



The Mount Sinai Hospital Institute for critical care medicine response to the COVID-19 pandemic

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Background: The coronavirus disease 2019 (COVID-19) pandemic resulted in a surge of critically ill patients. This was especially true in New York City. We present a roadmap for hospitals and healthcare systems to prepare for a Pandemic.

Methods: This was a retrospective review of how Mount Sinai Hospital (MSH) was able to rapidly prepare to handle the pandemic. MSH, the largest academic hospital within the Mount Sinai Health System, rapidly expanded the intensive care unit (ICU) bed capacity, including creating new ICU beds, expanded the workforce, and created guidelines.

Results: MSH a 1,139-bed quaternary care academic referral hospital with 104 ICU beds expanded to 1,453 beds (27.5% increase) with 235 ICU beds (126% increase) during the pandemic peak in the first week of April 2020. From March to June 2020, with follow-up through October 2020, MSH admitted 2,591 COVID-19-positive patients, 614 to ICUs. Most admitted patients received noninvasive support including a non-rebreather mask, high flow nasal cannula, and noninvasive positive pressure ventilation. Among ICU patients, 68.4% (n = 420) received mechanical ventilation; among the admitted ICU patients, 42.8% (n = 263) died, and 47.8% (n = 294) were discharged alive.

Conclusions: Flexible bed management initiatives; teamwork across multiple disciplines; and development and implementation of guidelines were critical accommodating the surge of critically ill patients. Non-ICU services and staff were deployed to augment the critical care work force and open new critical care units. This approach to rapidly expand bed availability and staffing across the system helped provide the best care for the patients and saved lives.

Key Words: COVID-19; critical care; pandemics; surge capacity

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a novel respiratory virus of the Coronaviridae family of enveloped, single-stranded RNA viruses and caused the coronavirus disease 2019 (COVID-19). First identified in China in December 2019, COVID-19 became a pandemic in 2020, leading to the largest public health crisis in decades. The first COVID-19 case in the United States (US) was reported in January 2020. By March 2020, COVID-19 cases were identified in all 50 states, District of Columbia, Puerto Rico, Guam, Northern

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Marianas, and the US Virgin Islands.

New York City (NYC) was the epicenter of the US COVID-19 outbreak. As of February 22, 2021, there were 1,590,000 diagnosed cases and 46,346 deaths [1]. The rapid increase in cases necessitated an unprecedented increase in critical care capacity and development of institutional guidelines for COVID-19 care. In the present study, how increased ICU capacity and the process for creating, disseminating, and revising guidelines for critically ill COVID-19 patients at Mount Sinai Health System (MSHS) are discussed. The aim is to provide a possible roadmap for other institutions to quickly scale up resources for managing critically ill COVID-19 patients.

MATERIALS AND METHODS

This was a retrospective review of the response of Mount Sinai Hospital to the COVID-19 pandemic and was exempt from IRB Review. The present manuscript was descriptive in design to explain the efforts made by the Mount Sinai Hospital (MSH) to prepare for the COVID-19 pandemic. Because no patients were involved in policy initiative for the COVID surge management, IRB approval was not required.

KEY MESSAGES

- This review provides a roadmap for hospitals and health systems on how to prepare for a surge in critical care capacity.
- The coronavirus disease 2019 pandemic requires a team effort across multiple disciplines to manage a surge of critically ill patients.

MSHS, comprised of the Icahn School of Medicine at MSH and eight hospitals with more than 3,800 inpatient beds and more than 42,000 employees, is one the largest health systems in the US. The Institute for Critical Care Medicine (ICCM) at MSH is comprised of seven adult ICUs with over 6,000 admissions annually as well as several team-based services. The ICCM led the COVID-19 critical care response within MSH. More than 45 critical care faculty within the ICCM are responsible for staffing subspecialty ICUs and include several teams such as the rapid response team (RRT), vascular access team, difficult airway response team (DART), patient safety quality team, clinical research team, and post-ICU recovery clinic.

Providing care for a rapidly increasing number of critically

Table 1. Pre-COVID-19 and COVID-19 ICU beds at Mount Sinai Hospital

Unit	Pre-COVID-19		COVID-19	
	Patient population	No. of beds	Patient population	No. of beds ³
PACU				
Main OR PACU	OR Post Op	30	MICU/SICU/medicine stepdown (COVID negative)	30
Annenberg 6 PACU	Ambulatory Post Op	12	Transplant critically ill (COVID negative)	12
Annenberg 7 PACU	Neurosurgical Post Op	12	OR PACU (COVID negative)	12
ICU				
MICU	Medical critically ill	14	COVID-19 critically ill	28
SICU	Surgical critically ill	14	COVID-19 critically ill	28
TICU	Transplant critically ill	12	COVID-19 critically ill	24
CICU	Cardiac critically ill	14	COVID-19 critically ill	28
NSICU	Neurosurgical critically ill	18	COVID-19 critically ill	36
CVU	Cardiac surgical Critically ill	14	COVID-19 critically ill	28
CTICU	Cardiac surgical Critically ill	12	COVID-19 critically ill	24
Step down unit				
Medicine stepdown	Medicine stepdown	14	COVID-19 critically ill	14
Cardiac stepdown	Cardiac stepdown	6	COVID-19 critically ill	12
Surgical stepdown	Surgical stepdown	14	COVID-19 critically ill	14
Medicine overflow	General medicine patients	16	Neurosurgical critically ill	16

COVID-19: coronavirus disease 2019; ICU: intensive care unit; PACU: post-anesthesia care unit; OR: operating room; Post Op: postoperative patients; MICU: medical ICU; SICU: surgical ICU; TICU: transplant ICU; CICU: cardiac ICU; NSICU: neuroscience ICU; CVU: cardio vascular; CTICU: cardio thoracic ICU.
³ICU rooms were set up for two patients but varied depending on patient needs and nursing staff.

ill patients with acute respiratory failure due to a highly contagious viral illness requires guidelines to inform care and maximize healthcare provider safety. ICCM, Department of Emergency Medicine, Department of Anesthesiology, Perioperative and Pain Medicine, and the Infection Prevention team helped develop guidelines by referencing and adapting professional society guidelines. These guidelines were continuously revised and published on a systemwide COVID-19 website accessible to all hospital employees without the need for in-network access.

RESULTS

COVID-19 rapidly became a worldwide pandemic with over 111 million confirmed cases and over 2.47 million deaths in 188 countries/regions [1]. MSHS and MSH rapidly adapted to the surge in critically ill patients. MSH expanded from a 1,139-bed quaternary care academic referral hospital with 104 ICU beds to 1,453 beds with 235 ICU beds during the pandemic peak (Table 1), which occurred the first week of April (Figure 1). From March to May 2020, MSH admitted 2,161 COVID-19-positive patients, 541 to ICUs. Most admitted patients received noninvasive ventilatory support including a non-rebreather mask, high flow nasal cannula, and noninvasive positive pressure ventilation. Among ICU patients, 68.4% received mechanical ventilation, and among 420 patients that were intubated, 55.0% died and 43.1% were discharged alive. Among the 614 patients admitted to the ICU, 42.8% died and 47.8% were discharged alive (as of Oct 19, 2020) (Table 2). Advanced age correlated with increased death and likelihood of intubation (Table 3).

Table 2. Clinical characteristics and outcomes of COVID-19 patients admitted to Mount Sinai Hospital

Variable	Total	Never ICU	Admitted to ICU
Demographics	(n=2,591)	(n=1,977)	(n=614)
Age (yr)	60.1±17.5	60.1±17.9	60.0±16.0
Male	1,457 (56.2)	1,073 (54.2)	384 (62.5)
Major comorbidity	(n=2,494)	(n=1,904)	(n=590)
HTN	847 (33.9)	671 (35.2)	176 (23.2)
Diabetes	553 (22.2)	416 (21.8)	137 (23.2)
Obesity	250 (10.0)	199 (10.5)	51 (8.6)
CKD	326 (13.1)	262 (13.7)	64 (10.8)
COPD	99 (3.9)	85 (4.5)	14 (2.4)
Noninvasive support	(n=2,291)	(n=1,682)	(n=609)
NRB	858 (37.4)	507 (30.1)	351 (57.7)
HFNC	353 (15.4)	154 (9.2)	199 (32.7)
NIPPV	298 (13.0)	108 (6.4)	190 (31.1)
Invasive ventilator	(n=2,591)	(n=1,977)	(n=614)
Intubated	420 (16.2)	0	420 (68.4)
Clinical outcome	(n=2,591)	(n=1,977)	(n=614)
Died	485 (18.7)	222 (11.2)	263 (42.8)
Discharged from index visit	2,051 (79.1)	1,757 (88.8)	294 (47.8)
Discharged home	1,623 (62.6)	1,435 (72.6)	188 (30.6)
Discharged to facility	428 (15.6)	322 (16.3)	106 (17.2)
Among intubated patients			(n=420)
Died			231 (55.0)
Discharged from index visit			181 (43.1)
Discharged home			80 (19.0)
Discharged to facility			101 (24.0)

Values are presented as mean ± standard deviation or number (%). COVID-19: coronavirus disease 2019; ICU: intensive care unit; HTN: hypertension; CKD: chronic kidney disease; COPD: chronic obstructive pulmonary disease; NRB: non-rebreather; HFNC: high-flow nasal cannula; NIPPV: non-invasive positive pressure ventilation.

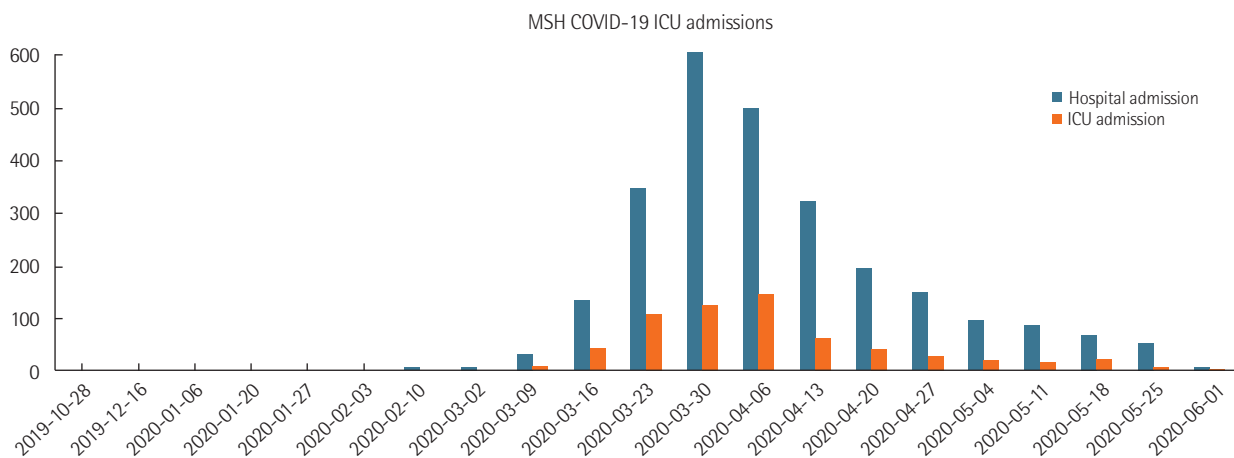


Figure 1. Mount Sinai Hospital (MSH) coronavirus disease 2019 (COVID-19) intensive care unit (ICU) versus hospital admissions.

Table 3. Clinical outcomes of COVID-19 patients admitted to Mount Sinai Hospital based on age

Age (yr)	All patients (n=2,161)					Ever ICU patients (n=614)			
	n	Admitted to ICU	Intubated	Died	Discharged	n	Intubated	Died (%)	Discharged
18–20	12	6 (50)	0	0	12 (100.0)	6	0	0	6 (100)
20–30	131	18 (13.7)	5 (3.82)	2 (1.5)	127 (96.9)	18	5 (27.8)	2 (11.1)	16 (88.9)
30–40	255	53 (20.8)	30 (11.8)	8 (3.1)	240 (94.1)	53	30 (56.6)	8 (15.1)	43 (81.1)
40–50	266	68 (25.6)	44 (16.5)	25 (9.4)	232 (87.2)	68	44 (64.7)	21 (30.9)	45 (66.2)
50–60	486	121 (24.9)	84 (17.3)	66 (13.6)	402 (82.7)	121	84 (69.4)	45 (37.2)	73 (60.3)
60–70	645	180 (27.9)	144 (22.3)	144 (22.3)	491 (76.1)	180	144 (80)	96 (53.3)	82 (45.6)
70–80	658	117 (25)	87 (18.6)	115 (24.6)	348 (74.4)	117	87 (74.4)	66 (56.4)	49 (41.9)
>80	328	51 (15.5)	26 (7.93)	125 (38.1)	199 (60.7)	51	26 (51)	25 (49.0)	25 (49.0)

Values are presented as number (%).
 COVID-19: coronavirus disease 2019; ICU: intensive care unit.

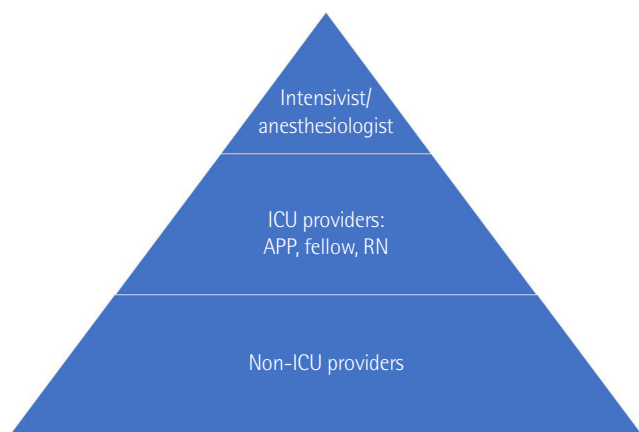


Figure 2. Force multiplier pyramid: a schema for critical care personnel expansion. ICU: intensive care unit; APP: advanced care practitioner; RN: registered nurse.

DISCUSSION

The 2015 American Hospital Association report estimated that more than 28,800 intensivists delivered ICU care in the US. COVID-19 created a surge in critically ill patients, resulting in hospitals searching for additional staff [2,3]. When the MSH ICU capacity was increased from 7 to 11 adult ICUs, 1–2 attendings, 1–2 advanced care practitioners (APPs), 1–2 fellows, and 1–2 residents per 12-hour shift with 24/7 in house intensivist coverage were on duty [4,5]. At least one of the two attendings in each ICU was an adult intensivist, the other was from anesthesiology, surgery, cardiothoracic surgery, neurosurgery, neurology, pediatric ICU, or neonatal ICU. Figure 2 shows the force multiplier pyramid and Table 4 shows the staff deployed to COVID ICUs. Staff shortages were addressed by

Table 4. Staff deployed to COVID ICUs

Fellow	Resident	APP
Critical care	Anesthesiology	General surgery & surgical subspecialties
Pulmonary critical care	Surgery & surgical subspecialties	Emergency
Neurocritical care	Interventional radiology	APPs from outside MSHS
Cardiology & cardiology subspecialties	Medicine	
Pediatric subspecialties	Pediatrics	

COVID: coronavirus disease; ICU: intensive care unit; APP: advanced care practitioner; MSHS: Mount Sinai Health System.

employing tiered staffing models and training staff from non-critical care areas to serve in critical care areas under intensivist supervision. Travel nurses helped supplement staffing in all ICUs. Equipment such as ventilators, medication, and tube feeding pumps were deployed based on need [6,7].

During the COVID-19 surge, the ICU bed capacity was doubled from 104 to 208. All seven adult ICUs became COVID-19 ICUs. All ICU rooms were converted to negative pressure rooms with HEPA (high efficiency particulate air) filters with outside exhaust and redesigned to accommodate up to two patients. Two ICUs were changed to post-anesthesia care units (PACUs), designated as COVID-19-negative, and were staffed by PACU anesthesiologists, pain management fellows, and intensivists (Table 1). A space formerly used as an ICU reopened as a COVID-19-negative neuroscience ICU and was staffed by neurosurgeons, intensivists, neurologists, and neurosurgery residents. Two medical/surgery units were repurposed as COVID-19-positive ICUs. This unit utilized anesthesia machines as

ventilators due to ventilator shortage and was co-managed by anesthesiologists and intensivists (Supplementary Material 1).

Establishing a new ICU usually requires years of planning, development, investment, and training. This is the first report of creating a de novo anesthesiology-run ICU within days. A location that already had a supply of medical gas, waste pipelines, and an uninterrupted power source was chosen. A telemetry unit was converted to an ICU because it had network interface and a central monitoring station that allowed for remote vital sign monitoring; alarm notification for patient decompensation; and vitals, medication records, and ventilator settings that integrated with the electronic health records. Details of how a stepdown unit was converted into an anesthesia-led critical care unit are described in Supplementary Material 1.

The greatest challenge in converting medical/surgical stepdown beds into ICUs was lack of patient visibility. Doors were kept closed to maintain negative pressure and minimize viral spread. Although windows were added to the doors, patient visibility was inadequate. Audio and visual equipment with a staffed monitoring station were added to many rooms. Tablets allowing video conferencing were attached to walls and focused on both the patient and vital sign monitors to allow audiovisual “spot checks.” Communicating critical information and calling for help from behind closed doors necessitated a hands-free device compatible with personal protective equipment (PPE). Nursing staff was familiar with Vocera (Vocera, San Jose, CA, USA), so the system was expanded to include physicians. Low-tech solutions such as whiteboards and dry erase markers allowed writing of critical information on windows. Early in the pandemic, resources were limited, and webcams were not available; however, webcams were eventually installed in COVID-19 patient rooms and proved extremely helpful to monitor patients.

The most important part of the de novo anesthesiology-run ICU was building a team of individuals from different departments with various levels of training. Nurses assigned to this unit were from a medical/surgical floor and were not trained in critical care. One ICU nurse per shift was assigned as an educator [4]. A de-emphasis on title and role was paramount for seamless teamwork and reduced unnecessary exposure and PPE use. Anesthesiology and nursing collaborated to minimize multiple room entries by pairing one person entering and calling out information or needed equipment to a teammate outside who would record information or gather supplies. Intravenous infusion pumps with extra-long tubing were used

for access to each room.

MSH has an intensivist-led central venous access service that facilitates tunneled and non-tunneled central venous catheter placement. This service was expanded with the addition of two cardiothoracic anesthesiologists who were deployed to free intensivists to focus on patient care. Dedicated proning teams were created for acute respiratory distress syndrome (ARDS) patients (a team comprised of surgical technicians who were available because elective procedures were suspended). This was overseen by a designated team within ICCM and deployed via Vocera and available 24/7 [8,9]. All ICCM faculty, house staff, and nurses were instructed on safe proning practices including simulation sessions.

Palliative care physicians were placed in all COVID-19 ICUs to assist with family meetings and discussions regarding care goals. Social workers facilitated family meetings via video conferencing. Tablets were placed in each ICU room to facilitate video communication between medical teams, families, and patients. ICCM RRT respond to decompensating patients in the hospital. Normally, this team includes an intensivist, critical care fellow, nurse practitioner, and respiratory therapist. During the COVID-19 outbreak, the team expanded to include two certified registered nurse anesthetist during the day and an interventional radiology or anesthesiology resident at night. CRNAs and APPs from outside institutions provided additional help.

Staff deployed to COVID-19 ICUs were required to perform new roles and learn new processes at an unprecedented speed. The ability to rapidly train and orient staff from a variety of backgrounds, disciplines, and from within and outside MSH posed a significant challenge [10,11]. To address this, a training and reference manual, the ICCM handbook, was created. The target audience was medical staff outside critical care (internal medicine, surgery, anesthesiology, interventional radiology, and pediatrics) [12] who had volunteered for COVID duty.

The handbook provided a simple yet comprehensive guide to: (1) complement COVID-19 educational training [13], (2) review before deployment to COVID-19 ICUs, (3) provide just-in-time training, and (4) serve as a simple reference for experienced providers. No precedent existed at the time of handbook preparation; thus, initial topics were based on review of existing protocols from institutions in Italy and US, and from references from prior respiratory viral pandemics (including MERS, SARS, and influenza) [14]. Topics included staff safety, PPE use, patient transport, sample collection, pharmacologic treatment, airway management and resuscitation, protocol

for extended PPE use, ARDS management, and daily workflow in COVID-19 ICUs.

The handbook consisted of a table of contents, a three-page summary for quick reference, and an appendix with protocols (Supplementary Material 2). Protocols were based on state, critical care society, and system guidelines and were structured with illustrations and step-by-step instructions. Sample collection and PPE donning/doffing instructions included illustrations from the centers for disease control and prevention, and intubation and cardiac arrest protocols included a list of needed supplies. The handbook was circulated via the publicly accessible MSHS COVID-19 staff resource website [15].

The first week of the COVID-19 crisis in NYC made it evident that institutional guidelines for intubation of COVID-19-positive patients were needed to ensure maximum frontline worker safety. Prior to crisis onset, ICCM developed a DART including critical care, emergency, anesthesiology, and otolaryngology. Each member reviewed literature [16,17] and guidelines released by the Society for Critical Care Medicine and the Anesthesia Patient Safety Foundation [12,18] to develop COVID-19-specific airway management guidelines.

DART addressed anticipated ventilator shortages [19] and safety of noninvasive ventilatory strategies. While delaying intubation could increase the risk of acute catastrophic decompensation and respiratory arrest, controversy remained over the extent of increased viral aerosolization [20,21]. Airway management dictates preparation for intubation as well as multiple backup plans for unanticipated difficulties [22]. “Go bags” were organized for intubation to minimize supply contamination and waste. Anticipated difficult intubations included larger “go bags” with additional supplies.

Many professional society guidelines have the most experienced person perform laryngoscopy for COVID-19 intubations [12,18,23]. Our guidelines recommended that COVID-19 intubations be performed by two experienced operators, one for laryngoscopy and the other to assist. COVID-19 intubation teams included intensivists, anesthesiology attendings, anesthesiology senior residents, and nurse anesthetists. DART activations, available for backup at MSH 24/7, assembled critical care, anesthesiology, and otolaryngology physicians for difficult intubations. COVID-19 DART intubations allowed otolaryngologists into the room only if a surgical airway was needed to limit the number of providers exposed and to preserve PPE. Guideline dissemination occurred via email to all departments who provide airway management and through virtual departmental conferences and grand rounds. In addition, high-fi-

delity simulation sessions were offered in small groups to all airway providers across departments followed by debriefing to evaluate and reinforce adherence to protocols. MSHS COVID-19 intubation guidelines, updated as of April 16, 2020, are included in Supplementary Material 2.

MSH responded to the COVID-19 surge by quickly expanding critical care bed capacity from 104 to over 200 ICU beds. Teamwork across multiple disciplines and guidelines for airway management, cardiac arrest, anticoagulation, vascular access, and proning was critical to hospital success. Non-ICU staff were used to help reinforce the ICU staff and open additional ICUs.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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SUPPLEMENTARY MATERIALS

Supplementary materials can be found via <https://doi.org/10.4266/acc.2021.00402>.

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Supplementary Material 1. Anesthesiology intensive care unit (ICU) document**Process of establishing an anesthesia led critical care unit**

Goal: rapidly deploy anesthesiology personnel and equipment to create a critical care unit in medical/surgery units with support from ICCM.

1. Environment**a. Requirements:**

- i. Oxygen, air, vacuum wall line setup with splitters if needed
- ii. Network jack access
- iii. Uninterrupted power supply (red outlets)
- iv. Central monitoring station preferred- anesthesia machine vital monitors can be interfaced with telemetry units

b. Recommendations

- i. Options to ameliorate partial or no view rooms
 1. Punch a window into all of the doors
 2. Reverse the direction of the bed so the head of the bed can be seen from the door
 3. Position anesthesia machine so the articulating arm with the vital sign monitor can either face the door/window or AV system
 4. Whiteboard installed on door to record personnel names as well as current ventilator settings
 5. AV hookup
 - a. Centrally monitored AV system- preferred- 9 AV tower units per monitoring booth with someone stationed who can monitor all 9 patients and report immediately.
 - b. Tablet/zoom setup- secure camera/tablet to wall facing both patient and monitors. Can only be dialed in to from a second tablet allowing only for spot checks and not continuous monitoring.
 6. Communication system- Vocera.
 - a. Critical to supply units to all staff members including physicians
 - b. Must develop unique call signs with hierarchy and emergency broadcast function (see appendix)
 - c. Allows communication through closed doors while wearing PPE to communicate and record vital signs, ventilator settings, supply needs or broadcast for emergency assistance when no one can see or hear you.

2. Staffing

- a. In house attending physician support recommended given unique environment and machinery with need for rapid problem solving.
- b. Consider dynamic staffing model to spread resources between many new units in order to maintain flexibility and reduce number of staff needed to cover each unit
 - i. Surge system: a backup process to call in order to have more staff immediately available if unit gets very busy with concurrent admission or emergencies.
 1. Surge pager: 3,908 or 3,910 – daytime covered by cardiac anesthesiology attending. Evening weekends covered by CT anesthesia fellow in house
 2. NICS ICU faculty (Amion): nights
 3. CTICU critical care anesthesiologist or surgeon (in house)
 4. Backup call attending (24/7 backup coverage scheduled in case of emergency or illness that would not interfere with other clinical duties)- last resort as home call
 - ii. Secondary resources
 1. Prone team
 2. Line service

3. Palliative care team
4. SW or case manager for identifying NOK and placement if needed
5. Walking rounds with ICCM and or anesthesiology leadership

3. Supplies

a. Anesthesia machine- deployed and interfaced by anesthesiology department

i. Equipment:

1. Circuits
2. HEPA or B/V filters- one placed in expiratory limb, 2nd placed at circuit Y
3. HME humidifying filter with gas analyzer sampling line
4. D-fend cartridges
5. CO₂ absorbers
6. Spirometry tubing (allows for plateau pressure measurement)
7. ECG, NIBP, SP2 and invasive monitoring cables
8. 25ft network cables for each room. One waterproof/washable keyboard for machine/network interface management

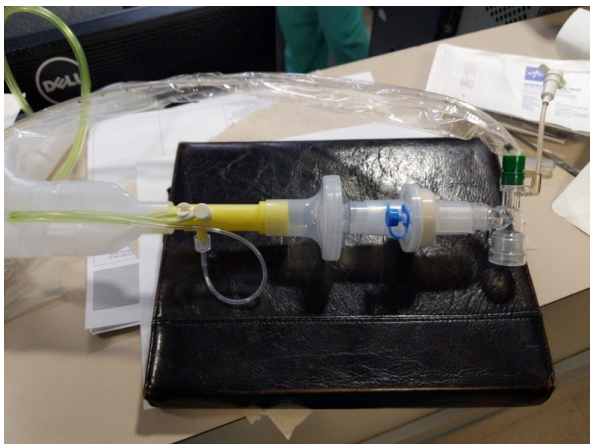
b. Workroom:

- i. Med/surg floors do not have critical care equipment. Goal is to utilize equipment familiar to anesthesiologists to improve workflow.
- ii. Create a supply area with stock assessment and refill workflow. Anesthesiology equipment managers and techs may help with this process.
- iii. Create packs or “go bags” with supplies for specific tasks (e.g., airway pack, central line pack, arterial line pack.) Goal of “go bags” are to provide critical equipment rapidly without creating waste by bringing too much equipment into a room even during an emergency (see appendix for content)
- iv. Stockroom area should be outside of COVID care area to reduce contamination and protect those who take inventory and stock.
 1. Stocked and locked anesthesia cart is quickest simplest solution as familiar to anesthesia team and techs who restock.
 2. 2 ultrasound machines, 1 video laryngoscope
 3. Airway packs with intubation equipment (see airway section)
 4. Invasive monitoring and central access packs and extra supplies
 5. Sterile gloves
 6. Airway supply cart with equipment needed to maintain anesthesia machines and circuits (list above)



4. Setup

- a. Circuit order
 - i. Circuit -> BV filter -> HME filter -> in line suction elbow -> ETT or mask
 - ii. Must have BV filter proximal to HME in order to prevent moisture buildup in BV filter. Sampling line for ETCO₂ goes to waste gas line and does not contaminate environment
- b. Self-inflating resuscitation bag on machine
- c. Rubberized perfusion clamp for ETT clamping for disconnects



5. Workflow:

- a. Different from other units given:
 - i. poor visibility of patients
 - ii. No respiratory therapy support as they are not familiar with anesthesia machines
 - iii. RN colleagues may not have critical care training
- b. Add ventilator rounds twice daily as well as extra scheduled patient evaluations
 - i. Team works in pairs with one person entering room to assess status of circuit, filters, CO₂ absorber, change ventilator settings as well as examine patient and environment. 2nd person outside room to pass supplies and record data.
 - ii. Coordinated with nurses so nursing tasks can be accomplished by anesthesiology team when they enter the room saving PPE and reducing RN exposure.
- c. Ventilator Management (adapted from on American society of Anesthesiology and Anesthesia Patient Safety Foundation recommendations)
 - i. Power cycle and complete check out prior to connecting. Machine automatically power cycles off after 49 days (GE). Therefore, leave off until connection imminent as to not start the timer.
 - ii. Initial mode: Pressure control volume guaranteed
 - iii. May need to increase Pmax to attain TVs.
 - iv. May need to add air to ETT cuff if Pmax is increased.
 - v. Flows at 10 L/min- goal is to match Flows to MV. Flows > MV leads to poor humidification which can damage lungs. Flow < MV leads to rapid buildup of moisture in the circuit and even the machine that can cause poor filter or machine performance.
 - vi. Set FiCO₂ alarm to 5 mm and replace CO₂ absorber whenever it rises >3 mm or majority color changes
 - vii. Check sampling line D-fend for fluid and replace if needed. Not frequent if setup with spirometry tubing with sampling line proximal to filters.
 - viii. Measuring plateau pressures: On the ventilator screen- select spirometry, then source and then select patient (instead of machine). Pplat will appear in spirometry section on left side of ventilator monitor.

6. Miscellaneous

- a. Creating a team based approach is the most important element in rapidly creating a fully functional intensive care unit in a space not designed for one and with staff who may not be familiar or trained in critical care. This requires constant communication and coordination between physician and nursing leaders as well as establishing an environment where tasks that are often performed by one type of provider can be done by any person entering a COVID room. Anesthesiologists know how to manage critical care pumps, lines/tubing, patient turning,
- b. Education: Daily discussions focusing on teaching non-anesthesiology team members how identify and interpret alarms and setting on anesthesia ventilator.
- c. Rapid escalation pathways: what is learned today is implemented tomorrow. All team members must be able to voice ideas or concerns in order to adapt and improve care for patients in a new patient care area.

Appendix:

APSF/ASA Guidance on Purposing Anesthesia Machines as ICU Ventilators:

<https://www.asahq.org/in-the-spotlight/coronavirus-covid-19-information/purposing-anesthesia-machines-for-ventilators>
(Please attach included PDF in appendix)

Airway "go bag" contents:

1. 8.0 and 7.5 endotracheal tube
2. soft stylet
3. 10 ml syringe.
4. Medium sized oral airway
5. 3 × 10 ml syringe, labeled Rocuronium, Etomidate and Succinylcholine
6. 1 × 20 ml syringe labeled propofol
7. 1 HME filter
8. 1 orogastric tube
9. 3 lube packets
10. 1 pair of eye protector sticker
11. 1 McGrath size 3 blade

Central line "go bag" contents:

1. 7fr triple lumen kit
2. 1 surgical gown
3. 1 sterile ultrasound probe cover with lubricant
4. 1 Biopatch (if CHG Tegaderm not available)
5. 1 CHG Tegaderm or standard Tegaderm dressing
6. 3 Luer-lock adapters
7. 1 sterile 24 inch arterial line tube (for manometry)

Arterial line "go bag" contents:

1. 20 g 12 cm arterial line kit
2. 1 sterile ultrasound probe cover with lubricant
3. 1 Biopatch (if CHG Tegaderm not available)
4. 1 CHG Tegaderm or standard Tegaderm dressing
5. 1 armboard
6. 2 rolls of 1 inch tape
7. 1 heparinized ABG syringe

Example Vocera call infrastructure:

Designations (nickname)

1. 7 east anesthesia resident 1-4 (7E residents 1-4)
2. 7 east anesthesia attending 1-2 (7E attending 1-2)
3. 7 east nurse anesthetist (7E CRNA)

Broadcast designations: may be called by any staff member in case help is needed

1. Broadcast to 7 east anesthesia team – calls all physician team members
2. Broadcast to 7 east emergency - calls all physician team members as well as charge nurse
3. NO PUSH TO TALK given its use as primary communication tool between other staff members

Institute of Critical Care Medicine Handbook for Management of Critically Ill COVID-19 Patients

Last Updated 5/15/20

Please note that we will continuously update this handbook as policies evolve

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With deep gratitude to friends and colleagues too numerous to name, from institutions across the world

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DEFINITIONS

COVID	
COVID-19 like illness	New onset of subjective or measured fever ($\geq 100.4\text{F}$, 38.0C) <u>OR</u> cough <u>OR</u> shortness of breath <u>OR</u> sore throat that <u>cannot be attributed</u> 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 <u>and</u> a positive laboratory test
PROVIDER SAFETY	
<u>Limited reuse</u> of PPE	Using the same N95 respirators for <u>multiple encounters</u> with patients, <u>but doffing after each encounter</u> . The respirator is stored in between encounters and is donned prior to the next encounter with a patient
<u>Extended use</u> of PPE	Wearing the same N95 respirators for repeated close contact encounters with several different patients, <u>without removing between patient encounters</u>
PPE reprocessing program	Sterilizes N95 that are not misshapen, heavily soiled or wet
PUBLIC SAFETY	
Isolation	"separation of <u>sick</u> people with a contagious disease from people who are not sick"
Quarantine	"separation of <u>asymptomatic</u> 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"

MSHS COVID-19 PPE Practices 3/25/20
 MSHS PPE workflow for Endemic Units with Aerosolizing Procedures 3/25/20
 NYC DOH Health Alert

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):

- Encouraged practices
 - **DO CONSERVE:**
 - **N95:** extended use / limited reuse; **face shield:** reuse; **N95 :** reprocessing program
 - **DON'T:** wear gown/gloves at workstation or when not working with patients
- Surgical facemask in all common areas
- **In patient room:** surgical facemask¹, face shield, isolation gown, gloves
- **N95** (instead of surgical facemask) is used for (1) aerosol-generating procedures (e.g., intubations, cardiac arrest, chest physiotherapy) and (2) in rooms with PUI/COVID+ patients on HFNC/bipap
- **Isolation gown:** offers full protection against droplets; 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 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
- Limit use of CT scans when possible

RESPIRATORY SUPPORT

- Limit use of aerosol-generating modalities whenever possible (e.g., sputum induction, nebulized medications)

Updated 2/22/21

- Use MDI instead of nebulized medications
- **Supplemental oxygen if SpO₂ <92%**
 - Nasal cannula and non-rebreather masks may be used as usual
 - Avoid Venti masks due to risk of aerosolization
 - A carefully monitored trial of HFNC (if unavailable, BIPAP with filter on exhalation port) is acceptable. Patient needs to be in airborne isolation room and HCP need to use N95 (instead of surgical masks) for PPE
 - If BIPAP must be used, use closed circuit ventilator with a filter on exhalation port

INTUBATION:

- **N95** (instead of surgical mask), face shield, **double gloves**, gown, **hat** must be used
- Plan for **rapid sequence intubation** by **most experienced** physician. **Ideally 2 people** (max 3) in room during intubation. (see *Intubation Guidelines* in APPENDIX for details)

VENTILATOR MANAGEMENT

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

OTHER PROCEDURES

- Consider (1) **arterial line** to facilitate blood draws and reduce contact time, (2) **central line** if requiring pressors / difficult veins, (3) **NGT** at time of intubation to assess placement using same CXR
- **Procedures should be performed by an experienced physician** in order to minimize clinician time spent in close proximity to patient
- 2 providers (2 MDs or MD + RN) should be in the patient's room for the duration of the procedure
- If increased risk of aerosolization, use N95
- Non-disposable equipment (e.g. ultrasound) should be wiped down with green wipes in the room (>2min contact time). Repeat after exiting room.
- Avoid bronchoscopy unless absolutely necessary (high risk of aerosolization)

HEMODYNAMIC MANAGEMENT

- Use multimodal assessment strategy (skin temp, capillary refill, lactate) to guide fluid resuscitation
- Conservative fluid strategy, keep net negative, avoid maintenance fluids
- Prefer buffered crystalloids over colloids/unbalanced crystalloids
- Target MAP 60-65 using levophed as first-line agent, and vasopressin if 2nd agent needed
- If shock w/ cardiac dysfunction despite IVF and levophed, add dobutamine
- If refractory shock or chronic steroid use, consider stress dose steroids (hydrocortisone 50mg q6h)
- Be mindful of the potential for development of cardiomyopathy in COVID 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** (no clear evidence that ibuprofen can make COVID-19 worse, can avoid if concerned)
- **Bacterial co-infection may occur**, and treatment of bacterial pneumonia (CAP or HCAP as appropriate) should be initiated upon initial presentation. Consider stopping antibiotics after 48-72 hours if micro data is negative, there is no neutrophilia / bandemia, purulent sputum or lobar infiltrate
- **Viral co-infection is rare**, but may occur. If a patient tests positive for an additional respiratory viruses, the result should not be presumed to be false positives.
- **Nebulized medications** must be **avoided** whenever possible; **use MDI instead**
- Steroids can be used for refractory shock, COPD/asthma exacerbation
- **Severe disease +/- other end organ damage**: bilateral pneumonia p/us intubated or NRB / HFNC / BIPAP

Updated 2/22/21

- Consider: convalescent plasma, Remdesivir EUA, Mesenchymal stem cells (MSH only)
- If no end organ damage and intubated ≤ 48 hours: Tocilizumab (IL6-receptor monoclonal antibody)
- Clinical trials: Remdesivir, Gimsilumab (anti-GM-CSF)

CARDIAC ARREST

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

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 routine direct patient care
- If provider has history of high risk exposure to COVID-19, wear surgical mask in common areas unless N95 is indicated
- N95 conservation
 - o Surgical mask can be worn over an N95 during patient encounters if using goggles; change surgical mask between patients if aerosolizing procedure (not necessary with face shield)
 - o Wear same 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 ≥ 72 hours without use of antipyretics **AND**
 - o Marked **improvement** in symptoms (e.g. cough, shortness of breath) **AND**
 - o At least two consecutive negative PCR for SARS-CoV2 collected > 24 hours apart

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

Personal Protective Equipment (PPE) FAQ During COVID-19

This document is applicable to all inpatient settings, including the Emergency Department. This information is subject to change based upon updated information

MASKS

Does a surgical mask provide enough protection for me?

Using a surgical mask is intended to protect staff by reducing the risk of potential exposure. We are concerned about transmission from patients to staff but also between anyone who may be contagious but does not know it (this includes staff, patients and visitors).

How does the Governor's Executive Order on mask use impact me?

The Governor's Executive Order stated that all individuals should use a face mask in public when they are unable to maintain a distance of six feet from other people. MSHS will be providing surgical masks to all staff for compliance with this order. Please speak with your supervisor about obtaining a mask if you have any questions.

When do I wear an N95 respirator?

N95 respirator with eye protection (attached or separate face shield/goggles) should be worn when performing aerosol-generating procedures for PUI or COVID-19 patients (e.g., tracheal intubation, non-invasive ventilation, tracheostomy, cardiopulmonary resuscitation, bronchoscopy) or by staff working on units/treatment areas where COVID-19 is considered to be endemic with regularly occurring aerosolizing procedures (e.g., ED, ICU, L&D, OR).

What is MSHS doing to ensure that we have N95 respirators when we need them most?

We have been very actively and successfully sourcing N95 respirators for our staff during the COVID-19 pandemic. Adhering to our policy is critically important at this time. We are asking staff to store N95 respirators between patients and use the same N95 respirator for COVID positive patients cohorted in the same room, unit, or area.

EYE PROTECTION

What should I wear to protect my eyes when with a COVID positive patient or a PUI?

Acceptable eye protection includes full face shield, surgical mask with attached face shield, and goggles.

Are goggles equal to a face shield in terms of protecting my eyes?

Goggles are an equal alternative to a face shield for eye protection as both will protect your eyes from splashes, sprays and droplets.

Can I reuse face shields in between patients with COVID or PUIs?

Similar to N95 respirators, we are asking staff to clean and store face shields between patients. They should be discarded at the end of the shift.

GOWNS

What gown should I wear for protection when with a COVID positive patient or PUI?

The gowns available at your sites have been evaluated by our infection prevention, life safety, and other clinical experts and validated as safe and effective.

GENERAL PPE

What about full body suits or "Tyvek" suits?

Full body suits or “Tyvek” suits are not part of the recommended PPE. They are not articles of clothing and so should not be worn under gowns. Gowns are easier to put on and, in particular, to take off. They are generally more familiar to healthcare workers and hence more likely to be used and removed correctly. Full body suits require a lot of training to avoid contamination during doffing. Any protective barrier PPE worn to care for a COVID-19 positive patient or PUI is considered contaminated. This PPE must be discarded before leaving the contaminated area—the patients’ room or the unit if the entire unit is a cohorted COVID unit.

Can I bring my own PPE to wear at work?

No, staff must wear the PPE that is provided to them to ensure an appropriate level of protection. All PPE used on site at Mount Sinai facilities should come from the Mount Sinai Health System supply chain.

MSHS PPE FAQ During COVID-19 (Updated 5/12/20)

Extended use and limited reuse of N95 Respirators and Face Shields

EXTENDED USE

Extended use refers to the practice of wearing the same N95 respirators for repeated close contact encounters with several different patients, **without removing between patient encounters**.

Extended use is well suited to situations for cohorted COVID patients whose care requires use of a respirator (e.g., housed on the same hospital unit or same room).

Instructions:

- The N95 respirator is worn continuously by a provider taking care of multiple patients in a cohort.
- Limited Reuse procedure below applies when patient care is complete or at the end of shift

LIMITED REUSE

Limited reuse refers to the practice of using the same N95 respirator with multiple patients during one shift. The respirator is stored in between encounters and is donned before the next encounter with a patient. The N95 respirator and face shield are discarded at the end of the shift.

Step-by-Step Instructions:

After completing care of a known or suspected COVID-19 patient:

1. **While in patient room**
 - a. Doff all PPE except mask and face shield
 - b. Perform hand hygiene
2. **Exit room** while wearing face shield and mask
3. Put on clean **gloves**
4. **Remove face shield** from the back of the head
 - a. Use **green wipe** (e.g. hydrogen peroxide) to disinfect face shield (wipe inside to outside), allow to dry 2 min
 - b. Place clean face shield in dedicated paper bag to individual employee and place in designated area or hang on hook outside of patient room
 - c. To remove residue, use alcohol wipes
5. **Remove gloves**, hand **hygiene**, put on **clean gloves**
6. **Remove N95 respirator** from back of head
 - a. Place N95 respirator in dedicated paper bag to that individual employee (and patient where applicable) and place in designated area
7. Discard the N95 respirator and face shield at the end of shift.

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

2. RESPIRATORY CARE AND TRANSPORT

Tips:

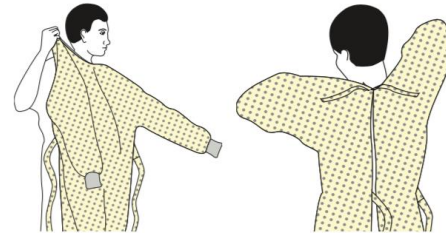
- Caution when using HFNC or BIPAP due to risk of dispersion of aerosolized virus in the health care environment with poorly fitting masks⁴
- Avoid nebulized medications; use MDI instead
- Avoid Venti-mask because of risk of aerosolization
- Staff transporting patient should wear a mask

Type of Patient	In Unit		Transport	
	Not intubated	Intubated	Not intubated	Intubated
Patient Under Investigation (PUI) <u>OR</u> 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 <u>caution</u> and <u>close monitoring for decompensation</u> . Patient needs to be in negative pressure room and providers need to use N95 masks.	Mechanical ventilator with <u>filter</u> 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 <u>filter</u> on exhalation port No BMV

3. PPE DONNING AND DOFFING PROCESS

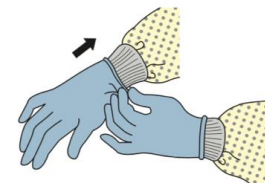
DONNING PPE

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 thumb hole
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 **don't 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

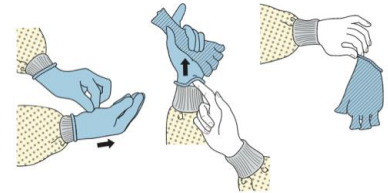
If no ante-room

- 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

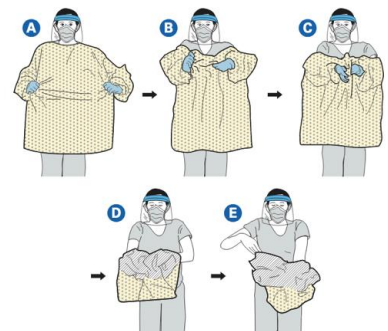
Method 1 – Gloves, then Gown Removal

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 Removal

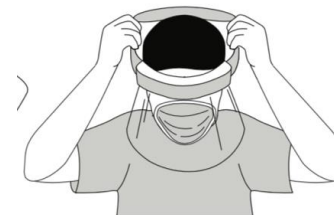
1. Untie **gown**
 - Roll off gown inside out into a bundle, peeling off **gloves** inside out at the same time
 - Bare hands only touch inside of bundle. Discard.
2. Perform **hand hygiene**
3. If any **breach** is noted, perform hand hygiene immediately.



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

1. Equipment

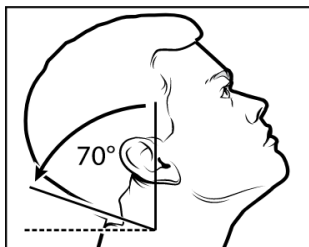
- 1 x Flocked swab with plastic shaft with tube of Universal Transport Medium (UTM) in same package
- Tongue depressor (optional but helpful)
- Completed Label with: patient's full name, date of birth, date and time of specimen collection, specimen source (OP or endotracheal)
- Biohazard bag for sample
- Bag of ice for sample transport

2. Don PPE and enter patient's room (surgical mask, face shield, gown, gloves)

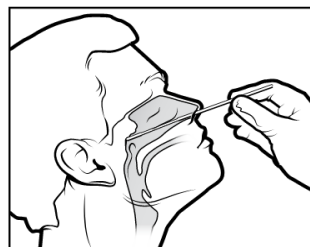
Flocked Swab



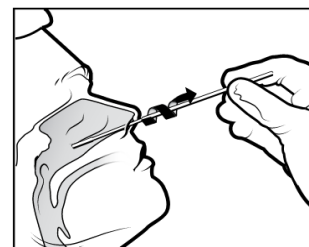
Use "Flocked Swabs to collect specimens"



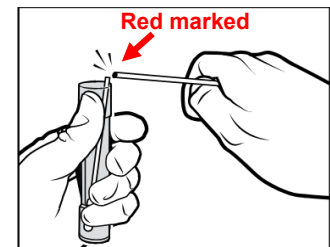
1 Tilt patient's head back 70 degrees.



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

 **Mount Sinai Health System Adult Treatment Guidance for SARS-CoV-2 Infection (COVID-19)¹**

Illness Severity ¹	Current Potential Therapy Options	Notes
<p>Asymptomatic</p> <p>Symptomatic not requiring supplemental oxygen (> 94% on room air)</p>	<p>Supportive care</p> <p>SARS CoV-2 specific antibody therapy for patients at high risk of progression to severe COVID-19</p>	<p>Initiation of either remdesivir or corticosteroids is not recommended.</p> <p>Emergency use authorization (EUA) monoclonal antibody therapies:</p> <p>Bamlanivimab² The FDA issued an EUA on November 9, 2020 for bamlanivimab, a single monoclonal SARS-CoV2 antibody, in select non-hospitalized patients 12 years of age or older (≥40kg) with a laboratory-confirmed COVID-19 (i.e., direct SARS-CoV2 viral test), symptom onset within 10 days and risk factors for progression to severe COVID-19.</p> <p>Casirivimab/Imdevimab The FDA issued an EUA on November 21, 2020 for casirivimab/imdevimab, a dual monoclonal SARS-CoV2 antibody cocktail, for similar indications as bamlanivimab.</p>
<p>Hospitalized requiring low-flow nasal cannula (SpO2 ≤ 94% on RA)</p>	<p>Supportive care</p> <p>Consider:</p> <ul style="list-style-type: none"> • Anticoagulation • Convalescent plasma or SARS-CoV-2 specific antibody therapy^{3,4*} • Dexamethasone • Remdesivir <p>In addition to remdesivir, anticoagulation, antibody therapy, and dexamethasone consider referring for enrollment in available Clinical Trials.</p> <p>*Not inclusive of EUA bamlanivimab and casirivimab/imdevimab</p>	<p>Remdesivir – requires ID consultation and is non-formulary</p> <p>Remdesivir is not recommended in patients with an eGFR < 30 mL/min with an ALT > 5 times with upper limit of normal. Remdesivir was FDA approved for the treatment of COVID-19 on October 22, 2020 in hospitalized patients 12 years of age and older weighing at least 40 kg.</p> <p>Convalescent plasma- requires ID consultation⁷</p> <p>On August 23, 2020, the FDA issued an EUA for the use of convalescent plasma in hospitalized patients. The Mount Sinai Health System has protocol in place for the administration of convalescent plasma. In patients with evidence of SARS-CoV-2 antibodies, SARS-CoV-2 antibody therapy is not recommended.</p> <p>Dexamethasone 6 mg IV/PO once daily for up to 10 days.</p> <p>Patients with symptom duration of < 7 days have not demonstrated benefit from dexamethasone. Dexamethasone should not be continued after discharge unless patient has a history of being on chronic steroid therapy.</p>
<p>Hospitalized requiring non-rebreather, high flow nasal cannula, or non-invasive ventilation (i.e., BiPAP)</p>	<p>Supportive care</p> <p>Recommended:</p> <ul style="list-style-type: none"> • Anticoagulation • Convalescent plasma or SARS-CoV-2 antibody therapy⁴ • Dexamethasone • Remdesivir <p>In addition to remdesivir, anticoagulation, antibody therapy, and dexamethasone consider referring for enrollment in available Clinical Trials.</p> <p>*Not inclusive of EUA bamlanivimab and casirivimab/imdevimab</p>	<p>See above</p>
<p>Hospitalized requiring mechanical ventilation or ECMO</p>	<p>Supportive care</p> <p>Consider</p> <ul style="list-style-type: none"> • Anticoagulation • Dexamethasone <p>In addition to anticoagulation and dexamethasone consider referring for enrollment in available Clinical Trials.</p>	<p>Evaluation for the appropriateness of convalescent plasma will be on case-by-case basis. Currently, data demonstrating benefit are lacking in these populations.</p> <p>Remdesivir is not recommended.</p>

MSHS COVID-19 Treatment Guidance November 30, 2020

Medications:

Anticoagulation^{8,9} [The Mount Sinai Health System COVID-19 Anticoagulation Protocol](#)

Bamlanivimab²⁻¹⁰

The FDA issued an emergency use authorization (EUA) for outpatient infusion of bamlanivimab on November 9, 2020. Bamlanivimab is a monoclonal antibody targeting the S protein of SARS-CoV-2. Benefit has not been observed in patients who require oxygen or who are hospitalized.

- National [allocation](#) of bamlanivimab will be made weekly to states based on reported 7-day hospitalizations. The allocation to MSHS is limited and in order to allow adherence to the EUA the prescribing of bamlanivimab will be adjudicated by a multidisciplinary committee after screening and Infectious Diseases consultation.
- Patients 12 years or older (and over 40 kg) referred for bamlanivimab must have a documented direct SARS-CoV2 viral test (antigen or PCR), symptoms of COVID risk for progressing to severe COVID-19. These high-risk conditions are described in the [fact sheet for health care providers](#).

Dosing:

700 mg IV x 1 dose infused over 1 hour

Caution:

Monitor for infusion reactions and/or anaphylaxis for 1 hour after infusion

- Adverse events should be reported to FDA [Medwatch](#).

Casirivimab/Imdevimab

The FDA issued an EUA for outpatient infusion of casirivimab/imdevimab on November 21, 2020. Casirivimab/Imdevimab is a monoclonal antibody cocktail targeting the S protein of SARS-CoV-2. Benefit has not been observed in patients who require oxygen or who are hospitalized.

- National [allocation](#) of casirivimab/imdevimab will be made weekly to states based on reported 7-day hospitalizations. The allocation to MSHS is limited and in order of adherence to the EUA the prescribing of casirivimab/imdevimab will be adjudicated by a multidisciplinary committee after screening and Infectious Diseases consultation.
- Patients 12 years or older (and over 40 kg) referred for casirivimab/imdevimab must have a documented direct SARS-CoV2 viral test (antigen or PCR), symptoms of COVID risk for progressing to severe COVID-19. These high-risk conditions are described in the [fact sheet for health care providers](#).

Dosing:

1200 mg of casirivimab with 1200 mg of imdevimab x 1 dose infused over 1 hour

Caution:

Monitor for infusion reactions and/or anaphylaxis for 1 hour after infusion

- Adverse events should be reported to FDA [Medwatch](#).

Dexamethasone¹¹⁻¹³

- Dexamethasone is recommended in patients with confirmed COVID-19 who require supplemental oxygen including those who require mechanical ventilation. Corticosteroids to be beneficial in COVID-19 patients who do not require respiratory support and use in this population could be potentially harmful.
- The benefit of dexamethasone was observed in patients > 7 days out from symptom onset.
- Dexamethasone prescribed specifically for the treatment of COVID-19 should not be continued after discharge unless the patient is on chronic corticosteroid therapy.

Dosing:

Dexamethasone 6 mg PO or IV q 24 hours for up to 10 days

Alternative corticosteroids (dose equivalent to dexamethasone): Methylprednisolone 32 mg IV q 24 hours, Hydrocortisone 160 mg, or Prednisone 40 mg PO q 24 hours

Caution:

- Monitor for hyperglycemia and secondary infections.

Remdesivir^{14,16}

- [Exclusions for initiation and continuation](#): eGFR < 30 mL/min, ALT > 5 x ULN
- Consult Infectious Diseases for consideration for remdesivir therapy. The approval of remdesivir, which is non-formulary, will be determined by a multidisciplinary committee.
- Use of remdesivir in pediatric patients (< 12 years of age) and patients weighing < 40 kg would be considered off-label use of remdesivir. Use of the lyophilized powder in patients weighing ≥ 3.5 kg is available under an emergency use authorization. Due to the lack of data in adults < 40 kg, using the EUA to document the off-label use.

Remdesivir was FDA-approved for the treatment of COVID-19 on October 22, 2020 in hospitalized patients 12 years of age and older weighing at least 40 kg. The Adapti (ACTT-1) is a randomized placebo-controlled trial. In this trial hospitalized patients with lab-confirmed COVID-19 on low-flow oxygen had shorter median symptom duration and improved 29-day survival (HR for death 0.3). The trial was not powered to evaluate for differences in recovery time or mortality in patients receiving non-invasive ventilator combined data from four trials including ACTT-1. In the analysis, low and high flow oxygen were combined and did not demonstrate a mortality benefit.

Dosing:

Patients ≥ 40 kg: 200 mg IV on day 1 then 24 hours later start 100 mg IV q 24h for 4 days for a total duration of 5 days¹⁵ or until hospital discharge, whichever is sooner hospitalized solely to complete course of remdesivir if discharge is appropriate.

Caution:

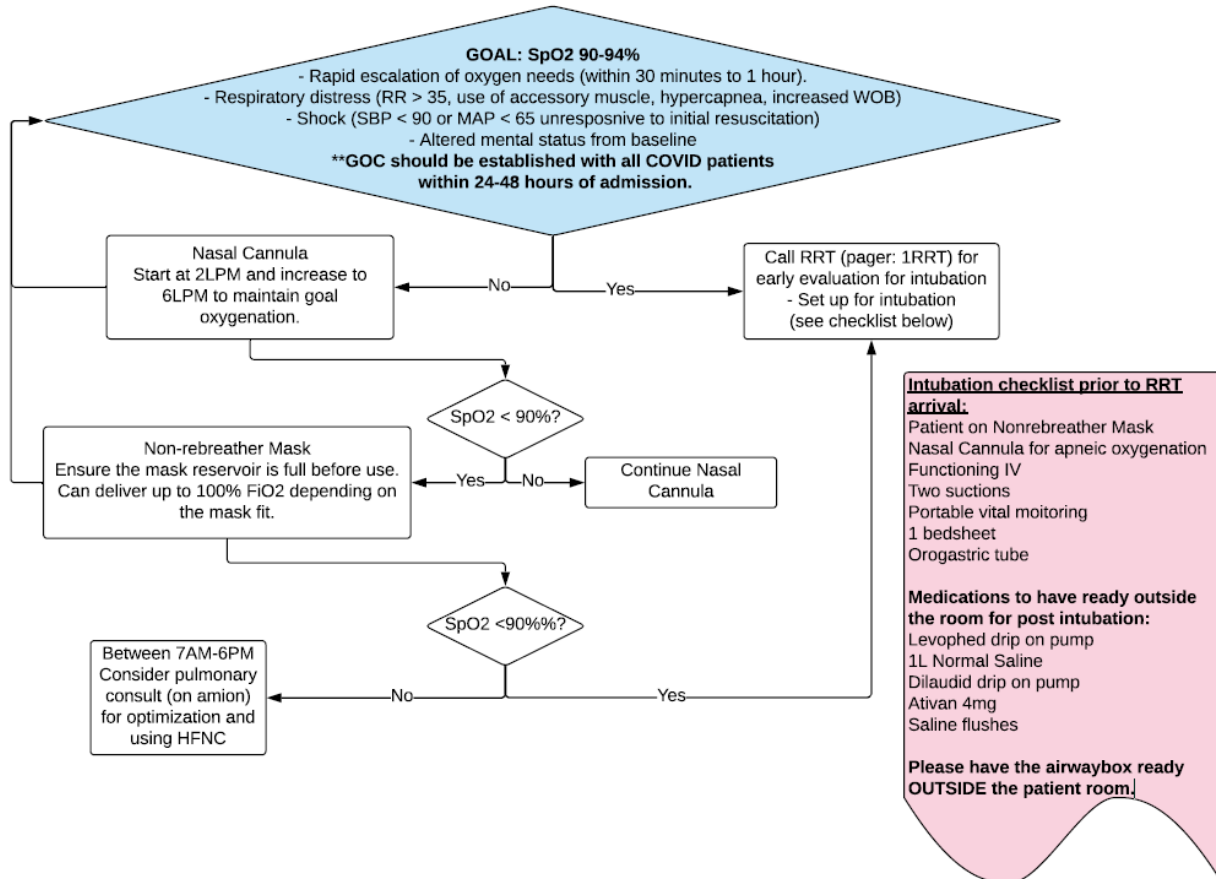
- Hepatic function tests should be checked prior to initiating remdesivir and daily. Elevation in transaminases have been observed in clinical trials including in both COVID-19. Hepatic function tests should be checked prior to initiating remdesivir and daily.
- Remdesivir should be discontinued if ALT > 5 times the upper limit of normal or if there is signs and symptoms of liver inflammation (e.g., increased bilirubin, alkaline phosphatase).
- Remdesivir should be discontinued if patient's eGFR < 30 mL/min.
- Adverse events should be reported to FDA [Medwatch](#).

Medications **NOT** currently recommended for the treatment of SARS-CoV2 (COVID-19):

ACE inhibitors and ARBs ¹⁷	Patients prescribed ACE inhibitors and ARBs for preexisting conditions should be continued on their ACE inhibitor and ARB. Currently, there is no scientific or clinical evidence that taking ACE inhibitors or ARBs increases the risk of acquiring COVID severity of illness for those acquiring infections.
Azithromycin ¹⁸	Azithromycin with or without hydroxychloroquine is NOT recommended for the treatment of COVID-19.
Baricitinib and kinase inhibitors (Janus kinase (JAK) inhibitors and Bruton's tyrosine kinase (BTK) inhibitors ¹⁹	On November 19, 2020, a EUA was issued for the combination of baricitinib, a JAK inhibitor, with remdesivir for the treatment of COVID-19 in patients age 2 and older based on limited data from ACTT-2. Patients treated with the combination had a median time to recovery that was similar to those treated with remdesivir alone. ²⁰ In a subsequent analysis, a day 29 mortality benefit was noted in patients who at baseline had low oxygen saturation, or non-invasive ventilation. Patients with prior initiation of remdesivir and receipt of antibody therapy (e.g., monoclonal antibody convalescent plasma) were excluded. Currently, MSHS does not recommend the use of baricitinib with or without remdesivir for the treatment of COVID-19. There are insufficient data to recommend the use of JAK or BTK inhibitors for the treatment of COVID-19. Use of one of these agents for the treatment of COVID-19 requires ID non-formulary approval at all times. Clinical trials evaluating the role of these agents are ongoing.
Famotidine ²¹	Use of H2 blockers or proton pump inhibitors specifically for the treatment of COVID-19 is not recommended.
Hydroxychloroquine ^{18,22-26}	Hydroxychloroquine is NOT recommended for prophylaxis or treatment of COVID-19. Co-administration of remdesivir and hydroxychloroquine may result in reduced antiviral activity of remdesivir. ²⁵ Patients prescribed hydroxychloroquine for preexisting rheumatologic conditions should be continued on their current dose.
Interferons ²⁷	Data specific to SARS CoV-2 are lacking. Interferon is currently not recommended for the treatment of COVID-19. Clinical trials are ongoing.
Ivermectin ²⁸	Despite inhibitory activity <i>in vitro</i> , clinical data are lacking. Ivermectin is not recommended for the treatment of COVID-19.
IVIg	Use of IVIG for COVID-19 is not recommended.
Lopinavir/ritonavir (Kaletra) ^{29,30}	Lopinavir/ritonavir is not recommended for the treatment of COVID-19.
Nitazoxanide ³¹	Displays inhibitory activity against the virus <i>in vitro</i> however no clinical data in humans exists.
Oseltamivir	SARS-CoV-2 does NOT use neuraminidase as part of the viral replication cycle therefore neuraminidase inhibitors are not likely to be effective.
Tocilizumab (IL-6 inhibitors) ³²⁻³⁸	Randomized controlled clinical trials of IL-6 inhibitors failed to meet clinical endpoints and failed to show mortality benefit. Use of tocilizumab for the treatment of COVID-19 is NOT recommended and should not be prescribed off-label.
Ribavirin	There are insufficient data to recommend the use of ribavirin for the treatment of COVID-19.
Zinc	There are insufficient data to recommend the use of zinc for the treatment of COVID-19.

Mount Sinai Health System Treatment Guidelines for COVID-19 (Nov 30, 2020)

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



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

Updated 2/22/21

22

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:

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

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: Goal SpO₂ 92%-94% or pO₂ 55-80
- Check plateau pressure (P_{Plat}, inspiratory pause during controlled breaths) Q8H: goal P_{Plat} < 30
- Check Driving pressure (P_{Plat} – 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 opioid (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 dyssynchrony 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 P_{Plat} < 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

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

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

- If Pplat < 30 and driving pressure is < 14, increase Vt by 1cc/kg upto 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: Hyponatremia, 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 of 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)

Important Things to Consider Before ACLS

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

Team Members (max 5) in room, all wearing PPE:

1. Cardiac Arrest Leader
2. RN N1: Medication administration and recording.
3. RN or MD: CPR
4. RN or MD: CPR (If not using LUCAS)
5. Respiratory therapist: Only if the patient requires intubation, Use ONLY two person bag mask ventilation technique to ensure a seal. Ventilate with a Bag Valve Mask (BVM) with a HEPA filter.

Team Members (2) outside room, not wearing PPE:

1. MD, RN or PA: Remains outside the room - Wearing PPE. Supplies medications and hands off materials as well as observes for breach in PPE of providers inside the room.

ACLS Process

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

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- b. Identified as a Code leader and assigns responsibilities.
- c. Manage airway if required

****Follow standard ACLS protocol**

Intubating during code:

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

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

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:

- Exit room
- Doff PPE
- Debrief

MSHS PUI / COVID-19 Positive Cardiac Arrest Guide, 3/24/20