Institute for Critical Care Medicine
The Mount Sinai Hospital

Handbook for Management of Critically Ill COVID-19 Patients

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DEFINITIONS

COVID	
COVID-19 like illness	New onset of subjective or measured fever (≥100.4F, 38.0C) OR cough OR shortness of breath OR sore throat that *cannot be attributed* to an underlying or previously recognized condition
Patient Under Investigation (PUI) (aka Suspected COVID-19)	Person with COVID-19 like illness, COVID-19 test pending
Confirmed COVID-19	Person with COVID-19 like illness and a positive laboratory test
PROVIDER SAFETY	
Limited reuse of PPE	Using the same N95 respirators for *multiple encounters* with patients, *but doffing after each encounter*. The respirator is stored in between encounters and is donned prior to the next encounter with a patient
Extended use of PPE	Wearing the same N95 respirators for repeated close contact encounters with several different patients, *without removing between patient encounters*
PPE reprocessing program	Sterilizes N95 that are not misshapen, heavily soiled or wet
PUBLIC SAFETY	
Isolation	"separation of *sick* people with a contagious disease from people who are not sick"
Quarantine	"separation of *asymptomatic* people who were exposed to a contagious disease to see if they become sick"
Social distancing	"stay at home to the extent possible and only leave home for essential tasks"

SUMMARY OF CRITICAL CARE MANAGEMENT OF COVID-19 SUSPECTED OR CONFIRMED PATIENTS

Level of Care:
- Patients with confirmed COVID and rapidly increasing O2 requirements should be closely monitored and considered for transfer to ICU level of care

Staffing:
- Minimize number of clinical staff who enter patient room
- Medical students are not permitted to participate in the clinical care of COVID patients

PPE (PUI & COVID-19 positive):
- Surgical facemask in all common areas
- **In patient room**: surgical facemask[1], face shield, isolation gown, gloves
- **N95** (instead of surgical facemask) is used for in rooms with PUI/COVID+ patients
- **Isolation gown:** offers full protection against droplets; the **same** gown can be worn when interacting with COVID-19 patients in an isolation cohort (discard if visibly ripped or soiled)
- **Gloves:** change between every patient encounter (mask and face shield change between patients NOT required)

Hand Hygiene
- must be performed to prevent transmission; sanitizer or soap and water are acceptable

Patient Room:
- Isolation designation: Special Droplet + Contact precautions
- If requiring frequent aerosolized procedures (e.g., HFNC, BiPAP, trach collar), will need negative pressure room
- Cohorting is allowed for COVID-19 positive patients. Cohorting is NOT allowed for PUI (must be single room)

Patient Visitors:
- No visitors
- Encourage patients to communicate with family/ friends using available smart tablets

Patient Transport:
- Necessity should be confirmed by MD prior to transport
- Non-intubated patients: wear a facemask, nasal cannula under facemask, or nonrebreather during transport
- Intubated patients and patients on BiPAP should be transported on the ventilator with HEPA filter (no BMV)
- Staff transporting patient should wear a surgical mask
- The receiving department should be informed that enhanced droplet and contact precautions are required

Mobility:
- Standard care. No ambulation outside room.

Personal clothing & Equipment:
- Use ONLY disposable stethoscopes
- Clean personal devices (phone, pager, etc.) frequently with rubbing alcohol

LABORATORY TESTING
- ☐ Obtain procalcitonin, d-dimer, fibrinogen, C-reactive protein, LDH, ferritin in addition to routine testing
- ☐ A negative result in a symptomatic patient who is not improving and with a high suspicion for COVID-19 may represent a false negative. Consider discussing with Infection Prevention and continuing isolation in meantime
- ☐ In critically ill, consider arterial line to aid ABGs, blood draws, BP monitoring with less staff exposure

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

RESPIRATORY SUPPORT
- ☐ Limit use of aerosol-generating modalities whenever possible (e.g., sputum induction, nebulized medications)
- ☐ Use MDI instead of nebulized medications
- ☐ **Supplemental oxygen if SpO2 <92%**
  - o Nasal cannula and non-rebreather masks may be used as usual
  - o Avoid Venti masks due to risk of aerosolization
  - o BIPAP closed circuit ventilator with a filter on exhalation port

INTUBATION:
- ☐ **N95** (instead of surgical mask), face shield,
- ☐ Plan for **rapid sequence intubation** by **most experienced** physician (*see **Intubation Guidelines** in APPENDIX for details*)

VENTILATOR MANAGEMENT
- ☐ Initiate all patients on **low tidal volume** ventilation immediately **(4-6cc/kg IBW)**
- ☐ Goal SpO2 no higher than 96%
- ☐ Moderate to severe ARDS (P/F<200)
  - o Use ARDSNet low or high PEEP ladder (goal **plateau <30 cm H2O**)
  - o If ventilator dyssynchrony, sedate to RASS -4/-5
  - o If persistent ventilator dyssynchrony, persistently high Plateau, consider neuromuscular blocking agents (bolus preferred over continuous infusion; if no improvement, infusion x 4 - 48hr)
- ☐ Severe ARDS (P/F<100)
  - o Consider **early proning** and consulting ECMO team (*Proning Guidelines)*
  - o consider inhaled epoprostenol (prefer over iNO) as a bridge to proning / ECMO
  - o **ECMO** team should be consulted if patient is intubated with **FiO2 >90%** with: **P/F < 50** for > 3h *or* **P/F <80** for > 6h (Call EMCO team for consults)

OTHER PROCEDURES
- ☐ Consider (1) **arterial line** to facilitate blood draws and reduce contact time, (2) **central line** if requiring pressors / difficult veins, (3) **NGT** at time of intubation to assess placement using same CXR

If increased risk of aerosolization, use N95
- ☐ Non-disposable equipment (e.g. ultrasound) should be wiped down with green wipes in the room (>2min contact time). Repeat after exiting room.

HEMODYNAMIC MANAGEMENT
- ☐ Use multimodal assessment strategy (skin temp, capillary refill, lactate) to guide fluid resuscitation
- ☐ *Conservative fluid* strategy, keep net negative, avoid maintenance fluids
- ☐ Prefer *buffered crystalloids* over colloids/unbalanced crystalloids
- ☐ Target MAP 60-65 using *levophed* as first-line agent, and *vasopressin* if 2nd agent needed
- ☐ If shock w/ cardiac dysfunction despite IVF and levophed, add *dobutamine*
- ☐ If refractory shock or chronic steroid use, consider *stress dose steroids* (hydrocortisone 50mg q6h)
- ☐ Be mindful of the potential for development of cardiomyopathy in COVID patients
- ☐ Diuresis per FACCT-Lite strategy if off vasopressors >12 hours and not clinically hypovolemic

PHARMACOLOGIC TREATMENT (see *TREATMENT guidelines in* APPENDIX)
- ☐ Acetaminophen for **fever**
- ☐ **Bacterial co-infection are common**, and treatment of bacterial pneumonia (CAP or HCAP as appropriate) should be initiated upon initial presentation. Consider stopping antibiotics after 48-72 hours if micro data is negative, there is no neutrophilia / bandemia, purulent sputum or lobar infiltrate
- ☐ **Viral co-infection is rare**, but may occur. If a patient tests positive for an additional respiratory viruses, the result should not be presumed to be false positives.
- ☐ Steroids, 6mg Dexamethasone is standard of care

CARDIAC ARREST
- • Don PPE **before** entering room – **N95**, eye protection, **hat**, gown, **double** gloves; room door remains closed
- ☐ Use automated external compression device (LUCAS) if available
- ☐ If patient already intubated: **perform CPR on VC mode, FiO2 100%, Resp needs to adjust vent alarms to ensure pt is getting proper tidal volumes**

APPENDIX

1. HEALTHCARE PROVIDER SAFETY WITH PUI / COVID-19 PATIENTS

For current information on MSHS PPE Guidelines and Directory
https://www.mountsinai.org/about/covid19/staff-resources/ppe-directory-guidelines
"PPE Practices" file includes
- Criteria to discontinue Special Droplet and Contact Precautions for COVID-19
- PPE recommendations (N95 respirator, gown, eye protection)
- Process for extended use / reuse of N95 respirators and face shields
- Prevention of skin breakdown with extended use of N95 respirators

For current information on types of approved PPE:
https://www.mountsinai.org/files/MSHealth/Assets/HS/About/Coronavirus/PPE_Directory.pdf

For current information on the Extended Use/Reuse
https://www.mountsinai.org/files/MSHealth/Assets/HS/About/Coronavirus/Process-for-the-Limited-Reuse-and-Extended-Use-of-N95s-and-Face-Shields-v2.pdf

For the current Staff Masking Policy:
https://www.mountsinai.org/files/MSHealth/Assets/HS/About/Coronavirus/Staff-Masking-Policy.pdf

PPE Tips:
- Minimize the frequency of room entry by consolidating tasks and bringing in all the supplies you need
- Limit number of HCP in room during procedure to those essential for procedure support
- PPE conservation is encouraged: practice extended use and limited reuse for N95, reuse for face shield; reprocessing program for N95
- For HCP with:
    o Glasses – consider eyeglass hooks to prevent them from slipping down
    o Long hair – tie hair back, no loose strands, don't tuck hair into collar of yellow gown
    o Beards – beard cap or beard trim

Surgical Mask and N95 Respirator Use
- Surgical mask should be worn when providing <u>routine direct patient care</u>
- If provider has history of <u>high risk exposure</u> to COVID-19, wear surgical mask in <u>common areas</u> unless N95 is indicated
- N95 conservation
    o Surgical mask can be worn <u>*over an N95*</u> during patient encounters if using <u>*goggles*</u>; change surgical mask between patients if aerosolizing procedure (not necessary with face shield)
    o Wear <u>*same*</u> N95 for the duration of the shift; only change if soiled or wet; discard @ end day
    o At end of shift: if not heavily soiled, wet, misshapen, place in reprocessing box
- Procedures that require N95 to prevent high risk exposure
    o BIPAP, CPAP, High Flow Nasal Cannula (HFNC) for duration of therapy
    o Intubation
    o Chest physiotherapy, nebulizer, suctioning tracheostomy and airway
    o Tracheostomy placement
    o bronchoscopy, bronchoalveolar lavage
    o Sputum induction, endotracheal aspirate collection

Isolation Precautions
To discontinue Special Droplet and Contact Precautions for inpatient COVID-19 patients, must meet ALL 3
    o **Afebrile** (<100.0F) for $\geq$72 hours without use of antipyretics <u>AND</u>
    o Marked **improvement** in symptoms (e.g. cough, shortness of breath) <u>AND</u>
    o At least <u>two consecutive **negative PCR**</u> for SARS-CoV2 collected <u>> 24 hours apart</u>

Adapted from MSHS COVID-19 Personal Protective Equipment (PPE) Practices, Updated 5/11/20

2. RESPIRATORY CARE AND TRANSPORT

Tips:
- [ ] Avoid nebulized medications; use MDI instead
- [ ] Staff transporting patient should wear a mask

Type of Patient	In Unit		Transport	
	Not intubated	**Intubated**	**Not intubated**	**Intubated**
Patient Under Investigation (PUI) _OR_ Confirmed COVID-19 positive	Nasal cannula or nonrebreather High Flow Nasal Cannula BIPAP – use closed circuit (840 vent) with filter on exhalation port. Use these with _caution_ and _close monitoring for decompensation_. Patient needs to be in negative pressure room and providers need to use N95 masks.	Mechanical ventilator with _filter_ on exhalation port	Nasal cannula under surgical mask or nonrebreather If possible, avoid transporting on HFNC / BIPAP because of risk of aerosolization	Portable ventilator with _filter_ on exhalation port No BMV

3. PPE DONNING AND DOFFING PROCESS

DONNING PPE

1. Perform **hand hygiene**
2. Don **yellow gown**
   - Coach makes sure gown covers your back
   - Tie straps on the _side_ of your body
3. Put on **mask***
   - Do not cross straps
   - _Pinch_ nose to ensure tight fit
4. Put on **eye protection** (face shield or goggles)
5. Put on **gloves**
   - Make sure thumbs are in gown thumbhole
   - Gloves _over_ yellow gown so _no skin exposed_
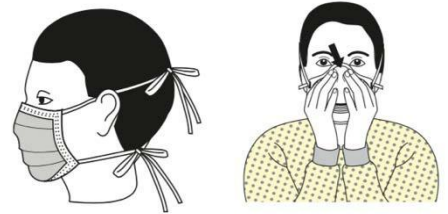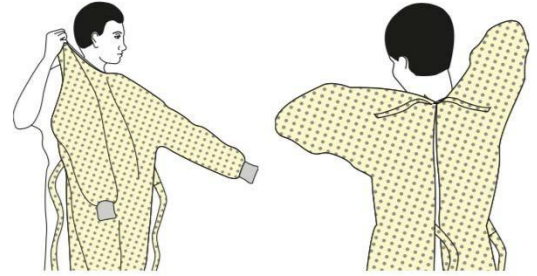
*Use **N95** instead of mask for
- _aerosolizing procedures_
- _COVID+ or PUI patient on HFNC or BIPAP_
- _Endemic treatment area with regularly occurring aerosolizing procedures (e.g., ED, ICU, OR, Labor & Delivery)_
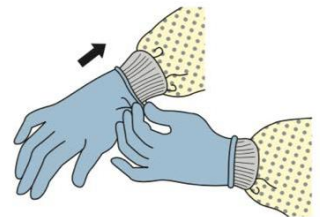
Adapted from instructions by Dr. Sam Acquah, Critical Care

DOFFING PPE

Remember front of gown / face shield / mask can be contaminated, so **do not touch the front**

In *endemic treatment areas with regularly occurring aerosolizing procedures (e.g., ED, COVID-only ICU)*
- Face shield and N95 do NOT have to be removed between patient encounters unless soiled
- If NOT enclosed treatment area (e.g., ED), *doff gown* (and gloves) after each patient encounter
- N95 can be worn for the *duration of your shift*
- Used N95 must be removed with *clean hands* and can be stored in paper bag until reuse

If ante-room
- doff all PPE in ante-room

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

Glove and Gown Removal
Method 1 – Gloves, then Gown Removal
1. Remove **gloves** using non-touch technique
2. Perform **hand hygiene**
3. Grasp inner *neck* of **gown**, *break apart*
   - Pull gown off and away from shoulders
   - As you go, turn gown *inside-out* and roll into inside-out *bundle*
   - discard
4. Perform **hand hygiene**
5. If any **breach** is noted, perform hand hygiene *immediately*.
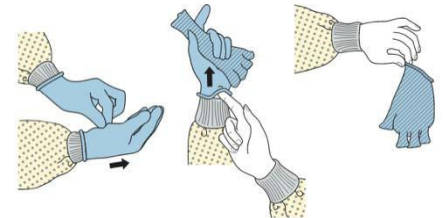
*Method 2 – Simultaneous Gown and Glove Remova***l**
1. Untie **gown**
   - Roll off gown *inside out* into a bundle, peeling off **gloves** *inside out* at the same time
   - *Bare hands* only touch *inside* of bundle. Discard.
2. Perform **hand hygiene**
3. If any **breach** is noted, perform hand hygiene *immediately*.
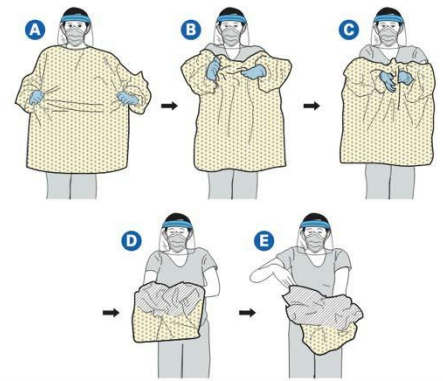
Face Shield Removal

After aerosolizing procedure, when soiled, or simply need to remove
1. with **clean gloves**, remove from *back of the head*
2. Use hydrogen peroxide wipe (green canister) to wipe inside→ outside of face shield. Let sit 1 minute.
3. remove residue with alcohol wipe
4. Place in dedicated paper bag or re-wear

Mask Removal

1. **Remove gloves**. Perform **hand hygiene**
2. Remove from *back of your head*
3. N95: *Leaning forward*, first remove *bottom* strap, then remove *top* strap and discard or store in paper bag until next use
4. Perform hand hygiene

4. SPECIMEN COLLECTION FOR COVID-19 TESTING

Tips: Your test is only as good as your specimen. Insert NP swab into nostril *parallel* to the palate. CDC does NOT consider NP swab collection an aerosolizing procedure so N95 not required.

If intubated, endotracheal aspirate (ET) is preferred
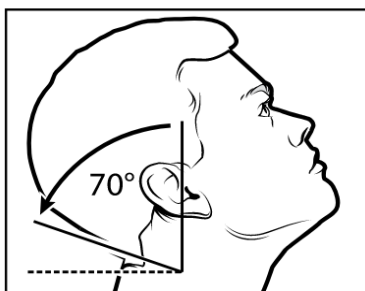
Flocked Swab

1. Equipment
   - **1** x Flocked swab with *plastic* shaft with tube of *Universal Transport Medium (UTM) in same package*
   - Tongue depressor (optional but helpful)
   - *Completed Label* with: patient's full name, date of birth, date and time of specimen collection, specimen source (OP or endotracheal)
   - Biohazard bag for sample
   - Bag of ice for sample transport
2. Don PPE and enter patient's room (surgical mask, face shield, gown, gloves)

Use "Flocked Swabs to collect specimens

Red marked

1 Tilt patient's head back 70 degrees.

U.S. Department of Health and Human Services Centers for Disease Control and Prevention
CDC
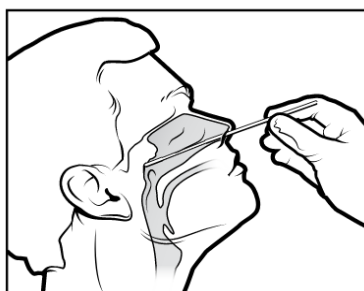
2 Insert swab into nostril. (Swab should reach depth equal to distance from nostrils to outer opening of the ear.) Leave swab in place for several seconds to absorb secretions.
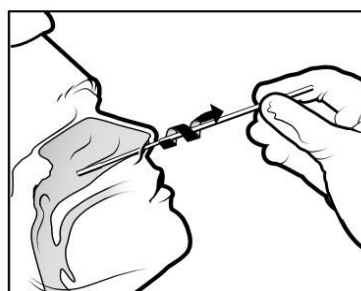
3 Slowly remove swab while rotating it. (Swab both nostrils with same swab.)
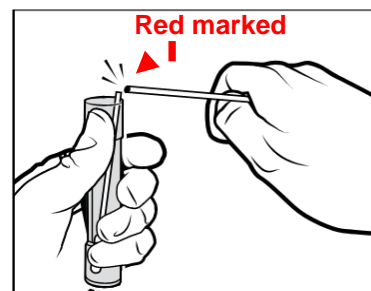
4 Place tip of swab into sterile viral transport media tube and snap/cut off the applicator stick.

3. Collect specimens
   a. **Nasopharyngeal swab:** Estimate distance to insert NP swab by measuring distance from *nose to ear.* Using *same swab,* repeat in other nostril.
   b. Immediately place swab into tube of UTM, *break* swab at the *red marked line* leaving tip in tube.
   c. *Close* and *label* tube, **otherwise lab will reject specimen.** Place tube and downtime form in biohazard specimen bag
4. Exit room
5. Place specimen bag inside *ice* bag and *immediately* transport to **Microbiology Lab**

Adapted from instructions by Dr. Sarah Schaefer, Infection Prevention

5. MSHS TREATMENT GUIDELINES FOR COVID-19

Current research and treatments for COVID-19 are rapidly changing, please refer to the MSHS treatment guidelines posted for the most up-to-date treatments: https://www.mountsinai.org/about/covid19/staff-resources/staff-clinical-guidelines-information

6. MANAGEMENT OF ACUTE HYPOXEMIC RESPIRATORY FAILURE ON GENERAL INPATIENT FLOORS

GOAL: SpO2 90-94%
- Rapid escalation of oxygen needs (within 30 minutes to 1 hour).
- Respiratory distress (RR > 35, use of accessory muscle, hypercapnea, increased WOB)
- Shock (SBP < 90 or MAP < 65 unresposnive to initial resuscitation)
- Altered mental status from baseline
**GOC should be established with all COVID patients within 24-48 hours of admission.

No →

← Yes

Nasal Cannula
Start at 2LPM and increase to 6LPM to maintain goal oxygenation.

Call RRT (pager: 1RRT) for early evaluation for intubation
- Set up for intubation
(see checklist below)

SpO2 < 90%?

Non-rebreather Mask
Ensure the mask reservoir is full before use. Can deliver up to 100% FiO2 depending on the mask fit.

← Yes — No →

Continue Nasal Cannula

SpO2 <90%%?

Between 7AM-6PM
Consider pulmonary consult (on amion) for optimization and using HFNC

← No — Yes →

Intubation checklist prior to RRT arrival:
Patient on Nonrebreather Mask
Nasal Cannula for apneic oxygenation
Functioning IV
Two suctions
Portable vital moitoring
1 bedsheet
Orogastric tube

Medications to have ready outside the room for post intubation:
Levophed drip on pump
1L Normal Saline
Dilaudid drip on pump
Ativan 4mg
Saline flushes

Please have the airwaybox ready OUTSIDE the patient room.

7. MSHS COVID-19 AIRWAY MANAGEMENT GUIDE

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

Airway Management:
- Patients can be started on nasal cannula and titrated up to non-rebreather with a goal of SpO2 around 90%
- Preferable in a negative pressure room but if not available can use in a room with a door with all providers wearing N95 and face shield and a sign on the door
- A trial of HFNC starting at 100% and titrate Flow for goal SpO2 > 90%, surgical masks should be placed over HFNC
- CPAP/BiPAP with viral filter also can be used, again starting at 5-10 EPAP and if needed can add 5 of IPAP while watching to make sure tidal volumes are <6-8 cc/kg of IBW
- Decision to intubate these patients needs to be carefully weighted in regard to risk vs benefit
- While it is important to not expose patients to the risk and increased mortality of intubation it is also important not to wait too long before intubating the patient
- Indications for consideration of intubation:
  - worsening mental status
  - increasing hypercapnia not resolved with NIV
  - Refractory hypoxemia SpO2< 85% for extended periods of time without recovery on NIV
  - Increased WOB and tachypnea not responsive to NIV

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

Pre-intubation:
1. Ventilator should ideally be set up prior to intubation.
2. Advance planning and clear communication are paramount
3. If patient is not in a single patient room, separate from other patients by 6 feet using curtains or screens
4. Set up and confirm ETCO2 waveform capnography is working
5. Minimize personnel
6. All equipment/medications that are needed should be setup and brought into the room prior to the start of the procedure, see intubation check List
7. Don PPE (gown, gloves, n95 respirator, eye protection, hair cover) outside of the patient's room

Intubation:
1. Prolonged pre-oxygenation for more than 5 minutes with 100% FiO2 non rebreather (caution: expiratory ports may aerosolize secretions)
2. Most experienced provider should intubate, second provider should push medications and assist
3. Goal is Rapid Sequence Intubation (RSI)
4. Can use push dose vasopressors for post intubation hypotension if needed
5. If manual ventilation is needed, use 2 hands to provide good seal, place filter between mask and bag, and deliver small tidal volumes.
6. Do not use non-invasive ventilation if it can be avoided
7. Preferred use of video-laryngoscopy (using the device that the intubator is most experienced with and hand-held device if available) to increase the distance
8. Inflate cuff immediately after intubation
9. Doff outer gloves after intubation and prior to touching other equipment

10. Attach filter to ETT, then the rest of the system
11. Institute mechanical ventilation on volume control mode at 6-8cc/kg IBW flowing the ARDS net titration.
12. Use disposable stethoscope to auscultate from the patient's side
13. Avoid awake intubation (risk of aerosolizing the virus during topicalization and coughing)
14. Avoid supraglottic airway (LMA) ventilation, unless warranted for a difficult airway

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

Suggested COVID-19 Airway "Go" Bag Contents, can be individualized for each department
1. HEPA filter
2. N95 masks x 4 (2 small, 2 regular)
3. Face shields x 2
4. Video laryngoscope, 3 blade x 2, 4 blade x 2
5. Stylet x 2
6. Isolation gown x 2
7. Waterproof (blue) gown x 2
8. Sterile gown x 1
9. Bouffant hat x 2
10. Sterile gloves: 6.0, 6.5, 7.0, 7.5
11. Biohazard bag x 1

Intubation Check List:
o Working IV (ideally two IVs)
o BVM (± PEEP Valve) on Oxygen
o Waveform Capnograph on BVM
o Video Laryngoscope
o Backup Laryngoscope
o ET tube the size your plan to use and 1 size smaller
o ET tube stylet
o Oral airway
o Bougie
o LMA sized for the patient
o Suction
o NRB for pre-oxygenation
o Nasal Cannula for Apneic Oxygenation
o Paralytic (succinylcholine 1-1.5 mg/kg or rocuronium 1.2 mg/kg)
o Induction Agent (Suggest ketamine 1-2mg/kg or etomidate)
o Flushes
o Post intubation sedation (hydromorphone or midazolam) (setup on PCA or Pump)
o Orogastric tube
o Norepinephrine on pump only if needed
o Bolus dose of phenylephrine

Mount Sinai Hospital COVID-19 Airway Management, Updated April 16, 2020

8. VENTILATOR MANAGEMENT OF ARDS IN COVID-19 PATIENTS

Initial ventilator settings post intubation while in the room:
Volume Control ventilation Initial settings:
RR 16-24, higher if with baseline respiratory acidosis
Vt = 6cc/kg of IBW
Flow 50L/min
FiO2 100%
PEEP 16

- ☐ Titrate FiO2 first then PEEP using the ARDSNet PEEP ladder: <u>Goal SpO2 92%-94% or pO2 55-80</u>
- ☐ Check plateau pressure (PPlat, inspiratory pause during controlled breaths) Q8H: <u>goal Pplat < 30</u>
- Check Driving pressure (PPlat – PEEP) Q8H: Goal < 14
- ☐ Check arterial blood gas: Goal pH 7.25-7.45
- ☐ Initial sedation target for a RASS -2 to -3 (eyes closed but responds to voice) using opiod (Fentanyl/dilaudid) and propofol

Ventilator management to achieve optimal oxygenation and ventilation during ARDS:

Key Principles:
- ☐ Prevention of ventilator induced lung injury (VILI) using lung protective ventilation
- ☐ Prevention of ventilator dyschrony that will worsen VILI by ensuring adequate sedation
- ☐ Permissive hypercapnea (tolerate pH as low as 7.25)
- ☐ Reduce oxygen toxicity secondary to hyperoxia

Sedation Management:
Goal: ventilator synchrony without stacking, double triggering, or exceeding RR > 40
- ☐ Fentanyl/Dilaudid with propofol to achieve goal RASS of -2 to -3
- ☐ Benzodiazepines should only be used if patient has a contraindication for propofol (i.e. propofol infusion syndrome, hypertriglyceridemia, or pancreatitis - monitor triglycerides and lipase every 3-4 days) or max dose propofol + opioid infusion is not sufficient for sedation
- ☐ If patient continues have ventilator dyssynchrony , target RASS -4 to -5 (unarousable to voice / sternal rub)
- If with persistent dyssynchrony despite RASS -5, paralyze with cisatracurium bolus (0.2mg/kg) and infusion titrated to vent synchrony for 4 – 48hr

Oxygenation Management:
Goal SpO2 92%-94% or pO2 55-80 while maintaining PPlat < 30 or Driving pressure < 14
- ☐ Sedation to achieve vent synchrony and improve oxygenation is essential.
- ☐ Titrate FiO2 and PEEP using the low PEEP ladder

Lower PEEP/higher FiO2

FiO₂	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

FiO₂	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	14	14	14	16	18	18-24

- ☐ Monitor PPlat and driving pressure after selecting a PEEP:
  - <u>Goal Pplat < 30 in those with a BMI < 35</u>
  - <u>Goal PPlat < 35 in those with a BMI > 35.</u>
  - If PPlat > 30 and driving pressure > 14, reduce Vt by 1cc/kg
  - If PPlat > 30 and driving pressure < 14, monitor closely

- If Pplat < 30 and driving pressure is < 14, increase Vt by 1cc/kg up to 8cc/kg of IBW as long as PPlat remains < 30 and driving pressure remains < 14
- If patient has persistent (>12 hours) FiO2 requirements > 75% and P:F < 150, consider prone position ventilation

Ventilation Management:
Goal: Low tidal volume ventilation (4-6cc/kg of IBW) while allowing for some permissive hypercapnea (pH 7.25-7.45). Tidal volumes should not exceed 8cc/kg of IBW.
- Monitor blood gases ~30 minutes after titrating the ventilator and at least once per shift
- Decrease RR if pH > 7.45
- If pH is < 7.25, increased RR up to 35 until pH 7.25-7.35
- If pH is persistent below 7.25 despite adequate vent synchrony (comatose/paralyzed) and increasing Vt (as permitted by plateau and driving pressures as described in Oxygenation section), initiate prone ventilation. Please email # Prone or obtain a prone consult.

Fluid management: Maintain euvolemia to net negative fluid balance with the assistance of diuretics and renal replacement therapy as indicated.

Adjuvant therapies:
- Consider inhaled pulmonary vasodilators (inhaled epoprostenol) for refractory hypoxemia (pO2 < 55) if patient is not responding to prone ventilation.
- Initiate ECMO consultation for P:F < 80 despite all the above interventions. Please see ECMO guidelines

For more information about different models of critical care, critical care-capable, subacute ventilator models and their respective capabilities:
https://www.mountsinai.org/files/MSHealth/Assets/HS/About/Coronavirus/Ventilator-Quick-Reference.pdf

9. GENERAL MANAGEMENT OF COVID PATIENTS IN THE ICU

Laboratory:

On admission:
- CBC with differential (CBC)
- Complete metabolic panel (CMP), Magnesium, Phosphorus
- Arterial blood gas (ABG)
- Troponin
- B-type natriuretic protein (BNP)
- Inflammatory markers: Lactate dehydrogenase (LDH) , Ferritin, C-reactive protein
- D-dimer and fibrinogen
- PT and PTT
- Creatinine kinase (CPK)
- Erythrocyte sedimentation rate (ESR)
- Procalcitonin
- Viral Hepatitis panel
- Ella - Cytokine Release Panel
- Type and Screen

Daily: CBC, CMP, Magnesium, Phosphorous, LDH, CPK, ESR, CRP, Ferritin, PT and PTT, D-dimer, Fibrinogen

Intermittent: Type and Screen as needed, Triglycerides and Lipase Q3 days if on propofol

Imaging:
- Portable CXR to confirm tubes and line placements
- Daily CXR imaging discouraged unless indicated for clinical decompensation
- CT chest routinely to diagnose COVID-19 is not indicated
- Point of Care Ultrasound to assess for lung sliding, B-lines, pleural fluid preferred methods of imaging while in ICU

Daily ICU Management

Nutrition

Management of electrolytes: Hypernatremia, Hyperkalemia

GI Prophylaxis

DVT Prophylaxis

Oral care and eye care

HOB elevation

Appropriate use and discontinuation of central lines and Foleys as needed

Daily communication with family

10. ADULT VV ECMO IN COVID-19 PATIENTS WITH SEVERE ARDS

1. **Indications for ECMO:**

ECMO for hypoxemic respiratory failure is indicated for patients who despite optimization of ventilator support have ongoing refractory respiratory failure.

COVID-19 confirmed patients who have not been on ventilators for more than 7 days and meet the criteria for refractory severe ARDS as defined by:
- PaO2/FiO2 ratio < 50 on FiO2>90% for > 3 hours or
- PaO2/FiO2 ratio < 80 on FiO2>90% for >6 hours.

2. **Before consideration of ECMO ventilator management should be optimized utilizing:**
- Low tidal volumes <4-6ml/kg
- Target plateau <30cm H2O
- Attempt recruitment maneuvers if indicated
- Titration of PEEP to optimize PaO2/FiO2 with PEEP in range of 16-22 cmH2O (high PEEP ladder)
- Optimal sedation with RASS -4 to -5 and if still asynchronous paralyzed for at least 4 hr to max 48 hrs
- Restrictive fluid strategy to avoid volume overload and try to maintain negative fluid balance
- Attempt to optimize oxygenation with inhaled Flolan/Nitric oxide. If ineffective, discontinue.
- Attempt prone positioning to improve oxygenation and lung compliance before considering ECMO

3. **Absolute contraindications:**
- Severe multi-organ failure
- Irreversible Neurologic injury
- Active malignancy with poor prognosis
- Active Intracranial bleed or other absolute contraindications to anticoagulation
- Patient refuses consent
- Documented severe dementia or moribund state

4. **Relative contraindications:**
- Age >50
- Weight >150 Kg
- Severe cardiac failure with EF <25%
- Severe pulmonary HTN with mean PAP > 50 mmHg
- Chronic respiratory illness or ventilator requirement for >7 days with high FiO2 requirements and high peak pressures
- Prolonged cardiac arrest with concern for neurologic damage

5. **Mount Sinai Hospital (Upper East) request for VV ECMO in COVID-19 positive patients:**
- All moderate to severe COVID-19 patients with ARDS will be evaluated by the Acute Respiratory Failure team
  - First call: Drs. Sam Acquah 201-396-9706 or Mehdi Oloomi 718-514-5331
  - If not available: AMION → Institute for Critical Care Medicine → COVID-19 → ECMO on call attending
- On call physician takes all info, ensures best practices for ARDS management being done and presents to ECMO multidisciplinary group on call
- If patient meets criteria, location and timing of ECMO will be discussed
- All ECMO decisions for these patients will be approved by ICCM leadership

6. **Other MSHS request for VV ECMO for COVID-19 positive patients:**
- All calls should go through the transfer center 646-605-5902
- VV ECMO calls will be handled by VV ECMO team
- On call physician takes all info, ensure best practices for ARDS management being done and presents to necessary ECMO multidisciplinary group on call
- if deemed an ECMO candidate, attempts must be made to stabilize patient and transfer to Mount Sinai Upper East Side as soon as possible
- At this time no outside cannulation – only patients that can be safely transferred will be considered for ECMO

Adapted from protocol by Drs. Sam Acquah, Anelechi Anyanwu, Mehdi Oloomi, Roopa Kohli-Seth

11. PUI / COVID-19 POSITIVE CARDIAC ARREST GUIDE (FOR FLOOR / ICU CODES)

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Important Things to Consider Before ACLS

- Enter the room after donning PPE - use N95 mask, face shield or other eye protection, bouffant, gown, gloves, and other equipment as indicated.
- Minimize staff and throughput within the room. Do not enter the room if you are not needed. –
- Use automated external compression device (LUCAS) if available.
- If patient is already intubated: perform CPR, clamp the ET tube to prevent loss of PEEP if readily available, utilize BVM with PEEP valve, while leaving the HEPA filter in line to prevent aerosolization.
- If the patient is not intubated, proceed with bag valve mask ventilation with a viral filter using the two-person ventilation technique
- The airway should be prioritized once the intubation team arrives.
- Opening of the room door should be kept to a minimum for entering personnel and hand off items.
- Review advanced directives and explore goals of care as appropriate before and during

</div>

Team Members (up to 7 in room, all wearing PPE):
1. Cardiac Arrest Leader
2. RN N1: Medication administration
3. Licensed Provider: CPR
4. Licensed Provider: CPR (If not using LUCAS)
5. Licensed Provider: Bag mask ventilation (ventilator) (2 handed vice grip)
6. Licensed Provider: Bag mask ventilation (squeezing the bag)
7. Respiratory therapist: Only if the patient is intubated or will be intubated for management of the ventilator after the code. Use ONLY two-person bag mask ventilation technique to ensure a seal. Ventilate with a bag valve mask (BVM) with a HEPA filter. If patient is already intubated, clamp ET tube prior to disconnect from ventilator if readily available, leave HEPA filter and continuous ETCO2 in line, connect BVM with PEEP valve, release clamp and bag according to ACLS guidelines.

Team Members (2) <u>outside</u> room, not wearing PPE:
1. Team member: Remains outside the room in PPE. Supplies medications and hands off materials as well as observes for breach in PPE of providers inside the room. The RN will be responsible for recording in the code narrator.

ACLS Process
1. The person who identifies patient in cardiac arrest (already in the room wearing PPE)
    a. Activate Cardiac Arrest notification (e.g. press "code blue button")
    b. Start chest compressions
2. 2nd person to arrive:
    a. Bring cardiac arrest cart and intubation box outside the room
    b. Don PPE
    c. Obtain defibrillator, defibrillator pads, and backboard
    d. Enter room
    e. Place backboard
    f. Place defibrillator pads on patient and connect to defibrillator.
    g. Check for appropriate IV/IO access (2 large bore IVs or IO)

3. 3rd person to arrive: (Designated Code Leader until relieved by Critical Care MD)

     a. Don PPE
     b. Assist critical care MD in setting up intubation equipment (if the patient is not already intubated) Prior to entering room, gather all needed supplies.
     c. Brings ACLS medications into the room.
- Consider: epinephrine x 5; bicarb X 2; calcium x 1; flushes x 10
- Bring additional supplies including IV fluid and IV start kit into the room.

     d. Assist with CPR, if LUCAS is not available

4. First Critical Care MD to arrive
     a. Don PPE
     b. Enter Room
     c. Assess need for definitive airway. If needed, insert definitive airway. Once airway is secure, proceed to step If not needed, proceed to step D.
     d. Assume Code leader role by announcing role and assigns responsibilities to team members (team members should provide a verbal response with acknowledgment of assignment).

Follow standard ACLS protocol

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

1. Intubate using video-laryngoscope
2. Inflate the balloon prior to any ventilations.
3. Place a HEPA filter, continuous ETCO2, and Ballard between ET tube and BVM.
4. Clamp tube prior to disconnecting BVM to place patient on ventilator to prevent loss of PEEP during transition if readily available

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

Post-CPR: -
- Doff all PPE except for N95 in room.
- Exit room -> perform hand hygiene
- Doff PPE -> perform hand hygiene
- Debrief