Considerations for Safe Labor, Delivery, and Neonatal Care during the COVID-19 Pandemic

During the COVID-19 pandemic, maximal protection of healthcare workers in obstetric and neonatal intensive care units (NICUs) and the mothers and newborns they care for are key aspects of specialized obstetric care, but limited outcomes data are available. Authors of a systematic review (SR) published in April 2020 that examined 385 published cases as of April 20, 2020, concluded that “COVID-19 infection during pregnancy probably has a clinical presentation and severity resembling that in non-pregnant adults and probably is not associated with poor maternal or perinatal outcomes.” Limited data from this SR and additional individual retrospective case series suggest that the risk of mother-to-baby transmission in women with COVID-19 infection is very low. However, uncertainty about whether the virus crosses the placental barrier has led many obstetric departments to prohibit the practice of delayed umbilical cord clamping in term infants to minimize newborn exposure to any virus in the immediate environment. Guidance from multiple organizations describes ways to protect staff, measures to limit transmission, recommendations for COVID-19 testing for pregnant women and for infants born to infected mothers, and optimal maternal care and breastfeeding recommendations. We also identified 13 articles that describe safe care strategies for patients or staff. Also, COVID-19 registries are collecting further data on maternal and neonatal outcomes.

Evidence limitations. Limited evidence reported during the COVID-19 pandemic consists primarily of small retrospective reviews describing outcomes of pregnant women with COVID-19 infection and their newborns. Most data derive from hospitals in China and may not be generalizable to other countries due to differences in healthcare practices. SR authors discussed several limitations, including the possibility of incomplete data, since not every healthcare facility may have shared cases of COVID-19 during pregnancy, lack of study quality assessment, and the possibility of overlapping data resulting in double-counting of patients. In addition, variables unrelated to COVID-19 may have been present that could have affected mother or newborn outcomes and are not accounted for in retrospective review of cases.
Executive Summary

Findings
We assessed 1 SR and 5 retrospective reviews not included in the SR.

- Maternal complications: One multicenter retrospective review (Yan et al. 2020) reported that 1 of 8 (12.5%) infected women who presented in the first and early second trimester had a missed spontaneous abortion, and 21 of 99 infected women (21.2%) had preterm birth, including 6 with preterm premature rupture of membranes. One single-center retrospective review (Chen et al. 2020) reported that 3 of 17 (17.6%) infected women gave birth prematurely and 12 of 14 (85.7%) infected women who received continuous epidural anesthesia during cesarean delivery experienced significant intraoperative hypotension.

- Maternal mortality: One SR (Elshafeey et al. 2020) of 385 pregnant women with COVID-19 reported 1 maternal death. Two multicenter retrospective reviews (Yan et al. and Cao et al. 2020) reported no maternal deaths.

- Neonatal complications/mortality: The SR reported 4 of 256 neonates born of infected mothers tested positive for the disease: 2 were stillborn, and 1 died shortly after birth. Four retrospective studies (Yan et al., Yang et al., Liu et al., and Chen et al.) reported that the neonates tested for SARS-CoV-2 had negative results. Yan et al. (multicenter study) reported 1 of 99 (~1%) infants developed severe neonatal asphyxia, resulting in neonatal death. Chen et al. and Cao et al. (single-center studies) reported no serious neonatal asphyxia events or deaths.

- Vertical transmission risk: The SR authors reported that samples from the cord blood, placenta, and amniotic fluid of 4 infants who tested positive for COVID-19 after birth were negative. Yan et al. reported 10 paired amniotic fluid and cord blood samples tested negative for SARS-CoV-2. Liu et al. reported real-time polymerase chain reaction (RT-PCR) tests of breast milk and amniotic fluid were all negative.

Evidence
Search dates: Through April 27, 2020. We reviewed full text of 1 SR and 5 additional clinical studies reporting on pregnancy outcomes of 602 women with COVID-19 infection.

- 1 SR (Elshafeey et al. 2020; 33 retrospective studies; n = 385 women) summarized the existing case series and case reports on COVID-19 infection during pregnancy and childbirth

- 1 multicenter retrospective review of pregnant women (Yan et al. 2020; n = 116 women)

- 3 single-center retrospective reviews of pregnant women (Yang et al. 2020, n = 55 women; Chen et al. 2020, n = 17 women; Cao et al. 2020, n = 10 women)

- 1 single-center retrospective review of neonates (Liu et al. 2020; n = 19 neonates)

Guidelines
Searched PubMed, EMBASE, and ECRI Guidelines Trust® (EGT) for relevant documents published through April 28, 2020. We identified 32 documents.

- We identified 2 relevant guidelines supported by SRs and 30 other documents. See the Selected Resources and References section of full report for 11 summaries of recommendations by major U.S. and international organizations and links to remaining documents.

Guidelines Supported by Systematic Reviews


Other Documents

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Background

COVID-19 and Pregnancy

COVID-19, caused by SARS-CoV-2, was first identified during an investigation into an outbreak in Wuhan, China, in December 2019. Since then, the illness has spread throughout the world (see CDC Fact Sheet). WHO declared it a pandemic in January 2020.

ACOG recommends that pregnant women take the same steps as the general public to avoid exposure to the coronavirus infection including washing hands often with soap and water for at least 20 seconds, cleaning hands with a hand sanitizer that contains at least 60% alcohol if you can’t wash them, avoiding touching eyes, nose, and mouth, staying home as much as possible, staying at least 6 feet away from other people if you need to go out, and avoiding people who are sick.

Clinicians should monitor all pregnant women for signs and symptoms of COVID-19 (i.e., fever, cough, dyspnea, sore throat, fatigue).(1)

Based on limited available data, “pregnancy does not increase the risk of acquiring SARS-CoV-2 infection and does not worsen the clinical course of COVID-19 compared with non-pregnant individuals of the same age.”(1) However, the International Society of Infectious Disease in Obstetrics and Gynecology cautions that “pregnant women need to be considered as a high-risk population for COVID-19 infection, and if suspected or proven to be infected with the virus, they require special care to improve their survival rate and the well-being of their babies.” Maximal protection of healthcare workers in obstetric and neonatal intensive care units (NICUs) and the mothers and newborns they care for are key aspects of specialized obstetric care.

Infection Control Precautions

Healthcare workers who care for pregnant women are urged to use strict infection control precautions to reduce the risk of COVID-19 transmission, including the following recommendations in an UptoDate article as of May 7, 2020:(1)

- Ensuring the obstetric unit has infection control practices for pregnant patients who have confirmed or suspected COVID-19 consistent with CDC guidelines.
- Screening all patients for signs and symptoms of COVID-19, as well as whether they have had close contact with a confirmed case or persons under investigation, before entering the hospital for admission to the labor and delivery unit.
- Prioritizing testing of pregnant women with suspected COVID-19 at admission or who develop symptoms of COVID-19 during admission.
- Wearing a surgical mask in the health care setting, under the assumption that every patient and health care colleague might be infected with COVID-19.
- Requiring all asymptomatic patients to wear a cloth face covering.
- Caring for pregnant COVID-19-positive inpatients in specially equipped (e.g., negative-pressure) rooms in antepartum, intrapartum, and postpartum COVID-19-only units.
- Screening the support person for fever and other symptoms before entering the building and disallowing those with any symptoms consistent with COVID-19, exposure to a confirmed case within 14 days, or a positive test for COVID-19 within 14 days from attending the labor and birth.
CLINICAL EVIDENCE ASSESSMENT
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Patient Care
Care concerns for pregnant women with confirmed maternal COVID-19 infection include potential complications, timing/route of delivery, and issues related to postpartum care (i.e., mother-newborn separation, neonatal care, breastfeeding).

Potential Complications
Pregnant women with comorbid conditions (e.g., hypertension, diabetes, severe obesity, severe asthma, cardiovascular disease) who contract COVID-19 may be at increased risk of severe illness, and those who develop COVID-19 pneumonia may be at increased risk of preterm and caesarean delivery. Most neonatal complications have been due to preterm birth.(1)

Early in the pandemic, concerns arose over potential intrauterine vertical transmission of COVID-19 from mother to baby. To date, “SARS-CoV-2 has not been detected in cord blood or amniotic fluid.”(1) However, a recent case report of a patient with confirmed COVID-19 infection who experienced a second-trimester miscarriage reported that placental samples were COVID-19-positive, although swabs from the axillae, mouth, meconium, and fetal blood obtained from the stillborn infant tested negative.(2) Due to uncertainty about whether the virus crosses the placental barrier, “many institutions have chosen to prohibit the practice of delayed umbilical cord clamping in term infants to minimize newborn exposure to any virus in the immediate environment.”(1)

Neonates can acquire COVID-19 after birth if they are exposed to infected parents or caregivers. Their “immature immune system leaves them vulnerable to serious respiratory viral infections, raising concern that SARS-CoV-2 may cause severe disease among neonates.” (See AAP’s document Initial Guidance: Management of Infants Born to Mothers with COVID-19). However, when infection occurs in the newborn, its severity has generally been described as mild.(1)

Timing/Route of Delivery
Timing of delivery depends on the severity of the mother’s COVID-19 illness. Delivery is not indicated for most women with preterm COVID-19 that is not severe and who have no medical/obstetric indications for prompt delivery. For women with severe illness, timing of delivery needs to be individualized, and caregivers should consider the postnatal transmission risk in the delivery room and whether delivery might improve the mother’s respiratory status. For hospitalized patients who have COVID-19 pneumonia and are not intubated, delivery of fetuses with gestational ages of 32 to 34 weeks may be considered, especially if the mother’s pulmonary status is expected to worsen, thereby placing the fetus at risk as well. For hospitalized pregnant woman who are intubated and critically ill with COVID-19, delivery of fetuses with gestational ages of 32 to 34 weeks may be considered if the patient is stable, but delivery could also worsen the mother’s condition.(1)

COVID-19 infection is not a reason for clinicians to change the planned delivery route; decisions to perform a cesarean delivery should be based on usual indications.(1)

Guidance Differs on Mother-Newborn Separation/Neonatal Care
Temporary separation of mothers with known or suspected COVID-19 from their newborns after birth can cause significant stress, disrupt breastfeeding, and have a negative impact on newborn stress, feeding, and mother-child bonding.(1)

However, guidance from CDC, WHO, and AAP differs for healthcare providers on this issue. CDC guidelines state, “the determination of whether or not to separate a mother with known or suspected COVID-19 and her infant should be made on a case-by-case basis using shared decision-making between the mother and the clinical team.” According to these guidelines, considerations in this decision include:

- The clinical condition of the mother and of the infant.
- SARS-CoV-2 testing results of mother (confirmed vs. suspected) and infant (a positive infant test would negate the need to separate).
- The mother’s desire to breastfeed.
Facility capacity to accommodate separation or colocation.

The ability to maintain separation upon discharge.

If separation is implemented, CDC guidelines recommend that “infants born to mothers with known COVID-19 at the time of delivery be considered infants with suspected COVID-19.” As such, infants with suspected COVID-19 should be isolated from other healthy infants and cared for according to CDC’s Interim Infection Prevention and Control Recommendations for Patients with Suspected or Confirmed Coronavirus Disease 2019 (COVID-19) in Healthcare Settings.

WHO recommends that, “mothers and infants be enabled to remain together and practice skin-to-skin contact, kangaroo mother care and to remain together and to practice rooming-in throughout the day and night, especially immediately after birth during establishment of breastfeeding, whether they or their infants have suspected, probable, or confirmed COVID-19.”

AAP recommends that “newborns be separated at birth from mothers with COVID-19 when the physical environment allows.”

Breast Milk, SARS CoV2, and Transmission

According to ACOG, to date, “the COVID-19 virus has not been found in breast milk, but there is not enough information yet on whether women who are sick can pass the virus through breast milk.” At this time AAP and WHO continue to encourage breastfeeding in women with suspected or confirmed COVID-19 infection due to its many benefits. These organizations provide detailed guidance on this topic (see Guidelines section below).

Guidelines, Position and Consensus Statements

Searches of PubMed, EMBASE, EGT, and other web-based resources identified 32 relevant guidelines and documents published through April 28, 2020. We sought guidelines that are clearly supported by published systematic reviews (SRs) or included in EGT, a publicly available online repository of guidelines supported by SRs and developed by nationally and internationally recognized medical organizations and specialty societies. These guidelines must meet certain U.S. National Academy of Medicine criteria. Due to the many publications identified, we summarize below only those published by major U.S. and international organizations. For more information on guidelines published by countries outside the United States (i.e., Canada, China, India, Italy, United Kingdom), see links under the Selected Resources and References section.

Guidelines Supported by Systematic Review

Neonatal Care

AAP. Initial Guidance: Management of Infants Born to Mothers with COVID-19 2020. This guidance recommends the following:

Airborne, Droplet, and Contact Precautions should be utilized when attending deliveries from women with COVID-19 due to the increased likelihood of maternal virus aerosols and the potential need to administer newborn resuscitation to infants with COVID-19 infection that can generate virus aerosol.

When the physical environment allows, newborns should be separated at birth from mothers with COVID-19. Families who choose to have their infants room in with the mother should be educated on the potential risk to the newborn of developing COVID-19.

SARS-CoV-2 has not been detected in breast milk to date. Mothers with COVID-19 can express breast milk to be fed to their infants by uninfected caregivers until specific maternal criteria are met.
Infants born to mothers with COVID-19 should be tested for SARS-CoV-2 at 24 hours and, if still in the birth facility, at 48 hours after birth. Centers with limited resources for testing may make individual risk/benefit decisions regarding testing.

A newborn who has a documented SARS-CoV-2 infection (or who remains at risk for postnatal acquisition of COVID-19 due to inability to test the infant) requires frequent outpatient follow-up via telephone, telemedicine, or in-person assessments through 14 days after discharge.

After hospital discharge, a mother with COVID-19 is advised to maintain a distance of at least 6 feet from the newborn, and when in closer proximity use a mask and hand-hygiene for newborn care until (a) she is afebrile for 72 hours without use of antipyretics, and (b) at least 7 days have passed since symptoms first appeared.

A mother with COVID-19 whose newborn requires ongoing hospital care should maintain separation until (a) she is afebrile for 72 hours without use of antipyretics, and (b) her respiratory symptoms are improved, and (c) negative results are obtained from at least two consecutive SARS-CoV-2 nasopharyngeal swab tests collected ≥24 hours apart.

General


Other Documents

Labor and Delivery

Consider staggering staff schedules (e.g., creating a patient-facing team and a home-based telehealth team that rotates responsibilities weekly or every 2 weeks) to reduce concomitant exposure risks and minimize the potential for future staffing shortages.

Hospital visitors should be restricted or eliminated for women who test positive for SARS-CoV2 or persons under investigation (PUIs.)

Women who test positive for SARS-CoV2 or PUIs should ideally be placed in an isolation room with droplet and contact precautions. Airborne infection isolation rooms (single-patient negative-pressure rooms with a minimum of 6 air changes per hour), if available, can be used if performance of aerosolizing procedures is anticipated.

Hospital facilities can inform whether specific rooms, such as operating rooms or rooms in which higher acuity evaluations are performed (e.g., when intubation may be required), can be safely converted to negative-pressure rooms. These rooms can be designated for cesarean deliveries for women who test positive for SARS-CoV2 or PUIs.

For patients with known or suspected COVID-19, HCWs should use N95 (or facemasks if N95 is not available), eye protection, gloves, and gowns during the second stage of labor, in addition to other personal protective equipment that may be typically indicated for labor and delivery. Surgical drapes could be used as an additional physical respiratory droplet barrier during the second stage and at delivery.

Each hospital should facilitate discussions between obstetric care, maternal-fetal medicine, neonatology, critical care, infectious disease, and obstetric anesthesiology providers regarding pregnancy management in the setting of worsening maternal respiratory status.
Neonatal Care

— AAP, Guidance on Newborn Screening during COVID-19. 2020. AAP recommends “that pediatricians continue to follow federal and state guidelines on newborn screening including newborn bloodspot screening, newborn hearing screening and critical congenital heart disease screening.”

Breastfeeding

— AAP, Breastfeeding Guidance Post Hospital Discharge for Mothers or Infants with Suspected or Confirmed SARS-CoV-2 Infection. 2020. This guidance states:

In a family with suspected or confirmed COVID-19, counsel families to consider delaying weaning and extending the duration of breastfeeding to maximize the protection conferred via human milk during the pandemic.

If a mother and/or infant has COVID-19 and mother wants to express her milk, she should put on a mask and thoroughly clean her hands and breasts as well as any pump parts, bottles, and artificial nipples. Optimal milk expression is facilitated by use of an efficient electric double pump. She should express milk as often as her baby is eating or at least 6-8 times per 24 hours.

If a mother and/or infant has COVID-19 and mother wants to breastfeed directly, encourage proper washing of hands and breasts with soap and water prior to handling the infant and advise the mother to wear a mask while nursing.

If a mother and/or infant has COVID-19 and mother chooses not to breastfeed during the first weeks after birth, engage in a discussion about the importance of breastfeeding and expressed human milk in protecting against infections and other diseases during this most vulnerable time.

If an infant is discharged early, an in-person visit within 24-48 hours is preferred. Avoid use of waiting rooms to decrease viral exposure. Implement strategies such as seeing infants first thing in the morning, using separate entrances for well/sick, rooming upon arrival or waiting in car until appointment time.

General


Pregnant women admitted with suspected COVID-19 or who develop symptoms suggestive of COVID-19 during admission should be prioritized for testing. Because of the potential for asymptomatic patients presenting to labor and delivery units, particularly in high prevalence areas, additional testing strategies may be appropriate.

Health care professionals should follow their health care facility’s policies and their local and state health department policies for notification of a person under investigation for COVID-19. Patients with known or suspected COVID-19 should be cared for in a single-person room with the door closed. Airborne Infection Isolation Rooms may be reserved for patients undergoing aerosol-generating procedures.

Infants born to patients with known COVID-19 at the time of delivery should be considered infants with suspected COVID-19.

Infants born to a pregnant individual with suspected COVID-19 for whom testing is unknown (either pending results or not tested) are not considered to be infants with suspected COVID-19.

To reduce the risk of transmission of the virus that causes COVID-19 from the patient to the newborn, facilities may consider temporarily separating patients who have confirmed COVID-19 or are persons under investigation from their newborns until the patient’s transmission-based precautions are discontinued. ACOG recognizes that separation of patients from their newborns
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may be linked to additional risks including, but not limited to, undue stress on the patient and disruption of breastfeeding. The determination of whether to keep patients with known or suspected COVID-19 and their infants together or separated after birth should be made on a case-by-case basis, using shared decision-making between the patient and the clinical team.

CDC: Considerations for Inpatient Obstetric Healthcare Settings. 2020. Guidance recommendations include:
- Healthcare facilities should ensure recommended infection control practices for hospitalized pregnant patients who have confirmed COVID-19 or are PUIs are consistent with CDC’s Interim Infection Prevention and Control Recommendations for Patients with Confirmed Coronavirus Disease 2019 (COVID-19) or Persons under Investigation for COVID-19 in Healthcare Settings.
- All healthcare facilities that provide obstetric care must ensure that their personnel are correctly trained and capable of implementing recommended infection control interventions. Individual healthcare personnel should ensure they understand and can adhere to infection control requirements.
- Healthcare facilities providing inpatient obstetrical care should limit visitors to pregnant women who have known or suspected COVID-19 infections.

Emergency Cardiovascular Care Committee and Get With the Guidelines®-Resuscitation Adult and Pediatric Task Forces of the American Heart Association in Collaboration with the American Academy of Pediatrics, American Association for Respiratory Care, American College of Emergency Physicians, the Society of Critical Care Anesthesiologists, and American Society of Anesthesiologists: Supporting Organizations: American Association of Critical Care Nurses and National EMS Physicians. Interim Guidance for Basic and Advanced Life Support in Adults, Children, and Neonates with Suspected or Confirmed COVID-19. 2020. This guidance states:
- Neonatal resuscitation: Routine neonatal care and the initial steps of neonatal resuscitation are unlikely to be aerosol-generating... Suction of the airway after delivery should not be performed routinely for clear or meconium-stained amniotic fluid. Suctioning is an aerosol-generating procedure and is not indicated for uncomplicated deliveries. Endotracheal instillation of medications, such as surfactant or epinephrine, are aerosol-generating procedures, especially via an uncuffed tube. Intravenous delivery of epinephrine via a low-lying umbilical venous catheter is the preferred route of administration during neonatal resuscitation.
- Closed incubators: Closed incubator transfer and care should be used for neonatal intensive care patients when possible but do not protect from aerosolization of virus.
- Maternal cardiac arrest: The tenets of maternal cardiac arrest are unchanged for women with suspected or confirmed COVID-19. The cardiopulmonary physiological changes of pregnancy may increase the risk of acute decompensation in critically ill pregnant patients with COVID-19. Preparation for perimortem delivery, to occur after 4 minutes of resuscitation, should be initiated early in the resuscitation algorithm to allow the assembly of obstetrical and neonatal teams with PPE even if ROSC is achieved and perimortem delivery is not required.

- Pregnant women with confirmed COVID-19 infection should be managed by designated tertiary hospitals and should be counseled on the risk of adverse pregnancy outcome.
- Negative pressure isolation rooms should be set up for safe labor and delivery and neonatal care. This may not be possible in many low-resource settings but all possible attempts should be made for isolation and infection control.
During the COVID-19 pandemic period, a detailed history regarding exposure relevant to COVID-19 and clinical manifestations should be acquired routinely from all pregnant women attending for routine care.

Chest CT scan should be included in the work-up of pregnant women with suspected/probable/confirmed COVID-19 infection.

Suspected/probable cases should be treated in isolation and confirmed cases should be managed in a negative pressure isolation room. A woman with confirmed infection who is critically ill should be admitted to a negative pressure isolation room in the ICU.

Antenatal examination and delivery of pregnant women infected with COVID-19 should be carried out in a negative pressure isolation room on the labor ward. Human traffic around this room should be limited when it is occupied by an infected patient.

All medical staff involved in management of infected women should wear appropriate PPE as required.

Management of COVID-19-infected pregnant women should be undertaken by a multidisciplinary team (obstetricians, maternal–fetal medicine subspecialists, intensivists, obstetric anesthetists, internal medicine or respiratory physicians, midwives, virologists, microbiologists, neonatologists, infectious disease specialists).

Timing and mode of delivery should be individualized, dependent mainly on the clinical status of the patient, gestational age, and fetal condition.

At present, limited data suggest that there is no evidence of vertical mother-to-baby transmission in women who develop COVID-19 infection in late pregnancy.

There is currently insufficient evidence regarding the safety of breastfeeding and the need for mother/baby separation. If the mother is severely or critically ill, separation appears the best option, with attempts to express breastmilk to maintain milk production. If the patient is asymptomatic or mildly affected, breastfeeding and colocation (rooming-in) can be considered by the mother in coordination with healthcare providers.

Healthcare professionals engaged in obstetric care should be trained and fitted appropriately for respirators.


Delivery of pregnant women infected with COVID-19 should be carried out in a negative-pressure isolation room on the labor ward. Human traffic around this room should be limited when it is occupied by an infected patient.

Both regional anesthesia and general anesthesia can be considered, depending on the clinical condition of the patient and after consultation with the obstetric anesthetist.

Following an ultrasound scan of a suspected, probable or confirmed COVID-19-infected pregnant patient, surfaces of transducers should be cleaned and disinfected according to manufacturer specifications, taking note of the recommended ‘wet time’ for wiping transducers and other surfaces with disinfection agents.

— WHO. Clinical Management of Severe Acute Respiratory Infection when COVID-19 Is Suspected. 2020. Guidance recommendations include:

Infants born to mothers with suspected, probable, or confirmed COVID-19 should be fed according to standard infant feeding guidelines, while applying necessary precautions for IPC [infection prevention and control].
As with all confirmed or suspected COVID-19 cases, symptomatic mothers who are breastfeeding or practicing skin-to-skin contact or kangaroo mother care should practice respiratory hygiene, including during feeding (for example, use of a medical mask when near a child if the mother has respiratory symptoms), perform hand hygiene before and after contact with the child, and routinely clean and disinfect surfaces with which the symptomatic mother has been in contact.

Breastfeeding counselling, basic psychosocial support, and practical feeding support should be provided to all pregnant women and mothers with infants and young children, whether they or their infants and young children have suspected or confirmed COVID-19.

In situations when severe illness in a mother with COVID-19 or other complications prevents her from caring for her infant or prevents her from continuing direct breastfeeding, mothers should be encouraged and supported to express milk, and safely provide breastmilk to the infant, while applying appropriate IPC measures.

Parents and caregivers who may need to be separated from their children, and children who may need to be separated from their primary caregivers, should have access to appropriately trained health or non-health workers for mental health and psychosocial support.

Clinical Literature
We searched PubMed, EMBASE, Google Scholar, the Cochrane Library, and selected web-based resources for documents relevant to this topic and published through April 27, 2020. Our search strategies included the following keywords: birth, coronavirus, COVID19, delivery, infant, labor, newborn, pregnancy. Please see the Selected Resources and References section for detailed search strategies.

We included SRs and clinical studies (not included in the SRs) that examined outcomes of pregnant women with COVID-19 and outcomes of newborns born to women with COVID-19.

We excluded single case reports(4-17), studies with fewer than 10 patients(18-21), and conference abstracts.

We review full text of articles available through open access or our library subscriptions and abstracts of the remaining articles. We identified and reviewed full text of one SR and five clinical studies that were not included in the SR. Table 1 summarizes the SR findings. Table 2 summarizes the clinical study findings.

Systematic Reviews
- 1 SR (33 studies; n = 385 women) summarized the existing literature on COVID-19 infection during pregnancy and childbirth and reported on maternal mortality, stillbirths and neonatal mortality, and vertical transmission of SARS-CoV-2 infection to a newborn.(22)

Clinical Studies
- 1 multicenter retrospective review (n = 116 women) reported on risk of spontaneous abortion and spontaneous preterm birth in pregnant women with a COVID-19 infection, neonatal complications, and vertical transmission of SARS-CoV-2 infection to a newborn.(23)
- 1 single-center retrospective review (n = 55 women) reported on maternal COVID-19 screening and neonatal complications.(24)
- 1 single-center retrospective review (n = 19 neonates) reported on neonatal complications and vertical transmission of SARS-CoV-2 infection to a newborn.(25)
- 1 single-center retrospective review (n = 17 women) reported on epidural and general anesthesia safety in pregnant patients with COVID-19 infection, maternal complications, and neonatal complications/mortality.(26)
- 1 single-center retrospective review (n = 10 women) reported on maternal mortality and neonatal asphyxia rates.(27)
Evidence limitations. Limited evidence reported during the COVID-19 pandemic consists primarily of small retrospective reviews describing outcomes of pregnant women with COVID-19 infection and their newborns. Most data derive from hospitals in China and may not be generalizable to other countries due to differences in healthcare practices. SR authors(22) discussed several limitations, including the possibility of incomplete data, since not every healthcare facility may have shared cases of COVID-19 during pregnancy, lack of study quality assessment, and the possibility of overlapping data resulting in double-counting of patients. In addition, variables unrelated to COVID 19 may have been present that could have affected mother or newborn outcomes and are not accounted for in retrospective review of cases.

Table 1. Systematic Review

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<thead>
<tr>
<th>Author/ Year</th>
<th>Purpose</th>
<th>Resources Searched and Inclusion Criteria</th>
<th>Findings Reported By Authors</th>
<th>Authors’ Conclusions</th>
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<tbody>
<tr>
<td>Elshafeey et al. 2020(22) Reviewed full text Egypt</td>
<td>To “summarize the existing literature on COVID-19 infection during pregnancy and childbirth, particularly concerning clinical presentation and outcomes.”</td>
<td>LitCOVID, EBSCO MEDLINE, CENTRAL, CINAHL, Web of Science, and Scopus electronic databases were searched through April 19, 2020, for relevant studies.</td>
<td>“We identified 33 studies reporting 385 pregnant women with COVID-19 infection: 368 (95.6%) mild; 14 (3.6%) severe; and 3 (0.8%) critical. Seventeen women were admitted to intensive care, including six who were mechanically ventilated and one maternal mortality. A total of 252 women gave birth, comprising 175 (69.4%) cesarean and 77 (30.6%) vaginal births. Outcomes for 256 newborns included four RT-PCR positive neonates, two stillbirths, and one neonatal death.”</td>
<td>“COVID-19 infection during pregnancy probably has a clinical presentation and severity resembling that in non-pregnant adults. It is probably not associated with poor maternal or perinatal outcomes.”</td>
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### Table 2. Clinical Studies

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<th>Author/Year</th>
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<th>Findings Reported by Authors</th>
<th>Authors’ Conclusions</th>
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<td>Yan et al. 2020(23)</td>
<td>Multicenter retrospective review 116 pregnant women with COVID-19 pneumonia from 25 hospitals in China between January 20, 2020, and March 24, 2020.</td>
<td>To “evaluate the clinical characteristics and outcomes in pregnancy and the vertical transmission potential of SARS-CoV-2 infection.”</td>
<td>“The median gestational age on admission was 38(+0) (IQR 36(+0)-39(+1)) weeks. The most common symptoms were fever (50.9%, 59/116) and cough (28.4%, 33/116); 23.3% (27/116) patients presented without symptoms. Abnormal radiologic findings were found in 96.3% (104/108) of cases. There were eight cases (6.9%, 8/116) of severe pneumonia but no maternal deaths. One of eight patients (1/8) that presented in the first- and early-second-trimester had a missed spontaneous abortion. Twenty-one of 99 patients (21.2%, 21/99) that had delivered had preterm birth, including six with preterm premature ruptured of membranes. The rate of spontaneous preterm birth before 37 weeks was 6.1% (6/99). There was one case of severe neonatal asphyxia that resulted in neonatal death. Eighty-six of the 100 neonates that had testing for SARS-CoV-2 had negative results, of these ten neonates had paired amniotic fluid and cord blood samples that were tested negative for SARS-CoV-2.”</td>
<td>“SARS-CoV-2 infection during pregnancy is not associated with an increased risk of spontaneous abortion and spontaneous preterm birth. There is no evidence of vertical transmission of SARS-CoV-2 infection when the infection manifests during the third-trimester of pregnancy.”</td>
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# Clinical Evidence Assessment

**Considerations for Safe Labor, Delivery, and Neonatal Care during the COVID-19 Pandemic**

<table>
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</table>
| Yang et al. 2020(24) | Single-center retrospective review 55 pregnant women with suspected COVID-19 who gave a birth between January 20 2020, and March 5, 2020, in a large hospital birthing center. | “To observe the clinical features and outcomes of pregnant women who have been confirmed with COVID-19.” | “Among the 55 cases, 13 patients were assigned into the confirmed COVID-19 group and the other 42 patients were assigned into the control group... All the 13 confirmed pregnant women were diagnosed with asymptomatic and mild COVID-19, and no one of the patients developed severe COVID-19 or died. For the parturient women with asymptomatic and mild COVID-19, the clinical symptoms and laboratory indicators are not obvious. Pulmonary CT [computed tomography] image of those manifestations is not the specific clinical features of COVID-19 pneumonia. The count of lymphocyte was lower in the confirmed COVID-19 cases, but there was no change in the normal cases. In Wuhan where the incidence of COVID-19 is high, pulmonary CT screening on admission may be necessary to reduce the transmission of COVID-19 during the outbreak period.”
“20 babies (from confirmed mother and from normal mother) were subjected to SARS-CoV-2 examination by throat swab samples in 24 h after birth and no case was tested positive.” | “It took time to confirm COVID-19 in the laboratory at a particular time, but pregnant women were in labor and had no time to confirm COVID-19. Pulmonary CT scan plus blood routine examination of WBC, Neutrophil and Lymphocyte are more suitable for finding pregnancy women with asymptomatic or mild COVID-19 infection, and thus protecting normal pregnancy women and medical staffs.” |
| Liu et al. 2020(25) | Single-center retrospective review 19 neonates admitted to Tongji Hospital between January 31, 2020, and February 29, 2020. | “To investigate the clinical characteristics of neonates born to SARS-CoV-2 infected mothers and increase the current knowledge on the perinatal consequences of COVID-19.” | “10 mothers were confirmed COVID-19 by positive SARS-CoV-2 RT-PCR in throat swab, and 9 mothers were clinically diagnosed with COVID-19. Delivery occurred in an isolation room and neonates were immediately separated from the mothers and isolated for at least 14 days. No fetal distress was found. Gestational age of the neonates was \( 38.6 \pm 1.5 \) weeks, and average birth weight was \( 3293 \pm 425 \) g. SARS-CoV-2 RT-PCR in throat swab, urine, and feces of all neonates were negative. SARS-CoV-2 RT-PCR in breast milk and amniotic fluid was negative too. None of the neonates developed clinical, radiologic, hematologic, or biochemical evidence of COVID-19.” | “No vertical transmission of SARS-CoV-2 and no perinatal complications in the third trimester were found in our study. The delivery should occur in isolation and neonates should be separated from the infected mothers and care givers.” |
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**Considerations for Safe Labor, Delivery, and Neonatal Care during the COVID-19 Pandemic**

<table>
<thead>
<tr>
<th>Author/Year</th>
<th>Study Type and Patients</th>
<th>Objective</th>
<th>Findings Reported by Authors</th>
<th>Authors’ Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen et al. 2020(26)</td>
<td>Single-center retrospective review 17 pregnant women infected with SARS-CoV-2 who were admitted to Renmin Hospital of Wuhan University between January 30, 2020, to February 23, 2020</td>
<td>To “assess the management and safety of epidural or general anesthesia for Cesarean delivery in parturients with coronavirus disease (COVID-19) and their newborns, and to evaluate the standardized procedures for protecting medical staff.”</td>
<td>“The clinical characteristics of 17 pregnant women infected with SARS-CoV-2 were similar to those previously reported in non-pregnant adult patients. All of the 17 patients underwent Cesarean delivery with anesthesia performed according to standardized anesthesia/surgery procedures. Fourteen of the patients underwent continuous epidural anesthesia with 12 experiencing significant intraoperative hypotension. Three patients received general anesthesia with tracheal intubation because emergency surgery was needed. Three of the parturients are still recovering from their Cesarean delivery and are receiving in-hospital treatment for COVID-19. Three neonates were born prematurely. There were no deaths or serious neonatal asphyxia events. All neonatal SARS-CoV-2 nucleic acid tests were negative. No medical staff were infected throughout the patient care period.”</td>
<td>“Both epidural and general anesthesia were safely used for Cesarean delivery in the parturients with COVID-19. Nevertheless, the incidence of hypotension during epidural anesthesia appeared excessive. Proper patient transfer, medical staff access procedures, and effective biosafety precautions are important to protect medical staff from COVID-19.”</td>
</tr>
<tr>
<td>Cao et al. 2020(27)</td>
<td>Single-center retrospective review 10 pregnant women with COVID-19 at Maternal and Child Health Hospital of Hubei Province, Tongji Medical College between January 23, 2020, and February 23, 2020</td>
<td>To “evaluate the clinical characteristics and outcomes of pregnant women confirmed with COVID-19 to provide reference for clinical work.”</td>
<td>“All the 10 observed pregnant women including 9 singletons and 1 twin were native people in Wuhan. All of them were diagnosed mild COVID-19, and none one of the patients developed severe COVID-19 or died. Among the 10 patients, two patients underwent vaginal delivery, two patients underwent intrapartum cesarean section, and the remaining six patients underwent elective cesarean section. All of 10 patients showed lung abnormalities by pulmonary CT images after delivery. Their eleven newborns were recorded and no neonatal asphyxia was observed.”</td>
<td>“Pulmonary CT screening on admission may be necessary to reduce the risk of nosocomial transmission of COVID-19 during the outbreak period. And COVID-19 is not an indication of cesarean section.”</td>
</tr>
</tbody>
</table>

### Other Resources

Our literature searches also identified 13 articles that describe:

- A contingency plan for managing SARS CoV2 outbreak in NICUs. (28)
- A support tool for the planning of delivery and neonatal resuscitation of infants born by mothers with suspected or confirmed COVID-19 infection. (29)
A stepwise informed approach to rapidly establish an obstetric unit for suspected COVID-19 patients within existing resources.(30)

A classification system for maternal-fetal-neonatal SARS-CoV-2 infections.(31)

Safe handling of containers of expressed human milk in all settings during the SARS-CoV-2 (COVID-19) pandemic.(32)

Management strategies of neonatal jaundice during the coronavirus disease 2019 outbreak.(33)

Strategies to implement on labor and delivery units to reduce the risk of health care-associated transmission.(34)

Neonatal resuscitation and postresuscitation care of infants born to mothers with suspected or confirmed SARS-CoV-2 infection.(35)

Reorganization tips for preparing an obstetric unit in the heart of the epidemic strike of COVID-19.(36)

A protocol for intrapartum care of pregnant women with COVID-19 during labor and delivery.(37)

An operating room guide for confirmed or suspected COVID-19 pregnant patients requiring Cesarean delivery. 2020.(38)

Recommended ways to protect labor and delivery personnel from COVID-19 during the second stage of labor.(39)

Considerations for supporting the emotional, mental, and physical health needs of maternity care providers in the context of the unprecedented COVID-19 crisis.(40)

Selected Resources and Reference

Search Summaries

Our master’s-level medical librarians searched the following databases to identify the literature and related materials.

ECRI Resources [searched January 1, 2015, through April 28, 2020]

Search Strategy:

(COVID OR coronavirus) AND (labor OR deliver* OR pregnan* OR infant* OR neonat*)

Scan of COVID-19 Resource Center

Results: We identified one related report.

- People who are at higher risk for severe COVID-19 complications. [Clinical Risk Management Services]. 2020 Apr 14.


Search Strategy:


- #3 (coronavirus OR “corona virus” OR coronavirinae OR coronaviridae OR betacoronavirus OR COVID19 OR “COVID 19” OR nCoV OR “CoV 2” OR CoV2 OR sarscov2 OR 2019nCoV OR “novel CoV” OR “wuhan virus”) OR ((wuhan OR hubei OR huanan) AND (“severe acute respiratory” OR pneumonia) AND (outbreak)) OR "Coronavirus"[Mesh] OR “Coronavirus Infections”[Mesh] OR “COVID-19” [Supplementary Concept] OR “severe acute respiratory syndrome coronavirus 2” [Supplementary Concept] OR “Betacoronavirus”[Mesh]

- #4 (#1 OR #2) AND #3

Results: We identified 99 records.
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Search Strategy:

---
#1 ‘childbirth’/exp OR ((labor*:ti,ab OR labour*:ti,ab OR deliver*:ti,ab) AND (obstetric*:ti,ab OR pregnan*:ti,ab)) OR ‘obstetric delivery’/exp OR caesarean*:ti,ab OR cesarean*:ti,ab OR birth*:ti,ab OR births:ti,ab OR childbirth:ti,ab OR ‘child birth’:ti,ab OR ‘birth’/de OR parturition:ti,ab
---
#2 ‘newborn’/exp OR ((new:ti,ab OR newb*:ti,ab OR newly:ti,ab) AND (infant:ti,ab OR infants:ti,ab)) OR neonate*:ti,ab OR newborn*:ti,ab OR neonatal:ti,ab
---
#3 ‘coronavirus’ OR ‘corona virus’ OR ‘coronavirinae’ OR ‘coronaviridae’ OR ‘betacoronavirus’ OR ‘COVID19’ OR ‘COVID 19’ OR ‘ncov’ OR ‘cov 2’ OR ‘cov2’ OR ‘sarscov2’ OR ‘2019ncov’ OR ‘novel cov’ OR ‘wuhan virus’ OR ((wuhan OR hubei OR huanan) AND (‘severe acute respiratory’ OR ‘pneumonia’) AND outbreak) OR ‘coronavirinae’/exp OR ‘coronavirus infection’/exp OR ‘COVID 19’/exp OR ‘severe acute respiratory syndrome coronavirus 2’/exp OR ‘betacoronavirus’/exp
---
#4 (#1 OR #2) AND #3

Results: We identified four unique records.


Search Strategy:

---
#1 (coronavirus OR "corona virus" OR coronavirinae OR coronaviridae OR betacoronavirus OR COVID19 OR “COVID 19” OR nCoV OR "CoV 2" OR CoV2 OR sarscov2 OR nCoV OR "novel CoV" OR “wuhan virus”) OR ((wuhan OR hubei OR huanan) AND (‘severe acute respiratory’ OR ‘pneumonia’) AND outbreak)) OR [mh Coronavirus] OR [mh “Coronavirus Infections”] OR [mh Betacoronavirus]

Results: We did not identify any unique relevant publications.

Guidelines, Position and Consensus Statements [searched January 1, 2020, through April 28, 2020]

Search Strategy:

coronavirus OR “corona virus” OR coronavirinae OR coronaviridae OR betacoronavirus OR COVID19 OR “COVID 19” OR nCoV OR “CoV 2” OR CoV2 OR sarscov2 OR nCoV OR “novel CoV” OR “wuhan virus”

Results: We identified 32 relevant documents.

Selected Standards and Guidelines

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- Breastfeeding guidance post hospital discharge for mothers or infants with suspected or confirmed SARS-CoV-2 infection. [last updated 2020 Apr 23].

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- Breastfeeding when mothers have suspected or proven COVID-19. 2020 Apr 6.
- Delivery room considerations for infants born to mothers with suspected or proven COVID-19. 2020 Apr 6.
  - Centers for Disease Control and Prevention (CDC). [cited 2020 Apr 28]
  - Considerations for inpatient obstetric healthcare settings. [revised 2020 Apr 4].
  - Coronavirus disease (COVID-19) and breastfeeding. [last reviewed 2020 Mar 18].
  - Pregnancy and breastfeeding. [last reviewed 2020 Apr 15].
- Expert consensus for managing pregnant women and neonates born to mothers with suspected or confirmed novel coronavirus (COVID-19) infection. 2020.
  - Choice of PPE for obstetric anaesthetists according to mode of transmission risk. 2020 Apr 11.
  - Management of pregnant women with known or suspected COVID-19. 2020 Mar 16.
- Perinatal-neonatal management of COVID-19 infection - guidelines of the Federation of Obstetric and Gynecological Societies of India (FOGSI), National Neonatology Forum of India (NNF), and Indian Academy of Pediatrics (IAP). 2020.
- Queensland Health. [cited 2020 Apr 28].
- Royal College of Paediatrics and Child Health. COVID-19 - guidance for neonatal settings. [last modified 2020 Apr 27].
- Society for Maternal-Fetal Medicine (SMFM) and Society for Obstetric and Anesthesia and Perinatology (SOAP). Labor and delivery COVID-19 considerations. [last updated 2020 Apr 14].
Selected Web Resources. [searched April 28, 2020].

  - Coronavirus (COVID-19), pregnancy and breastfeeding: a message for patients. [last updated 2020 Apr 16].
  - COVID-19 FAQs for obstetrician-gynecologists, obstetrics. [cited 2020 Apr 28].
- Royal College of Obstetricians & Gynaecologists. Coronavirus infection and pregnancy. [cited 2020 Apr 28].
- UptoDate. [cited 2020 Apr 28]. Note: subscription required to access full text.


We identified registered clinical trials on this topic. See the list of ongoing trials and the comprehensive list of ongoing and completed trials. [Note: ongoing and comprehensive trial lists may contain trials that are outside the scope of this Clinical Evidence Assessment.]

References Reviewed (PubMed and EMBASE search dates were January 1, 2020, through April 27, 2020)


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Policy Statement
The information presented in this Clinical Evidence Assessment is highly perishable and reflects the state of the literature on this topic at the time at which searches were conducted and the Clinical Evidence Assessment was prepared. Clinical Evidence Assessments provide a guide to the published clinical literature and other information about a topic on which we received a client inquiry. The scope is customized to address the specific information needs of the requestor. The content reflects the information identified from searches of the available, published, peer-reviewed scientific literature, gray literature, and websites at the time the searches were conducted.

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