt > 30 cmH2O should prompt lowering of Vt in 1 mL/kg intervals until a Pplt < 30 cmH2O is achieved.
- Adequate PEEP
    - In general, patients with COVID-19-associated ARDS require significant levels of PEEP to maintain alveolar recruitment
    - The PEEP table from the PROSEVA trial (below) is a reasonable starting point for setting PEEP.
    - Use of an esophageal balloon to guide PEEP titration should be considered for patients with refractory hypoxemia or clinical suspicion of elevated intrapleural pressure (obesity, ascites, pleural space disease, etc.

PEEP (cm H_2O)	5	5	8	8	10	10	10	12	14	14	14	16	18	18-24
F_IO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	1.0

- Early use of prone positioning
    - See below for details
- Neuromuscular blockade
    - NMB agents should be considered for:
        - refractory hypoxemia despite the above interventions and/or
        - significant patient ventilator dyssynchrony despite deep sedation (https://link.springer.com/article/10.1007/s00134-020-06227-8).
    - Intermittent NMB should be considered prior to continuous infusion
    - NMB is NOT a requirement for prone positioning

NIH NHLBI ARDS Clinical Network
Mechanical Ventilation Protocol Summary

INCLUSION CRITERIA: Acute onset of
1. $PaO_2/FiO_2 \leq 300$ (corrected for altitude)
2. Bilateral (patchy, diffuse, or homogeneous) infiltrates consistent with pulmonary edema
3. No clinical evidence of left atrial hypertension

PART I: VENTILATOR SETUP AND ADJUSTMENT
1. Calculate predicted body weight (PBW)
   Males = 50 + 2.3 [height (inches) - 60]
   Females = 45.5 + 2.3 [height (inches) -60]
2. Select any ventilator mode
3. Set ventilator settings to achieve initial V_T = 8 ml/kg PBW
4. Reduce V_T by 1 ml/kg at intervals ≤ 2 hours until V_T = 6ml/kg PBW.
5. Set initial rate to approximate baseline minute ventilation (not > 35 bpm).
6. Adjust V_T and RR to achieve pH and plateau pressure goals below.

---

pH GOAL: 7.30-7.45
Acidosis Management: (pH < 7.30)
If pH 7.15-7.30: Increase RR until pH > 7.30 or $PaCO_2$ < 25 (Maximum set RR = 35).

If pH < 7.15: Increase RR to 35.
If pH remains < 7.15, V_T may be increased in 1 ml/kg steps until pH > 7.15 (Pplat target of 30 may be exceeded).
May give $NaHCO_3$
Alkalosis Management: (pH > 7.45) Decrease vent rate if possible.

I: E RATIO GOAL: Recommend that duration of inspiration be ≤ duration of expiration.

PART II: WEANING

A. Conduct a SPONTANEOUS BREATHING TRIAL daily when:
1. $FiO_2 \leq 0.40$ and PEEP ≤ 8.
2. PEEP and $FiO_2 \leq$ values of previous day.
3. Patient has acceptable spontaneous breathing efforts. (May decrease vent rate by 50% for 5 minutes to detect effort.)
4. Systolic BP ≥ 90 mmHg without vasopressor support.
5. No neuromuscular blocking agents or blockade.

OXYGENATION GOAL: PaO_2 55-80 mmHg or SpO_2 88-95%
Use a minimum PEEP of 5 cm H_2O. Consider use of incremental FiO_2/PEEP combinations such as shown below (not required) to achieve goal.

Lower PEEP/higher FiO2

FiO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7
PEEP	5	5	8	8	10	10	10	12

FiO_2	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	14	14	14	16	18	18-24

Higher PEEP/lower FiO2

FiO_2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5
PEEP	5	8	10	12	14	14	16	16

FiO_2	0.5	0.5-0.8	0.8	0.9	1.0	1.0
PEEP	18	20	22	22	22	24

PLATEAU PRESSURE GOAL: ≤ 30 cm H_2O
Check Pplat (0.5 second inspiratory pause), at least q 4h and after each change in PEEP or V_T.
If Pplat > 30 cm H_2O: decrease V_T by 1ml/kg steps (minimum = 4 ml/kg).
If Pplat < 25 cm H_2O and V_T< 6 ml/kg, increase V_T by 1 ml/kg until Pplat > 25 cm H_2O or V_T = 6 ml/kg.
If Pplat < 30 and breath stacking or dys-synchrony occurs: may increase V_T in 1ml/kg increments to 7 or 8 ml/kg if Pplat remains ≤ 30 cm H_2O.

B. SPONTANEOUS BREATHING TRIAL (SBT):
If all above criteria are met and subject has been in the study for at least 12 hours, initiate a trial of UP TO 120 minutes of spontaneous breathing with FiO2 ≤ 0.5 and PEEP ≤ 5:
1. Place on T-piece, trach collar, or CPAP ≤ 5 cm H_2O with PS ≤ 5
2. Assess for tolerance as below for up to two hours.
   a. $SpO_2 \geq 90$: and/or $PaO_2 \geq 60$ mmHg
   b. Spontaneous $V_T \geq 4$ ml/kg PBW
   c. RR ≤ 35/min
   d. pH ≥ 7.3
   e. No respiratory distress (distress= 2 or more)
      - HR > 120% of baseline
      - Marked accessory muscle use
      - Abdominal paradox
      - Diaphoresis
      - Marked dyspnea
3. If tolerated for at least 30 minutes, consider extubation.
4. If not tolerated resume pre-weaning settings.

Definition of UNASSISTED BREATHING
(Different from the spontaneous breathing criteria as PS is not allowed)

1. Extubated with face mask, nasal prong oxygen, or room air, OR
2. T-tube breathing, OR
3. Tracheostomy mask breathing, OR
4. CPAP less than or equal to 5 cm H_20 **without pressure support or IMV assistance.**

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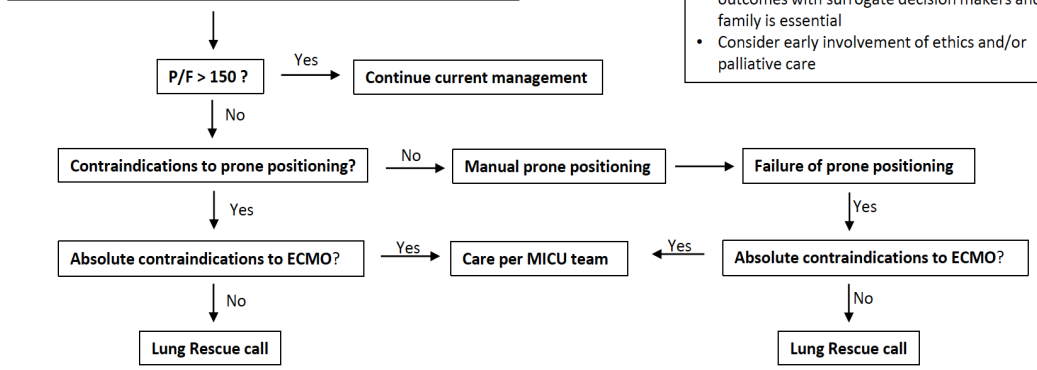
Suggested COVID + ARDS Ventilator Management

- **Low tidal volume ventilation**
  - May tolerate higher V_T if P_{plt} < 30 cmH_2O and/or DP < 15 cmH_2O as many pts have compliant lungs early in course
- **High PEEP strategy**
  - See PROSEVA table below
- **Conservative fluid strategy**



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 (metastatic 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, SpO2 < 85% or PaO2 < 55 mmHg on FiO2 0.8 sustained for > 15 minutes
- While proned with NMB, pH < 7.20 with a PaCO2 > 60 mmHg for 3 hrs
- While proned with NMB, Pplt > 35 cmH2O sustained for > 30 minutes after addressing reversible etiologies (e.g mucus plug) and optimizing PEEP
- Unstable arrythmia
- Need for 3 or more vasopressors to maintain a MAP > 65 mmHg or addition of 2 new vasopressors while proned

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

Suggested PEEP Table (from PROSEVA)

PEEP ($cm H_2O$)	5	5	8	8	10	10	10	12	14	14	14	16	18	18-24
F_iO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	1.0

Section 13: Prone Positioning

Northwestern Memorial Hospital's approved protocol for the use of prone positioning in acute respiratory distress syndrome can be found here.

Highlights:

- Proning is one of the few techniques in ARDS that improves outcomes
- Consider proning when PaO2:FiO2<150
- Consider proning as early as possible in disease course
- Sedate patient to RASS -5 (no response to verbal or physical stimuli); the patient may still exhibit reflexes such as cough/gag, they do NOT need to be paralyzed prior to proning (unless otherwise indicated)
- Mobilize team (details in protocol)
- General goal is 16 hours in prone position out of every 24 hour period

Section 14: 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

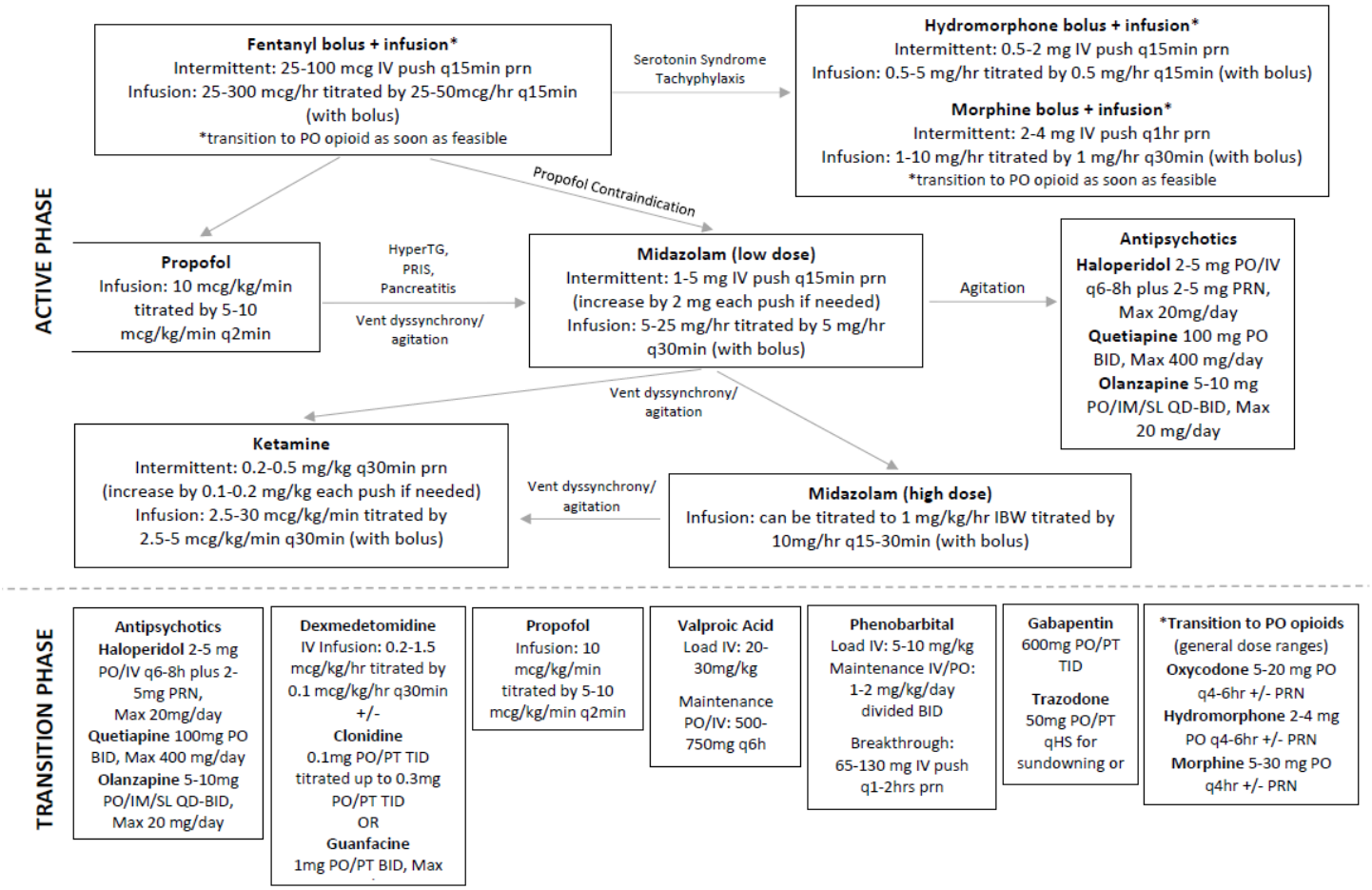
- Team members from Pulmonary and Critical Care Medicine (PCCM) including PCCM attending and Thoracic Surgery along with the bedside ECMO specialist should ideally round together daily in the COVID-ICU at 7:30 AM on all cannulated patients.
- The goal of these rounds should be to collaboratively discuss 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
- Thoracic Surgery
    - 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 15: Sedation Management

Active and Transitional Phase COVID-19 Sedation Guidance Figure



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.

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, ferritin, CK
        - 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 may be high to combat agitation and to allow for patient ventilator synchrony which may require paralysis, prone ventilation, and bronchoscopy.

- Phase 2 – Transition ICU phase
    - Characterized by
        - Improving fevers
        - Resolving shock
        - Inflammatory markers stabilize and may trend down
        - Improving CPK levels
        - Improving LFTs
        - 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 declining
        - Fevers have resolved
    - 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**
    - 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.
     - 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 q8Hprn 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.

Section 16: 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 17: Neurocritical Care Consultation

Indications for Neurocritical Care Consultation

- Encephalopathy without focal motor or cranial nerve features*
    - Non-intubated patient with oxygen saturation >92%, serum (venous or arterial) pH>7.3, MAP >65mmHg
        - Consult if GCS 12 or less
    - 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)
    - 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 18: OB Consultation Guidelines

Communication/Operations

- MICU to notify OB-C attending (2.2804) of any admissions of pregnant women
    - All pregnant women > 16 weeks should have a set up for resuscitative hysterotomy in their MICU room (including a bedside cesarean tray and a timeout blade)
        - Rooms of pregnant women in whom fetal intervention or neonatal resuscitation would be considered should also have NICU equipment available
        - Coordinate set up by notifying L&D Charge Nurse (2.0807)
    - OB-C attending should notify the L&D unit attending (2.2032), OB anesthesiology (2.2016), and L&D Charge Nurse (2.0807) of any new MICU admissions. In addition, they should communicate daily (morning shift, ~8-10 am) about the MICU OB census
        - The MICU OB census should be on the L&D back board to promote awareness
        - The OB Anesthesiology fellow or designee should complete an anesthesia consultation
- At each L&D sign out, the L&D team should identify who would be responsible for responding to a MICU OB emergency alongside the OB-C unit attending
    - This team member and their Ascom phone number should be designated on the grease board and relayed to the OB-C attending and OB-C nursing staff

OB Clinical Care

- The OB-C attending should round in the MICU daily (ideally with MFM fellow, if available, to promote communication/awareness between teams).
    - If the OB-C is not an MFM and a fellow cannot join rounds, MFM should be updated daily to assist with any clinical questions and/or contribute to management
- All women > 22w0d should have an MFM/NICU consultation to inform fetal monitoring and neonatal resuscitative desires
- Fetal monitoring
    - For women in whom fetal intervention would be considered, NSTs should occur daily
    - For women in whom fetal intervention is not being considered, FHT should occur weekly for women who are not intubated; daily for those who are intubated
- If maternal respiratory deterioration occurs despite maximum supportive efforts, consider a controlled cesarean in the Feinberg OR as resuscitative measure
    - MICU physician to notify OB-C attending if respiratory status is worsening to discuss whether delivery should be considered
- In the event of a maternal code in Feinberg or in the MICU, the Feinberg/MICU team will immediately notify the OB-C attending (2.2804) who will deploy to the patient's location. The OB-C nursing staff will notify a) the designated co-responder, b) the L&D unit attending, and c) the NICU team if applicable via an OB Emergency page.
    - If there are any active clinical issues on OB-C, the L&D unit attending will cover while the OB-C is in the MICU

Section 19: 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 or elastomeric 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 a need for increased pulmonary procedures, especially for patients in the COVID ICUs. The PCCM teams will perform or identify physicians to perform necessary pulmonary procedures (bronchoscopy and pleural procedures). The interventional pulmonary team will perform percutaneous tracheostomies and the Thoracic Surgery Service will perform surgical tracheostomies when needed.
- All services should identify patients requiring bronchoscopy or pleural procedures on rounds when possible and communicate these to a PCCM team immediately after rounds. 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), when service is active.

Specific procedure guidelines

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.
    - Consider trialysis 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:
    - Ultrasound
    - Chlorapreps x 3
    - Multi-Lumen Central Venous Catheterization Kit
    - Triple Lumen Insertion with Thyroid Kit (contains thyroid drape and sterile dressing)
    - If placing a 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 the room: Many do not have suture or gauze; if angiocath is desired, bring separately.
    - Blue caps for TLC
    - Sterile ultrasound probe cover
    - Sterile saline
    - Sterile bowl
    - Sterile gloves, gown, bouffant
    - 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)
- 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.

Bronchoscopy

Video reviewing protocol here: https://www.youtube.com/watch?v=9EIRi83PZ6s

NMH COVID-19 ICU Bronchoscopy protocol:

Bronchoscopy in the COVID ICU will be performed for diagnostic and therapeutic purposes, including, but not limited to:

- Diagnostic evaluation of newly intubated patient, including COVID rule-out testing
- Evaluation of possible VAP or superimposed bacterial CAP
- Airway clearance

Bronchoscopy can be performed at the discretion of the ICU attending, but the general 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 1-2 member(s) of the IP service or the ICU attending. The ICU fellow will participate if willing and available (per fellow's preference).

Given the longer circuit break with NBBAL, these will not be performed on COVID-19 patients.

The nurse will help with printing order labels, pre-procedural sedation including administration of neuromuscular blockade but then will leave the room.
RT may help with gathering equipment but does not need to be present in the room.

Role 1: primary bronchoscopist (fellow, attending, IP attending) – this person is responsible for assessing the clinical situation, consenting the family, ensuring all necessary equipment are ready, ordering lab tests, ensuring adequate sedation, performing the bronchoscopy, cleaning the equipment afterwards, and ensuring samples delivered to the lab.

Role 2: secondary bronchoscopist (supervising IP attending or ICU attending or fellow) – this person will assist the primary bronchoscopist, silence ventilator alarms, assist in circuit manipulation, instill saline for lavage, withdraw BAL, and connect lukens trap.

Order checklist:

- Adequate sedation – goal of RASS -4 if neuromuscular blockade to be used
- Cisatricurium 0.2mg/kg (Pharmacist may often have, otherwise call 9th floor pharmacy)
- Labwork
  - BAL cell count and differential
  - BAL amylase
  - BAL respiratory culture (normal, +/- fungal, AFB per clinician determination)
  - Lower Respiratory Tract Panel (BioFire Pneumonia Panel)
  - SARS-CoV-2 test (repeat even if status already known, to monitor for clearance/reinfection)
  - Cytology, Galactomannan, PJP DFA per clinician determination
  - Extra patient label for research specimen

PPE checklist:

- N95 mask or elastomeric respirator (ensure adequate fit) + covering surgical mask
- Gown, gloves (discard after procedure)
- Face shield or goggles (wipe down after procedure)

Equipment checklist:

- Ambu scope (large/orange if concern for mucus plugging, but check ETT size; regular/green otherwise)
- Ambu tower (ensure adequately charged)
- Drape or chuck to lay down supplies on
- Scope adaptor for ETT
- Clamp for ETT
- Scope lubricant
- Extra suction tubing, if far from the bed
- 4x 30cc syringes (slip tip preferred – if luer lock, ensure slip tip adaptors available; often in the scope bag)
- Normal saline (500cc bottles)
- Lukens trap
- Orange specimen cup + labels
- Research Eppendorf tube + patient sticker
- Extra specimen bags outside room for double-bagging specimens

Procedure steps:

1. Outside the room, Primary Bronchoscopist times out with nursing and ensures consent has been signed, orders placed and labels printed. Sedation adjusted to goal RASS-4 with cisatraciurium 0.2mg/kg administered at provider's discretion (this is suggested when patient in early/acute phase with likely high viral load and tenuous status but may not be necessary for convalescing patients late in disease stage). FiO2 increased to 100%.
2. As able, Primary Bronchoscopist preps the bronch equipment outside the room
    a. Drawing up 30cc normal saline x4
    b. Connecting AmbuScope to Monitor
    c. Lubricating AmbuScope
    d. Pre-loading AmbuScope onto scope adaptor
    e. Applying labels to specimen cups and research tube
3. Primary Bronchoscopist and Secondary Bronchoscopist enter room; Nursing and RT available but are outside the room.
    a. Primary Bronchoscopist responsible for narrating steps out loud, stands at the side of the patient; Secondary Bronchoscopist stands next to first, closer to the ventilator
    b. Primary Bronchoscopist ensures equipment set up, suction connected and functioning, sedation is adequate and vitals are stable to tolerate the procedure
    c. Primary Bronchoscopist clamps ETT
    d. Secondary Bronchoscopist disconnects inspiratory limb from the vent distal to the filter (i.e., the filter remains connected to the ventilator)
    e. Primary Bronchoscopist places the adaptor (pre-loaded with the scope) onto the ETT
    f. Secondary Bronchoscopist reconnects the inspiratory limb
    g. Primary Bronchoscopist unclamps the ETT
    h. Primary Bronchoscopist performs inspection, toileting secretions as needed, wedges into target lobe
    i. Secondary Bronchoscopist instills saline in 30cc aliquots, 120cc recommended, draws back and discards first 5 cc, draws back more sample if able, then connects the lukens trap (goal >40cc return)
    j. Primary Bronchoscopist suctions sample into lukens trap or Ambusampler device
    k. Secondary Bronchoscopist disconnect lukens trap, hooks back up to wall suction
    l. Primary Bronchoscopist cleans up any remaining secretions, pulls scope back to edge of adaptor, then clamps ETT
    m. Secondary Bronchoscopist disconnects inspiratory limb from the vent distal to the filter (i.e., the filter remains connected to the ventilator)
    n. Primary Bronchoscopist removes adaptor and scope in one motion
    o. Secondary Bronchoscopist reconnects the inspiratory limb
    p. Primary Bronchoscopist unclamps the ETT
    q. Sample placed into orange specimen cup from lukens trap (have had several break), with 10-15cc placed in Eppendorf tube for research team
        i. Samples bagged first in room, then placed in another bag held by someone outside the room
        ii. Orange specimen cup + labels delivered to 7th floor lab
        iii. Research specimen - 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.
    r. Disposable equipment placed in red biohazard bag for disposal
    s. Monitor and pole wiped down before leaving room, returned to RT room
    t. Primary Bronchoscopist returns FiO2 to pre-procedure level (assuming tolerated) and ensures hemodynamics acceptable

u. Both proceduralists doff PPE and wash hands; surgical mask over N95 should be discarded but N95 can be reused; goggles/faceshields wiped down and reused
v. Primary Bronchoscopist documents procedure note

Special Circumstances:
- Prone positioning: continue with standard procedure
- iNO: continue with standard procedure
- Brushings: sometimes requested by research team, who will provide brushes, brush cutter (wire cutter can also be found in bronch suite), research tube/medium for brush to be cut into

Please do not hesitate to contact the Interventional Pulmonary team with questions.

- Non-ICU bronchoscopy
  - 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.
  - 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.

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**
    - **Step 1: Pre-procedural preparation**
        - The day prior to procedure, contact OR scheduling to request Anesthesia 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
            - Shiley 6 and Shiley 6 XLT tracheostomy tubes with cuffs
            - Bronch adapter
            - Sterile basin
            - Two packages of sterile OR towels
            - Kerlix to pack nose/mouth
            - Clamp for ventilator circuit
            - Bag-mask device with PEEP valve
            - Bottle of saline and sterile bowl
            - One medium size duoderm
            - Ultrasound machine
            - Disposable bronchoscope with monitor
            - Medications, including continuous ICU sedatives, phenylephrine and cisatracurium, provided by Anesthesia
            - 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, 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 FiO_2 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 FiO_2 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 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 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)**
  - 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.
  - 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.
  - 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.
  - 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.
  - 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
  - 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
  - Perform standard prepping of neck and draping of patient.
  - Inject trach site with 1% lidocaine with 1:100,000 epinephrine solution (at surgeon's discretion).
  - Make a horizontal incision using Bovie cautery. Make sure fume evacuator is present and deployed.
  - Dissect down to trachea quickly using vertical dissection, strictly keeping to the midline and retracting. Divide thyroid isthmus only if needed to expedite procedure.
  - 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.
  - 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).
  - Remove endotracheal tube and insert tracheotomy tube. Dispose of the endotracheal tube safely (in a double biohazard bag).
  - Inflate the cuff on tracheostomy tube and connect to ventilator.
  - Follow NMH protocol for doffing.

Section 20: 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.

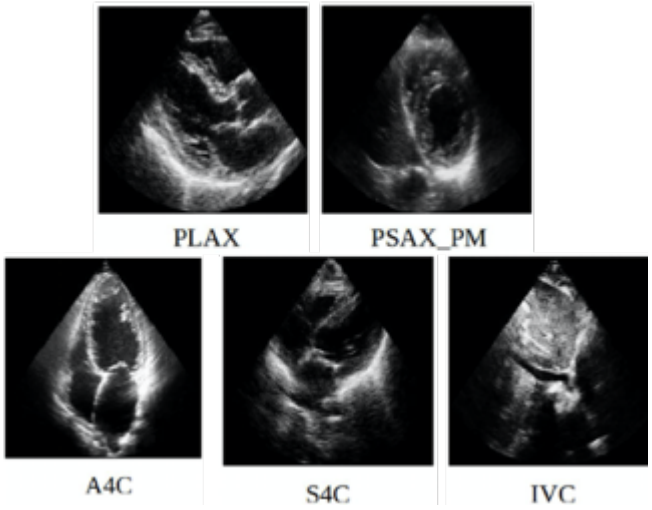
Designate 1 portable ultrasound to be used solely for COVID+ patients

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

Don and Doff appropriate PPE including gown, gloves, N95 mask and goggles/face shield per NM guidelines

Point of care cardiac ultrasound

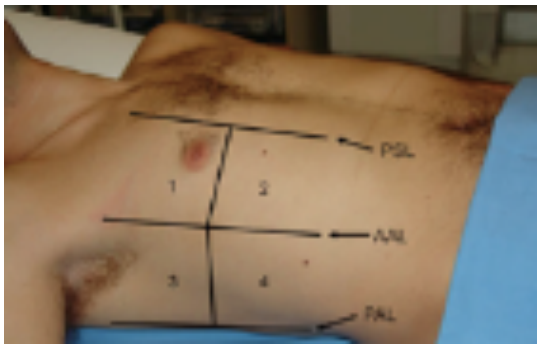
- Indications
  - Shock
  - Suspected new heart failure
  - Rising troponin
  - Recommend **against** POCUS for frequent assessment of volume responsiveness (favor pulse pressure variation and/or clinical response to small fluid boluses to limit exposure)
- Probe
  - Phased array
- Preset
  - Cardiac
- Views
  - Parasternal long axis
  - Parasternal short axis (mid papillary level)
  - Subcostal four chamber
  - Inferior vena cava



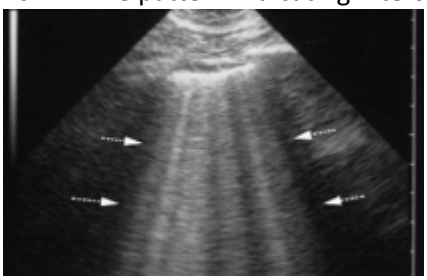
- Notable cardiac disease pattern
  - Acute cardiac injury
    - Incidence 7% – 22%
    - Troponin and/or EKG changes
    - Acute coronary syndrome
    - Incidence unknown
    - May see regional wall motion abnormalities
  - Fulminant myocarditis
    - Case reports
    - Globally reduced LV function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

Point of care lung ultrasound

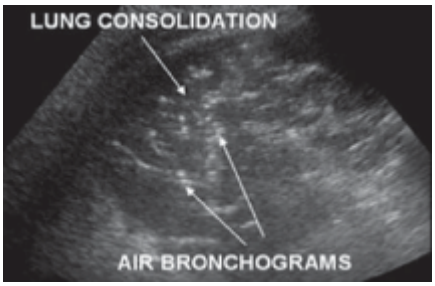
- Indications
  - Peak pressure alarm (rule out pneumothorax)
  - Progressive hypoxemia
- Probe
  - Phased array
  - Linear probe may be used if solely ruling out pneumothorax
- Preset
  - Abdominal (for phased array)
- Views
  - Anterior chest – Ultrasound 4 lung zones on each side (see picture)
  -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



- Notable disease patterns
  - B-line pattern indicating interstitial edema



  - Consolidation with air bronchograms



Section 21: Optimizing the Electronic Health Record (Epic)

- COVID-19 test results will appear under different names depending on which platform the test was run. Results can be found under COVID-19 or SARS-COV-2. Please note the coronavirus result on the Lower Respiratory Tract Panel is for the endemic human coronavirus, not the pandemic COVID-19 virus.

Common COVID-19 orders and order sets

- COVID Order Panel order set
    - use to order COVID NP and BAL test
- COVID Inpatient Orders order set
    - admission orders
    - ICU specific orders (labs, tests)
    - treatment medications (Remdesivir, dexamethasone)
    - VTE prophylaxis
- Convalescent Plasma order set
    - use to order convalescent plasma
    - Please note convalescent plasma consent form can be found on NMI on the Blood Bank or Antimicrobial Stewardship Program page. You will need this in addition to standard blood consent.
- COVID ICU Sedation/Analgesia order set
    - orders for Dilaudid, Ketamine, Midazolam, and Morphine based on the COVID Sedation Guidelines
- Remdesivir Order Panel
    - use to order Remdesivir
- Helpful ICU order sets
    - Ventilator Management
    - Sedation/Analgesia for ICU patients
        - orders for Propofol, fentanyl, and precedex

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
- **Documenting COVID-19 despite a negative test**
    - If a COVID-19 test is suspected to be falsely negative, please use one of the following phrases
        - Evidence of COVID-19 despite negative test
        - Patient with COVID-19

Section 22: 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 the 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.

Section 23: Clearing patient of COVID status

https://nmi.nmh.org/wcs/blob/1390909567123/clinical-clearance-guidelines.pdf

Key points for intubated or trached patients:

- After 20 days from first positive test, patient must have two negative tests >24 hours apart;
- if still intubated, these must both be BAL specimens;
- if trached, one of the two tests must be lower respiratory tract (endotracheal aspirate or BAL);
- if now extubated, any two specimen types will suffice.