Surveillance PROTOCOL

Canadian COVID-19 in Pregnancy Surveillance:
Epidemiology, Maternal and Infant Outcomes

Protocol Version Date April 21, 2020

Coordinating Centre Lead: **Dr. Deborah Money,** MD, FRCSC
Professor, Depts. of Obstetrics & Gynecology, Medicine, SPPH
Executive Vice-Dean,
University of British Columbia
Clinician Scientist,
Women's Health Research Institute
Phone 604 827 0327| deborah.money@ubc.ca

Coordinating and Data Management Centre Women's Health Research Institute (WHRI)
B327-4500 Oak Street
Vancouver, BC V6H 3N1

Supported by Women's Health Research Institute (WHRI)

Table of Contents

Co-investigators/Collaborators/Partners:
Full list in development

Global Research in Pregnancy and the Newborn Collaboration

Public Health Agency of Canada

Canadian Perinatal Surveillance System

British Columbia:
Julie van Schalkwyk, MD, FRCSC
Site Head, Obstetrics & Gynecology, BC Women's Hospital & Health Centre, Clinical Associate Professor, Department of Obstetrics & Gynecology, University of British Columbia

Chelsea Elwood, B.M.ScH, M.Sc, MD, FRCSC
Clinical Assistant Professor, Department of Obstetrics and Gynecology, University of British Columbia

Joseph Ting, MPH, MBBS, MRCPCH, FRCPC, DRCOG
Clinical Associate Professor, Department of Pediatrics, University of British Columbia

Ashley Roberts, MD, FRCPC
Clinical Assistant Professor, Department of Pediatrics, University of British Columbia

Arianne Albert, PhD
Senior Biostatistician, Women's Health Research Institute

Elisabeth McClymont, PhD
Postdoctoral Fellow, Department of Obstetrics & Gynecology, University of British Columbia

KS Joseph, MD, PhD
Professor, Department of Obstetrics & Gynecology, University of British Columbia

Ellen Giesbrecht, MD, FRCSC
Senior Medical Director, Acute Perinatal, BC Women's Hospital

Alberta:
Eliana Castillo, MD, FRCSC
Clinical Associate Professor, Obstetrics & Gynecology, University of Calgary

Sheila Caddy, MD, FRCSC
Clinical Assistant Professor, Obstetrics & Gynecology, University of Calgary

Verena Kuret, MD, FRCSC
Clinical Assistant Professor, Obstetrics & Gynecology, University of Calgary

Ariela Rozenek, MD
Resident, Obstetrics & Gynecology, University of Calgary

Saskatchewan:
Jocelyne Martel, MD, FRCSC
Clinical Professor, Obstetrics & Gynecology, University of Saskatchewan

Manitoba:
Vanessa Poliquin, MD, FRCSC
Assistant Professor, Obstetrics, Gynecology & Reproductive Sciences, Director of Research, Max Rady College of Medicine, University of Manitoba

Carla Loeppky, PhD
Director of Epidemiology and Surveillance & Lead Epidemiologist, Manitoba Health Seniors and Active Living, Assistant Professor, Community Health Sciences, University of Manitoba

Kerry Dust, PhD
Scientist, Cadham Provincial Laboratory

Heather Watson-Burgess, MD
Resident, Max Rady College of Medicine, University of Manitoba

Quebec:
Isabelle Boucoiran, MD, FRCSC
Professeure adjointe de clinique, Obstétrique-Gynécology, Université de Montréal

Haim Abenhaim, MD, FRCSC
Associate Professor, Obstetrics & Gynecology, McGill University

Fatima Kakkar, MD, FRCSC
Professeure adjointe de clinique, Département de pédiatrie, Université de Montréal

Arnaud Gagneur, MD, PhD
Professeur, Faculté de médecine et des sciences de la santé, Université de Sherbrooke

Ontario:
Jon Barrett, MBBCH, MD, FRCOG, FRCSC
Professor, Maternal-Fetal Medicine, University of Toronto

John Snelgrove, MD, MSc, FRCSC
Assistant Professor, Maternal-Fetal Medicine, University of Toronto

Mark Yudin, MD, FRCSC
Associate Professor, Obstetrics & Gynecology, St. Michael's Hospital, University of Toronto

Anne Sprague, RN, BN, Med, PhD
Project Advisor, BORN Ontario

Maha Othman, MD, PhD
Associate Professor, Biomedical and Molecular Sciences, Queen's University

Deshayne Fell, PhD
Assistant Professor, School of Epidemiology and Public Health, University of Ottawa

Ann Kinga Malinowski, MD, MSc, FRCSC
Assistant Professor, Maternal-Fetal Medicine, University of Toronto

Wendy Whittle, MD, FRCSC
Assistant Professor, Maternal-Fetal Medicine, University of Toronto

Greg Ryan, MD, FRCSC
Professor, Obstetrics & Gynecology, University of Toronto

Mark Walker, MD, FRCSC, MSc, MHCM
Scientific Director, BORN Ontario, Professor, Obstetrics & Gynecology, University of Ottawa

Nova Scotia:
Heather Scott, MD, FRCSC
Associate Professor, Obstetrics & Gynecology, Dalhousie University

New Brunswick:
Lynn Murphy-Kaulbeck, MD, MSc, FRCSC
Medical Director, NB Perinatal Health Program, Associate Professor, Maternal Fetal Medicine, Dalhousie University

Gaetane Leblanc Cormier, BSc, MBA
Director, NB Perinatal Health Program

Newfoundland:
Joan Crane, MD, MSc, FRCSC
Professor, Obstetrics & Gynecology, Memorial University

Tina Delaney, MD, FRCSC
Associate Professor, Obstetrics & Gynecology, Memorial University

Phil A. Murphy, MSc
Clinical Epidemiologist, Children's and Women's Health, Eastern Health, Professional Associate, Obstetrics & Gynecology, Pediatrics, Memorial University

PEI:
Krista Cassell, MD
Obstetrician/Gynecologist, Charlottetown

Yukon:
Sarah Saunders, MD, FRCSC
Obstetrician/Gynecologist, Whitehorse General Hospital

Shannon Ryan
Project Coordinator, Congenital Anomalies Surveillance, Health and Social Services

Additional Territories – low burden of COVID-19 – will be added should there be a shift in the pandemic

SUMMARY

Title	Canadian COVID-19 in Pregnancy Surveillance: Epidemiology and Maternal and Infant Outcomes
Goal	To provide data on COVID in pregnancy to support clinical care and public policy.
Objectives	1. To determine the burden of SARS-CoV-2 infection in pregnancy in Canada 2. To capture and report maternal outcomes, including degree of respiratory illness and requirement for hospitalization and/or ventilation support 3. To determine fetal and infant outcomes including evidence of transmission of maternal SARS-CoV-2 infection to the infant 4. To provide data to facilitate planning and support for COVID-19 affected pregnancies in the Canadian context 5. To contribute data to international collaborations, allowing for optimized international understanding of COVID-19 in pregnancy
Timeline	April 2020-December 2023, to be adjusted based on Canadian and global epidemiology
Project design	Prospective Observational / Surveillance Cohort
Inclusion criteria	• Currently pregnant or recently delivered • Living in Canada • Documented SARS-CoV-2 infection in pregnancy
Data collection and time points	• At time of first referral to provincial or site lead for surveillance project (with retrospective data collection for any prior ultrasound and clinical data) • At time of delivery or termination of pregnancy • At 6-8 week postpartum follow-up for both maternal and infant data collection • Optional longer follow up for infants

1.0 BACKGROUND

1.1 EPIDEMIOLOGY OF SARS-COV-2

In December 2019, a novel coronavirus, eventually termed Severe Acute Respiratory Syndrome associated Coronavirus-2 (SARS-CoV-2) was identified in Wuhan, China. On March 11, 2020, the WHO declared Coronavirus Disease 19 (COVID-19), the respiratory illness caused by SARS-CoV-2 infection, an official global pandemic. As of April 8, 2020, globally, SARS-CoV-2 has infected >1,500,000 people and caused over 88,000 deaths.[1] As of April 8, 2020, Canada has 19,289 confirmed cases and 435 deaths, with cases occurring in individuals returning from international travel or their close contacts and via extensive community spread.[2]

Given that pneumonia is a significant cause of maternal morbidity and the leading cause of fatal non-obstetric infection in pregnant women, the global spread of SARS-CoV-2 raises unique questions and significant concerns for the health of pregnant women and their fetuses. Pregnant women and their families are looking to prenatal care providers for information on risks and guidance on how to prevent transmission and manage infection with SARS-CoV-2. Globally, there is a dearth of data on SARS-CoV-2 to inform recommendations for pregnant women and their care providers. We propose a Canadian surveillance program to better understand COVID-19 in pregnancy, to increase understanding of the epidemiology of COVID-19 in pregnancy, and to provide critical data to inform recommendations for pregnant women and their infants.

1.2 RESPIRATORY INFECTIONS IN PREGNANCY

Due to physiological and immunological changes during pregnancy, pregnant women exhibit greater predisposition and susceptibility to some infections. Pregnant women with lower respiratory tract infection often have more severe illness, and have higher rates of admission to hospital and intensive care compared to non-pregnant counterparts.[3] Recognizing there are very limited data on SARS-CoV-2 in pregnancy, we look to experience with other respiratory illnesses to help guide clinical management, while simultaneously seeking to rapidly acquire quality data specific to SARS-CoV-2.

There have been two other large outbreaks of highly pathogenic coronaviruses that have had global implications in the past two decades: Severe Acute Respiratory Syndrome (SARS) and Middle Eastern Respiratory Syndrome (MERS). Although these viruses do not mirror our initial understanding of SARS-CoV-2 in terms of genetic structure or clinical manifestations, they provide insight with respect to the potential impacts of SARS-CoV-2 on pregnant women. Published reports of SARS and MERS in pregnant women are limited to a small body of case reports and case series.[4-9] From these limited reports, we know that a high proportion of pregnant women with SARS and MERS suffered severe illness and required intensive care and cardiorespiratory support. Importantly, cases of maternal death have been associated with SARS and MERS infection. Only one case-control study assessed SARS outcomes in pregnant women compared to non-pregnant women, demonstrating that pregnant women with SARS had worse outcomes than similarly aged non-pregnant women.[10]

Fetal-infant health is a unique and critical consideration for the care of pregnant women. Reports on the impact of SARS and MERS on pregnancy outcomes provide varied findings. Among women affected by SARS and MERS during the first trimester, outcomes include spontaneous abortion.[4] Reports of pregnancies affected by SARS and MERS during the second and third trimester, include stillbirth, intrauterine growth restriction, and preterm birth.[4,9] In contrast to these adverse outcomes,

a number of pregnancies had no adverse outcomes despite maternal infection with SARS or MERS.[6-8] Broadly speaking and drawing upon available evidence and knowledge of other respiratory disease in pregnancy, severity of respiratory compromise is likely the best predictor of adverse pregnancy outcomes.

1.3 SARS-CoV-2 IN PREGNANCY

Data on the impact of SARS-CoV-2 in pregnancy has been limited in the published literature. As of April 9, 2020, there were 24 publications in the literature that contained original case data for pregnancy outcomes.[11-34] It appears that there were many redundant case reports, so we have ascertained that there appears to be 126 unique cases described in the published literature.

The general pregnancy outcomes, demonstrate that there were 87 women who have delivered in the course of these study description and 39 whose pregnancy was not completed at the time of publication. Hence there are 89 neonates born to 87 women (2 sets of twins), from which to draw conclusions. Of these, 75% were born via caesarian section – this is related to the preponderance of data from China where their policy was to primarily deliver by caesarian section. Notably, 36.6% (n=26) delivered preterm (<37 weeks gestational age), of which, 21.1% were late preterm (34-36+6 weeks), 9.9% were less than 34 weeks and 5.6% were born preterm with no exact gestational age reported. The infant outcomes reveal that 25.9% (n=14) were low birth weight (<2500g).

Vertical transmission of SARS-CoV-2 has been greatly debated. In this review of the literature, there were 76.4% of cases with at least some infant testing and outcome information. Overall, 91.2% of cases showed no evidence of vertical transmission and there were 6 cases where evidence was equivocal. 5.9% (n=4) of neonates had positive nasopharyngeal or throat swabs, however postnatal transmission via droplet or contact exposure cannot be ruled out in the hospital environment for these cases. Other types of testing revealed that 13.8% (n=12) had umbilical cord blood tested for SARS-CoV-2 and all were negative, 12.6% (n=11) had amniotic fluid tested for SARS-CoV-2 and all were negative, 12.6% (n=11) had breast milk tested for SARS-CoV-2 and all were negative, 10.3% (n=9) had placental testing for SARS-CoV-2 and all were negative, 3.4% (n=3) had vaginal secretions tested for SARS-CoV-2 and all were negative.

Adverse neonatal outcomes were primarily related to prematurity. Other serious adverse outcomes such as birth asphyxia, stillbirth, and neonatal death were rare among all neonates. These adverse outcomes are not necessarily attributed to SARS-CoV-2 exposure. Three specific cases are of particular interest:
1) One infant [32] was born via Caesarean section for fetal distress at 31+2 weeks, birth weight of 1580 g, and Apgars of 3, 4, and 5 at one, five and ten minutes. Neonatal respiratory distress syndrome and pneumonia were confirmed by chest x-ray on NICU admission and resolved by Day of Life 14 with non-invasive ventilation, caffeine, and antibiotics. This infant also had suspected sepsis with an *Enterobacter*-positive blood culture, which resolved with treatment. This infant also had positive nasopharyngeal and anal swabs for SARS-CoV-2 on Day of Life 2 and 4, which was repeated and negative by Day of Life 7. It is difficult to establish an association for this infant's health status with SARS-CoV-2 infection given the confounding issues of prematurity, asphyxia, and bacterial sepsis.
2) In 1/89 neonates (1.1%) was a stillbirth.[25] Delivery was via Caesarean section at approximately 34 weeks. Although there was no underlying medical disease, this pregnant patient became critically ill with COVID-19 and their condition deteriorated during hospitalization. The patient required ICU admission and had multiple organ dysfunction syndrome (MODS), including: ARDS requiring intubation and mechanical ventilation, acute hepatic failure, acute renal failure, and septic shock.

This patient was still on ECMO support at the conclusion of the study. The study only reports that no evidence of vertical transmission of SARS-CoV-2 was found, but details regarding the specifics of infant or other testing are not provided.
3) In 1/89 neonates (1.1%) was a neonatal death.[34] This infant was born via Caesarean section at 34+5 weeks, birth weight 2200 g, and Apgars of 8 and 8 at one and five minutes. About 30 minutes after birth, the infant developed shortness of breath and moaning, so was admitted to NICU. At 8 days of life, the infant developed refractory shock, multiple organ failure, and DIC from gastric bleeding. In spite of transfusion and resuscitation efforts the infant unfortunately died on Day of Life 9. The infant had a negative throat swab for SARS-CoV-2. The mother's COVID-19 diagnosis was made postpartum upon development of fever 3 days postpartum.

1.4 CURRENT RECOMMENDATIONS FOR PERINATAL MONITORING & CARE

To date, the SOGC recommends enhanced pregnancy surveillance for pregnancies in which the mother has developed COVID-19 and continuous external fetal monitoring in labour as there have been higher rates of fetal distress noted in the small case series published to date. The recommendations are built on contemporaneous understanding of the virus and will be modified if new information is available. It is recommended that the infant be tested within approximately 2 hours of birth and assessed for signs of COVID-19 both immediately and through the following 14 days with virtual follow-up after discharge.

The Canadian maternity care system is a global leader and informs maternity care in many countries internationally. With an assembled pan Canadian team, we are poised to provide critical Canadian data to guide healthcare for pregnant women and their infants both nationally and internationally. Evidence-based, SARS-CoV-2 informed recommendations for maternity care are urgently needed. Globally, our team is uniquely situated to acquire and analyze data on SARS-CoV-2 in pregnancy and assess related maternal and infant outcomes. As evidenced in other countries, a time-sensitive, infectious diseases informed response to the pandemic is critical to reduce disease transmission, mortality, and general societal impact. Early initiation of a perinatal SARS-CoV-2 surveillance program will help allow Canada to determine key data and develop evidence-based recommendations for maternity care providers and pregnant women impacted by SARS-CoV-2. Given our other ongoing Canadian perinatal surveillance initiatives, if significant numbers of cases of pregnant women with SARS-CoV-2 are collected, we will also have the ability to do a contemporaneous comparison with pregnant women without infection to determine the likelihood that any complications are related to COVID-19.

2.0 OBJECTIVES

1. To determine the burden of SARS-CoV-2 infection in pregnancy in Canada
2. To capture and report maternal outcomes, including degree of respiratory illness and requirement for hospitalization and/or ventilation support
3. To determine fetal and infant outcomes including evidence of transmission of maternal SARS-CoV-2 infection to the infant
4. To provide data to facilitate planning and support for COVID-19 affected pregnancies in the Canadian context
5. To contribute data to international collaborations, allowing for optimized international understanding of COVID-19 in pregnancy

3.0 STUDY DESIGN

3.1 Study Design

This project is a prospective multi-provincial observational surveillance program in Canada to monitor COVID-19 in pregnant women from key referral centres. Data will be collected from care providers of affected pregnancies and will assess pregnancy outcomes and early neonatal outcomes.

Each participating centre will offer consultation and support as needed for cases of COVID-19. The surveillance will be supported by central coordination and data management through the Women's Health Research Institute (WHRI) at BC Women's Hospital and Health Centre, Vancouver, British Columbia.

3.2 Inclusion Criteria

(1) Currently pregnant or recently delivered
(2) Living in Canada
(3) Documented SARS-CoV-2 infection in pregnancy

4.0 PROTOCOL

4.1 Case Identification

Potential cases for inclusion will be identified by clinical or public health report of suspected COVID-19 and/or confirmatory SARS-CoV-2 laboratory result during pregnancy, or at the time of delivery or postpartum if not identified antepartum.

1. Care providers from our extensive reproductive infectious diseases and maternity care network will identify potential participants, receive data collection forms (DCFs) and complete and return them to the coordinating centre via fax or direct entry into the REDCap database.

2. SARS-CoV-2 testing laboratories/ public health surveillance will liaise with coordinating team to identify lab confirmed cases of SARS-CoV-2 in pregnancy for follow-up.

Regional consultation is required to address how any regional differences in reporting of SARS-CoV-2 may impact local protocols. Approvals required will also vary based on regional regulations. Data transfer agreements will be set up as needed.

4.2 Data Collection

Data collection will commence following case identification, but will allow for retrospective data collection as needed, depending on when during the pregnancy (or postpartum period) a case is identified. Data elements to be collected are described

in the Data Collection Form.

Information will be abstracted from medical records and transcribed to the DCF. The care provider or regional lead will facilitate location and acquisition of information as needed. Data collection will include:

1. Dates of potential exposure
2. Reports from testing laboratory for maternal and infant testing, including timing of testing in pregnancy
3. Symptoms of progression of disease
4. Outcome of disease
5. Pregnancy outcomes: Reports from obstetric care providers, maternal fetal medicine, and/or infectious disease physicians, ultrasound reports, delivery reports, including any specimen results at delivery (i.e., testing for infant)
6. Infant outcomes: Pediatric reports (infant follow-up time points at birth and 6-8 weeks)

In addition to setting up a multi-provincial database, the coordinating centre will monitor and facilitate comprehensive data collection through central tracking of data collection points and data management. A REDCap (Research Electronic Data Capture) database is proposed to permit local access to local data and to provide premium case tracking software to regional sites. REDCap is a uniquely designed program, which allows for multi-site entry and automatic blocking or separation of personally identifiable information as per privacy standards. Automated systems will be programmed to advise sites and coordinators when pending data is expected and when follow up is required to ensure up-to-date, comprehensive surveillance of participants.

Considerations:

- There may be considerable burden in tracking patient care across health care professionals over time and collecting the required data from multiple physicians. However, the care of pregnant women with SARS-CoV-2 is likely to be somewhat centralized in many provinces, given these women are likely to be referred to obstetricians with infectious disease and maternal-fetal experience. This central coordination can be leveraged to collect data through multiple points in time, with multiple health care providers.

4.3 Provincial Protocols in Brief

British Columbia

British Columbia has approval to proceed with a quality improvement/ quality assurance (QI/QA) database for surveillance of COVID-19 in pregnancy. Public Health will communicate identified pregnant cases to the team. Provincial team members will directly enter DCF data into the REDCap database. Research ethics approval, including waiver of consent, is being sought to pipe data from the QI/QA database into a parallel REDCap research database to allow for pan-Canadian data compilation.

Yukon
In development.

Alberta
In development.

Saskatchewan
Saskatchewan is seeking approval to proceed with a waiver of consent and to identify cases through Public Health. Saskatchewan will have a siloed data access group within the central REDCap database at the coordinating centre. Provincial team members will directly enter DCF data into a Saskatchewan data access group on REDCap.

Manitoba
Public Health will communicate identified pregnant cases to the team. Manitoba will seek consent from all cases. Upon consent, provincial team members will directly enter DCF data into a Manitoba data access group on REDCap.

Ontario
Ontario will utilize the existing infrastructure of the Better Outcomes Registry Network (BORN) Ontario database, with added COVID-19 specific questions. The BORN registry does not require consent. Data is entered by clinicians providing care. The database has been optimized for agreement with variables collected on DCFs by other provinces. A data transfer agreement will allow for relevant data to be shared with the pan-Canadian data compilation.

Quebec
In development.

Newfoundland
In development.

New Brunswick
In development.

Nova Scotia
In development.

Prince Edward Island
In development.

4.4 Data Management / Stewardship

Data management will be performed by the coordinating centre, Reproductive Infectious Diseases Team, Women's Health Research Institute, a University of British Columbia Faculty of Medicine Centre at BC Women's Hospital and Health Centre in Vancouver, BC. DCFs completed by regional coordinators will be sent to the coordinating centre for data entry or directly entered by sites via REDCap database access accounts, which allow for siloed entry and access to site-specific data.

Collected data will be entered into a REDCap database designed to mirror the DCF. Branching will be programmed into data entry to allow for more efficient data entry. Each case will be assigned a unique identification number (ID#). No direct personal identifiers will be included in the national database. Where approved per-site, full infant date of birth will be collected in order to accurately track events occurring within hours or days of birth. Specific birthdates will not be reported. Where approved per-site, maternal or infant date of death, should they occur, will be collected in order to accurately track event timing in relation to disease onset and/or delivery, if approved by local site. Specific dates of death will not be reported.

All centre/provincial/territorial leads will be given site-specific access to the REDCap database so they may electronically retrieve their jurisdiction's data, if desired. In cases where provinces prefer to use existing infrastructure for added efficiency, they may do so and will liaise with the central coordinating team to ensure inclusion of all necessary data elements. In the case of Ontario, for example, the BORN perinatal database will be utilized with additional COVID-19 data elements added. We will then collate all provincial data after permissions obtained to assess national data.

4.5 Statistical Analysis and Metrics

National reporting and analysis will be provided at regular intervals by the coordinating centre to fulfill provincial public health needs, PHAC mandates and align with WHO recommendations. Findings will be reported regularly based on case numbers and novel findings. At a minimum this will be reported to public health monthly, which will include summary statistics and no individual information. Data suppression rules will be applied to all stages of analysis, which stipulate no variable with less than 5 cases can be reported to maintain confidentiality. Summary statistics and project updates will also be posted on our team's University of British Columbia, Reproductive Infectious Diseases Program website.

Data will be summarized using descriptive statistics (e.g. mean and standard deviation or n and percent). Comparisons of maternal/fetal outcomes will be made among different variables (e.g. severity of symptoms, need for ventilation, treatments attempted, maternal age, maternal education, etc.) using generalized linear models with adjustment for confounders where required for the specific outcome. Maternal outcomes will include the risk for preterm birth and delivery complications. Fetal

outcomes will include Apgar scores at 1 and 5 minutes, birthweight, admission to NICU, positive test for SARS-CoV-2, and need for resuscitation at delivery.

Missing variables will be excluded or imputed using multiple imputation depending on the scale of missingness, and the needs of the analysis. No individual data will be presented. Statistical analyses will be carried out in the statistical package R v3.5.

Results will be published in peer-reviewed journals and will be presented at national and international conferences, in addition to the regular provincial and national public health reporting.

REFERENCES

1. World Health Organization. Coronavirus disease (SARS-COV-2) situation report 50 (Accessed March 10, 2020). https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports.
2. Government of Canada. Coronavirus diseases (SARS-COV-2): Outbreak Update. (Accessed March 10, 2020). https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection.html.
3. Rasmussen S, Smulian JC, Lednicky JA, Wen TS, Jamieson J. Coronavirus Disease 2019 (SARS-COV-2) and Pregnancy: What obstetricians need to know. *AJOG* 2020; https://doi.org/10.1016/j.ajog.2020.02.017.
4. Wong et al. (2003) Pregnancy and perinatal outcomes of women with severe acute respiratory syndrome. *AJOG*; 191:292-7.
5. Maxwell et al. (2017) No. 225-Management Guidelines for Obstetric Patients and Neonates Born to Mothers With Suspected or Probable Severe Acute Respiratory Syndrome (SARS). *JOGC*; 39(8):e130-e137.
6. Zhang JP, Wang YH, hen 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; 38:516-520.
7. Robertson CA, Lowther SA, Birch T, Tan C, Sorhage F, Stockman, L, McDonald C, Lingappa JR, Bresnitz E. SARS and pregnancy: A case report. *Emerg Infect Dis,* 2004; 10:345-348.
8. Yudin MH, Steele DM, Sgro MD, Read SE, Kopplin P, Gough KA. Severe acute respiratory syndrome in pregnancy. *Obstet Gynecol*, 2005; 105:124-127.
9. Schwartz DA, Graham AL. Potential Maternal and Infant Outcomes from Coronavirus 2019-nCoV (SARS-CoV-2) Infecting Pregnant Women: Lessons from SARS, MERS, and Other Human Coronavirus Infections. *Viruses*, 2020; 12: 178-194.
10. Lam CM, Wong SF, Leung TN, Chow KM, Yu WC, Wong T, Lai ST, Ho LC. A case-controlled study comparing clinical course and outcomes of pregnant and non-pregnant women with severe acute respiratory syndrome. *BJOG*, 2004; 111:771-774.
11. Breslin, N. et al. COVID-19 in pregnancy: early lessons. AJOG MFM. Accepted for publication. (2020).
12. Breslin, N. 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. (2020).

13. Chen, H. et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. Lancet 395, 809–815 (2020).
14. Chen, R. et al. Safety and efficacy of different anesthetic regimens for parturients with COVID-19 undergoing Cesarean delivery: a case series of 17 patients. Can J Anaesth. (2020).
15. Chen, Shuo. et al. Clinical Features and placental pathological analysis of three cases of pregnant women with new coronavirus infection. Chinese J Pathol. 49, (2020).
16. Chen, Siyu. et al. Clinical analysis of pregnant women with 2019 novel coronavirus pneumonia. J Medical Virology. Accepted for publication. (2020).
17. Chen, Yan et al. Infants born to Mothers with a New Coronavirus (COVID-19). Front Pediatr. (2020).
18. Dong, L. et al. Possible Vertical Transmission of SARS-CoV-2 from an infected mother to her Newborn. JAMA. (2020).
19. Fan, C. et al. Perinatal Transmission of COVID-19 Associated SARS-CoV-2: Should We Worry? Clin Infectious Diseases. (2020).
20. Lee, Dong Hwan et al. Emergency caesarean section on severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) confirmed patient. Korean J Anesthesiol. March 31 2020, epub ahead of print. (2020).
21. Li, Na et al. Maternal and neonatal outcomes of pregnant women with COVID-19 pneumonia: a case-control study. Clin Infect Dis. e-pub ahead of print. (2020).
22. Li, Y. et al. Lack of Vertical Transmission of Severe Acute Respiratory Syndrome Coronavirus 2, China. Emerg Infectious Diseases. 26(6). (2020).
23. Liu, D. et al. Pregnancy and Perinatal Outcomes of Women with Coronavirus Disease (COVID-19) Pneumonia: A Preliminary Analysis. Am J Roentgenol. 1–6. (2020).
24. Liu, Weiyong et al. Coronavirus disease 2019 (COVID-19) during pregnancy: a case series. Preprint. (2020).
25. Liu, Y. et al. Clinical Manifestations and outcome of SARS-CoV2 infection during pregnancy. Journal of Infection. (2020).
26. Wang, S. et al A case report of neonatal COVID-19 in China. Clin Infectious Diseases. (2020).
27. Wang, X. et al. A case of 2019 Novel Coronavirus in a pregnant woman with preterm delivery. Clin Infectious Diseases. (2020).
28. Wen, R. et al. A patient with SARS-CoV-2 infection during pregnancy in Qingdao, China. J Microbio Immunol Infection. (2020).
29. Xia, Haifa et al. Emergency caesarean delivery in a patient with confirmed coronavirus disease 2019 under spinal anesthesia. British J of Anesthesia. (2020).
30. Yu, N et al. Clinical features and obstetric and neonatal outcomes of pregnant patients with COVID-19 in Wuhan, China: a retrospective, single-center descriptive study. Lancet Infect Dis. (2020).
31. Zambrano, Lysien et al. A pregnant woman with COVID-19 in Central America. Travel Med and Infect Dis. epub ahead of print. (2020).
32. Zeng, L. et al. Neonatal Early Onset Infection with SARS-CoV-2 in 33 neonates born to mothers with COVID-19 in Wuhan, China. JAMA Pediatrics. Accepted for publication. (2020).
33. Zhang, Lujiang et al. Analysis of pregnancy outcomes of pregnant women during the epidemic of new coronavirus pneumonia in Hubei. Chinese J Obstet Gynecol. 1–7. (2020).
34. Zhu, H. et al. Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia. Transl Pediatr. 9(1), 51-60. (2020).