This tool was developed to provide a pragmatic framework to assist with severity classification, diagnostic workup, disposition, and treatment of patients with suspected or confirmed SARS-CoV-2 (COVID-19) in the emergency department.

- It is designed to assist with the management of adult patients (≥18 years old) with symptomatic infection.
- For information on pediatric MIS-C protocols (CHOP, Minnesota, and Yale)
- This tool is not intended to represent a legal standard of care for emergency physicians. Recommendations offered in this tool are not intended to represent the only diagnostic or management options available to the emergency physician. Individual physicians’ judgment and consideration of patient resources/preferences is essential.
- This tool is not exhaustive in regards to diagnostic and treatment recommendations. Patients may present with particular conditions (MI, PE, stroke) that could be manifestations of severe or critical COVID-19. These conditions may require additional specific diagnostic and therapeutic interventions not discussed in this tool.
- Evidence on this topic (including differences in severity that may occur with evolving variants) is changing quickly and may alter recommendations.
- A digitized version of this tool can now be found at MDCalc.

### Step 1 - Severity Classification
Assess the patient’s severity of disease utilizing NIH criteria.

<table>
<thead>
<tr>
<th>MILD</th>
<th>MODERATE</th>
<th>SEVERE</th>
<th>CRITICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals who have various signs and symptoms of COVID-19 (ANY):</td>
<td>Individuals who show evidence of lower respiratory disease during (ANY):</td>
<td>Individuals who have (ANY):</td>
<td>Individuals with (ANY):</td>
</tr>
<tr>
<td>Fever</td>
<td>SpO2 &lt;94% on room air at sea level (in those with normal baseline SpO2 at rest)</td>
<td>SpO2 &lt;94% on room air at sea level (in those with normal baseline SpO2 at rest)</td>
<td>Respiratory failure</td>
</tr>
<tr>
<td>Cough</td>
<td>Clinical assessment</td>
<td>Clinical assessment</td>
<td>Septic shock</td>
</tr>
<tr>
<td>Sore throat</td>
<td>Imaging</td>
<td>Imaging</td>
<td>Multiorgan dysfunction or failure</td>
</tr>
<tr>
<td>Malaise</td>
<td>AND who have:</td>
<td>AND who have:</td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td>SpO2 ≤94% on room air at sea level (in those with normal baseline SpO2 at rest)</td>
<td>Ratio of arterial partial pressure of oxygen to fraction of inspired oxygen (PaO2/FiO2)</td>
<td></td>
</tr>
<tr>
<td>Muscle pain</td>
<td>SpO2 ≤94% on room air at sea level (in those with normal baseline SpO2 at rest)</td>
<td>&lt;300 mm Hg (if ABG obtained)</td>
<td></td>
</tr>
<tr>
<td>Nausea, vomiting, diarrhea</td>
<td>RR &gt; 30 breaths/min</td>
<td>RR &gt; 30 breaths/min</td>
<td></td>
</tr>
<tr>
<td>Loss of taste and smell</td>
<td>Lung infiltrates &gt;50%</td>
<td>Lung infiltrates &gt;50%</td>
<td></td>
</tr>
<tr>
<td>BUT who do NOT have (ANY):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shortness of breath</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyspnea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abnormal chest imaging (if obtained)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Consider Risk Prognostication and Assessment (see Page 3)

### Step 2 - Diagnostic Testing
The following imaging and lab tests should be considered based on your patients severity and risk for disease progression. Diagnosing acute SARS-CoV-2 infection solely on the basis of serologic test results is not recommended by NIH. [Antigen Testing Algorithm for Community Settings](#)

<table>
<thead>
<tr>
<th>MILD</th>
<th>MODERATE</th>
<th>SEVERE</th>
<th>CRITICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on clinician’s judgement, diagnostic testing may not be necessary in patients with (ALL):</td>
<td>Imaging: the optimal imaging technique has not yet been defined for people with symptomatic COVID-19. Initial evaluation for these patients may include:</td>
<td>Imaging: the optimal imaging technique has not yet been defined for people with symptomatic COVID-19. Initial evaluation for these patients may include:</td>
<td>Additional tests to consider include:</td>
</tr>
<tr>
<td>Mild Severity</td>
<td>Chest X-ray</td>
<td>Chest X-ray</td>
<td>ABG</td>
</tr>
<tr>
<td>PRIEST score ≤4 (See Page 3)</td>
<td>Pulmonary Ultrasound</td>
<td>Pulmonary Ultrasound</td>
<td>Coagulation screen - (d-dimer, PT/PTT, fibrin degradation products)</td>
</tr>
<tr>
<td>1 or less Risk Factors</td>
<td>CT Chest (if indicated)</td>
<td>CT Chest (if indicated)</td>
<td>Inflammatory markers - (procalcitonin / c-reactive protein)</td>
</tr>
<tr>
<td>Exertional SpO2 may have limited ability to identify adverse outcomes in otherwise well-appearing patients:</td>
<td>ECG: should be performed if indicated</td>
<td>ECG: should be performed if indicated</td>
<td>Ferritin</td>
</tr>
<tr>
<td>&lt;3% change in SpO2</td>
<td>ECG</td>
<td>ECG</td>
<td>LDH</td>
</tr>
<tr>
<td>Labs:</td>
<td>CBC w/ differential</td>
<td>CBC w/ differential</td>
<td>CK, CK-MB</td>
</tr>
<tr>
<td></td>
<td>CMP</td>
<td>CMP</td>
<td>Troponin</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Blood and sputum cultures</td>
</tr>
</tbody>
</table>

It is recommended to utilize ACEPT’s COVID-19 Field Guide section on [Laboratory Abnormalities](#) to review lab results.

### Step 3 - Disposition
The following represents a pragmatic approach for disposition of patients depending on their disease severity. Clinicians may want to consider a patient’s risk for progression of disease based on PRIEST Score / Risk Assessment (see Page 3), imaging, and labs in their disposition decision. See Steps 4 and 5 on the next page for treatment guidance.

<table>
<thead>
<tr>
<th>MILD</th>
<th>MODERATE</th>
<th>SEVERE</th>
<th>CRITICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge Home</td>
<td>Discharge Home, consider if ALL:</td>
<td>Discharge Home, consider if ALL:</td>
<td>Admission</td>
</tr>
<tr>
<td>Supply patient with educational materials on precautions and items to be monitoring at home</td>
<td>PRIEST Score ≥4</td>
<td>PRIEST Score ≥4</td>
<td>ICU</td>
</tr>
<tr>
<td>In patients with PRIEST Score ≥5 and/or multiple Risk Factors</td>
<td>1 (or less) Risk Factors</td>
<td>1 (or less) Risk Factors</td>
<td>Transfer</td>
</tr>
<tr>
<td>Clinicians should consider early follow-up with primary care physician or other health system access points.</td>
<td>No concerning Imaging or Lab results</td>
<td>No concerning Imaging or Lab results</td>
<td>Consider transfer if your facility does not have the resources or capacity to care for a critically ill COVID patient that could deteriorate.</td>
</tr>
<tr>
<td>Patient should be educated on their increased risk for severe disease and precautions to return to the ED.</td>
<td>Capability and resources to care for self at home</td>
<td>Capability and resources to care for self at home</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No other condition that warrants admission</td>
<td>No other condition that warrants admission</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Admission, consider if ANY:</td>
<td>Admission, consider if ANY:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PRIEST Score ≥5</td>
<td>PRIEST Score ≥5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multiple Risk Factors</td>
<td>Multiple Risk Factors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Concerning Imaging or Lab results</td>
<td>Concerning Imaging or Lab results</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Does NOT have the capability or resources to care for self at home</td>
<td>Does NOT have the capability or resources to care for self at home</td>
<td></td>
</tr>
<tr>
<td>Admission Location:</td>
<td>Based on clinician’s judgement</td>
<td>Based on clinician’s judgement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observation</td>
<td>Observation</td>
<td>ICU</td>
</tr>
<tr>
<td></td>
<td>Inpatient Floor</td>
<td>Inpatient Floor</td>
<td>Transfer</td>
</tr>
<tr>
<td></td>
<td>Intermediate</td>
<td>Intermediate</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[CDC Patient Educational Materials](#) • [SAEM Patient Toolkit](#)
Emergency Department COVID-19 Management Tool

Step 4 - Non-Pharmacologic Treatment
The following treatments should be considered based on your patient’s severity and risk of disease progression.

<table>
<thead>
<tr>
<th>MILD</th>
<th>MODERATE</th>
<th>SEVERE</th>
<th>CRITICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Consider home oxygen therapy (for those who may benefit)</td>
<td>- Oxygen support-nasal cannula, titrate up to 6L with an oxygen goal of &gt;92%</td>
<td>- Intubation is recommended for severe respiratory failure:</td>
<td></td>
</tr>
<tr>
<td>- Monitor home O2 saturation with portable monitor</td>
<td>- High-Flow Nasal Cannula (HFNC) or high-velocity therapy (titrated up to a flow of 60L and FiO2 up to 100%) are recommended over NIPPV (AI)</td>
<td>- Oxygenation goal for ventilated patients should be 92-96%:</td>
<td></td>
</tr>
<tr>
<td>- Progressive ambulation as tolerated (if no contraindication)</td>
<td>- Consider trial of awake prone positioning if patient can be monitored or can self-rescue.</td>
<td>- Consider using a conservative fluid strategy over a liberal fluid strategy (BII).</td>
<td></td>
</tr>
<tr>
<td>- Resting in the prone position if dyspneic</td>
<td>- Non-Invasive Positive Pressure Ventilation (NIPPV) if HFNC not available</td>
<td>For mechanically ventilated adults with refractory hypoxemia despite optimized ventilation, consider prone ventilation for 12 to 16 hours per day over no prone ventilation.</td>
<td></td>
</tr>
<tr>
<td>- Adequate rest/sleep</td>
<td>- Consider trial of awake prone positioning if patient can be monitored or can self-rescue.</td>
<td>- For mechanically ventilated adults with refractory hypoxemia despite optimized ventilation, consider prone ventilation for 12 to 16 hours per day over no prone ventilation.</td>
<td></td>
</tr>
<tr>
<td>- Balanced diet</td>
<td>- Insufficient data recommend for or against use of Nitric Oxide.</td>
<td>- Anti-interleukin-6 receptor monoclonal antibodies (except tocilizumab)</td>
<td></td>
</tr>
<tr>
<td>- Adequate hydration</td>
<td>- Recommend against routine use of Heliox; may be considered in croup-like pediatric presentations.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COVID-19 vaccination is recommended for everyone 6 months of age and older, regardless of a history of symptomatic or asymptomatic SARS-CoV-2 infection.
- People who recently had SARS-CoV-2 infection may consider delaying their next COVID-19 vaccination dose by 3 months from symptom onset or positive test (if infection was asymptomatic).
- Additional information HERE and Vaccination FAQs.

Step 5 - Pharmacologic Treatment
The following medications should be considered for treatment based on the patient’s severity and risk of disease progression.

Pharmacologic recommendations for patients with COVID-19 continue to evolve.
- For the latest updates and details visit the NIH or IDSA Guidelines.
- For the latest information on local availability of therapies for COVID, check your State Health Department.
- For tips and tricks on how to talk with patients about COVID treatment options see the SAEM Provider Toolkit.

DISCHARGED FROM EMERGENCY DEPARTMENT

- All patients should be offered symptom management (AII).
- Based upon the emergence of the Omicron Variant of Concern (VOC), and its subvariants, the following are the current recommendations for treatment of patients with a HIGH RISK of disease progression.
- Preferred Therapies: Use 1 of the following (listed in order of preference).
  1. Nirmatrelvir 300 mg with ritonavir 100 mg (Paclitaxel) orally twice daily for 5 days, initiated as soon as possible and within 5 days of symptom onset in those aged ≥12 years and weighing ≥40 kg (AII). See Caution note, below and in the Footnote Section before prescribing.
  2. Remdesivir 200 mg IV on Day 1, followed by remdesivir 100 mg IV daily on Days 2 and 3, initiated as soon as possible and within 7 days of symptom onset in those aged ≥12 years and weighing ≥40 kg (BIIa). (off label use)
- Alternative therapy - For use when neither of the preferred therapies are available, feasible, or can be clinically appropriate:
  - Molnupiravir 800 mg orally twice daily for 5 days, initiated as soon as possible and within 5 days of symptom onset in those aged ≥12 years and weighing ≥40 kg (BIIa) (off label use)
- Bevteflowalmp: no longer authorized by the FDA (See Footnote Section)

Providers should have CAUTION when prescribing Paclitaxel due to the ritonavir component, which has significant and complex drug-drug interactions. Please see the Footnotes section for links to more information on these.
- See the Footnotes page for links to the EUA FDA fact sheets for these drugs

ADMITTED TO HOSPITAL

- Hospitalized for reasons other than COVID-19, but with COVID-19:
  - See left column “Discharged from ED” for treatment recommendations.
- Hospitalized but does not require supplemental O2:
  - Do not use dexamethasone (Ala) or other corticosteroids (AlII)
  - For patients at high risk of disease progression: Remdesivir (BII)
- Hospitalized and requires supplemental O2:
  - For pts only requiring minimal supplemental O2: Remdesivir (BIIa)
  - For most patients: Dexamethasone plus remdesivir (BIIa)
  - If remdesivir is not available: Dexamethasone (BIIa)
- For patients on dexamethasone with rapidly increasing oxygen needs and systemic inflammation: Add baricitinib or tocilizumab on top of these 3 options (BIIa)
- Hospitalized and requires O2 through bi-flow device or noninvasive ventilation:
  - For most patients: One of the following: Dexamethasone plus baricitinib (AI) or dexamethasone plus tocilizumab (BIIa)
  - If neither baricitinib/tofacitinib nor tocilizumab/sarilumab can be procured:
    - Dexamethasone (AI)
  - Optional: Add remdesivir to any 1 of the above selections (CIIa)
- Hospitalized and requires mechanical ventilation or ECMO:
  - Upon initiation of MV or ECMO, if not already initiated: One of the following: Dexamethasone plus baricitinib (BIIa) or dexamethasone plus tocilizumab (BIIa)
  - If neither baricitinib/tofacitinib nor tocilizumab/sarilumab can be procured:
    - Dexamethasone (AI)
    - Zinc supplementation (BIIa)
    - Additional details on these options can be found at the NIH Inpt Treatment Page

Steroids: Dexamethasone (or other corticosteroids) should NOT be initiated in these patients in the absence of another indication. (AlII)

Insufficient Evidence: At this time there is insufficient data to recommend either for or against the following medications for SARS-CoV-2 (COVID-19):
- Anti-interleukin-6 receptor monoclonal antibodies (except tocilizumab)
- Anti-IL-6 monoclonal antibody (silimubumab), except in a clinical trial (BII).
- Azithromycin alone (AI)
- Budesonide
- Chloroquine or hydroxychloroquine with or without azithromycin (Al)
- Colchicine (IIa-BIIa) (Off label use)
- Famotidine

DO NOT USE - The following are recommended AGAINST for the treatment of SARS-CoV-2 (COVID-19) at the time of publication of this tool:
- Interferons: None in non-hospitalized patients (Ala); in hospitalized: do not use beta (AI), alpha (AlIIa), or lambda (AlIIa)
- Ivermectin
- Lopinavir/ritonavir (AI) or other HIV protease inhibitors (AlIIa) except in a clinical trial
- Meflozin
- Nitazoxanide (BIIa)
- Zinc supplementation above the recommended daily dietary allowance for the prevention of COVID-19, except in a clinical trial (BII)

Anticoagulation: Unless contraindicated, anticoagulation is recommended for admitted COVID-19 patients. The recommendations and evidence for therapeutic vs. prophylactic anticoagulation are rapidly evolving. The latest information can be found at the NIH Anticoagulation Page
Supplement - Risk Prognostication and Assessment

Providers may choose to additionally utilize a risk prognostication tool and/or assess patients risk factors for complicated illness. The COVID PRECISE Consortium living systematic review of COVID prognostic scores identifies the highest quality prognostic models as:

- The PRIEST model to predict whether patients with COVID-19 will have an adverse outcome, such as death. This model can be used to triage patients with COVID-19 that go to the ED.
- The 4C Mortality Score for COVID-19, the Carr model, and the Xie model, to predict whether patients hospitalized with COVID-19 will have an adverse outcome, such as death, critical care or ventilatory support.
- These models could guide physicians to make the best possible decisions for individual patients regarding, for example, intensive care support.

Optional - Risk Prognostication

Patients with MILD and MODERATE Severity should be further assessed to determine their risk of disease progression. The PRIEST Score is a validated tool to predict a patient's risk for end organ failure and/or mortality using readily available data on initial presentation to the ED. The ACEP working group recognizes that there are other risk prognostication calculators that have been published. The PRIEST Score is included here as it offers a pragmatic approach with variables that don’t require diagnostic testing and don’t overlap with medical conditions that are within the separate risk assessment section.

Optional - Risk Assessment

The CDC notes that patient race/ethnicity, socioeconomic status, and healthcare resources may affect clinical outcomes and advise consideration in clinical risk assessment.

The CDC maintains a list of underlying medical conditions associated with higher risk of severe COVID-19. If your patient has one (or especially multiple) risk factors, you may want to consider in the approach taken in subsequent steps for diagnostic testing, disposition, and treatment.
Step 5 - Pharmacologic Treatment

**Medications** - recommendations are maintained by the NIH and USPSTF.

Recommendations for the treatment of patients discharged home, but who have a HIGH risk for disease progression is evolving quickly due to the Omicron Variant of Concern (VOC).

- Guidance can be found on the NIH Outpatient Treatment Page  
  - Paxlovid EUA Fact Sheet: [www.fda.gov/media/155050/download](www.fda.gov/media/155050/download)
  - Molnupiravir EUA Fact Sheet: [www.fda.gov/media/155054/download](www.fda.gov/media/155054/download)

The SAEM Provider Toolkit offers tips and tricks on how to communicate with patients about COVID treatment options.


### CAUTION with prescribing Paxlovid

- Ritonavir-boosted nirmatrelvir (Paxlovid) has significant and complex drug-drug interactions, primarily due to the ritonavir component of the combination. Before prescribing, clinicians should carefully review the patient’s concomitant medications, including over-the-counter medications and herbal supplements, to evaluate potential drug-drug interactions.

- Clinicians who are not experienced in prescribing ritonavir-boosted drugs should refer to resources such as the NIH Paxlovid Drug-Drug Interactions page, the Ontario COVID-19 Science Advisory Table, the EUA fact sheet for ritonavir-boosted nirmatrelvir (Paxlovid) or the Liverpool COVID-19 Drug Interactions website for additional guidance.

- Consultation with an expert (e.g., clinical pharmacist, HIV specialist, and/or the patient’s specialist provider[s], if applicable) should also be considered.

- Molnupiravir is not recommended for pregnant females unless there are no other options and therapy is clearly indicated (AII). Feeding breastmilk should be avoided during molnupiravir use and for 4 days after the last dose of the drug (AII).

- For patients with a eGFR of 30-60 ml/min, the FDA recommends nirmatrelvir 150 mg (one 150-mg tablet) with ritonavir 100 mg (one 100-mg tablet) twice daily for 5 days

### Optional - Risk Stratification

- The PRIEST Score is a validated tool to predict a patient’s risk for end organ failure and/or mortality.

- The PRIEST Score can be accessed on MDCalc.

- See notes about pulse oximetry within Section 4 footnotes.

- 4C Mortality Score for COVID-19 is available on MDCalc.

- The Carr model(36) and the Xie model (37) have also been validated for risk stratification of COVID-19 patients.

### Optional - Risk Assessment

The CDC maintains a reference for medical conditions associated with high risk for severe COVID-19.

- Race/Ethnicity and access to healthcare: the CDC has more information on how race, ethnicity, and access to health care resources may affect outcomes.

- Economic Disparity: has been shown to be an independent variable of risk.

- Pregnancy: has been shown to have increased hospitalization (OR 3.5).

- Severe cases have been shown to have pre-term labor 45.4% compared to 6.9% of mild and recovered cases.

### NIH Rating of Recommendations

- A = Strong
- B = Moderate
- C = Weak

### Rating of Evidence

- I = One or more randomized trials without major limitations
- IIa = Other randomized trials or subgroup analyses of randomized trials
- IIb = Nonrandomized trials or observational cohort studies
- III = expert opinion

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**FOOTNOTES**

### Step 1 - Severity Classification

- All severity classifications are outlined by the NIH. The NIH COVID-19 Treatment Guidelines Panel is a multi-disciplinary team of experts that meets routinely to discuss the impact of new evidence on best practices in addition to providing a standardized system for classifying clinical severity.

### Step 2 - Diagnostic Testing

- **Exertional SpO2:** post-exertional SpO2 may provide modest prognostic information of adverse outcome at 30 days 1,12,21

- **Optimal time interval is not established.**

- **Some have suggested 1-2 minutes and a sit-stand option in the patient’s room (due to COVID restrictions).**

- **A 3% drop has been used in several studies.**

- **Another study used a quick walk test of 6 minutes. Decrease in ≤3% or ≥5% (conservative cutoff or postexercise ≤90% suggest poor outcome (need for mechanical ventilation) with LR+ = 3.5 and LR- = 0.22.**

- **Diagnostic Testing:** A validated tool to predict a patient’s risk for end organ failure and/or adverse outcome at 30 days.

### Step 3 - Disposition

Discharge of select COVID patients with Home Oxygen has been shown to be associated with low rates of mortality and return admission.

- The CDC maintains Patient Educational Materials.

- SAEM Patient Toolkit has materials for patients to understand more about COVID.

**Helpful links from JAMA include:**

- What does this mean for families?
  - [https://jamanetwork.com/journals/jamapediatrics/fullarticle/2763176](https://jamanetwork.com/journals/jamapediatrics/fullarticle/2763176)

- Masks
  - [https://jamanetwork.com/journals/jama/fullarticle/2764955](https://jamanetwork.com/journals/jama/fullarticle/2764955)

- Stepping the spread
  - [https://jamanetwork.com/journals/jama/fullarticle/2763533](https://jamanetwork.com/journals/jama/fullarticle/2763533)

- What is herd immunity?
  - [https://jamanetwork.com/journals/jama/fullarticle/2772168](https://jamanetwork.com/journals/jama/fullarticle/2772168)

### Step 4 - Non-Pharmacologic Treatment

**Home Supplemental O2**

Discharge of select COVID patients with Home Oxygen has been shown to be associated with low rates of mortality and return admission.

**Studies in COVID and other viral illnesses** have shown the benefit of:

- Rest
- Healthy diet
- Adequate sleep
- Exercise

**Issues with SpO2 measurements**

- If sending patients home with instructions for pulse oximetry, be mindful that SpO2 readings should always be considered an estimate of oxygen saturation. The FDA has just issued precautions on SpO2 devices.

- Although pulse oximetry is useful for estimating blood oxygen levels, pulse oximeters may not accurately detect hypoxemia under certain circumstances. Pulse oximetry results can be affected by skin pigmentation, thickness, or temperature. In fact, an SpO2 reading of 90% may represent a range of SaO2 from 86% to 94%. Clinicians should keep this limitation in mind when making patient decisions.

**Vaccination**

- Additional information on current vaccinations recommendations, can be found HERE and [Vaccination FAQ](https://www.cdc.gov/vaccines/facts/faq.html)

- SMART Phrases from ACEP for patients can be found HERE

**Treatment of Severe and Critical patients**

- Recommendations for respiratory support, IV fluids, and other interventions are maintained by the NIH.
CITATIONS


2. Citation Removed


CITATIONS (continued)


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