Committee Opinion No. 400: COVID-19 and Pregnancy

Chelsea Elwood, Vanessa Poliquin, Isabelle Boucoiran, Julie Van Schalkwyk, Deborah Money, Mark Yudin, Ashley Raeside, Heather Watson, on behalf of the Infectious Disease Committee of the Society of Obstetricians and Gynaecologists of Canada.

Original: March 13th, 2020
Updates: July 27th, 2020 and Dec 1st, 2020

Disclaimer for the Committee Opinion

Within this Committee Opinion, the members of the Infectious Diseases Committee of the SOGC have attempted to provide general guidance principles for the management of COVID-19 in the pregnant patient. Owing to the diversity of epidemiology of COVID-19 across jurisdictions at any point in time, the adaptation of these principles will vary greatly for individual providers within the context of their current infrastructure and resources. We acknowledge that some providers will still have specific questions that are beyond the scope of these guidelines and we encourage you to consult with local experts if possible, and look at national, regional and institutional resources for up-to-date information on testing and infection prevention protocols. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection.html

Background: COVID-19 Illness

In December 2019, a novel coronavirus, eventually termed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was identified in Wuhan, China. By March 2020, Canada had detected several dozen cases, most of them in returning international travellers or their close contacts.[1] The clinical presentation of infection with SARS-CoV-2 is commonly referred to as COVID-19. By early April over 22,000 cases had been detected nationally, with the majority having been acquired through community spread.[2] As of Nov 20, 2020, COVID-19 has infected more than 315,751 people in Canada and resulted in 11,265 deaths, according to the Public Health Agency of Canada. Given that pneumonia, sepsis and multi-organ failure are important causes of maternal morbidity and mortality with this disease, the emergence and global spread of COVID-19 has raised concerns about the implications of this outbreak for pregnant individuals and their fetuses. Patients are looking to their pregnancy care providers for information and guidance on how to prevent or manage infection with COVID-19.

Background: Respiratory Illness in Pregnancy

Due to physiologic changes that occur in pregnancy, when compared with their non-pregnant counterparts, pregnant patients with lower respiratory tract infections historically experience worse outcomes, including higher rates of hospital and intensive care unit admission.[3] Since 2002, there have been two other global outbreaks of highly pathogenic coronaviruses: severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). The literature on SARS and MERS in pregnancy are limited to a handful of case reports and series.[4-9] Many of these cases involved severe morbidity including the need for intensive care and cardiorespiratory support and associated mortality. The only published case-control study showed that pregnant individuals with SARS experienced worse outcomes than non-pregnant peers of similar age.[10] As well, stillbirth, intrauterine growth restriction, and preterm birth have been reported in pregnancies affected by SARS and MERS in the second and third trimesters.[4, 9] It is important to note, however, that a number of pregnancies had good outcomes despite maternal infection with SARS or MERS,[6-8] with adverse outcomes largely related to the severity of maternal respiratory compromise.

Pregnancy as a Risk Factor for COVID-19 Morbidity

The reported case-fatality rate for the general population infected with COVID-19 is lower than that of either SARS or MERS.[3] Evaluation is ongoing to determine whether there are any specific effects of COVID-19 on pregnant individuals and their fetuses, but recent data from outcomes in Canada can help inform. To date,there have been over 1600 pregnant patients in Canada diagnosed with COVID-19. An ongoing case count is updated regularly and can be accessed at: https://ridprogram.med.ubc.ca/cancovid-preg/.[11] Early data suggested that, in general, most pregnant women who acquired COVID-19 in pregnancy experience mild to moderate symptoms and have a good prognosis but data on adverse outcomes is evolving.[12] The rate of Canadian pregnant women infected with COVID-19 who are asymptomatic will be available in early 2021 to help inform the frequency of asymptomatic infection but to date this has been quite common.[13] What has been consistently reported, is that similar to the general population, comorbidities including advanced maternal age (>35 years), obesity, pre-existing diabetes mellitus and hypertension put pregnant women at increased risk of severe COVID-19 disease, including ICU admission and need for mechanical ventilation.[14-16] These medical comorbidities are strongly tied to the social determinants of health.[17] Emerging disaggregated data show that communities of colour, and people living in poorer neighbourhoods are experiencing disproportionately higher rates of COVID-19 infection, severe disease, and mortality.[14, 18-20]

COVID-19 Outcomes in Obstetrical Populations

Reports to date internationally[14-16, 21, 22] suggest that the proportion of pregnant women with severe or critical illness ranges from 5% to 31%, however comparison between regions is challenging due to the lack of standardized definitions for disease severity. This is being rectified with a global effort towards data

harmonization. A meta-analysis of 77 studies reporting on pregnant women infected with COVID-19 found that the proportion requiring ICU admission was approximately 4%, need for invasive ventilation was 3%, need for extracorporeal oxygenation was 0.4%, and maternal mortality occurred for 0.1% of cases.[12] This review identified that, compared to non-pregnant women of the same age, pregnant women have an elevated risk for ICU admission (RR 1.62, 95% CI 1.33-1.96) and mechanical ventilation (RR 1.88, 95% CI 1.36-2.60), but the risk of death was not different (RR 0.81, 95% CI 0.49-1.33). However, interim Canadian data from a 3 province analysis of population outcomes in pregnancy reveals that hospitalization and ICU admission are both increased in pregnant women over non-pregnant women by a wider margin.[11] The rate of hospitalization was 11% and the rate of ICU admission was 2.3% (**Table 1**).

Table 1: COVID-19 in Pregnancy; Canadian Interim Data n = 353*

COVID-19 Outcome	Cases	Percent
Hospitalization	39	11%
Oxygen Supplementation	8	2.3%
ICU Admission	8	2.3%
Mechanical Ventilation	<6	N/A
Coagulopathy	<6	N/A
Mortality	0	0

*Interim Canadian data reflects ON, BC and AB cases March 1, 2020 - Sept 30, 2020
**National data as of Dec 2/20

Obstetrical Outcomes in COVID-19 Positive Cases

Overall, pregnancy outcomes among the reported cases have been largely good.[6, 23-43] Spontaneous and iatrogenic preterm labour have been the most reported adverse pregnancy outcomes among patients with COVID-19. Rates of preterm birth (before 37 weeks gestation) as high as 30% were reported from early cohorts,[14, 44] however more recent review studies estimate a more reassuring 15% incidence.[12] In the interim Canadian data (Table 2)[11] the rate of preterm birth was 15% which is approximately 2 fold the background rate in the population. While comparison of perinatal outcomes between jurisdictions is limited by the same challenges as for maternal outcomes, most authors agree that pregnancy outcomes may be associated with the severity of maternal infection.[35, 44] Obstetrical intervention and timing of delivery to optimize outcome must be carefully considered. At present there are inadequate data to recommend for or against induction of labour with a diagnosis of mild COVID-19 at term. While expectant management may result in an emergent delivery in the setting of acute antenatal decompensation,[45] case reports demonstrate patients with an initially mild presentation suffering sudden deterioration in the

immediate postpartum period, presumed to be secondary to parturition.[46] Delivery planning should be assessed on an individual basis with a multidisciplinary team.

Table 2: Obstetrical Outcomes in COVID-19; Canadian Interim Data n = 353*

Pregnancy Outcome	Outcome / Reported	Percent
Live Birth	295 / 311	95%**
Preterm Birth	50 / 344	15%
Caesarean Section	98 / 294	33%
Neonatal Intensive Care	47 / 305	15%
5 Minute Apgar ≥7	287 / 293	98%

*Interim Canadian data reflects ON, BC and AB cases March 1, 2020 - Sept 30, 2020
**Non-live birth includes spontaneous and therapeutic abortions, and stillbirth

Transmission Routes

Although the literature around aerosol generation and the role of different aerosol size in transmission continues to evolve, based on the best evidence to date the primary mode of transmission of COVID-19 appears to be droplet and contact type spread, requiring close prolonged contact with infectious individuals. The transmission of COVID-19 does not appear to be in keeping with other airborne viruses such as measles and the secondary attack rate in hospitals is low at 0.7%.[47] While there are rare circumstances where the airborne transmission of virus may have occurred, these have been in crowded circumstances with poor ventilation outside of healthcare settings,[48-50] which have extensive engineering and other controls to prevent transmission. The risk of 'airborne' transmission from aerosols in health care continues to be from Aerosol Generating Medical Procedures (AGMP) and presently there is inadequate evidence that any stage of pregnancy, labour and delivery is an AGMP. Given this providers may choose their personal protective equipment based on local guidance and comfort.

Vertical Transmission

The available case literature for COVID-19 in pregnancy suggests that, similar to findings related to SARS-CoV-1 and MERS, vertical transmission is uncommon and teratogenicity has not been observed to date.[23-30, 32, 34-37, 39-43] However, data concerning COVID-19 infection during the first trimester, when embryogenesis occurs, are limited, so risk of congenital anomaly associated with COVID-19 cannot yet be excluded. While the potential for vertical transmission is a topic of great concern, universally accepted definitions which clearly delineate in utero infection versus environmental contamination do not yet exist.

For example, a small number of cases have reported findings suggestive of vertical transmission but only a few of these have included convincing evidence such as a positive newborn nasopharyngeal PCR (polymerase chain reaction) within the first 24 hours of life.[51-54] Where newborn testing is performed beyond 24 hours, the possibility of horizontal transmission cannot be excluded and as such, the origin of infection as occurring in utero is less compelling. The complexity of interpreting neonatal serologic status also lends confusion to the diagnosis of vertical transmission with the use of tests known to have high false-positive rates. Until widespread, reliable serologic assays are available, these findings should be interpreted with caution. There may be an association between severe maternal illness and vertical transmission, as highlighted in a recent Canadian case in which both the mother and newborn had a known immunologic disorder leading to increased susceptibility to infection.[55] The majority of studies, however, reflect a large number of reassuring pregnancy outcomes with negative PCR testing of both the newborn in the first hours of life and all other products of conception.[24, 25] Estimating the burden of and risk factors for vertical transmission of COVID-19 is an important priority for the CANCOVID-Preg study, but to date it is considered very rare.

Horizontal Transmission: Newborn Risk

Estimating the risk of newborn infection related to cohorting infants with their mothers remains unclear and controversial. As this is a droplet and contact transmitted virus, extrapolation has been made from the outcomes from similarly transmitted infections (influenza, H1N1, SARS), where mothers and infants have safely roomed-in together provided maternal health is adequate for newborn care and infant health does not require neonatal ward admission.[56] Transmission of SARS-CoV-2 antibodies via breast milk has been documented, however, the protective benefits are not yet clear.[57] Guidelines from China[58] and the USA[59] however, recommend immediate separation of mother and infant, whereas FIGO,[60] the WHO,[61] RCOG[62] and the Italian COVID-19 Obstetrics Task Force[22] all recommend preserving the mother-infant dyad with use of a maternal mask, hand hygiene, and cleansing the breast if applicable, with all newborn contact. These represent two very disparate interpretations of the same body of literature. Given the general benefits of breastfeeding for maternal mental health and infant thriving,[63-65] and specific evidence that it helps prevent newborn respiratory infection,[41] taken with the generally mild disease seen in the paediatric population, we recommend rooming-in and breastfeeding within the first hour of life as per maternal values.

Interim Canadian data reflect 98% of newborns were assessed for Apgar >7 at 5 minutes, 85% of normal birthweight, with 15.4% admitted to neonatal intensive care - in keeping with a 15% preterm birth rate. Infant testing at birth is incompletely reported, but 80.4% of newborns delivered of COVID-associated pregnancies had negative testing, with <6 infants positive.[11]

Based on our current understanding of the global outbreak, the following points represent our understanding of COVID-19 in pregnancy with specific recommendations for antepartum, intrapartum and postpartum care. Contact with healthcare workers should be minimized and hospital stay should

include a prompt discharge plan.[66] Across all periods of pregnancy, care is required to avoid stigmatization and to ensure that patients feel welcome in their care environment. Providers should continue to deliver standard of care for obstetrical management regardless of a patient's COVID-19 status. Use of virtual means may facilitate engagement in care during the infectious period, but if in-person care is medically indicated, it should not be delayed.

Antepartum Care

- Obstetrical patients with respiratory symptoms should be asked to wear a surgical mask immediately upon presentation to a healthcare facility if they are able to tolerate it.
- Pregnant patients suspected of having or having been exposed to COVID-19 should be triaged quickly, given a mask to wear, and transferred to a single-occupancy room as quickly as possible.
- Testing should be performed as per local guidelines and recommendations. Pregnancy does not appear to alter test performance.
- Expectant management at home may be appropriate for many pregnant patients, however given the increase in adverse outcomes, close virtual follow-up should be instituted to permit rapid admission should clinical condition worsen. For those requiring admission, droplet and contact infection precautions are adequate.
- Medically indicated obstetrical or medical visits need to be accommodated with appropriate infection control measures.
- The use of N95 respirators is indicated for aerosol-generating medical procedures (e.g., intubation) in the setting of suspected or known COVID-19 infection not yet declared recovered by public health authorities. The duration and discontinuation of precautions should be determined in accordance with Public Health Agency of Canada guidelines,[38] and provincial and territorial guidance.
- Health care providers can consider empiric antibiotic therapy for superimposed bacterial pneumonia in pregnant patients with confirmed COVID-19 infection or severe respiratory disease. First-line antibiotics are oral amoxicillin for stable patients and ceftriaxone for severe disease, based on general recommendations for the management of pneumonia.
- For maternal surveillance, close monitoring or initiation of an obstetrical early warning system is appropriate.
- Initiation of antepartum corticosteroids for fetal maturation is recommended as per current guideline[67] if preterm delivery is anticipated based on maternal condition.[39]
- Initiation of corticosteroid therapy for maternal benefit should be initiated in cases of severe infection to reduce the risk of COVID-19 associated mortality. Standard of care for adults severely affected by COVID-19 would be dexamethasone 6 mg daily for up to 10 days.[a]
- Given that the impacts on the placenta are still unknown, women convalescing from COVID-19 should be instructed to monitor for fetal movements (where appropriate based on gestational age) and decreased fetal movement should be assessed as per standard care.

- Antepartum fetal surveillance of confirmed cases of COVID-19 should occur monthly and include fetal ultrasound assessment for growth and anatomy.

[a]Efforts to reduce mortality across populations include steroid therapy, demonstrated to be effective in the RECOVERY trial. A ten-day course of dexamethasone has been shown to significantly decrease mortality for patients on supplemental oxygen (RR 0.80 [0.67 to 0.96]; p = 0.0021) or on mechanical ventilation (RR 0.65 [95% confidence interval 0.48 to 0.88]; p = 0.0003).[68] This pan-national study included an alternate regimen (V7.0 item 2.4.1) in pregnancy, with steroids less likely to cross the placenta, in order to minimize fetal impact of prolonged corticosteroid exposure, and to minimize lactation inhibition seen with dexamethasone.[69] They advised prednisolone or hydrocortisone instead, while authors of the Green Journal recommended methylprednisolone for similar reasons.[70] However, to date, very little is known about the impact of any of these medications in COVID-19 affected pregnancy due to limited inclusion in clinical trials. Where both maternal and fetal needs indicate for steroid therapy (e.g. maternal oxygen saturation <95% requiring supplementation and premature fetal viability), dexamethasone should be considered the drug of choice for a routine two-day course. The remaining eight-day interval of maternal therapy (or 10 day previable/term/postpartum course) should be prescribed in balance between unintended fetal effects and severity of presentation, determined by a multidisciplinary team. While prednisolone, methylprednisolone and hydrocortisone have minimal placental passage, they performed slightly less well than dexamethasone in the RECOVERY Trial.

Intrapartum Care

- Droplet and contact precautions should be used, including wearing a surgical mask with eye protection, a gown, and gloves.
- Use of N95 respirators should be reserved for aerosol-generating procedures (e.g., intubation) in the setting of suspected or known COVID-19 infection not yet declared recovered by public health authorities.
- In the event of precipitous birth, with insufficient time to screen and determine COVID status or risk adequately, it is safest to presume exposure until such time as screening can be completed.
- Health care personnel in the room should be minimized.
- It is advisable to limit the presence of symptomatic family and household contacts in the delivery suite and visitation should be permitted in accordance with locally developed infection prevention and control protocols.
- Intrapartum fetal monitoring in the form of EFM should be considered given evidence showing fetal distress during labour.
- Cesarean delivery should be reserved for obstetrical indications.
- There is no data to indicate that the second stage of labour generates aerosols and, as such, droplet and contact precautions are considered sufficient for vaginal delivery.

- Given that intubation is considered an aerosol-generating procedure, consideration should be given for the surgical team to wear N95 respirators for Cesarean delivery, because the need to convert from neuraxial to general anesthesia is often unpredictable. Depending on the supply chain for PPE, it may be necessary to triage the use of N95 based on likelihood of needing to convert to a general anaesthetic and this should be discussed with the entire surgical team prior to surgery.
- There is no evidence to avoid delayed cord clamping or to encourage early cleansing of the infant. Routine practices such as skin-to-skin contact (with use of maternal mask and performance of hand-hygiene) and delayed cord clamping should continue.
- Hospital birth is preferred to home birth for patients who are being tested or who have tested positive for COVID-19, in light of the challenges associated with ensuring appropriate personal protective equipment in the home setting, inability to control ventilation and the high rates of fetal distress that have been reported in the literature.
- Regardless of the gestational age at which a pregnant patient was infected COVID-19, the newborn infant should be tested for COVID-19 at birth (i.e., nasopharyngeal swab for COVID-19 polymerase chain reaction within the first 2 hours of life).

Postpartum and Newborn Care

- Management in the post-partum period should be guided by a patient-centred discussion about the available evidence and its limitations.
- If breastfeeding is chosen, it should be encouraged within the first hour of life after appropriate hand hygiene, while the mother is wearing a mask. Cleansing the chest/breast could be considered. Hydration should be emphasized especially in the setting of fever.
- If maternal choice is to bottle feed, skin-to-skin contact is still encouraged. If the mother is too unwell to provide infant care, support should be offered with pumping, donor milk or formula-based nutrition based on patient wishes.
- We do not recommend universal isolation of the infant from either confirmed or suspected infection in the mother. Patients should be educated about skin-to-skin contact benefits both mother and newborn:
    - Decreased maternal anxiety in the immediate postpartum
    - Decreased depression for the first year postpartum
    - Increased uterine tone with decreased bleeding
    - Improved weight gain and sleep quality in the newborn
- Given the significant mental health burden of both the pandemic and a diagnosis of COVID-19, prioritizing close contact for the mother-baby unit is of particular importance. Expectations and infant-care support should be individualized to maternal condition and values.
- Discharge counselling should reinforce good handwashing and application of a mask prior to all infant care, with frequent cleaning of high-touch surfaces. Consideration should be given to the

mother's ability to access necessary equipment such as masks and provisions should be made accordingly.[57]

Consideration for Vaccination

Pregnant women are currently an under-represented investigational population in the ongoing development of COVID-19 vaccines. This should not automatically exclude pregnant women from being vaccinated when vaccines become available. Of note, many pregnant women will fall into early categories for vaccine implementation such as health care workers. Policies regarding how and when to offer a vaccine to pregnant women should consider likelihood of infection, and probability and severity of harms associated with infection, weighed against the protection from the vaccine as compared to other alternative methods of protection, and the likelihood of harms associated with a vaccine. It is important to continue to advocate for the inclusion of pregnant women in vaccine research; as identified by the PREVENT Working Group, "the absence of evidence and the mere theoretical or even documented risk of fetal harm is generally not sufficient to justify denying pregnant women access to a vaccine in an outbreak or epidemic."

Conclusion

In the current COVID-19 pandemic, the unique needs of pregnant individuals and their fetus/newborn(s) need to be addressed. As with any epidemic, data are evolving and a measured approach to management is required. Based on this evidence to date on COVID-19 as well as the literature on outbreaks of SARS, MERS and other emerging pathogens, and based on evolving data from CANCOVID-Preg, the SOGC's Infectious Disease Committee has created this committee opinion to help guide maternity care providers in the care of pregnant patients. This guidance is based on the evidence to date and will continue to be updated as more information emerges.

REFERENCES

1. Government of Canada. Coronavirus disease (COVID-19): Outbreak update. 2020. Available from: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection.html.

2. COVID-19 Canadian Outbreak Tracker. Esri Canada. Available from: https://resources-covid19canada.hub.arcgis.com/app/eb0ec6ffdb654e71ab3c758726c55b68.

3. Rasmussen SA, Smulian JC, Lednicky JA, Wen TS, Jamieson DJ. Coronavirus Disease 2019 (COVID-19) and pregnancy: what obstetricians need to know. Am J Obstet Gynecol. 2020;222:415-26. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32105680.

4. Wong SF, Chow KM, Leung TN, Ng WF, Ng TK, Shek CC, et al. Pregnancy and perinatal outcomes of women with severe acute respiratory syndrome. Am J Obstet Gynecol. 2004;191:292-7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/15295381.

5. Maxwell C, McGeer A, Tai KFY, Sermer M. No. 225-Management Guidelines for Obstetric Patients and Neonates Born to Mothers With Suspected or Probable Severe Acute Respiratory Syndrome (SARS). J Obstet Gynaecol Can. 2017;39:e130-e7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28729104.

6. Zhang JP, Wang YH, Chen LN, Zhang R, Xie YF. [Clinical analysis of pregnancy in second and third trimesters complicated severe acute respiratory syndrome]. Zhonghua Fu Chan Ke Za Zhi. 2003;38:516-20. Available from: https://www.ncbi.nlm.nih.gov/pubmed/14521763.

7. Robertson CA, Lowther SA, Birch T, Tan C, Sorhage F, Stockman L, et al. SARS and pregnancy: a case report. Emerg Infect Dis. 2004;10:345-8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/15030710.

8. Yudin MH, Steele DM, Sgro MD, Read SE, Kopplin P, Gough KA. Severe acute respiratory syndrome in pregnancy. Obstet Gynecol. 2005;105:124-7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/15625153.

9. Schwartz DA, Graham AL. Potential Maternal and Infant Outcomes from (Wuhan) Coronavirus 2019-nCoV Infecting Pregnant Women: Lessons from SARS, MERS, and Other Human Coronavirus Infections. Viruses. 2020;12. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32050635.

10. Lam CM, Wong SF, Leung TN, Chow KM, Yu WC, Wong TY, et al. A case-controlled study comparing clinical course and outcomes of pregnant and non-pregnant women with severe acute respiratory syndrome. BJOG. 2004;111:771-4. Available from: https://www.ncbi.nlm.nih.gov/pubmed/15270922.

11. Money D. Canadian Surveillance of COVID-19 in pregnancy: Epidemiology, Maternal and Infant Outcomes. Report #1: Released December 2nd, 2020Early Release: Maternal and Infant Outcomes (March 1, 2020 to September 30, 2020) from Three Canadian Provinces 2020. Available from: https://med-fom-ridresearch.sites.olt.ubc.ca/files/2020/12/CANCOVID-Preg-report-1-BC-AB-ON-data_02DEC2020-V2.pdf.

12. Allotey J, Stallings E, Bonet M, Yap M, Chatterjee S, Kew T, et al. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. BMJ. 2020;370:m3320. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32873575.

13. Prabhu M, Cagino K, Matthews KC, Friedlander RL, Glynn SM, Kubiak JM, et al. Pregnancy and postpartum outcomes in a universally tested population for SARS-CoV-2 in New York City: a prospective cohort study. BJOG. 2020;127:1548-56. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32633022.

14. Knight M, Bunch K, Vousden N, Morris E, Simpson N, Gale C, et al. Characteristics and outcomes of pregnant women admitted to hospital with confirmed SARS-CoV-2 infection in UK: national population based cohort study. Bmj. 2020;369:m2107.

15. Ellington S, Strid P, Tong VT, Woodworth K, Galang RR, Zambrano LD, et al. Characteristics of Women of Reproductive Age with Laboratory-Confirmed SARS-CoV-2 Infection by Pregnancy Status - United States, January 22-June 7, 2020. MMWR Morb Mortal Wkly Rep. 2020;69:769-75. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32584795.

16. Kayem G, Lecarpentier E, Deruelle P, Bretelle F, Azria E, Blanc J, et al. A snapshot of the Covid-19 pandemic among pregnant women in France. Journal of gynecology obstetrics and human reproduction. 2020;49:101826-. Available from: https://pubmed.ncbi.nlm.nih.gov/32505805 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7270811/.

17. Stankiewicz A, Herel M, DesMeules M. Report Summary--Rio Political Declaration on Social Determinants of Health: A Snapshot of Canadian Actions 2015. Health Promot Chronic Dis Prev Can. 2015;35:113-4. Available from: https://www.ncbi.nlm.nih.gov/pubmed/26378770.

18. Enhanced Epidemiological Summary. COVID-19 in Ontario – A Focus on Material Deprivation Public Health Ontario. 2020. Available from: https://www.publichealthontario.ca/-/media/documents/ncov/epi/2020/06/covid-19-epi-material-deprivation.pdf?la=en.

19. Enhanced Epidemiological Summary. COVID-19 in Ontario – A Focus on Diversity Public Health Ontario. 2020. Available from: https://www.publichealthontario.ca/-/media/documents/ncov/epi/2020/06/covid-19-epi-diversity.pdf?la=en#:~:text=The%20case%20fatality%20rate%20for,3.3%25%20(Table%202).

20. Zambrano LD, Ellington S, Strid P, Galang RR, Oduyebo T, Tong VT, et al. Update: Characteristics of Symptomatic Women of Reproductive Age with Laboratory-Confirmed SARS-CoV-2 Infection by Pregnancy Status - United States, January 22-October 3, 2020. MMWR Morb Mortal Wkly Rep. 2020;69:1641-7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/33151921.

21. Breslin N, Baptiste C, Gyamfi-Bannerman C, Miller R, Martinez R, Bernstein K, et al. Coronavirus disease 2019 infection among asymptomatic and symptomatic pregnant women: two weeks of confirmed presentations to an affiliated pair of New York City hospitals. American Journal of Obstetrics & Gynecology MFM. 2020;2:100118. Available from: http://www.sciencedirect.com/science/article/pii/S2589933320300483.

22. Ferrazzi EM, Frigerio L, Cetin I, Vergani P, Spinillo A, Prefumo F, et al. COVID-19 Obstetrics Task Force, Lombardy, Italy: Executive management summary and short report of outcome. Int J Gynaecol Obstet. 2020;149:377-8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32267531.

23. Breslin N, Baptiste C, Gyamfi-Bannerman C, Miller R, Martinez R, Bernstein K, et al. COVID-19 infection among asymptomatic and symptomatic pregnant women: Two weeks of confirmed presentations to an affiliated pair of New York City hospitals. Am J Obstet Gynecol MFM. 2020:100118. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32292903.

24. Chen H, Guo J, Wang C, Luo F, Yu X, Zhang W, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. Lancet. 2020;395:809-15. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32151335.

25. Chen S, Huang B, Luo DJ, Li X, Yang F, Zhao Y, et al. [Pregnant women with new coronavirus infection: a clinical characteristics and placental pathological analysis of three cases]. Zhonghua Bing Li Xue Za Zhi. 2020;49:E005. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32114744.

26. Chen S, Liao E, Cao D, Gao Y, Sun G, Shao Y. Clinical analysis of pregnant women with 2019 novel coronavirus pneumonia. J Med Virol. 2020.

27. Chen Y, Peng H, Wang L, Zhao Y, Zeng L, Gao H, et al. Infants Born to Mothers With a New Coronavirus (COVID-19). Front Pediatr. 2020;8:104. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32266184.

28. Dong L, Tian J, He S, Zhu C, Wang J, Liu C, et al. Possible Vertical Transmission of SARS-CoV-2 From an Infected Mother to Her Newborn. JAMA. 2020. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32215581.

29. Fan C, Lei D, Fang C, Li C, Wang M, Liu Y, et al. Perinatal Transmission of COVID-19 Associated SARS-CoV-2: Should We Worry? Clin Infect Dis. 2020. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32182347.

30. Lee DH, Lee J, Kim E, Woo K, Park HY, An J. Emergency cesarean section on severe acute respiratory syndrome coronavirus 2 (SARS- CoV-2) confirmed patient. Korean J Anesthesiol. 2020. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32229802.

31. Li N, Han L, Peng M, Lv Y, Ouyang Y, Liu K, et al. Maternal and neonatal outcomes of pregnant women with COVID-19 pneumonia: a case-control study. Clin Infect Dis. 2020.

32. Li Y, Zhao R, Zheng S, Chen X, Wang J, Sheng X, et al. Lack of Vertical Transmission of Severe Acute Respiratory Syndrome Coronavirus 2, China. Emerg Infect Dis. 2020;26. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32134381.

33. Liu D, Li L, Wu X, Zheng D, Wang J, Yang L, et al. Pregnancy and Perinatal Outcomes of Women With Coronavirus Disease (COVID-19) Pneumonia: A Preliminary Analysis. AJR Am J Roentgenol. 2020:1-6.

34. Liu W, Wang Q, Zhang Q, Chen L, Chen J, Zhang B, et al. Coronavirus disease 2019 (COVID-19) during pregnancy: a case series. 2020. Available from: file:///C:/Users/cgreen/Downloads/preprints202002.0373.v1.pdf.

35. Liu Y, Chen H, Tang K, Guo Y. Clinical manifestations and outcome of SARS-CoV-2 infection during pregnancy. J Infect. 2020.

36. Wang S, Guo L, Chen L, Liu W, Cao Y, Zhang J, et al. A case report of neonatal COVID-19 infection in China. Clin Infect Dis. 2020. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32161941.

37. Wang X, Zhou Z, Zhang J, Zhu F, Tang Y, Shen X. A case of 2019 Novel Coronavirus in a pregnant woman with preterm delivery. Clin Infect Dis. 2020. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32119083.

38. Wen R, Sun Y, Xing QS. A patient with SARS-CoV-2 infection during pregnancy in Qingdao, China. J Microbiol Immunol Infect. 2020. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32198004.

39. Yu N, Li W, Kang Q, Xiong Z, Wang S, Lin X, et al. Clinical features and obstetric and neonatal outcomes of pregnant patients with COVID-19 in Wuhan, China: a retrospective, single-centre, descriptive study. Lancet Infect Dis. 2020;20:559-64. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32220284.

40. Zeng L, Xia S, Yuan W, Yan K, Xiao F, Shao J, et al. Neonatal Early-Onset Infection With SARS-CoV-2 in 33 Neonates Born to Mothers With COVID-19 in Wuhan, China. JAMA Pediatr. 2020. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32215598.

41. Xia H, Zhao S, Wu Z, Luo H, Zhou C, Chen X. Emergency Caesarean delivery in a patient with confirmed COVID-19 under spinal anaesthesia. Br J Anaesth. 2020;124:e216-e8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32192711.

42. Zhu H, Wang L, Fang C, Peng S, Zhang L, Chang G, et al. Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia. Transl Pediatr. 2020;9:51-60. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32154135.

43. Zambrano LI, Fuentes-Barahona IC, Bejarano-Torres DA, Bustillo C, Gonzales G, Vallecillo-Chinchilla G, et al. A pregnant woman with COVID-19 in Central America. Travel Med Infect Dis. 2020:101639. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32222420.

44. Kayem G, Lecarpentier E, Deruelle P, Bretelle F, Azria E, Blanc J, et al. A snapshot of the Covid-19 pandemic among pregnant women in France. J Gynecol Obstet Hum Reprod. 2020;49:101826. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32505805.

45. Silverstein JS, Limaye MA, Brubaker SG, Roman AS, Bautista J, Chervenak J, et al. Acute Respiratory Decompensation Requiring Intubation in Pregnant Women with SARS-CoV-2 (COVID-19). AJP Rep. 2020;10:e169-e75. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32509416.

46. An P, Wood BJ, Li W, Zhang M, Ye Y. Postpartum exacerbation of antenatal COVID-19 pneumonia in 3 women. CMAJ. 2020;192:E603-E6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32376643.

47. Koh WC, Naing L, Chaw L, Rosledzana MA, Alikhan MF, Jamaludin SA, et al. What do we know about SARS-CoV-2 transmission? A systematic review and meta-analysis of the secondary attack rate and associated risk factors. PLoS One. 2020;15:e0240205. Available from: https://www.ncbi.nlm.nih.gov/pubmed/33031427.

48. Wei J, Li Y. Airborne spread of infectious agents in the indoor environment. Am J Infect Control. 2016;44:S102-8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27590694.

49. Hamner L, Dubbel P, Capron I, Ross A, Jordan A, Lee J, et al. High SARS-CoV-2 Attack Rate Following Exposure at a Choir Practice - Skagit County, Washington, March 2020. MMWR Morb Mortal Wkly Rep. 2020;69:606-10. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32407303.

50. Li Y, Qian H, Hang J, Chen X, Hong L, Liang P, et al. Evidence for probable aerosol transmission of SARS-CoV-2 in a poorly ventilated restaurant. medRxiv. 2020:2020.04.16.20067728. Available from: https://www.medrxiv.org/content/medrxiv/early/2020/04/22/2020.04.16.20067728.full.pdf.

51. Alzamora MC, Paredes T, Caceres D, Webb CM, Valdez LM, La Rosa M. Severe COVID-19 during Pregnancy and Possible Vertical Transmission. Am J Perinatol. 2020. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32305046.

52. Ferrazzi E, Frigerio L, Savasi V, Vergani P, Prefumo F, Barresi S, et al. Vaginal delivery in SARS-CoV-2-infected pregnant women in Northern Italy: a retrospective analysis. BJOG. 2020;127:1116-21. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32339382.

53. Khan S, Peng L, Siddique R, Nabi G, Nawsherwan, Xue M, et al. Impact of COVID-19 infection on pregnancy outcomes and the risk of maternal-to-neonatal intrapartum transmission of COVID-19 during natural birth. Infect Control Hosp Epidemiol. 2020:1-3. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32279693.

54. Vivanti AJ, Vauloup-Fellous C, Prevot S, Zupan V, Suffee C, Do Cao J, et al. Transplacental transmission of SARS-CoV-2 infection. Nat Commun. 2020;11:3572. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32665677.

55. Kirtsman M, Diambomba Y, Poutanen SM, Malinowski AK, Vlachodimitropoulou E, Parks WT, et al. Probable congenital SARS-CoV-2 infection in a neonate born to a woman with active SARS-CoV-2 infection. CMAJ. 2020;192:E647-E50. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32409520.

56. World Health Organization. Infection prevention and control in health care for confirmed or suspected cases of pandemic (H1N1) 2009 and influenza-like illnesses. 2009. Available from: https://www.who.int/csr/resources/publications/swineflu/swineinfinfcont/en/.

57. World Health Organization. Pregnancy, Childbirth, breastfeeding and COVID-19. 2020. Available from: https://www.who.int/reproductivehealth/publications/emergencies/COVID-19-pregnancy-ipc-breastfeeding-infographics/en/.

58. Chen D, Yang H, Cao Y, Cheng W, Duan T, Fan C, et al. Expert consensus for managing pregnant women and neonates born to mothers with suspected or confirmed novel coronavirus (COVID-19) infection. Int J Gynaecol Obstet. 2020;149:130-6.

59. American College of Obstetricians and Gynecologists. Novel Coronavirus 2019 (COVID-19). 2020. Available from: https://www.acog.org/clinical/clinical-guidance/practice-advisory/articles/2020/03/novel-coronavirus-2019.

60. The International Federation of Gynecology and Obstetrics. COVID-19 (Coronavirus) Statement. 2020. Available from: https://www.figo.org/news/covid-19-coronavirus-statement1.

61. World Health Organization. Clinical management of COVID-19. 2020. Available from: https://www.who.int/publications/i/item/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-(ncov)-infection-is-suspected.

62. Royal College of Obstetricians & Gynaecologists. Coronavirus (COVID-19) Infection in Pregnancy. 2020. Available from: https://www.rcog.org.uk/coronavirus-pregnancy.

63. Bigelow A, Power M, MacLellan-Peters J, Alex M, McDonald C. Effect of mother/infant skin-to-skin contact on postpartum depressive symptoms and maternal physiological stress. J Obstet Gynecol Neonatal Nurs. 2012;41:369-82. Available from: https://www.ncbi.nlm.nih.gov/pubmed/22537390.

64. Cooijmans KHM, Beijers R, Rovers AC, de Weerth C. Effectiveness of skin-to-skin contact versus care-as-usual in mothers and their full-term infants: study protocol for a parallel-group randomized controlled trial. BMC Pediatr. 2017;17:154. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28683833.

65. Stadler G, Snyder KA, Horn AB, Shrout PE, Bolger NP. Close relationships and health in daily life: a review and empirical data on intimacy and somatic symptoms. Psychosom Med. 2012;74:398-409. Available from: https://www.ncbi.nlm.nih.gov/pubmed/22582337.

66. World Health Organization. Infection prevention and control in health care for confirmed or suspected cases of pandemic (H1N1) 2009 and influenza-like illnesses. 2020. Available from: https://www.who.int/csr/resources/publications/swineflu/swineinfinfcont/en/.

67. Elwood C, Liauw J, Karacabeyli E, Wang C, Gundy S. Corticosteroids in COVID-19. 2020.

68. Lester M, Sahin A, Pasyar A. The use of dexamethasone in the treatment of COVID-19. Ann Med Surg (Lond). 2020;56:218-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32754312.

69. Hubina E, Nagy GM, Toth BE, Ivan G, Gorombey Z, Szabolcs I, et al. Dexamethasone and adrenocorticotropin suppress prolactin secretion in humans. Endocrine. 2002;18:215-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/12450312.

70. Saad AF, Chappell L, Saade GR, Pacheco LD. Corticosteroids in the Management of Pregnant Patients With Coronavirus Disease (COVID-19). Obstet Gynecol. 2020;136:823-6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/32769659.