



**Society for Maternal-Fetal Medicine
Management Considerations for Pregnant Patients With COVID-19
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The National Institutes of Health have published treatment guidelines for COVID-19. These guidelines can be found [here](#).

The COVID-19 pandemic has placed extreme stress on the national health care system. As the epidemiology of COVID-19 evolves, obstetrical care providers must manage pregnant patients with COVID-19 in the setting of little to no experience or rigorous data from which to develop protocols and guidance.

The recommendations provided here are not proscriptive and may not apply in your clinical setting. They are intended to introduce concepts to be considered in each setting and give examples of current practices from some centers that have seen a relatively higher volume of cases. These recommendations should be considered in the overall clinical context for each patient and center. This guidance will be updated as additional data and information emerge.

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1. Identification of Mild, Moderate, and Severe Symptoms of COVID-19

The severity scale for COVID-19 is as follows (the decision for management may be different in the pregnant patient with COVID-19, especially regarding oxygen saturation; see [Inpatient and Outpatient Care of Pregnant Patients With COVID-19](#)):

- Asymptomatic or presymptomatic disease or presumptive infection is defined as a positive COVID-19 test result with no symptoms.
- Mild disease is defined as flu-like symptoms, such as fever, cough, myalgias, and anosmia without dyspnea, shortness of breath, or abnormal chest imaging.
- Moderate disease is defined by evidence of lower respiratory tract disease with clinical assessment (dyspnea, pneumonia on imaging, abnormal blood gas results, refractory fever of 39.0 °C /102.2 °F or greater not alleviated with acetaminophen) while maintaining an oxygen saturation of greater than **or equal to 94%** on room air at sea level.
- Severe disease is defined by a respiratory rate greater than 30 breaths per minute (bpm), hypoxia with oxygen saturation **less than 94%**, a ratio of arterial partial pressure of oxygen to fraction of inspired oxygen of less than 300, or greater than 50% lung involvement on imaging.
- Critical disease is defined as multi-organ failure or dysfunction, shock, or respiratory failure requiring mechanical ventilation or high-flow nasal cannula.
- Refractory hypoxemia is defined as persistent, inadequate oxygenation and/or ventilation despite substantial and appropriate measures to optimize it and represents a further escalation of severity on the spectrum of disease.

2. Inpatient and Outpatient Care of Pregnant Patients With COVID-19

-Criteria for inpatient vs outpatient management

Many COVID-19 patients, including pregnant patients, have mild or no symptoms.

Outpatient monitoring with a 14-day self-quarantine can be considered for pregnant patients with COVID-19 who have mild symptoms or are asymptomatic. Clinical judgment, test availability, community spread, and other local policies should be used to decide which patients are tested for SARS-CoV-2. Signs and symptoms of COVID-19 range from mild to severe and include fever, myalgias, cough, and difficulty breathing as well as gastrointestinal symptoms and anosmia in some patients. According to the CDC, epidemiologic factors, such as the prevalence of SARS-CoV-2 in the local community, may also be used to guide testing. The CDC also recommends that depending on case burden and available resources, anyone with a close exposure should be tested immediately after exposure, and if negative, could be tested again about 5-7 days after last exposure or immediately if symptoms develop during quarantine. See [CDC for further testing guidelines](#). Recommendations for outpatient monitoring are outlined below.

- It is recommended that COVID-19 positive patients wear masks at all times and remain isolated, whether outpatient or inpatient, until convalesced, unless not feasible due to clinical care needs.
- Inpatient monitoring may be needed for the following categories of patients:
 - Pregnant COVID-19 patients with moderate to severe signs and symptoms or oxygen saturation less than 95%.
 - Pregnant COVID-19 patients with comorbid conditions, eg, uncontrolled hypertension, inadequately controlled gestational or pregestational diabetes, chronic renal disease, chronic cardiopulmonary disease, or immunosuppressive states (intrinsic or medication-related)
 - Pregnant COVID-19 patients with fevers greater than 39 °C despite acetaminophen, raising concern for secondary hemophagocytic lymphohistiocytosis (sHLH) or "cytokine storm syndrome." sHLH is a fulminant and often fatal hypercytokinemia associated with multi-organ failure. The disease is defined by unremitting fever, cytopenia, and high ferritin levels. If a patient has an Hscore (see Table 1) indicating a high probability for sHLH, inpatient

observation is warranted.¹ The Hscore has not been validated in pregnancy. If there is concern for sHLH in a pregnant patient, testing should be performed and interpreted by experienced providers (eg, intensivist, infectious disease expert).

Table 1. Hscore for Secondary Hemophagocytic Lymphohistiocytosis (sHLH)^{a,1}

Parameters	Score
Temperature	
<38.4 °C	0
38.4-39.4 °C	33
≥39.5 °C	49
Organomegaly	
None	0
Hepatomegaly or splenomegaly	23
Hepatomegaly and splenomegaly	38
Number of cytopenias^b	
1 lineage	0
2 lineages	24
3 lineages	34
Triglycerides	
<133 mg/dL	0
133–354 mg/dL	44
>354 mg/dL	64
Fibrinogen	
>250 mg/dL	0
≤250 mg/dL	30
Ferritin	
<2000 ng/mL	0
2000–6000 ng/mL	35
>6000 ng/mL	50
Serum aspartate aminotransferase	
<30 IU/L	0
≥30 IU/L	19
Hemophagocytosis on bone marrow aspirate	
No	0
Yes	35
Known immunosuppression	
No	0
Yes	18

^aThe Hscore generates a probability for the presence of sHLH. Scores greater than 169 are 93% sensitive and 86% specific for sHLH. This scoring system has not been validated in the pregnant population.

^bDefined as hemoglobin ≤9.2 g/dL and/or leukocyte count of ≤5000/mm³, and/or platelet count of ≤110,000/mm³.

-Protocols for outpatient care

- Pregnant outpatients with COVID-19 should be monitored closely by their obstetrical care providers for worsening symptoms. Patients should perform daily self-assessments and should be given specific instructions about when to contact their health care providers outside of regularly scheduled visits. If a pulse oximeter is available, it may help in outpatient management. Telehealth is a reasonable option as it limits exposure to other patients and health care workers and may be more convenient for patients and those caring for patients with COVID-19. If an obstetrical care provider recommends outpatient management, they should ensure that the institution has a reliable feedback mechanism for early detection of a worsening condition.
- Reasons to call a health care provider (or emergency medical services) for COVID-19 patients or caregivers for COVID-19 patients include the following:
 - Worsening shortness of breath
 - Tachypnea
 - Unremitting fever (greater than 39 °C) despite appropriate use of acetaminophen
 - Inability to tolerate oral hydration or needed medications
 - Oxygen saturation less than 95% either at rest or on exertion (if home pulse oximetry available)
 - Persistent pleuritic chest pain
 - New-onset confusion or lethargy
 - Cyanotic lips, face, or fingertips
 - Obstetrical complaints, such as preterm contractions, vaginal bleeding, or decreased fetal movement
- There is no guidance about the timing of frequency for follow-up outpatient care; however, it is reasonable to have a follow-up visit at least once within 2 weeks of diagnosis of COVID-19. These visits can either be through telemedicine or specialized COVID-19 clinics where available. Obstetrical care providers should remain involved in outpatient care to monitor for obstetrical complications and maternal and fetal well-being.

- Antenatal testing (nonstress tests, biophysical profiles) should be performed for the usual indications, with consideration of consolidating these tests as feasible, eg, a once-weekly full or modified biophysical profile instead of twice-weekly nonstress tests.
- Necessary and indicated medical care should not be avoided due to COVID-19 positive status. Outpatient practice accommodations should be developed to ensure continued indicated medical care. Efforts should be made to consolidate visits, eg, clinic and ultrasound on the same date and in the same location, as feasible, to mitigate risk to the patient, providers, and community.

-Oxygen saturation in pregnancy

- In general, the recommended oxygen saturation is 95% or greater in pregnancy. For nonpregnant patients with COVID-19, recommendations are to maintain an oxygen saturation of 92% or greater.² Obstetrical care providers should look for changes not only in measured oxygen saturation by pulse oximeter but also the supplemental oxygen requirements (face mask, high-flow nasal cannula, etc) needed to maintain appropriate levels and will need to consider targeting an oxygen saturation that is higher than would be used for a nonpregnant patient.
- Exertional oxygen saturation should also be assessed with a walking oxygen saturation test. Patients whose oxygen saturation is less than or equal to 95% on room air with exertion should be considered for inpatient admission.
- Obstetrical care providers should also follow trends in oxygen supplementation and work of breathing to maintain adequate oxygen saturation. Increases in work of breathing (respiratory rate greater than 30 bpm, use of accessory muscles, pursing of lips, and need for oxygen supplementation) could be a sign of worsening disease and signal a need for a higher level of support and care.
- Prior to discharge or downgrading of designated clinical severity, maternal oxygen saturation should be remeasured off oxygen and with ambulation or exertion.

-Protocols for inpatient care

- Frequency of vital sign assessment depends on the severity of illness and the corresponding level of nursing care required. For general ward patients with mild symptoms, vital signs including temperature, heart rate, respiratory rate, blood pressure, and pulse oximetry can be performed every 4 to 8 hours and as needed.

- For pregnant patients with severe disease, vital signs should be obtained every 2 to 4 hours. To reduce exposure to health care workers, continuous pulse oximetry and/or telemetry can be used to decrease patient contact and exposure risk.
- For patients with critical illness, continuous pulse oximetry and telemetry should be utilized. Noninvasive and invasive cardiovascular monitoring can be considered as indicated. Vital signs, including respiratory support as needed, should be recorded every 1 to 2 hours.
- Fetal and tocodynamometer monitoring should also be performed when fetal intervention, including delivery, would be considered based on gestational age, fetal and maternal status, and maternal preferences (see the section on delivery recommendations.)

3. Management of Severe Disease

-Early warning signs

Early warning signs include the following:

- An increased sensation of dyspnea and/or work of breathing
- Inability to maintain adequate oxygen saturation
- Persistent or more frequent fevers
- Worsening of myalgias

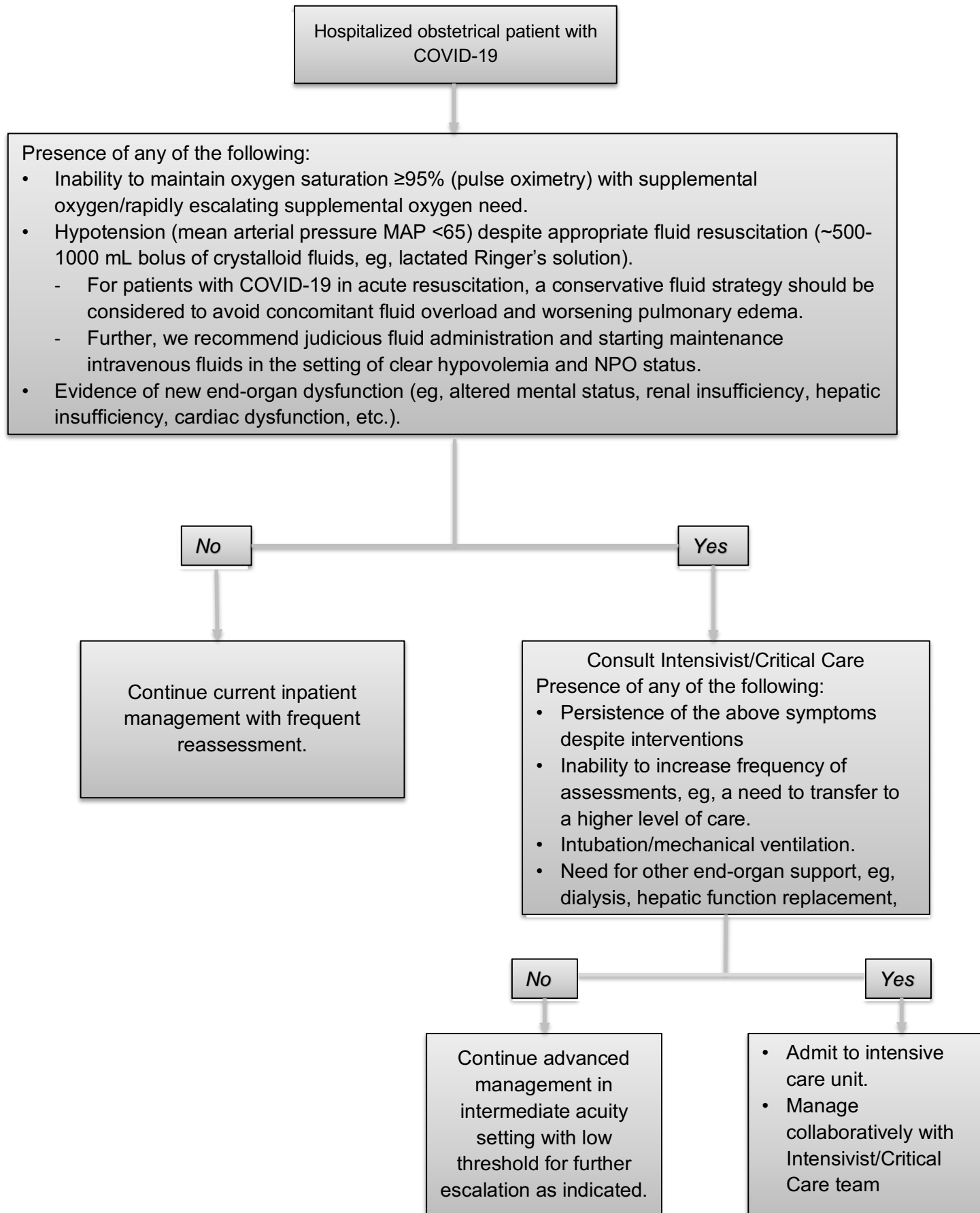
-Scoring systems

Scoring systems may be utilized to aid in the assessment of severe disease, such as modifications of the Sequential Organ Failure Assessment (SOFA) score,³ the "quick" qSOFA,⁴ and the modified Early Warning Signs score.⁵ However, data are limited or inconclusive on the effectiveness of early warning signs in pregnancy, and these scoring systems may not consistently reflect who will become the most critically ill with COVID-19. The Society for Maternal-Fetal Medicine has published [guidance](#) on the diagnosis and management of sepsis in pregnancy that discusses important considerations for the use of the SOFA and qSOFA scores in pregnancy.⁶

-Admission to intensive care

The following algorithm (Figure 1 on the next page) can be used when considering the admission of a COVID-19 patient to intensive care.

Figure 1. Algorithm for Intensive Care Unit Admission



-Timing of intubation

- Intubation timing should be individualized. Maternal status, preexisting comorbidities, presence of multi-organ failure, required oxygen supplementation, and need for transport to a facility with a higher level of care should be considered when placing a definitive airway.
- Typically, intubation is considered when oxygen requirements are as follows (consultation with Intensivist/Critical Care specialist or Anesthesiologist is recommended as these criteria are rapidly evolving):
 - Greater than 15 L per minute (by common nasal cannula or mask), or
 - Greater than 40 to 50 L per minute by high-flow nasal cannula, or
 - Greater than 60% fraction of inspired oxygen (FiO₂) by Venturi mask to maintain an oxygen saturation of 95% or greater by transcutaneous pulse oximeter.
- The inability of a patient to protect the airway due to altered mental status (Glasgow coma scale of less than 8) is a consideration for intubation as well.

-Alternatives to intubation for safe oxygen delivery

- Common nasal cannula (maximum of 15 L per minute deliverable)
- Face mask: "Non-rebreather" type; maximum dependent on source, typically up to 15 L per minute (LPN) from wall supply; may be increased to ~50 LPM with an additional source
- Venturi face mask: Supplies support via fraction of inspired oxygen (FiO₂); maximum of 60% oxygen delivery
- Use of noninvasive positive-pressure ventilation, eg, bilevel positive airway pressure (BiPAP) or continuous positive airway pressure (CPAP)

BiPAP and CPAP use are controversial due to the concern for aerosolizing infectious particles, although some institutions have employed these modalities in attempts to avoid intubation. We recommend adhering to common practice in each institution. Health care providers should follow hospital policy and guidance about wearing personal protective equipment when caring for these patients.

- Prone positioning

- Prone positioning is feasible in pregnant as well as postpartum patients, including the recently delivered. Padding and/or support devices (eg, pillows, padding from the operating room, etc) may need to be utilized to position the patient properly. The most important aspect of this maneuver is to ensure that the endotracheal tube remains in place throughout rotation and positioning and that it is secured afterward.
- "Passive prone positioning," in which the patient is not intubated and positions herself in either the lateral decubitus (typically for ~2 hours in each position) or fully prone position, may aid in patient comfort and theoretically help avoid intubation.

-Neuromuscular blockade (paralytics)

Neuromuscular blockade has shown a benefit in the management of moderate and severe ARDS, especially if instituted early (within 12 hours of intubation).⁷ Continuous or intermittent paralysis remains an option for moderate to severe ARDS. Thus, paralysis and deep sedation can be considered in COVID-19 with refractory hypoxemia. Timing and duration of paralysis should follow institutional protocols.

-Pulmonary vasodilators

In general, pulmonary vasodilators do not decrease ventilator-free days, ICU length of stay, or mortality. However, they can be useful in the setting of evolving refractory hypoxemia in the parturient patient. Although the improved oxygenation is transient, it may give practitioners the needed time to perform other interventions, such as transfer to a tertiary institution, use of other modes of rescue ventilator strategies, mechanical circulation, and/or delivery if after 32 weeks of gestation. Pulmonary vasodilators are not contraindicated during pregnancy, and use can be considered in the setting of maternal refractory hypoxemia. Fetal monitoring to determine delivery timing in viable neonates is not required but should be discussed with the multidisciplinary team.

Inhaled nitric oxide (NO)

Inhaled vasodilators are not standard therapy in ARDS management but are often considered salvage therapy in refractory hypoxemia. Inhaled nitric oxide (NO) and inhaled prostacyclins can dilate well-perfused ventilated lungs, thus allowing for decreased V/Q mismatch and pulmonary shunting in ARDS.⁸ They also decrease pulmonary vasodilation while avoiding systemic hypotension. Patients with ARDS treated with inhaled NO have shown acute increases in oxygenation; however, this response has not resulted in decreases in ventilator-free days and severe morbidity and

mortality.^{9, 10} Further, there is some concern for renal impairment and methemoglobinemia.¹¹ It is also interesting to note that the beneficial effects of inhaled NO are transient, with some studies showing waning effects after 48 to 96 hours.¹² The data on the effects of inhaled NO in pregnancy are limited; however, it has been used successfully in case series of pulmonary arterial hypertension and/or Eisenmenger syndrome.¹³⁻¹⁵ After pulmonary vasodilation, inhaled NO diffuses into the bloodstream and rapidly reacts with oxyhemoglobin to form methemoglobin; thus, methemoglobin levels should be assessed daily.¹⁶ Because it is instantly metabolized, inhaled NO is thought to avoid placental metabolism and is thus not contraindicated in pregnancy.

Inhaled prostacyclins

Like inhaled NO, inhaled prostacyclins are not routine therapy. Although they have been shown to improve oxygenation, inhaled prostacyclins have failed to show improvements in severe morbidity and mortality, and ventilator-free days.^{17, 18} Use of inhaled prostacyclins does not require special equipment; however, this advantage is offset by the frequent side effect of systemic hypotension, which occurs in 20% of patients. However, other adverse effects are infrequent, and it has a similar safety profile in pregnancy.

-Extracorporeal membrane oxygenation

- Extracorporeal membrane oxygenation (ECMO) is used to artificially perform the function of the lungs (venovenous; VV ECMO) or the heart as well as the lungs (venoarterial; VA ECMO) in patients with severe ARDS that is refractory to other measures (outlined above), with or without concomitant cardiac dysfunction.¹⁹
- ECMO cannulation requires placement of a large central venous or venous and arterial vascular access, and multi-site cannulation techniques and devices are available as indicated, such as VAVV ECMO. As these techniques have been employed for ARDS in general from many conditions, their application to ARDS in the setting of COVID-19 is reasonable and appropriate for patients who meet general indications (Box 1).
- ECMO cannulation requires significant skill, an abundance of resources, and a developed infrastructure that incorporates a multidisciplinary approach (eg. cardiac surgery, cardiology, critical care, anesthesia, perfusion specialists, nursing, blood bank, respiratory therapy). Further, risks of ECMO, which include stroke (10%), hemorrhage (30%), deep venous thrombosis (70%), pulmonary embolism (16%), and limb ischemia (<5%), should not be discounted.²⁰ Also, pump or equipment failure should be considered, which can lead to maternal and/or fetal extremis and hypoperfusion.

- Pregnancy is not a contraindication to the use of ECMO. However, there may be logistical challenges related to adequate catheter placement, circuit flow, unit and/or institutional obstacles, and overall care planning. Despite these challenges, this modality should not be withheld from a pregnant patient for whom it may potentially benefit if the patient is otherwise a candidate. In general, ECMO for a pregnant patient should occur in a center with significant experience with its use.²¹ Delivery timing for the patient either receiving ECMO while pregnant or for whom this therapy is being considered should be addressed in a multidisciplinary discussion with all senior physicians involved in the care of the patient. An indication for or current use of ECMO is not necessarily an indication for delivery. However, ECMO cannulation may prompt consideration of a timed delivery. The potential risks and benefits of all available options for both the pregnant patient and the fetus should be evaluated and discussed collaboratively with respect to the patient's or surrogate decision-maker's wishes as feasible. Delivery may be indicated for immediate life-threatening obstetrical concerns to either the mother or fetus/neonate, though ECMO should not be delayed to effect a delivery if no such immediate obstetrical indications exist.

Box 1. Potential indications for extracorporeal membrane oxygenation (ECMO)

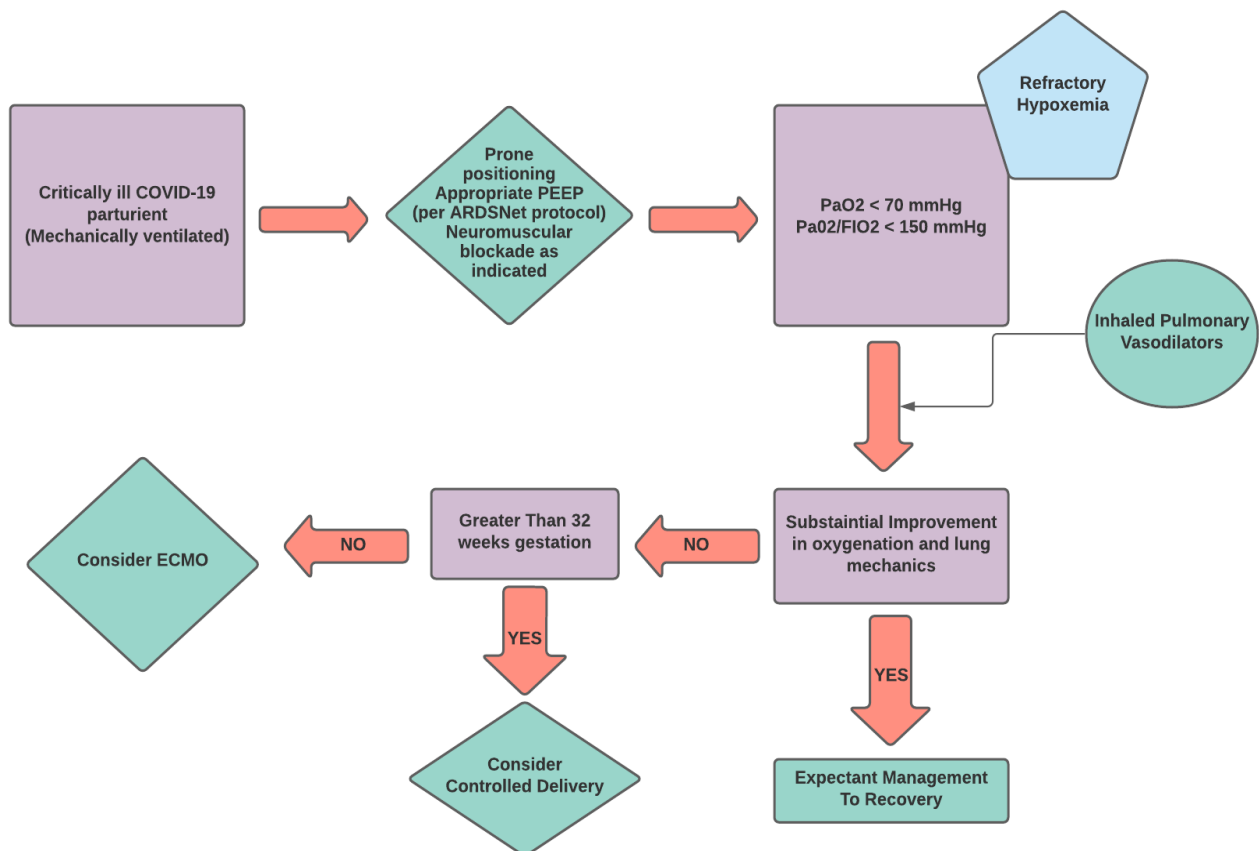
- Hypoxic respiratory failure despite optimal ventilation strategies (as per [ELSO guidelines](#) for ARDS)
- Severe hypercapnia (pH <7.2 and PaCO₂ >80 mm Hg for >6 hours)
- Prolonged ventilation <7 days
- Cardiogenic shock (refractory to conventional therapy—cardiac index <2 L/min/M², central venous oxygen saturation ScVO₂ <65%)
- Murray score >3
- Single organ failure with minimal or no comorbidities
- Massive pulmonary embolism
- Bridge to cardiac or lung transplantation
- Cardiac arrest

Murray score components: ratio of arterial oxygen tension to the fraction of inspired oxygen (PaO₂/FiO₂), positive end-expiratory pressure (PEEP), lung compliance, and chest radiograph
 Abbreviations: ARDS, acute respiratory distress syndrome; ELSO, Extracorporeal Life Support Organization; ScVO₂, central venous oxygen saturation

-Treatment of refractory hypoxemia

The definition of refractory hypoxemia is incomplete. However, it has been previously defined as the inability to maintain a partial pressure of oxygen in arterial blood (PaO_2) of greater than 60 mm Hg despite a fraction of inspired oxygen (FiO_2) of 1.0 (100%)²² as well as efforts to optimize positive end-expiratory pressure (PEEP) with prone positioning or other measures to improve oxygenation (eg, inhaled vasodilators, neuromuscular blockade). Furthermore, the definition of maternal refractory hypoxemia can be expanded to the inability to maintain $\text{PaO}_2 > 70$ mm Hg with maximal FiO_2 despite efforts to optimize ventilation as above. Figure 2 shows an algorithm for the management of refractory hypoxemia in pregnant patients.

Figure 2. Algorithm for Refractory Hypoxemia



-Therapeutic Anticoagulation in Critically Ill Pregnant Patients: Antenatal And Postpartum

Background/rationale

Critical illness, including severe COVID-19 infection, increases the risk of thromboembolic events. Patients who are critically ill or mechanically ventilated should receive prophylactic unfractionated heparin (UFH) or low-molecular-weight heparin (LMWH) if there are no contraindications to its use. There are limited, low-level data on the use of therapeutic anticoagulation for severe COVID-19 disease. Some experts have advocated for utilizing measurement of c-reactive protein and/or D-dimer to guide management; however, there are no clinical data to suggest that early, full-dose anticoagulation is beneficial in these patients.²³ In a French study, 16.7% of severe COVID-19 patients had pulmonary embolism despite prophylactic anticoagulation, and patients with COVID-19 complicated by ARDS had an increased risk of thromboembolic events.²⁴ A Dutch study of 184 ICU patients showed similar findings, with a high incidence of thrombosis (27%) in patients on prophylaxis.²⁵ However, other studies show lower rates of VTE and pulmonary embolism (3%). Further epidemiologic studies should be performed.²⁶

Pregnancy is an additional risk factor for thrombosis, especially in the third trimester and immediately postpartum, and contributes to severe adverse morbidity and maternal mortality.²⁷ Thus, anticoagulation should be considered for in-hospital management of COVID-19 disease in pregnancy.

Pharmacologic anticoagulation regimens

Anticoagulation regimens include both UFH and LMWH. In general, dosing regimens can be delineated into three dosing strategies: prophylactic, intermediate-dose, and full anticoagulation. Regimen and dosing may be institution- and medical service-specific. Obstetricians should check with their pharmacologic disciplines for timing, length of medication use, and dosing of UFH and LMWH.

- **Prophylaxis and treatment regimens:** Expert opinion from the American Society of Hematology recommends prophylactic dosing unless otherwise indicated for common conditions, eg, concomitant confirmed venous thromboembolism.²⁸ Approaches to full anticoagulation should be individualized and in accordance with current practice and protocols at each institution. Furthermore, the increased risk of preterm birth in inflammatory illness (spontaneous or iatrogenic) also places a pregnant patient at elevated risk of peripartum bleeding, which may be worsened by therapeutic anticoagulation. An institution or ICU may have clinical and biomarker criteria for starting full anticoagulation in severely ill patients.

For therapeutic anticoagulation without confirmed thrombosis in a critically ill pregnant patient, UFH should be considered due to its short half-life and reversibility with protamine sulfate. A standardized protocol enables the infusion to be held, discontinued, or mitigated as appropriate in patients at risk for delivery. The known potential risks of therapeutic anticoagulation compared with the unproven theoretical benefit in this cohort of patients should be discussed with the decision-maker for the patient, and informed consent should be subsequently documented. Further, UFH should be considered for prophylaxis in patients at high risk for preterm birth secondary to the aforementioned safety profile. If a heparin infusion is used, clinicians should follow their institutional protocol for UFH infusion, with standardized dosing adjustments and activated partial thromboplastin time and/or anti-Xa monitoring.

For patients receiving prophylactic dosing, LMWH may be preferred due to the once-daily dosing to limit exposures to health care personnel. For patients on UFH who develop new-onset thrombocytopenia, heparin-induced thrombocytopenia (HIT) should remain on the differential, despite the potential overlap in laboratory findings with COVID-19. The "4Ts" scoring system or HIT antibodies can be used to differentiate between the two potential etiologies of thrombocytopenia. The "4Ts" scoring system assigns 0-2 points each for thrombocytopenia, timing of platelet count change, thrombosis or other sequelae, and presence of other causes for thrombocytopenia.

- UFH/LMWH upon discharge: Use of LMWH and UFH after discharge remains controversial, especially in pregnancy, and routine VTE prophylaxis is not recommended after hospital discharge.²⁹ However, it is reasonable for providers to consider risks such as obesity, pregnancy, immobility, and inherited thrombophilias when considering VTE prophylaxis after discharge. Further, other high-risk populations may benefit from postdischarge VTE prophylaxis (these recommendations are made outside of pregnancy):
 - Modified Improve VTE Score ≥ 4 (Table 2)
 - Modified Improve VTE Score ≥ 2 and D-dimer > 2 times the upper limit of normal
 - Age 40-60, D-dimer > 2 times the upper limit of normal, previous VTE, and/or cancer

Table 2. Modified IMPROVE VTE Risk Score³⁰

Previous VTE	3
Known Thrombophilia	2
Current low limb paralysis or paresis	2
History of cancer	2
Intensive Care Unit Stay	1
Complete Immobilization \geq 1d	1
Age \geq 60	1

4. Treatment Options

A large number of treatment options have been investigated for the treatment of COVID-19 disease. While some have shown benefit in decreasing hospital length of stay or improving other outcomes, there is no cure or optimal and agreed-upon comprehensive approach. Pregnant patients with clinical findings of COVID-19 that warrant pharmacologic treatments should be considered for inpatient monitoring.

Clinical trials have investigated a number of pharmacological treatment strategies in nonpregnant populations, and other pharmacologic treatment strategies are ongoing. Proposed therapies have included azithromycin, remdesivir, tocilizumab, Bacillus Calmette–Guérin vaccine, and convalescent plasma. None of these therapies are contraindicated in pregnancy. As of the date of this publication, pregnancy remains an exclusion criterion for clinical trials of many of the therapies, but obstetrical providers should inquire about compassionate use protocols and criteria at their institution.

-Remdesivir

The Adaptive COVID-19 Treatment Trial (ACTT-1) investigated the use of the antiviral agent remdesivir among patients requiring oxygen therapy due to COVID-19 infection and demonstrated a decreased duration of disease in treated patients. Because of these promising results, [the National Institutes of Health \(NIH\) COVID-19 Treatment Guidelines Panel](#) recommends **remdesivir** for treatment of COVID-19 in hospitalized patients with SpO₂ ≤94% on ambient air (at sea level) or those who require supplemental oxygen **(AI)**. The Panel recommends **remdesivir** for treatment of COVID-19 in patients who are on mechanical ventilation or extracorporeal membrane oxygenation (ECMO) **(BI)**.³¹ There is no known fetal toxicity associated with remdesivir. SMFM recommends that remdesivir be offered to pregnant patients with COVID-19 meeting criteria for compassionate use. (<https://www.gilead.com/purpose/advancing-global-health/covid-19/emergency-access-to-remdesivir-outside-of-clinical-trials>).

-Dexamethasone

A recent pre-print report of the RECOVERY trial demonstrated that dexamethasone was associated with a decreased risk of mortality among people requiring mechanical ventilation and also demonstrated a small but statistically significant decrease in mortality risk among those requiring oxygen for COVID-19. Because of these promising preliminary results, [the NIH COVID-19 Treatment Guidelines Panel](#) recommends using dexamethasone (at a dose of 6 mg PO or IV per day for up to 10 days) in patients with COVID-19 who are mechanically ventilated **(AI)** and in patients with COVID-19 who require supplemental oxygen but who are not mechanically ventilated **(BI)**. The Panel

recommends against using dexamethasone in patients with COVID-19 who do not require supplemental oxygen **(AI)**.³² These recommendations are not specific to pregnant patients. Since the benefit of mortality reduction outweighs the risk of fetal steroid exposure for this short course of treatment, SMFM recommends that this treatment should also be offered to pregnant patients with COVID-19 requiring oxygen or mechanical ventilation:

- If glucocorticoids are indicated for fetal lung maturity, dexamethasone 6 mg IM every 12 hours for 48 hours (4 doses) followed by up to a total of 10 days of 6 mg dexamethasone PO/IV daily.
- If glucocorticoids are not indicated for fetal lung maturity, 6 mg dexamethasone daily (PO/IV) for up to 10 days should be utilized as in nonpregnant patients.

-Monoclonal antibodies

Monoclonal antibodies listed below have acquired Emergency Use Authorizations for treatment of mild to moderate COVID-19 in adult and pediatric (>12 years) patients, weighing at least 40kg, and who are at high risk for progressing to severe COVID-19 and/or hospitalization. High risk is defined in these cohorts as patients who meet at least one of the following criteria: BMI \geq 35, chronic kidney disease, diabetes, and immunosuppressive treatment.

- Bamlanivimab (Ly-CoV555), the monoclonal antibody used in clinical trials to treat COVID-19. This medication has not shown a benefit for patients who already require oxygen or are hospitalized. The FDA has authorized it for emergency use.³³
- Casirivimab (REGN10933) and imdevimab (REGN10987) are polyclonal “cocktails” of antibodies and are FDA- authorized for emergency use to treat mild to moderate COVID-19. Exclusion criteria for use include supplemental oxygen requirement, hospitalization, or severe disease.³⁴
- As these medications are used in mild to moderate COVID-19 patients, risks and benefits to the pregnant patient and fetus should be assessed by providers. The NIH COVID guidelines state that there is inadequate evidence for or against use of these agents in general. However, there is no absolute contraindication to their use in appropriate pregnant patients.

-Use of antibiotics

- If clinicians suspect community-acquired pneumonia coinfection, the use of antibiotics is reasonable. Clinicians should obtain culture data when possible before initiating antibiotics, although empirical antibiotic treatment may be given while awaiting these results. If antibiotics are indicated, clinicians should not wait more

than 45 minutes to start antibiotic therapy. Ceftriaxone plus azithromycin or ceftriaxone alone are commonly used to treat community-acquired pneumonia and are not contraindicated in pregnancy. For patients with severe disease or who have risk factors for hospital-acquired, ventilator-acquired, and/or drug-resistant types of pneumonia, broad-spectrum agents should be employed, such as cefepime, meropenem, piperacillin-tazobactam, linezolid, and vancomycin, all of which are acceptable in pregnancy.

- Although a procalcitonin level is not required in the assessment of COVID-19, it can be used to help delineate superimposed bacterial pneumonia. Many COVID-19 patients without bacterial pneumonia will have normal procalcitonin levels (less than 0.1 ng/mL). Patients with elevated levels may have a superimposed bacterial infection. Although an elevated procalcitonin level is suspicious of bacterial infection, culture data (eg, sputum, blood, urine) should also be collected with the implementation of antibiotics. It should be noted that a high procalcitonin level does not rule out COVID-19 infection.^{35, 36}

5. Timing of Delivery

-Timing of Delivery for Pregnant Patients with Refractory Hypoxemia

- In pregnant patients at or after 32 weeks of gestation with refractory hypoxemia, delivery may be considered if it will allow for further optimization of care. The severity of illness may dictate earlier delivery. Neonatal mortality is 0.2% at 32 weeks and remains at this level or lower for each week thereafter. Major morbidity occurs infrequently at these gestational ages as well: 8.7% at 32 weeks, 4.2% at 33, 4.4% at 34, 2.8% at 35, and 1.8% at 36 weeks of gestation, respectively.³⁷ There may be a benefit in reducing the physiological demands of pregnancy in certain patients, such as those with COVID myocarditis, in refractory hypoxemia, or prolonged recovery.
- The logistical and other potential clinical benefits of a controlled delivery may also facilitate optimization of care, and in rare instances, possible avoidance of perimortem delivery if further decline occurs. Care planning surrounding such assessments must be multidisciplinary with all involved decision-makers (including family/surrogates for the patient). It is strongly recommended that these plans be well-codified in writing in the patient's chart and/or other common communication tool for patient care.

-Timing of Delivery for Critically Ill Pregnant Patients

Timing of delivery in critically ill pregnant women should be individualized. Decisions should be based on maternal status, concurrent pulmonary disease (eg, cystic fibrosis, asthma, sarcoidosis), critical illness, ability to wean off the ventilator and ventilator mechanics, gestational age at time of delivery, and shared decision-making with the patient or healthcare proxy.

- The timing of delivery requires carefully weighing the benefits and risks for the patient and fetus, and the decision to deliver requires close communication between the maternal-fetal medicine and critical care teams. Improvement in lung mechanics gained by early delivery is theoretical. In the third trimester, the pressure of the uterus can decrease expiratory reserve volume, inspiratory reserve volume, and functional residual capacity, which can increase the risk of severe hypoxemia in pregnant patients, especially those who are critically ill.³⁸ Although data regarding delivery timing and acute respiratory distress syndrome are limited, it is reasonable to consider delivery in the setting of worsening or persistent critical illness.

- Disease progression in COVID-19 can be protracted, and maternal-fetal medicine and critical care teams should discuss individualized delivery criteria in the setting of worsening maternal status, worsening fetal status, or limited or no improvement in maternal status.
- Although the late third-trimester uterus may account for some mechanical restriction in ventilation, it is unclear whether delivery provides a substantial improvement in every case.
- Mechanical ventilation alone is not an indication for delivery.
- If delivery is considered based on severe hypoxemia, other options should also be discussed, including prone positioning, extracorporeal membrane oxygenation (ECMO), and the use of other advanced ventilator methods, especially if the gestational age is less than 30 to 32 weeks.
- If delivery is being considered and ECMO and pulmonary vasodilators are not available, transport should also be considered.

-Timing of Delivery in Asymptomatic or Mildly Symptomatic Pregnant Patients

- COVID-19-positive status is not an indication for delivery, and delivery should be reserved for routine obstetrical indications.
- Medically indicated deliveries should not be delayed solely due to COVID-19-positive status.
- In an asymptomatic or mildly symptomatic woman positive for COVID-19 at 37 to 38 6/7 weeks of gestation without other indications for delivery, expectant management can be considered until 14 days after the polymerase chain reaction (PCR) result was noted to be positive OR until 7 days after onset of symptoms and 3 days after resolution of symptoms. This option allows for decreased exposure of health care workers and the neonate to SARS-CoV-2 and decreased PPE utilization in areas with supply-chain limitations.
- In an asymptomatic or mildly symptomatic woman positive for COVID-19 at 39 weeks of gestation or later, delivery can be considered to decrease the risk of worsening maternal status.
- Mode of delivery should remain per routine indications. During delivery, COVID-19 patients should be instructed to wear a mask throughout labor, delivery, and postpartum, and appropriate personal protective equipment should be utilized by

health care workers. (See "[Coronavirus \[COVID-19\] and Pregnancy: What Maternal-Fetal Medicine Subspecialists Need to Know.](#)")

6. Other Obstetrical Considerations

-Fetal concerns in pregnant patients with COVID-19

Limited data are currently reassuring regarding fetal risks in the setting of maternal COVID-19 infection. There is no definitive evidence of fetal transmission despite over 3 million cases of COVID-19 worldwide.³⁹ Thus far, there is one reported fetal death, to a woman with critical illness and multi-organ dysfunction in several reported series.⁴⁰⁻⁴² We recommend antenatal surveillance for the usual obstetrical indications and testing for COVID-19 per local protocols.

-Intrapartum or postpartum fever without a clear cause

A fever that is unexplained by another cause during labor or immediately postpartum should be evaluated as usual. However, it is recommended that the patient also be tested and/or screened for COVID-19 according to the obstetrical care provider's institutional policy and guidelines.

-Preterm labor

Preterm delivery has been reported among infants born to women positive for COVID-19 during pregnancy. However, it appears that many cases are iatrogenic and not due to spontaneous preterm labor.^{36, 43, 44} Other severe systemic illnesses appear to increase the risk of preterm birth by approximately two-fold to three-fold.⁴⁵ Decisions regarding the use of magnesium sulfate for neuroprotection in patients with COVID-19 should be individualized based on at risk of preterm birth at less than 32 weeks of gestation. With severe respiratory compromise or COVID-19-related acute renal injury, it is reasonable to consider withholding or dose-adjusting magnesium sulfate, particularly in the intubated patient already receiving benzodiazepine. Intake and output of fluids should be strictly monitored to avoid hypervolemia, and magnesium should be discontinued or deferred if the risk of preterm birth is low. In COVID-19 pregnant patients, it is unclear whether the use of magnesium sulfate increases the risk of pulmonary edema due to limited data and potential confounding of disease process overlap.

-Preeclampsia

Laboratory findings for COVID-19 can overlap with those found in HELLP syndrome and preeclampsia with severe features. The diagnostic criteria for preeclampsia remain unchanged during the pandemic, and management should be dictated by established guidelines. However, it is reasonable to consider PCR testing for SARS-CoV-2 if a patient with transaminitis and thrombocytopenia has additional risk factors for COVID-19.

-Timing of thromboprophylaxis—antenatal vs labor vs postpartum

See the above discussion about anticoagulation in COVID-19 patient. Anesthesiology services should be consulted about the timing of anticoagulation if regional anesthesia is utilized. Aspirin and indomethacin may be used for their respective common obstetrical indications. The presence of COVID-19 should not modify their use as there is no convincing evidence of harmful interactions between these medications and the COVID-19 disease process

<https://www.hematology.org/covid-19/covid-19-and-vte-anticoagulation>.

7. Postpartum Care Considerations

-Inpatient postpartum considerations

- Individuals with COVID-19 seem to be particularly susceptible to fluid overload. Therefore, in the immediate postpartum period, obstetrical clinicians should be aware of the potential for hypervolemia. Close monitoring of intake and output along with respiratory symptoms is prudent, particularly in the first 24 to 48 hours postpartum.
- The specific duration of the inpatient stay for postpartum women with COVID-19 depends on the severity of their symptoms. Women who are asymptomatic/presymptomatic or women with mild symptoms without comorbid conditions may be able to recover at home after a normal postpartum recovery. Those with severe or critical disease require ongoing hospitalization. The decision regarding ongoing hospitalization for moderate diagnosis should be individualized.

-Outpatient postpartum considerations

- It should be emphasized that patients can clinically worsen after several days of apparently mild illness, and women should be instructed to call or be seen for care if symptoms worsen.
- As with prenatal visits, monitoring of the postpartum woman can include the use of telehealth.
- For any individual who tests positive for SARS-CoV-2, self-quarantine is important to avoid transmission to others, including family members. Obstetrical clinicians should work alongside the pediatric and social work teams to optimize safe discharge planning for the postpartum woman and her newborn.

-Breastfeeding

- Chen et al found no evidence of COVID-19 in the breast milk of 9 infected women.⁴⁶ Breastfeeding is encouraged and is a potentially important source of antibody protection for the infant.
- The CDC recommends that during temporary separation, women who intend to breastfeed should be encouraged to express their breast milk to establish and maintain milk supply. If possible, a dedicated breast pump should be provided. Before expressing breast milk, women should practice appropriate hand hygiene. After pumping, all parts of the pump that come into contact with breast milk should be thoroughly washed, and the entire pump should be appropriately disinfected

per the manufacturer's instructions. Expressed breast milk should be fed to the newborn by a healthy caregiver.

- For women and infants who are not separated, the CDC recommends that if a woman and newborn do room-in and the woman wishes to feed at the breast, she should put on a facemask and practice hand hygiene before each feeding (<https://www.cdc.gov/coronavirus/2019-ncov/hcp/inpatient-obstetric-healthcare-guidance.html>).⁴⁷

-Postpartum pain management considerations

For women who are asymptomatic, mildly symptomatic, or moderately symptomatic who require analgesic medication beyond acetaminophen, nonsteroid anti-inflammatory drugs (NSAIDs) should be used because opioids likely pose more clinical risks. For women with acute kidney injury, this decision must be individualized.

-Postpartum contraception considerations

When an acceptable clinical alternative is available, nonurgent postpartum procedures, such as a postpartum tubal ligation, should be postponed. Immediate postpartum insertion (defined as insertion within 10 minutes of delivery of the placenta up to hospital discharge) of an IUD or implant placement can be considered as alternatives to sterilization in the setting of SARS-CoV-2 infection. Immediate postpartum insertion of these methods may be especially feasible in areas where telehealth is being utilized for postpartum care. Obstetrical clinicians should ensure that safe and effective contraception options remain available to all postpartum women.⁴⁸

-Identification and management of postpartum depression and anxiety during the COVID-19 pandemic

The COVID-19 outbreak has engendered symptoms of depression and anxiety in the broader population. The additive risk factors of pregnancy and the postpartum period may potentiate these symptoms. Psychoeducation on ways to cope with stress, including taking breaks from news stories, practicing mindfulness, eating healthy meals, exercising regularly, and getting adequate sleep, should be incorporated into routine care.

Universal screening for perinatal depression both during pregnancy and the postpartum period has been recommended by the [American College of Obstetricians and Gynecologists](#). Ensuring that screening, utilizing a validated screen, continues to occur even during telehealth appointments is essential.

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