COVID-19 with hypoxia

**Indication for endotracheal intubation?**
- Yes: Endotracheal intubation
- No: Tolerating supplemental oxygen?
  - Yes: Not tolerating HFNC or HFNC is not available
    - Yes: Indication for endotracheal intubation?
    - No: Consider: a trial of NIPPV
    - Do IT: Monitor closely short intervals
    - Do Not: Delay intubation if worsening
  - No: Tolerating HFNC
    - Do IT: Expert in airway to intubate
    - Do IT: Use N-95/FFP-2 or equivalent and other PPE/infection control precautions
    - Do IT: Minimize staff in the room
    - Consider: Video-laryngoscope

**Tolerating supplemental oxygen?**
- Yes: Target SpO2 92% to 96%
- No: Delay intubation if worsening...

**Consider:** HFNC

**Do it:** Monitor closely for worsening

**Do it:** Appropriate infection control precautions

**Note:** N-95/FFP-2 are facial masks

HFNC = high-flow nasal cannula
NIPPV = noninvasive positive-pressure ventilation
PPE = personal protective equipment
SpO2 = peripheral capillary oxygen saturation
COVID-19 with mild ARDS

- **DO:**
  - Vt 4-8 ml/kg and Pplat <30 cm H₂O
  - Investigate for bacterial infection
  - Target SpO₂ 92% - 96%

- **CONSIDER:**
  - Conservative fluid strategy
  - Empiric antibiotics

COVID-19 with mod to severe ARDS

- **CONSIDER:**
  - Higher PEEP
    - PEEP should be tailored to individual response
  - NMBA boluses to facilitate ventilation targets
  - if PEEP responsive
    - Traditional recruitment maneuvers
  - Prone ventilation 12 -16 h

- **CONSIDER:**
  - if proning, high Pplat, asynchrony
    - NMBA infusion for 24 h
  - A trial of inhaled nitric oxide
    - STOP if no quick response
  - V-V ECMO or referral to ECMO center
    - follow local criteria for ECMO

Rescue/adjunctive therapy

- **CONSIDER:**
  - if proning, high Pplat, asynchrony
    - NMBA infusion for 24 h
  - Prone ventilation 12 -16 h

- **DON'T DO:**
  - Staircase recruitment maneuvers

Mod = moderate
ARDS = adult respiratory distress syndrome
Pplat = plateau pressure
SpO₂ = peripheral capillary oxygen saturation
PEEP = positive end-expiratory pressure
NMBA = neuromuscular blocking agents
ECMO = extracorporeal membrane oxygenation

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**COVID-19 Resources**

**Summary of recommendations of the COVID-19 guidelines therapeutic update**

**Severe COVID-19**

- **DO:** Systemic corticosteroids
- **CONSIDER:** Dexamethasone over other corticosteroids
- **DO:** Pharmacologic VTE prophylaxis
- **CONSIDER** avoiding: Remdesivir
- **CONSIDER** avoiding: Convalescent plasma outside of clinical trials
- **CONSIDER** avoiding: Full anticoagulation in patients without VTE outside of clinical trials

**Critical COVID-19**

- **DON'T DO:** Hydroxychloroquine
- **UNCERTAIN:** Awake proning

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### Surviving Sepsis Campaign Guidelines on the Management of Adults with Coronavirus Disease 2019 (COVID-19) in the ICU

**Recommendation Chart: Include First Updates**

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
</table>
| Severe   | Clinical signs of pneumonia (fever, cough, dyspnea, fast breathing) and one of the following:  
- Respiratory rate > 30 breaths/minute;  
- Severe respiratory distress; or  
- $\text{SpO}_2 < 90\%$ on room air |
| Critical | Presence of ARDS or respiratory failure requiring ventilation, sepsis or septic shock |

$\text{SpO}_2 = \text{oxygen saturation}$

### RECOMMENDATION

#### Infection Control and Testing

- **For healthcare professionals performing aerosol-generating procedures** on patients with COVID-19 in the ICU, we recommend using fitted respirator masks (N95 respirators, FFP2, or equivalent) as opposed to surgical/medical masks, in addition to other PPE (e.g., gloves, gown, and eye protection, such as a face shield or safety goggles)  
  - Best practice statement

- **We recommend performing aerosol-generating procedures** on ICU patients with COVID-19 in a negative-pressure room.  
  - Best practice statement

- **For COVID-19 patients requiring endotracheal intubation**, we recommend that endotracheal intubation be performed by the healthcare professional who is most experienced with airway management to minimize the number of attempts and risk of transmission.  
  - Best practice statement

- **For healthcare professionals providing usual care for nonventilated COVID-19 patients**, we suggest using surgical/medical masks as opposed to respirator masks, in addition to other PPE (e.g., gloves, gown, and eye protection, such as a face shield or safety goggles)  
  - Weak
• For healthcare professionals performing **non-aerosol-generating procedures on mechanically ventilated (closed circuit) patients** with COVID-19, we suggest using surgical/medical masks as opposed to respirator masks, in addition to other PPE (e.g., gloves, gown, and eye protection, such as a face shield or safety goggles).

| Weak |

• For healthcare professionals performing **endotracheal intubation on patients with COVID-19**, we suggest using video-guided laryngoscopy over direct laryngoscopy, if available.

| Weak |

• For intubated and mechanically ventilated adults with suspicion of COVID-19: For **diagnostic testing**, we suggest obtaining lower respiratory tract samples in preference to upper respiratory tract (nasopharyngeal or oropharyngeal) samples.

| Weak |

• For intubated and mechanically ventilated adults with suspicion of COVID-19: With regard to **lower respiratory samples**, we suggest obtaining endotracheal aspirates in preference to bronchial wash or bronchoalveolar lavage samples.

| Weak |

### HEMODYNAMICS

• For adults with COVID-19 and shock, we recommend against using dopamine if norepinephrine is available.

| Strong |

• For the acute resuscitation of adults with COVID-19 and shock, we recommend against using hydroxyethyl starches.

| Strong |

• In adults with COVID-19 and shock, we suggest using dynamic parameters of skin temperature, capillary refill time, and/or serum lactate measurement over static parameters to assess fluid responsiveness.

| Weak |

• For the acute resuscitation of adults with COVID-19 and shock, we suggest using a conservative over a liberal fluid strategy.

| Weak |

• For the acute resuscitation of adults with COVID-19 and shock, we recommend using crystalloids over colloids.

| Weak |

• For the acute resuscitation of adults with COVID-19 and shock, we suggest using buffered/balanced crystalloids over unbalanced crystalloids.

| Weak |

• For the acute resuscitation of adults with COVID-19 and shock, we suggest against using gelatins.

| Weak |

• For the acute resuscitation of adults with COVID-19 and shock, we suggest against using dextran.

| Weak |

• For the acute resuscitation of adults with COVID-19 and shock, we suggest against the routine use of albumin for initial resuscitation.

| Weak |

• For adults with COVID-19 and shock, we suggest using norepinephrine as the first-line vasoactive agent over other agents.

| Weak |

• For adults with COVID-19 and shock, if norepinephrine is not available, we suggest using either vasopressin or epinephrine as the first-line vasoactive agent over other vasoactive agents.

| Weak |
• For adults with COVID-19 and shock, we suggest adding vasopressin as a second-line agent over titrating norepinephrine dose, if target MAP cannot be achieved by norepinephrine alone.  

Weak

• For adults with COVID-19 and shock, we suggest titrating vasoactive agents to target a MAP of 60-65 mm Hg rather than higher MAP targets.  

Weak

• For adults with COVID-19 and shock with evidence of cardiac dysfunction and persistent hypoperfusion despite fluid resuscitation and norepinephrine, we suggest adding dobutamine over increasing norepinephrine dose.  

Weak

<table>
<thead>
<tr>
<th>VENTILATION</th>
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</thead>
<tbody>
<tr>
<td>• In adults with COVID-19, we suggest starting supplemental oxygen if the peripheral SpO₂ is &lt; 92%, and recommend starting supplemental oxygen if SpO₂ is &lt; 90%.</td>
</tr>
<tr>
<td>• In adults with COVID-19 and acute hypoxemic respiratory failure on oxygen, we recommend that SpO₂ be maintained no higher than 96%.</td>
</tr>
<tr>
<td>• If recruitment maneuvers are used, we recommend against using staircase (incremental PEEP) recruitment maneuvers.</td>
</tr>
<tr>
<td>• In mechanically ventilated adults with COVID-19 and ARDS, we recommend using low Vt ventilation (Vt 4-8 mL/kg of predicted body weight) over higher tidal volumes (Vt &gt; 8 mL/kg).</td>
</tr>
<tr>
<td>• For mechanically ventilated adults with COVID-19 and ARDS, we recommend targeting Pplat of &lt; 30 cm H₂O.</td>
</tr>
</tbody>
</table>
| • For mechanically ventilated adults with COVID-19 and moderate to severe ARDS, we suggest using a higher PEEP strategy over a lower PEEP strategy.  
  Remark: If using a higher PEEP strategy (i.e., PEEP > 10 cm H₂O), clinicians should monitor patients for barotrauma. | Strong |
| • In adults with COVID-19 receiving NIPPV or HFNC, we recommend close monitoring for worsening of respiratory status and early intubation in a controlled setting if worsening occurs. | Best practice statement |
| • For adults with COVID-19 and acute hypoxemic respiratory failure despite conventional oxygen therapy, we suggest using HFNC over conventional oxygen therapy. | Weak |
| • In adults with COVID-19 and acute hypoxemic respiratory failure, we suggest using HFNC over NIPPV. | Weak |
| • In adults with COVID-19 and acute hypoxemic respiratory failure, if HFNC is not available and there is no urgent indication for endotracheal intubation, we suggest a trial of NIPPV with close monitoring and short-interval assessment for worsening of respiratory failure. | Weak |
- For mechanically ventilated adults with COVID-19 and ARDS, we suggest using a conservative fluid strategy over a liberal fluid strategy.

  | Weak |

- For mechanically ventilated adults with COVID-19 and moderate to severe ARDS, we suggest prone ventilation for 12 to 16 hours over no prone ventilation.

  | Weak |

- For mechanically ventilated adults with COVID-19 and moderate to severe ARDS: We suggest using as-needed intermittent boluses of NMBAs over continuous NMBA infusion to facilitate protective lung ventilation.

  | Weak |

- In the event of persistent ventilator dyssynchrony or the need for ongoing deep sedation, prone ventilation, or persistently high plateau pressures, we suggest using a continuous NMBA infusion for up to 48 hours.

  | Weak |

- In mechanically ventilated adults with COVID-19 ARDS, we recommend against the routine use of inhaled nitric oxide.

  | Weak |

- In mechanically ventilated adults with COVID-19, severe ARDS, and hypoxemia despite optimizing ventilation and other rescue strategies, we suggest a trial of inhaled pulmonary vasodilator as a rescue therapy. If no rapid improvement in oxygenation is observed, the treatment should be tapered off.

  | Weak |

- For mechanically ventilated adults with COVID-19 and hypoxemia despite optimizing ventilation, we suggest using recruitment maneuvers over not using recruitment maneuvers.

  | Weak |

- In mechanically ventilated adults with COVID-19 and refractory hypoxemia despite optimizing ventilation, use of rescue therapies, and proning, we suggest using VV ECMO, if available, or referring the patient to an ECMO center.

  **Remark:** Because of the resource-intensive nature of ECMO and the need for experienced centers, healthcare professionals, and infrastructure, ECMO should be considered only for carefully selected patients with COVID-19 and severe ARDS.

  | Weak |

- We were not able to make a recommendation regarding the use of helmet NIPPV compared with mask NIPPV. It is an option, but we are not certain about its safety or efficacy in COVID-19.

  | No recommendation |

- There is insufficient evidence to issue a recommendation on the use of awake prone positioning in nonintubated adults with severe COVID-19.

<p>| No recommendation | New |</p>
<table>
<thead>
<tr>
<th>Therapy Recommendations</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strong New</strong></td>
<td></td>
</tr>
<tr>
<td>For adults with severe or critical COVID-19, we recommend against using hydroxychloroquine.</td>
<td></td>
</tr>
<tr>
<td>For adults with severe or critical COVID-19, we recommend using a short course of systemic corticosteroids over not using corticosteroids.</td>
<td></td>
</tr>
<tr>
<td>For adults with severe or critical COVID-19, we recommend using pharmacologic VTE prophylaxis over not using prophylaxis.</td>
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</tr>
</tbody>
</table>
| For adults with severe or critical COVID-19 who are considered for systemic corticosteroids, we suggest using dexamethasone over other corticosteroids.  
*Remark:* If dexamethasone is not available, clinicians may use other corticosteroids in doses equivalent to 6 mg daily of dexamethasone for up to 10 days. | Weak New |
| For adults with severe COVID-19 who do not require mechanical ventilation, we suggest using IV remdesivir over not using it.  
*Remark:* Remdesivir should ideally be started within 72 hours of positive SARS-CoV-2 polymerase chain reaction or antigen testing. | Weak New |
| For adults undergoing mechanical ventilation for critical COVID-19, we suggest against starting IV remdesivir. | Weak New |
| For critically ill adults with COVID-19 who develop fever, we suggest using acetaminophen/paracetamol for temperature control over no treatment. | Weak |
| In critically ill adults with COVID-19, we suggest against the routine use of standard IV IVIG. | Weak |
| For adults with severe or critical COVID-19, we suggest against the use convalescent plasma outside clinical trials. | Weak New |
| There is insufficient evidence to issue a recommendation on the routine use of therapeutic anticoagulation (compared to VTE prophylaxis) for adults with severe or critical COVID-19 and no confirmed VTE. | No recommendation New |

PPE=personal protective equipment, MAP=mean arterial pressure, SpO₂=oxygen saturation, HFNC=high-flow nasal canula, NIPPV=noninvasive positive pressure ventilation, ARDS=acute respiratory distress syndrome, Vt=tidal volume, Pplat=plateau pressure, PEEP=positive end-expiratory pressure, NMBA=neuromuscular blocking agent, VV=venovenous, ECMO=extracorporeal membrane oxygenation, IVIG=immunoglobulin.