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Management of patients with COVID-19 in the medical ICU

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■ ABSTRACT

COVID-19 management practices devised for the medical intensive care unit (ICU) are centered on two main goals: ensuring caregiver safety and providing the highest quality patient care through adherence to evidence-based best practices. Rapid, sweeping changes for successful management are based on creating an educational platform to introduce and then further cement these concepts through a unified approach to clinical care. Creating a culture change in a short period of time requires overcoming a host of challenges; however, the result is a more unified and focused approach.

■ INTRODUCTION

As the COVID-19 pandemic continues, it is essential for healthcare providers to follow updated literature and adapt these to individual institutions. In this review, we describe the COVID-19 management practices devised for the medical intensive care unit (ICU) in the Respiratory Institute at Cleveland Clinic.

The foundation of our ICU operations is centered on two main goals: ensuring caregiver safety, and providing the highest quality patient care through adherence to evidence-based best practices.

■ ENSURING CAREGIVER SAFETY

We need to preserve our workforce for the health of the community and the functioning of the institution. Identifying the appropriate situations for personal protection equipment (PPE) is essential, so we developed standards of care (**Table 1**) that outline when and how PPE should be used based on the

risk of transmission when in contact with potential COVID-19-positive patients, either confirmed or under investigation for infection. Equipment includes a surgical mask, gown, protective eyewear, and gloves for all caregiver interactions. An N95 respirator or a powered air-purifying respirator (PAPR) is used for encounters with patients undergoing therapies at high risk for aerosolization (eg, high-flow nasal cannula [HFNC], noninvasive ventilation [NIV]) or procedures at high risk for disease transmission (eg, intubation, tracheostomy, endoscopy).

In addition, to reduce the high risk of transmission during the process of donning or doffing PPE, especially when doffing, we instituted a “buddy” system to create an additional layer of caregiver safety (**Figure 1**). This person provides direct observation and feedback during the process of donning and doffing PPE to ensure caregiver safety.

We also made adjustments to respiratory practices to enhance safety by minimizing aerosolization. For hospitalized patients with COVID-19 who develop hypoxemia, oxygen is supplemented with a target oxygen saturation (SpO_2) range of 90% to 96%, and the patients are transferred to the ICU on escalating requirements for closer observation, as they can quickly deteriorate. In patients with increasing oxygen requirements, we prefer HFNC with a surgical mask placed on the patient, as tolerated, to minimize aerosolization. In patients with concomitant comorbid conditions that indicate the use of NIV with either continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BiPAP), such as chronic obstructive pulmonary disease or congestive heart failure, we use expiratory-port high-energy particulate air (HEPA) filters.

We use objective criteria to identify patient deterioration while on noninvasive ventilation (**Table 2**). Although we do not advocate early intubation, these patients are evaluated often to avoid delaying intu-

The statements and opinions expressed in COVID-19 Curbside Consults are based on experience and the available literature as of the date posted. While we try to regularly update this content, any offered recommendations cannot be substituted for the clinical judgment of clinicians caring for individual patients.

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TABLE 1
Recommendation for personal protective equipment for COVID-19

	Face Mask (surgical or ear-loop mask)	N95 (fit-tested respirator)	Protective Eyewear (goggles or faceshield)	Gown & Gloves
If you are a Patient or Visitor who is asymptomatic, no risk factors	No personal protective equipment precautions required. Follow CDC guidelines, limit social interactions, practice hand hygiene. Follow visitation guidelines to limit exposure.			
If you are a Patient with respiratory symptoms <u>OR</u> confirmed or pending test results for respiratory virus or COVID-19	Wear Face Mask while being transported (Not required while in hospital room)			
If you are a Visitor seeing a patient who is undergoing respiratory viral testing with pending results or who is COVID-19 positive <ul style="list-style-type: none"> VISITATION by EXCEPTION ONLY as per policy 	Wear Face Mask (in room w/patient only)			Wear Gown & Gloves
Caregivers Performing Screening at Hospital or Department at Point of Entry	Wear Face Mask*		Wear Protective Eyewear**	
Clinical Caregivers Actively Seeing Patients <ul style="list-style-type: none"> Contact/Droplet + Eyewear & Specified Precautions For transportation guidance please click here. 	Wear Face Mask		Wear Protective Eyewear	Wear Gown & Gloves
Collection of all Respiratory Viral Specimens for Testing (including COVID) <ul style="list-style-type: none"> caregivers obtaining nasopharyngeal/oropharyngeal swab 	Wear Face Mask		Wear Protective Eyewear	Wear Gown & Gloves
Performing Procedures and Surgeries <ul style="list-style-type: none"> aerosolized risk: Bronchoscopy, nebulization, NIPPV, open tracheal suctioning, intubation/extubation, endoscopies, naso-enteric tube placement, TEE, high flow O2; ear-nose throat surgery, oropharyngeal/tracheal surgeries, lung laparoscopic surgery 		Wear N95	Wear Protective Eyewear	Wear Gown & Gloves

***Face mask usage:** Extended use for face masks: One mask per shift. Change face mask with contamination with respiratory secretions or obvious soilage or damage. Masks should always be worn covering nose and mouth. Used mask handled by ear loops ONLY. Never touch the front of the mask. Perform hand hygiene after handling used mask. Do not reapply a used mask.

****Protective eyewear:** Reusable goggles or facemask preferable. Can be worn for extended period. Must be cleaned with disinfectant wipes with contamination/soilage and after each use.

bation. In patients who are intubated, we use inline nebulizers. In those not on mechanical ventilation, we use metered-dose inhalers.

Procedures for intubation, if required, have also been modified to ensure caregiver safety. Preoxygenation is achieved with delivery of 100% oxygen via a non-rebreather mask or HFNC; bag mask ventilation is not recommended. We have our most experienced operators use video laryngoscopy to perform intubation to minimize the duration of the procedure and to ensure maximum distance from the patient's oropharynx. After successful intubation, we put patients directly on mechanical ventilators with continuous capnometer monitoring.

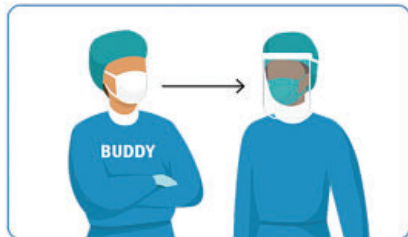
Chest radiography is performed at admission to

ensure placement for necessary procedures such as nasogastric tube and central line. However, we avoid daily chest radiography unless clinically indicated, such as when changing location of the endotracheal tube or changing ventilation parameters (eg, increasing resistance, hypoxemia). We developed a process for performing portable radiologic studies from outside the room.

■ MAINTAIN BEST PATIENT CARE

It is challenging to maintain our standards of care when isolation practices increase. We created a cohort unit in which we place all patients under investigation for or with confirmed COVID-19 to ensure the safety of other patients and our caregivers.

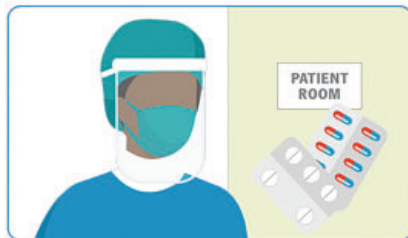
COVID-19: BUDDY SYSTEM PROTOCOLS



Ask your buddy to **watch you don PPE** before you enter the patient's room to make sure you are in compliance.



Need supplies? Knock on the glass while you are in the room to alert an available buddy. Open the door for them, and have them hand you the supplies.



When your patient **needs medications**, ask an available buddy to add the medications to the IV poles outside of the room, while you assist the patient inside.



When you're **ready to exit**, knock on the window to alert an available buddy. Doff to minimize risk of error.

Please note: The buddy system was designed to keep patients and caregivers safe. For a full list of PPE recommendations for a clinical setting, visit clevelandclinic.org/COVID19.

20-COC-1875986

Figure 1. Cleveland Clinic buddy system protocol.

We have 5 distinct medical ICUs. We dedicated 2 of these units (with plans to expand further based on patient volume) to the COVID-19 patient popula-

tion, either suspected or confirmed. Each patient has his or her own room with four distinct walls.

Given that there is no curative therapy for

TABLE 2
Failure criteria for noninvasive ventilation (NIV) and high-flow nasal cannula (HFNC)

NIV Failure Criteria

- Tidal volume > 9.5 mL/kg/IBW consistently over the first 4 hours
- $FiO_2 > 60\%$ to maintain target SpO_2

HFNC Failure Criteria

- ROX score^a ≥ 4.88 at 2, 6 and 12 hrs is a good predictor of no need for intubation and < 3.85 is high risk for need for intubation

^aROX score = $(SpO_2/FiO_2)/RR$.

COVID-19 and that therapeutic considerations have been extrapolated from limited experience, we developed multidisciplinary teams to help develop consistent clinical practice strategies. These teams include ICU providers, infectious disease specialists, and pharmacists.

For hypoxic respiratory failure, our mechanical ventilation strategy includes low tidal-volume-ventilation with a goal end-inspiratory plateau pressure of 30 cm H₂O or below and allows for permissive hypercarbia ($pH \geq 7.15$). We titrate the fraction of inspired oxygen and positive end-expiratory pressure ($FiO_2/PEEP$) according to established protocols.¹ It is often easier to use existing evidence-based protocols in a pandemic when unfamiliar teams may be caring for these patients. Early proning and neuromuscular blockade are recommended as adjuvant therapy in patients. For patients who are refractory to conventional mechanical ventilation, trials of salvage therapy with inhaled vasodilator and extra-corporeal life support can be considered. After initial volume resuscitation, as patients often come with evidence of volume depletion, we are vigilant in preventing and decreasing volume overload. In patients with acute lung injury, diuresis with the Fluid and Catheter Treatment Trial (FACTT) lite protocol should be implemented.²

Bacterial coinfections have been reported in patients with COVID-19.³ As a preventative measure, we start coverage with antibiotics in critically ill patients presenting with severe respiratory distress, basing it on their risk factors for community versus drug-resistant organisms (eg, MRSA, pseudomonas). Procalcitonin is ordered on admission and followed to help with de-escalation of antibiotic therapy.

TABLE 3
Cleveland Clinic MICU COVID-19 workup checklist (updated 4/15/2020)

1. Upon admission:

- Complete blood count with differential, basic metabolic panel (BMP), liver function tests (LFTs), lactate dehydrogenase (LDH), C-reactive protein (CRP), fibrinogen, D-dimer, high-sensitivity troponin, NT-proBNP, creatine kinase (CK), CK-MB, procalcitonin, ferritin, aPTT, INR, IL-6, electrocardiography

2. Follow-up:

- **Troponin:** If troponin upon admission is elevated, then check troponin daily for 3 days or clinical deterioration
- **CRP:** Check CRP daily, if it is elevated, consider checking triglyceride (TG), ferritin, fibrinogen, LFTs
- **TG:** Check TG every 48 hrs while on propofol
- **D-Dimer, ferritin, PT/INR, aPTT:** Monitor every 48 hrs for 3 times
 - If patient has evidence of diffuse vascular coagulation (DIC), then check fibrinogen, PT/INR and aPTT
 - Stop monitoring ferritin if patient is on Tocilizumab
 - Stop monitoring D-dimer and PT/aPTT if patient is on therapeutic anticoagulation

3. Chest x-ray (CXR):

- Perform CXR upon admission after all lines and tubes, then further CXR should perform only if it will change clinical management

4. Electrocardiography:

- Perform upon admission, and check QTc interval from bedside monitor

Critically ill patients with COVID-19 experience a sequelae of manifestations from activation of the innate inflammatory cascade, which increases the incidence of cardiomyopathy/heart failure, disseminated intravascular coagulation, venous thromboembolism (VTE), and the cytokine-release syndrome. Although there are currently no accepted standardized therapies for the prevention or treatment of these phenomena, we perform screening modalities that include ECG, troponin levels, ferritin, and select serology tests on admission with follow-up based on the patient's clinical course (Table 3). In patients at high risk for VTE (D-dimer > 3,000 ng/mL FEU), we perform point-of-care ultrasound to assess the presence of thromboembolism over extremities. Therapeutic anticoagulation is indicated for patients with conclusive evidence for VTE.

As with any new disease that has unproven thera-

pies, our approach is to develop the best evidence-based guidelines for our teams to follow and to engage in clinical trials to form better guidance.

Bundle care. We also have developed practices to preserve PPEs while maintain our standards of care. We bundle all care (eg, medications at same times, labs, and procedures) and limit traffic into the room to only what is essential. Our nursing and respiratory therapy teams have placed medication administration pumps and ventilator screen outside of patient rooms, which has decreased our PPE use by about 50% to 60%. This placement also allows for more efficient titration of medications and ventilator settings resulting in decreased sedative use and easier adjustment of ventilator support.

To further limit room traffic, we delegate one caregiver to perform a daily comprehensive physical examination with a dedicated single-use stethoscope that remains in the room. The results are documented and shared with all other care and consulting teams to limit entrance. They are repeated based on changes in patient's clinical condition.

Neurological assessment and skin examination are performed by bedside nurses every 2 to 4 hours with other bundled care. All other practices including daily routine lab draws and ancillary support such as physical therapy continue on an essential-only basis.

Family visitation is limited as an infection-control method, but the team has placed special emphasis on maintaining communication with patients and their supporting members. Updates are amended in various fashions based on the provider and patient's preference to be done outside of the rooms. This involved phone calls, videoconferencing, and in some instances communicating by writing on the glass ICU doors.

Be aware of information overload. Not a minute goes by without a new post, tweet, email, or letter

from caregivers at the frontlines with new disease manifestations or unproven therapies. At times, this generates an overwhelming amount of anxiety. We have created an educational team that is responsible for reviewing all available literature and developing an educational platform that serves our teams. This is done through an easily accessible, shared toolkit that allows our caregivers to rapidly find protocols and up-to-date educational resources (eg, webinars, simulations, checklists) especially with rapidly updated guideline. This resource becomes the source of truth for the institution, aligns caregivers, and decreases anxiety from misinformation.

■ SUMMARY

To deal with COVID-19, we have developed best practices for the ICU to maintain the highest quality patient care while ensuring the safety of all caregivers. This requires rapid, sweeping changes to the system. Success is based on creating an educational platform to introduce and then further cement these concepts through a unified approach to clinical care. Creating a culture change in a short period of time requires overcoming a host of challenges; however, the result is a more unified and focused approach.

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