

INITIAL GUIDANCE:

Management of Infants Born to Mothers with COVID-19

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ABSTRACT

COVID-19, the disease caused by the novel coronavirus SARS-CoV-2, has led to an unprecedented global pandemic affecting persons of all ages. Severe respiratory disease can occur in adults, particularly the elderly and those with underlying health conditions. Limited data are available for pregnant women and newborns with COVID-19. A few small case series suggest that congenital and perinatal transmission to newborns from infected women may occur, likely infrequently. Pediatric data demonstrate that children of all ages are susceptible to SARS-CoV-2, and that infants under 1 year of age are at risk for severe disease although this still is a relatively rare outcome. Based on current limited evidence as of 3/30/2020, this report provides interim guidance for the management of infants born to mothers with confirmed and suspected COVID-19.

BACKGROUND

The novel coronavirus SARS-CoV-2 causing the illness COVID-19 has spread to more than 200 countries and territories (1). In the United States, cases are reported in all 50 states, the District of Columbia, and U.S. territories (2). International epidemiologic studies demonstrate that SARS-CoV-2 infection may cause clinical conditions ranging from asymptomatic viral shedding, to mild illness resembling the common cold, to severe influenza-like illness and viral pneumonia (3). Although deaths from COVID-19 predominantly occur in elderly patients and those with comorbidities, mortality has also been reported in otherwise healthy young and middle-aged adults. Multiple reports document COVID-19 infections among pregnant women (4-12). To date, COVID-19 infection does not appear to have had as negative an impact on pregnant women as infection with the coronaviruses that cause SARS and MERS (which caused severe and often fatal illness among pregnant women) or infection with influenza (which causes disproportionate illness and death among pregnant women in the third trimester of gestation). Pediatric cases of COVID-19 are so far reported as less severe than disease occurring among older individuals. However, one report of pediatric patients in China found that among 86/731 (11.8%) confirmed cases occurring among infants less than 1 year of age, 21/86 (24%) of those infants suffered severe or critical illness (13). No deaths were reported among these infants. Case reports document COVID-19 in children as young as 2 days of age (14-16).

PERINATAL TRANSMISSION AND CONGENITAL INFECTION

Considerable uncertainty exists regarding the potential for vertical transmission (prenatal/congenital or perinatal) of SARS-CoV-2 from infected pregnant women to their newborns. Evidence-based guidelines for managing antenatal, intrapartum, and neonatal care

around COVID-19 would require an understanding of whether the virus can be transmitted transplacentally; a determination of which maternal body fluids may be infectious; and data of adequate statistical power that describe which maternal, intrapartum, and neonatal factors influence perinatal transmission. In the midst of the pandemic these data do not exist, with only limited information currently available to address these issues. Nevertheless, management of neonates born to women with COVID-19 disease is occurring daily around the United States. This guidance document seeks to outline approaches that can be used now as healthcare systems are dealing with this unprecedented crisis. As noted below under Neonatal Management Recommendations, this guidance may not be fully applicable to clinical settings where limitations on testing and personal protective equipment (PPE) continue to exist.

Respiratory secretions and saliva are the primary infectious fluids for human-to-human transmission of SARS-CoV-2. One study of non-pregnant patients with severe illness also detected virus in blood and stool (17). Viremia correlated with progression to severe illness. Table 1 provides information on viral detection in biologic specimens from pregnant women. Data from a total of 11 women in China failed to detect virus in maternal whole blood, serum, vaginal mucus, amniotic fluid, and/or breast milk when virus was detectable in maternal nasopharyngeal specimens (4, 8, 11, 12). One study detected virus in maternal feces (8).

In addition, Table 1 addresses our current understanding of peripartum (around the time of birth) transmission, summarizing published data of newborn viral detection at birth, including only reports where the timing and content of neonatal testing was provided. Four reports from China with a total of 17 tested newborns found no evidence for mother-to-newborn transmission. In

contrast, two additional reports together document detection of SARS-CoV-2 in 4/34 tested newborns. Pneumonia was clinically and radiographically diagnosed in these 4 infants and abnormalities in neonatal inflammatory markers and transaminase levels were variably documented. The majority of cases described in Table 1 are characterized by maternal illness occurring in the 3rd trimester, shortly before delivery; Cesarean delivery; and immediate mother/newborn separation with variable timing of reunification. Current evidence is insufficient to fully inform critical perinatal management issues including: (a) optimal mode of delivery for infected mothers, accounting for both maternal morbidity and infection risk to newborn; (b) risk of newborn infection in relation to perinatal factors (e.g., duration of rupture of membranes, severity of maternal illness, and timing of maternal illness in relation to delivery mode); (c) the impact and necessity of mother/newborn separation; (d) the role of breastfeeding in promoting or protecting newborns from infection; and (e) factors that influence the postnatal risk of infection after discharge from the birth hospital.

Two studies describe detection of SARS-CoV-2-specific IgM and IgG in a total of 3 newborns of infected women, suggesting that transplacental transfer may have occurred resulting in fetal production of IgM antibody (18, 19). Well-described issues with false-positive IgM results in other diseases limit the interpretation of these studies, but they do support the need for further studies to assess the potential for *in utero* transmission (20).

NEONATAL MANAGEMENT RECOMMENDATIONS

Current evidence suggests that neonates born to women with COVID-19 – as well as neonates born to women with testing for COVID-19 pending at the time of delivery - should be considered

as persons under investigation (PUIs) for infection. Guidelines for perinatal care provided by the Centers for Disease Control and Prevention (CDC) and by the American College of Obstetricians and Gynecologists support this designation (22, 23). The following interim guidance from the American Academy of Pediatrics is based on the current, quite limited evidence as of March 30, 2020, addressing risk of perinatal transmission to the newborn and the infectious risk to providers caring for the newborn. *They may not be applicable to every clinical environment, where availability of testing and PPE may require individualized risk/benefit assessment and different decision-making in the management of specific cases. The clinician should anticipate that this guidance will be revised when further evidence is available to inform newborn management.*

Personal protective equipment and isolation precautions: SARS-CoV-2 is a respiratory virus transmitted person-to-person primarily by respiratory droplets. Infection is mediated by virus present in respiratory secretions of an infected person contacting the mucus membranes of another person. CDC guidance states that high-risk exposure to a person with COVID-19 disease requires either direct physical contact or close (<6 feet) contact for a prolonged period of time. SARS-CoV-2 is not currently believed to be transmitted by infectious aerosols generated spontaneously by infected persons, but experimental evidence using aerosolizing equipment demonstrates that the virus can remain in the air for up to 3 hours (24). Definitions of precautions are as follows:

- **Droplet and Contact Precautions:** gown, gloves, standard procedural mask and eye protection (either face shield or goggles) should be used for most encounters with infants born to mothers with COVID-19. Personal eyeglasses are not adequate protection.

- **Airborne, Contact and Droplet Precautions:** gown, gloves, N95 respiratory mask with eye protection, or air-purifying respirator (powered air-purifying respirator (PAPR) or controlled air-purifying respirator (CAPR), both of which provide eye protection) should be used when patients require bag-mask ventilation, intubation, tracheal suctioning, nasal cannula oxygen at a flow greater than 2 liters per minute/kilogram, continuous positive airway pressure and/or positive pressure ventilation of any type, given the potential for these supports to generate aerosols.

Many centers currently suffer from shortages of PPE and clinicians may need to make risk-assessment decisions about the use of PPE in specific clinical circumstances.

Delivery Room Management of Neonates: Neonatal clinicians should attend deliveries based on their normal center-specific policies; maternal COVID-19 alone is not an indication to do so. This is important to conserve use of PPE. In addition, hospitals and physicians may reevaluate the appropriateness of institutional traditions for mandatory attendance by the neonatal team in the delivery room at low-risk deliveries, such as at planned cesarean section delivery at term gestation, and instead allow the neonatal team to “standby” to conserve PPE. If neonatal clinicians are needed to perform infant stabilization, the responding clinicians should use Airborne, Droplet, and Contact Precautions-level PPE, given both the increased likelihood of maternal virus aerosols and the potential need to intubate, perform airway suctioning, and initiate positive pressure ventilation, all of which may generate infant aerosols. Clinicians should not alter indicated newborn care due to maternal COVID-19, although in some hospitals, the physical location where some care is administered may be altered to facilitate maternal and infant separation if no additional risk accrues to the infant.

Maternal and newborn separation: While difficult, temporary separation of mother and newborn will minimize the risk of postnatal infant infection from maternal respiratory secretions. Published data on newborn health outcomes after birth to mothers with COVID-19 universally describe separation at birth, in many cases for prolonged periods of time (Table 1); therefore, the risks of postnatal infection in the immediate newborn period consequent to usual mother-infant care cannot be adequately assessed. The benefits of separation may be greater in mothers with more serious illness. The likely benefits of temporary maternal and newborn separation at birth for decreasing the risk of newborn infection should be discussed with the mother, optimally prior to delivery.

Newborn admission after maternal separation: Infants born at or near term (per local center policies) who are well-appearing at birth may be admitted to specific areas physically separate from newborns unaffected by maternal COVID-19. Newborns should be bathed as soon as reasonably possible after birth to remove virus potentially present on skin surfaces. Clinical staff should use Droplet and Contact Precautions until newborn virologic status is known to be negative by SARS-CoV-2 PCR testing, as detailed below. Infants born requiring neonatal intensive care optimally should be admitted to a single patient room with the potential for negative room pressure (or other air filtration systems.) If this is not available, or if the COVID-exposed infant census requires cohorting, infants should be maintained at least 6 feet apart and/or placed in air temperature-controlled isolettes. Airborne, Droplet, and Contact Precautions and negative room pressure should be used for the care of infants requiring CPAP or any form of mechanical ventilation.

Breast milk feeding: No study to date has demonstrated the presence of SARS-CoV-2 in breast milk (Table 1). Mothers may express breast milk (after appropriate breast and hand hygiene) and this milk may be fed to the infant by designated caregivers. Breast pumps and components should be thoroughly cleaned in between pumping sessions using standard center policies that must include cleaning the pump with disinfectant wipes and washing pump attachments with hot soapy water. In addition to the known benefits of breastfeeding, mothers' milk may provide infant protective factors after maternal COVID-19. Promoting breast milk feeding and supporting establishment of maternal milk supply may offer additional benefits to well and sick newborns.

Alternative well newborn care: If the mother chooses to room-in with her infant rather than be separated; or if the center does not have the capability of caring for the infant in a separate area, the infant should remain at least 6 feet from mother at all times, with breast milk feeding per the above recommendations. Placing the infant in an air temperature-controlled isolette rather than in a bassinet, or using a physical barrier such as a curtain between the mother and infant, may afford greater infant protection. If the mother also requests skin-to-skin contact with her infant, including direct breastfeeding, she should comply with strict preventive precautions, including the use of mask and meticulous breast and hand hygiene. Institutions could consider formal documentation of maternal decisions regarding the recommendations for separation.

Newborn viral testing: Where testing capacity is available, neonates should be tested for SARS-CoV-2 infection using available molecular assays. Testing well newborns may facilitate plans for

care after birth hospital discharge, and will contribute to the overall understanding of viral transmission. If testing is not readily available and/or is in short supply, centers may opt for clinical monitoring only. Testing infants who require prolonged neonatal intensive care should be performed to determine the potential contribution of COVID-19 to observed clinical illness. In addition, testing infants who require ongoing neonatal intensive care will allow centers to discontinue Droplet and Contact precautions or Airborne precautions and consumption of limited PPE if testing is negative.

The optimal timing and extent of testing is currently unknown. Informed by limited data on viral detection, and with the aim of distinguishing transient viral colonization from established infection, the following procedures are currently recommended:

- Molecular assay testing should be done first at ~24 hours of age
- Repeat testing should be done ~48 hours of age. For well newborns who will be discharged prior to 48 hours of age, clinicians may consider not obtaining this test. Note that there have been reports of neonates who test negative at 24 hours but positive at 48-72 hours (personal communication, D Kimberlin and K Puopolo).
- At each test, consider using swabs of throat and nasopharynx. One swab that samples first the throat and then the nasopharynx may be used to conserve swabs and PCR testing reagents. This single swab then should be placed in one viral transport media tube and sent to the lab for a single PCR test to be performed.
- Clinicians may consider additional rectal swab testing if available at their center, particularly for sick infants requiring prolonged hospital care. Many sites currently are not able to perform PCR testing of rectal swab specimens. If performed, the rectal swab

should be placed in a viral transport media tube separate from that used for the respiratory specimens, and then sent to the lab for PCR testing.

For infants who require ongoing hospital care, centers may transition to the use of universal precautions if two tests obtained at least 24 hours apart are negative. For infants who are positive on their initial PCR testing, follow-up testing of combined specimens from the throat and nasopharynx should be done at 48-72 hour intervals until two consecutive negative tests.

Newborn birth hospital discharge: Well newborns should receive all indicated care, including circumcision if requested. Well newborns should be discharged from the birth hospital based on the center's normal criteria. Specific considerations include:

- Infants determined to be infected by molecular testing (or whose status cannot be determined due to lack of testing), but with no symptoms of COVID-19, may be discharged home on a case-by-case basis with appropriate precautions and plans for frequent outpatient follow-up contacts (either by phone, telemedicine, or in-office) through 14 days after birth. Specific guidance regarding use of standard procedural masks, gloves and hand hygiene should be provided to all caretakers. See

<https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-prevent-spread.html>

Uninfected individuals >60 years of age and those with comorbid conditions should not provide care if possible.

- Infants with negative SARS-CoV-2 molecular testing should optimally be discharged to the care of a designated healthy (non-infected) caregiver. If the mother is in the same household, she should maintain a distance of at least 6 feet for as much of the time as

possible, and when in closer proximity to the neonate should use a mask and hand-hygiene for home newborn care until EITHER (a) she has been afebrile for 72 hours without use of antipyretics, *and* (b) at least 7 days have passed since symptoms first appeared; OR she has negative results of a molecular assay for detection of SARS-CoV-2 from at least two consecutive nasopharyngeal swab specimens collected ≥ 24 hours apart. Other caregivers in the home who remain under observation for development of COVID-19 should use standard procedural masks and hand hygiene when within 6 feet of the newborn until their status is resolved.

Maternal visitation for infants requiring ongoing hospital care: Mothers with COVID-19 should not visit infants requiring neonatal intensive care until they meet all the requirements outlined below. Given the potential consequences of disease transmission to preterm and/or critically ill newborns and neonatal caregivers, these recommendations are based on the most conservative CDC recommendations for discontinuing transmission-based precautions for patients with COVID-19 in the hospital setting (25), and are more stringent than the requirements for mothers and well newborns after hospital discharge.

- Resolution of fever without the use of antipyretics for at least 72 hours *and*
- Improvement (but not full resolution) in respiratory symptoms *and*
- Negative results of a molecular assay for detection of SARS-CoV-2 from at least two consecutive nasopharyngeal swab specimens collected ≥ 24 hours apart

It is understood that cough alone may persist for prolonged periods. Non-maternal parents who are PUIs should not visit infants requiring ongoing hospital care until they are determined to be uninfected by molecular testing and/or clinical criteria. Non-maternal parents who develop

symptoms of disease and are confirmed to have COVID-19 must also meet the requirements above before visiting infants in the neonatal intensive care unit.

KEY POINTS

- Current evidence is consistent with low rates of peripartum transmission and is inconclusive about *in utero* transmission of SARS-CoV-2 from mothers with COVID-19 to their newborns.
- Neonates can acquire SARS-CoV-2 after birth. Their immature immune system leaves newborns vulnerable to other serious respiratory viral infections, raising concern that SARS-CoV-2 may cause severe disease among neonates.
- 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.

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Table 1. SARS-CoV-2 in Pregnant Women and Newborns and Molecular Testing Results

Ref. #	Tested Patients	Clinical Data	Tested specimens
4	6 women 6 infants	<ul style="list-style-type: none"> • Maternal symptom onset 1-7 days before delivery • Births at 36 0/7 – 39 4/7 weeks • All cesarean delivery • Two births at 36 weeks due to preterm labor • No maternal intubations or deaths • No neonatal illness 	<ul style="list-style-type: none"> • Maternal throat swabs positive • Amniotic fluid and breast milk negative in all women • Neonatal cord blood and nasopharyngeal swabs negative
8	3 women 3 infants	<ul style="list-style-type: none"> • Maternal symptoms 1-15 days prior to delivery; tested positive 0-3 days prior to delivery • Births at 38 4/7 – 40 0/7 weeks • Cesarean delivery (2 cases); vaginal (1 cases) • Infants separated immediately after birth and bathed shortly thereafter • No maternal intubations or deaths; no neonatal illness 	<ul style="list-style-type: none"> • Maternal positive tests from oropharyngeal swab; feces positive in one woman • Breast milk, vaginal mucus, and placenta negative • Neonatal oropharyngeal swab, urine, feces, whole blood and serum collected immediately after birth and all negative. • Neonatal oropharyngeal swabs negative Day 1
11	1 woman 1 infant	<ul style="list-style-type: none"> • Mother with symptoms 6 days prior to delivery • Intubated on day of delivery due to progressive illness, prior to delivery • Birth at 30 weeks gestation • Cesarean delivery due to non-reassuring fetal status • Infant separated at birth and fed formula • Mother recovered; newborn well 	<ul style="list-style-type: none"> • Maternal sputum tested positive 2 days prior to delivery • Amniotic fluid and placental negative • Cord blood, newborn gastric aspirate and newborn throat swab negative at time of delivery • Newborn throat and stool swab negative Day 3 • Newborn throat swab negative Day 7 and Day 9
12	1 woman 1 infant	<ul style="list-style-type: none"> • Maternal symptoms 1 day prior to delivery • Cesarean delivery due to maternal condition • Mother wore N95 mask during delivery • Newborn separated at 10 minutes of age; fed formula • Infant with lymphopenia, elevated liver function tests 	<ul style="list-style-type: none"> • Maternal pharyngeal swab positive 1 day postpartum • Placenta and breast milk negative • Cord blood negative • Newborn pharyngeal swab positive at 36 hours of age • Newborn pharyngeal and anal swabs negative by 15 days of age
21	7 women 7 infants	<ul style="list-style-type: none"> • Maternal symptoms 1-4 days before delivery (2 cases); day of delivery (2 cases); 1-3 days after delivery (3 cases) 	<ul style="list-style-type: none"> • Maternal throat swab positive • Infant pharyngeal swabs on Day 1 (4); Day 3 (1); Day 7 (1); Day 9 (1) all negative

		<ul style="list-style-type: none"> • Births at 33 6/7 – 39 0/7 weeks • Cesarean delivery in all cases • Fetal distress (5 cases) • ROM 5-7 hours prior to delivery (2 cases) • 6/7 infants with respiratory or gastrointestinal symptoms; 1/6 infants died 	
16	3 women 3 infants	<ul style="list-style-type: none"> • Details reported for 3/33 positive mothers whose infants had positive tests • Mothers with positive tests 0-3 days prior to delivery • Births at 40 0/7, 40 4/7 and 31 2/7 weeks • Delivery by cesarean section • ROM prior to delivery in 1 (possibly 2) cases • Separation at birth • Two term infants developed fever and instability 1-2 days after delivery; both diagnosed with pneumonia and recovered • Preterm infant unstable from birth 	<ul style="list-style-type: none"> • Nasopharyngeal and anal swabs positive on days 2 and 4; all negative by day 6