SUMMARY

1. Rates of hospitalization and ICU admission have declined since December 31, 2021.
2. Preterm birth and NICU admission rates are similar between pre-Delta, Delta, and Omicron variant periods of the pandemic.
3. Risk of hospitalization, ICU admission, preterm birth, and infant NICU admission are significantly lower for those with ≥2 vaccinations compared to the unvaccinated.

1.0 BACKGROUND

The Canadian Surveillance of COVID-19 in Pregnancy project (CANCOVID-Preg) has been central to understanding the evolving epidemiology of COVID-19 in pregnancy. Previously published CANCOVID-Preg data have confirmed international findings that pregnant women/persons were at increased risk of severe illness from SARS-CoV-2, including the need for maternal hospitalization and admission to an intensive care unit (ICU).1-18 We are now monitoring disease severity in both vaccinated (i.e., 2+ doses) and unvaccinated (i.e., no doses) pregnant women/persons over time with variant emergence. By identifying pregnant women/persons who are most at risk for adverse maternal and infant outcomes, CANCOVID-Preg data can be used to inform public health and the clinical management of this population. This report highlights interim findings from nine provinces and territories [British Columbia (BC), Ontario (ON), Manitoba (MB), Quebec (QC), New Brunswick (NB), Nova Scotia (NS), Prince Edward Island (PE), Yukon Territory (YT) and Alberta (AB)], participating in the CANCOVID-Preg Project.
2.0 METHODS

On behalf of public health officials, with support from the Public Health Agency of Canada, the COVID-19 Immunity Task Force, the Canadian Institutes for Health Research, and the BC Women’s Health Foundation, this national, prospective, surveillance project was initiated in order to monitor pregnancy outcomes throughout the pandemic. This initiative is supported by central coordination at the University of British Columbia, based at the Women’s Health Research Institute in Vancouver, BC.

Data on laboratory-confirmed, SARS-CoV-2 PCR positive cases during pregnancy were obtained through public health agencies and/or provincial databases in each participating province until December 2021, when PCR testing in Canada declined. From January 2022 to December 2022, pregnant women/persons with either a positive PCR or rapid antigen test (RAT) were reported to CANCOVID-Preg by physicians and midwives across the country, and included in the dataset. Data were abstracted and entered directly into a Research Electronic Data Capture (REDCap) database, which utilizes a robust data confidentiality and security protocol. Data abstraction is ongoing and complete datasets have not yet been entered for all cases in the time period reported on. In ON, data were entered at the point of care into a data collection tool and securely transferred to the BORN Information System (where it was linked with the corresponding pregnancy or birth record). Public health laboratory notifications were also submitted to BORN Ontario for linkage to the BORN Information System. Data from ON were therefore exempt from the revised protocol and included a nearly full dataset for all patients.

In this report we present data from BC, MB, NB, NS, PEI, QC, YT, ON, and AB for cases identified within the date ranges described in Table 1. Like our previous reports, only high-level summary data were amalgamated (manuscript in preparation). Available data for this report are from 32,811 cases detected between March 1st 2020 and December 31st 2022. Variant time period analyses were based on the following estimates of variant dominance in Canada for pre-Delta: 2020-03-03 to 2021-04-04, Delta: 2021-04-04 to 2021-12-19, and Omicron: 2021-12-19 and onwards.19

<table>
<thead>
<tr>
<th>Province</th>
<th>N</th>
<th>Diagnosis Date Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC</td>
<td>2,531</td>
<td>2020-03-06 to 2022-12-30</td>
</tr>
<tr>
<td>MB</td>
<td>694</td>
<td>2020-03-21 to 2022-12-25</td>
</tr>
<tr>
<td>NB</td>
<td>326</td>
<td>2020-03-28 to 2022-09-14</td>
</tr>
<tr>
<td>NS</td>
<td>255</td>
<td>2020-03-16 to 2022-12-27</td>
</tr>
<tr>
<td>PEI</td>
<td>86</td>
<td>2021-12-20 to 2022-03-30</td>
</tr>
<tr>
<td>QC</td>
<td>2,717</td>
<td>2020-03-03 to 2022-12-29</td>
</tr>
<tr>
<td>YT</td>
<td>29</td>
<td>2021-02-26 to 2022-07-15</td>
</tr>
<tr>
<td>ON</td>
<td>20,338</td>
<td>2020-03-04 to 2022-12-31</td>
</tr>
<tr>
<td>AB</td>
<td>5,835</td>
<td>2020-03-16 to 2023-02-27</td>
</tr>
<tr>
<td>TOTAL</td>
<td>32,811</td>
<td>2020-03-03 to 2023-02-27</td>
</tr>
</tbody>
</table>
3.0 RESULTS

3.1 Demographic and Clinical Summaries

The majority of pregnancies with a positive SARS-CoV-2 diagnosis had a maternal age less than 36 (80%), a BMI less than 30 (77%), and a gravidity of 2 or more (67%). Approximately 1% of cases had pre-existing hypertension, and similarly 1% of cases had pre-existing type 1 or 2 diabetes.

Table 2. Demographic and clinical summaries.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30</td>
<td>10,238 (35%)</td>
<td>28,953</td>
</tr>
<tr>
<td>30-35</td>
<td>12,997 (45%)</td>
<td></td>
</tr>
<tr>
<td>≥ 36</td>
<td>5,718 (20%)</td>
<td></td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 18.5</td>
<td>755 (4%)</td>
<td>18,860</td>
</tr>
<tr>
<td>18.5 - 24</td>
<td>8,564 (45%)</td>
<td></td>
</tr>
<tr>
<td>25 - 29</td>
<td>5,120 (27%)</td>
<td></td>
</tr>
<tr>
<td>≥ 30</td>
<td>4,421 (23%)</td>
<td></td>
</tr>
<tr>
<td><strong>Gravida</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>8,709 (33%)</td>
<td>26,653</td>
</tr>
<tr>
<td>2+</td>
<td>17,944 (67%)</td>
<td></td>
</tr>
<tr>
<td><strong>Hypertension (chronic)</strong></td>
<td>Yes</td>
<td>298 (1%)</td>
</tr>
<tr>
<td><strong>Diabetes (type 1 or 2)</strong></td>
<td>Yes</td>
<td>373 (1%)</td>
</tr>
</tbody>
</table>

*Does not include data from AB.

3.2 Pregnancy Outcomes

In this sample, 9% of pregnant women/persons diagnosed with SARS-CoV-2 infection experienced a preterm birth, with the majority of preterm births (~72%) being late preterm (between 34 and 37 weeks). The majority of labours were spontaneous (54%), and vaginal deliveries (66%), with stillbirth rates below 1%. Singleton pregnancies accounted for 97% of all pregnancies.
### Table 3. Pregnancy outcomes.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiple Pregnancy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple</td>
<td>767 (2.8%)</td>
<td>27,719</td>
</tr>
<tr>
<td>Singleton</td>
<td>26,952 (97.2%)</td>
<td></td>
</tr>
<tr>
<td><strong>Pregnancy Outcome</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live Birth</td>
<td>26,018 (99.0%)</td>
<td>26,292</td>
</tr>
<tr>
<td>Stillbirth</td>
<td>156 (0.6%)</td>
<td></td>
</tr>
<tr>
<td>Loss</td>
<td>106 (1.6%)</td>
<td>6,437</td>
</tr>
<tr>
<td><strong>Mode of Delivery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caesarean</td>
<td>8,460 (33.7%)</td>
<td>25,107</td>
</tr>
<tr>
<td>Vaginal</td>
<td>16,647 (66.3%)</td>
<td></td>
</tr>
<tr>
<td><strong>Labour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induced</td>
<td>4,725 (17.6%)</td>
<td>26,873</td>
</tr>
<tr>
<td>No Labour</td>
<td>7,547 (28.1%)</td>
<td></td>
</tr>
<tr>
<td>Spontaneous</td>
<td>14,501 (54.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Gestational Age at Delivery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preterm (&lt; 37 weeks)</td>
<td>2,549 (9.2%)</td>
<td>27,767</td>
</tr>
<tr>
<td>Term (≥ 37 weeks)</td>
<td>25,218 (90.8%)</td>
<td></td>
</tr>
</tbody>
</table>

*Data from AB only available prior to October 2021.

### 3.3 Infant Outcomes

The majority of infants exhibited a 5-minute Apgar score greater than or equal to 7 (97%) and were within the normal weight range of 2500g - 4000g (84%). NICU admission rates were relatively high at approximately 13%.

### Table 4. Infant outcomes.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Apgar 5</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;7</td>
<td>826 (3%)</td>
<td>27,187</td>
</tr>
<tr>
<td>≥7</td>
<td>26,361 (97%)</td>
<td></td>
</tr>
<tr>
<td><strong>Birth Weight (g)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2500</td>
<td>1,976 (7%)</td>
<td>26,989</td>
</tr>
<tr>
<td>2500-4000</td>
<td>22,696 (84%)</td>
<td></td>
</tr>
<tr>
<td>&gt;4000</td>
<td>2,317 (9%)</td>
<td></td>
</tr>
<tr>
<td><strong>NICU admission</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3,164 (13%)</td>
<td>25,182</td>
</tr>
</tbody>
</table>

*Data from AB only available prior to October 2021.

### 3.4 Adverse Outcomes Over Time

The Omicron era saw a dramatic decline in hospitalizations and ICU admissions. Hospitalization rates fell from a peak of 7.6% during the Delta time period to just under 2.0% during Omicron, with ICU admission rates similarly falling from 2.2% during Delta to 0.1% during Omicron. However, there were similar rates of NICU admission across all time periods (12.3%, 13.1%, and 11.8%, respectively for pre-Delta, Delta, and Omicron), as well as a slight decline in preterm birth rates (9.7%, 8.9%, and 8.6%, respectively).
<table>
<thead>
<tr>
<th></th>
<th>Pre-Delta</th>
<th>Delta</th>
<th>Omicron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalization rate</td>
<td>5.0%</td>
<td>7.6%</td>
<td>2.0%</td>
</tr>
<tr>
<td>ICU admission rate</td>
<td>1.3%</td>
<td>2.2%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Preterm birth rate</td>
<td>9.7%</td>
<td>8.9%</td>
<td>8.6%</td>
</tr>
<tr>
<td>NICU admission rate</td>
<td>12.3%</td>
<td>13.1%</td>
<td>11.8%</td>
</tr>
</tbody>
</table>

### 3.5 Vaccination

The risk of hospitalization and ICU admission were both significantly lower among pregnant women/persons that received 2 or more COVID-19 vaccine doses. The relative risk (RR) of hospitalization was 0.26 (95% CI: 0.22-0.31) for those who received ≥2 doses versus none, while the RR of ICU admission was 0.10 (95% CI: 0.04-0.25). This was also the case, in a less pronounced manner, for infant NICU admission (RR: 0.87, 95% CI: 0.81-0.95) and preterm birth (RR: 0.86, 95% CI: 0.78-0.94). When looking only at the Omicron time period, this relationship between vaccination and reduced risk of adverse outcomes (hospitalization, ICU admission, preterm birth, and NICU admission) remains true.

### 4.0 DISCUSSION

The data presented in this report demonstrate findings that are fairly consistent with prior reports. Relatively high rates of admission to the NICU (12.5%) were observed (11.1% pre-pandemic).\(^{20}\) Rates of stillbirth (0.6%) are in keeping with background rates (0.8%)\(^{21}\) in the general population. Updated numbers for preterm birth exhibit relatively average rates of 9%.

With many additional data from the Omicron era now incorporated, this report demonstrates a decline in ICU admission and hospitalization in pregnant women/persons since June 2021. These findings highlight the lessening severity of disease associated with the passage of time and suggest that new variant emergence (i.e., Omicron) and/or vaccination is associated with reduced disease severity among pregnant women/persons and improved early infant outcomes. This highlights the ongoing value of vaccination in pregnancy to reduce risk of severe disease in pregnancy and to provide passive protection to the newborn.
REFERENCES


Appendix 1: List of Co-investigators/Collaborators/Partners
Global Research in Pregnancy and the Newborn Collaboration
Public Health Agency of Canada
Canadian Perinatal Surveillance System

British Columbia:

Chelsea Elwood, B.M.ScH, M.Sc, MD, FRCSC
Clinical Assistant Professor, Department of Obstetrics & 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

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

Eda Karacabeyli, MD, MHA
Maternal Fetal Medicine, Fellow
Department of Obstetrics & Gynecology, University of British Columbia

Kirsten Grabowska, MD
Clinical Assistant Professor, Division of Maternal Fetal Medicine, Surrey Memorial Hospital

Alberta:

Eliana Castillo, MD, FRCSC
Clinical Associate 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

Dr. George Carson, MD, FRCSC
Maternal Fetal Medicine, Regina General Hospital, Saskatchewan Health Authority

Dr. Jessica Minion, MD
Provincial Clinical Lead Public Health – Laboratory Medicine, Roy Romanow Provincial Laboratory
Regina, Saskatchewan Health Authority

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

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

Quebec:

Isabelle Boucoiran, MD, FRCSC
Professeure adjointe de clinique, Obstétrique-Gynécologie, Université de Montréal

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

Marc Beltempo, MD
Montreal Children’s Hospital & McGill University Health Centre

Richard Brown, MD
McGill University

Emmanuel Bujold, MD
CHU de Québec & Université Laval

Nathalie Dayan, MD
McGill University

Suzanne Demers, MD
Université Laval

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

Pascale Guérin, MD
Hôpital de Chicoutimi & CHU de Sherbrooke

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

France Leduc, MD
Hôpital de la Cité-de-la-Santé & Université de Montréal

Isabelle Malhamé, MD
McGill University Health Centre

Ali Nabeel, MD
Hôpital Maisonneuve-Rosemont & Université de Montréal

Jean-Charles Pasquier, MD
CHU de Sherbrooke

Bruno Piedboeuf, MD
CHU de Québec & Université Laval

Andrea Spence, PhD
Research Associate, Centre for Clinical Epidemiology | Centre d'épidémiologie Clinique Hôpital general juif - Sir Mortimer B. Davis - Jewish General Hospital

Marie-Claude Tanguay, MD
Hôpital Pierre-Boucher

Laurent H. Tordjman, MD
Hôpital Maisonneuve-Rosemont & Université de Montréal

Isabelle Vachon, MD
Hôpital du sacré coeur de Montréal & Université de Montréal

Bi Lan Wo, MD
Centre Hospitalier de l’Université de Montréal (CHUM)

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

Ann Sprague, RN, PhD
Project Advisor, BORN Ontario

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

Deshayne Fell, PhD
Associate Professor, School of Epidemiology and Public Health, University of Ottawa and Scientist, Children’s Hospital of Eastern Ontario Research Institute

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

Gillian Alton, PhD
Epidemiologist, BORN Ontario

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

Prakeshkumar Shah, MD, MRCP, MSc, FRCPC
Pediatrician-in-Chief, Mount Sinai Hospital,
Senior Clinician Scientist, Lunenfeld-Tanenbaum Research Institute
Professor, Departments of Paediatrics and Institute of HPME, University of Toronto,
Director, Canadian Neonatal Network

Darine El-Chaâr, MD, FRCSC, MSc
Medical Staff - Division of Maternal-Fetal Medicine, Department of Obstetrics, Gynecology and
Newborn Care, The Ottawa Hospital
JoAnn Harrold, MD, FRCPC  
Associate Professor, Pediatrics, University of Ottawa

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

**Nova Scotia:**

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

**New Brunswick:**

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

Shamara Baidoobonso, PhD  
Provincial Epidemiologist  
Manager, Population Health Assessment & Surveillance Unit

**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
Coordinating Centre Staff:

Gal Av-Gay, MSc
Biostatistician, Women's Health Research Institute, BC Women's Hospital & Health Centre

Lucia Forward, BSc
Research Manager, Women's Health Research Institute, BC Women's Hospital & Health Centre

Julie Hanna
Project Manager, Women's Health Research Institute, BC Women's Hospital & Health Centre

Tiffany Reeve, MSc
Research Manager, Women's Health Research Institute, BC Women's Hospital & Health Centre

Melissa Watt, CCRP
Research Coordinator, Women's Health Research Institute, BC Women's Hospital & Health Centre

Evelyn Maan, RN
Research Program Manager, Oak Tree Clinic/Women's Health Research Institute, BC Women's Hospital & Health Centre

Zahra Pakzad, MSc
Research Projects Manager, Women's Health Research Institute, BC Women's Hospital & Health Centre

Arezou Azampanah, MSc
Research Coordinator, Oak Tree Clinic/Women's Health Research Institute, BC Women's Hospital & Health Centre

Research Assistants, Women's Health Research Institute, BC Women's Hospital & Health Centre:

Suraya Bondy    Sara Cole    Sela Grays    Brandon Krezeski
Henry Payette    Omnia Taha    Iweoma Ùdevi    Sasha Walker