File No: AI22-30-09740

QB/PC File No: CI-20-01-29284

IN THE COURT OF APPEAL

BETWEEN:

GATEWAY BIBLE BAPTIST CHURCH, PEMBINA VALLEY BAPTIST CHURCH, REDEEMING GRACE BIBLE CHURCH, THOMAS REMPEL, GRACE COVENANT CHURCH, SLAVIC BAPTIST CHURCH, CHRISTIAN CHURCH OF MORDEN, BIBLE BAPTIST CHURCH, TOBIAS TISSEN and ROSS MACKAY

(Applicants) Appellants

-and-

HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF MANITOBA, and DR. BRENT ROUSSIN in his capacity as CHIEF PUBLIC HEALTH OFFICER OF MANITOBA, and DR. JAZZ ATWAL in his capacity as ACTING DEPUTY CHIEF OFFICER OF HEALTH MANITOBA

(Respondents) Respondents

APPELLANTS' APPEAL BOOK

VOLUME 6 (Pages AB1320 to AB1612)

May 20, 2022

Supreme Advocacy LLP

Eugene Meehan, Q.C.
Thomas Slade

[redacted]

Pejovic Law

Allison Kindle Pejovic

[redacted]

Counsel for the (Applicants), Appellants

AND TO: **Manitoba Justice, Legal Services Branch**
Constitutional Law Section
[redacted]

Michael Conner
Denis Guénette
[redacted]

Counsel for the Respondents

AND TO: **The Association for Reformed Political Action (ARPA) Canada**
[redacted]

André Schutten
[redacted]

Tabitha Ewert
[redacted]

Counsel for the Intervener
before the Court of Queen's Bench

INDEX

Tabs

<u>VOLUME 1</u>

1. **Pleadings 1**
   a. Amended Amended Notice of Application, dated April 30, 2021 1
2. **Affidavits of the Applicants/Appellants**
   a. Affidavit of Dale Wohlgemuth, affirmed December 14, 2020 19
      i. Ex A - Email entitled "Masks and PCR tests", dated September 21, 2020 22
      ii. Ex B - Email Response, dated November 5, 2020 24
   b. Affidavit of Christopher Lowe, sworn December 30, 2020 27
      i. Ex A – Relevant sections of the Public Health Orders, between March 2020 – May 2020 39
      ii. Ex B – Public Health Order, dated November 21, 2020 56
      iii. Ex C – Public Health Order dated December 22, 2020 86
   c. Affidavit of Ross Mackay, affirmed January 4, 2021 119
      i. Ex A – Public Health Order, dated November 11, 2020 125
      ii. Ex B – Ticket, dated November 20, 2020 129
      iii. Ex C – Public Health Order, dated November 22, 2020 131
      iv. Ex D – Public Health Order, dated December 22, 2020 138
   d. Affidavit of Jay Bhattacharya, sworn January 5, 2021 144
      i. Ex A – *The Great Barrington Declaration* 154
      ii. Ex B – Curriculum vitae of Jay Bhattacharya 161
      iii. Ex C – Expert Report on the COVID-19 Epidemic Response in Manitoba, Canada, dated January 5, 2021 188

VOLUME 2

e. Affidavit of Riley Toews, sworn January 5, 2021 230

   i. Ex A – Relevant sections of the Public Health Orders between March 2020 – May 2020 242

   ii. Ex B – Public Health Order, dated November 21, 2020 263

   iii. Ex C – Public Health Order, dated December 22, 2020 270

   iv. Ex D – Emails, government responses, the petition and government response 275

f. Affidavit of Tobias Tissen, affirmed January 5, 2021 412

   i. Ex A – Relevant sections of the Public Health Orders between March 2020 – May 2020 421

   ii. Ex B – Public Health Order, dated November 21, 2020 434

   iii. Ex C – Public Health Order, dated December 22, 2020 441

   iv. Ex D – Two tickets, dated November 23, 2020 446

   v. Ex E – Warning, dated November 29, 2020 452

   vi. Ex F – Tickets, dated December 9, 2020 455

g. Affidavit of Roger Thomas, affirmed January 6, 2021 461

   i. Ex A – Email entitled “Inquiry” and response, dated December 7, 2020 464

h. Affidavit of Thomas Rempel, affirmed January 7, 2021 467

   i. Ex A – Relevant sections of the Public Health Orders between March 2020 – May 2020 476

   ii. Ex B – Public Health Order, dated November 21, 2020 494

   iii. Ex C – Public Health Order, dated December 22, 2020 500

i. Affidavit of Riley Toews, affirmed March 24, 2021 505

j. Affidavit of Christopher Lowe, sworn March 25, 2021 510

k. Affidavit of Thomas Rempel, affirmed March 26, 2021 514

l. Affidavit of Tobias Tissen, affirmed March 26, 2021 518

VOLUME 3

m. Affidavit of Thomas Warren, sworn March 30, 2021 522

i. Ex A – Curriculum vitae of Thomas Warren 527

ii. Ex B – Expert Report of Thomas Warren M.D., Responding Expert Report on SARS-Co-V-2 and COVID-19, PCR Tests, and Asymptomatic Transmission, dated March 29, 2021 533

n. Affidavit of Jay Bhattacharya, sworn March 31, 2021 547

i. Ex A – Expert Report of Jay Bhattacharya M.D., Ph.D., Responding Expert Report on the COVID-19 Epidemic Response in Manitoba, dated March 31, 2021 552

o. Affidavit of Joel Kettner, sworn, April 1, 2021 574

i. Ex A – Curriculum vitae 587

ii. Ex B – Responding Expert Report on the COVID-19 Pandemic Response in Manitoba, dated April 1, 2021 611

p. Affidavit of Ross MacKay, affirmed April 1, 2021 649

q. Affidavit of David Hersey, sworn April 20, 2021 653

i. Ex A – Letter from the Applicants to the Respondents, dated March 19, 2021 658

ii. Ex B – Letter from the Respondents to the Applicants, dated March 30, 2021 663

VOLUME 4

Ex B continued (Item 2 – Insert 5) 797

iii. Ex C – Letter from the Applicants to the Respondents, dated April 1, 2021 878

iv. Ex D – Letter from the Respondents to the Applicants, dated April 6, 2021 884

VOLUME 5

Ex D continued (Spreadsheet of Ct values for positive PCR tests) 1058

v. Ex E – Letter from the Respondents to the Applicants, dated April 8, 2021 1220

vi. Ex F – Letter from the Applicants to the Respondents, dated April 13, 2021 1255

vii. Ex G – Letter from the Respondents to the Applicants, dated April 14, 2021 1260

VOLUME 6

3. Affidavits of the Respondent

a. Affidavit of Jason Kindrachuk, affirmed March 2, 2021 1320

i. Ex A – Curriculum vitae of Jason Kindrachuk 1323

ii. Ex B – Report Prepared for Manitoba Justice on SARS-COV-2 and COVID-19, dated February 26, 2021 1339

b. Affidavit of Carla Loeppky, affirmed March 4, 2021 1368

i. Ex A – Curriculum vitae of Carla Loeppky 1377

ii. Ex B – MHSAL Epidemiological Situation Report, January 14, 2021 1388

iii. Ex C – Demographic and Clinical Characteristics of COVID-19 Cases with a Severe Outcome in Manitoba, dated January 11, 2021 1422

iv. Ex D – Impacts of COVID-18 Public Health Measures on Various Health Indicators in Manitoba, dated November 1, 2020 1434

v. Ex E – COVID-19 Novel Coronavirus Covid Response Update, October 15, 2020 1479

vi. Ex F – COVID-19 Novel Coronavirus Covid Response Update, presented November 10, 2020 1516

vii. Ex G - COVID-19 Novel Coronavirus Covid Response Update, ... 1570

viii. Ex H – COVID-19 Epidemiological Information, dated March 2, 2021 1596

VOLUME 7

c. Affidavit of Jared Bullard, affirmed March 5, 2021 1613

i. Ex A – Curriculum vitae of Jared Bullard........ 1620

ii. Ex B – Curriculum viae of Dr. Van Caeseele 1647

iii. Ex C – *Principles and practice of molecular testing for Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-Cov-2) during the Coronavirus Disease 2019 (COVID-19) pandemic in Manitoba, Canada*, February 24, 2021 1686

d. Affidavit of Lanette Siragusa, affirmed March 5, 2021 1700

i. Ex A – Curriculum Vitae of Lanette Siragusa 1709

e. Affidavit of Szilveszter Jozsef Komlodi, affirmed March 5, 2021 1716

i. Ex A – List of resources and support programs available for individuals and businesses, from the Government's website........ 1728

ii. Ex B – Manitoba Bridge Grant 1731

iii. Ex C – Caregiver Wage Support Program 1750

iv. Ex D – Dine-in Restaurant Relief Program........ 1757

v. Ex E – Back to Work in Manitoba Wage Subsidy Programs 1762

vi. Ex F – Tax and Fee Deferrals 1770

vii. Ex G – Manitoba Gap Protection Program........ 1777

viii. Ex H – Manitoba Job Restart Program........ 1780

ix. Ex I – Canada-Manitoba Job Grant........ 1788

x. Ex J – Covid-19 Novel Coronavirus – Care for Your Mental Health 1790

xi. Ex K – Help Next Door 1808

xii. Ex L – Safe at Home Manitoba Grant Program 1811

xiii. Ex M – List of support programs offered by the federal government 1820

xiv. Ex N – Canada's COVID-19 Economic Response Plan 1824

xv. Ex O – Additional Support for Canadian Businesses from the Economic Impact of COVID-19 1843

VOLUME 8

f. Affidavit of Brent Roussin, affirmed March 8, 2021 1857

i. Ex 1 – Curriculum vitae of Brent Roussin 1920

ii. Ex 2 – High-level overview of the structure, current to February 18, 2021 1923

iii. Ex 3 – Government of Canada – COVID-19: Main modes of transmission 1925

iv. Ex 4 – Manitoba First Nations COVID-19 Pandemic Response Coordination Team Weekly Bulletin, February 19, 2021 1930

v. Ex 5 – Journal of the American Medical Association, *As Their Numbers Grow, COVID-19 "Long Haulers" Stump Experts*, September 23, 2020 1935

vi. Ex 6 – Nature Human Behaviour, *Ranking the effectiveness of worldwide COVID-19 government interventions,* December 2020 1939

vii. Ex 7 – Extracts of the Pan-Canadian Public Health Network, *Federal/Provincial/Territorial Public Health Response Plan for Biological Events* 1958

viii. Ex 8 – Pan-Canadian Public Health Network website 1985

ix. Ex 9 – The Royal College of Physicians and Surgeons of Canada, *Objectives of Training in the Specialty of Public Health and Preventative Medicine*, March 2018 1987

x. Ex 10 – Canadian Public Health Association, *Public Health: A Conceptual Framework*, March 2017 2009

xi. Ex 11 – Canadian Nurses Association, *Ethics in Practice for Registered Nurses,* February 2006 2024

xii. Ex 12 – Centers for Disease Control and Prevention, *High SARS-CoV-2 Attack Rate Following Exposure at a Choir Practice, Skagit County, Washington, March 2020*, May 15, 2020 2037

xiii. Ex 13 - Centers for Disease Control and Prevention, *High COVID-19 Attack Rate Among Attendees at Events at a Church – Arkansas, March 2020*, May 22, 2020 2043

xiv. Ex 14 – Shared Health Manitoba, *COVID-19 Infection Prevention and Control Guidance for Personal Care Homes*, January 11, 2021 2048

xv. Ex 15 – Shared Health Manitoba, *COVID-19 Infection Prevention and Control Checklist for Personal Care Homes*, January 11, 2021 2072

xvi. Ex 16 – Shared Health Manitoba, *COVID-19 Long Term Care/Transitional Care Cohorting Guidelines*, November 30, 2020 2079

xvii. Ex 17 – The Lancet, *Genomic evidence for reinfection with SARS-CoV-2: a case study,* January 2021 2084

xviii. Ex 18 – The BMJ, *Covid-19: Hong Kong scientists report first confirmed case of reinfection*, August 26, 2020 2092

xix. Ex 19 – The Government of Alberta, *Herd immunity and the Great Barrington Declaration,* October 28, 2020 2094

xx. Ex 20 – The Lancet, *John Snow Memorandum*, October 31, 2020 2098

xxi. Ex 21 – COVID-19 Infections in Manitoba: Race, Ethnicity and Indigeneity, March 1, 2021 2101

g. Reply Affidavit of James Blanchard, affirmed April 20, 2021 2112

i. Ex A – Curriculum vitae of James Blanchard 2115

ii. Ex B – Comments on Dr. Joel Kettner's "*Expert Report on the COVID-19 pandemic response in Manitoba*", April 20, 2021 2150

VOLUME 9

h. Reply Affidavit of Jared Bullard, affirmed April 29, 2021 2156

i. Ex A – World Health Organization, *WHO Information Notice for IVD Users 2020/05*, January 13, 2021 2165

ii. Ex B – World Health Organization, Diagnostic testing for SARS-CoV-2, Interim Guidance, September 11, 2020 2168

iii. Ex C – PCR and Ct values in COVID-19 testing – Frequently Asked Questions and Important Considerations 2189

i. Reply Affidavit of Jason Kindrachuk, affirmed April 29, 2021.......... 2194

i. Ex A – Reply Report.. 2197

j. Reply Affidavit of Brent Roussin, affirmed April 30, 2021................ 2210

i. Ex A – Letter from the Applicants to the Respondents, dated March 19, 2021 2219

ii. Ex B – Letter from the Respondents to the Applicants, dated March 30, 2021 2224

iii. Ex C – Manitoba Emergency Plan, April 2018 2229

iv. Ex D – *Federal/Provincial/Territorial Public Health Response Plan for Ongoing Management of COVID-19*, August 19, 2020 2339

v. Ex E – News Releases Manitoba, Covid-19 Bulletin #406, 407 and 408 2383

vi. Ex F – News Releases Manitoba 2390

vii. Ex G – News Releases Manitoba, *New Orders Protect Manitobans Against Third Wave*, April 19, 2021 and *New*

Public Health Orders in Place for Vaccinated Personal Care Home Staff, April 20, 2021 2407

viii. Ex H – New Releases Manitoba, *Province Launching Covid-19 Rapid Test Asymptomatic Screening Strategy to Protect Manitobans*, April 19, 2021 and *COVID-19 Enforcement Update,* April 20, 2021 2414

ix. Ex I – SafeathomeMB.ca 2421

VOLUME 10

k. Reply Affidavit of Carla Loeppky, affirmed April 30, 2021 2431

i. Ex A – Letter from the Applicants to the Respondents, dated March 19, 2021 2438

ii. Ex B – Letter from the Respondents to the Applicants, dated March 30, 2021 2443

iii. Ex C – List of modelling parameters 2448

iv. Ex D – Public Health Agency of Canada, FluWatch Report . 2452

v. Ex E – Manitoba Health, Seniors and Active Living Week 12 Bulletin, March 15-21, 2020 2465

vi. Ex F – Manitoba Health, Seniors and Active Living Week 19-20 Bulletin, March 5-18, 2021 2468

vii. Ex G – Manitoba Health, Seniors and Active Living, Annual Report of Seasonal Influenza, 2017-2018 2480

viii. Ex H – Manitoba Health, Seniors and Active Living, Annual Report of Seasonal Influenza, 2016-2017 2517

ix. Ex I – Manitoba Health, Seniors and Active Living, Annual Report of Seasonal Influenza, 2015-2016 2559

l. Reply Affidavit of Lanette Siragusa, affirmed April 30, 2021 2604

i. Ex A – Emails exchanged between the Applicants and Respondents, April 6 – April 8, 2021 2608

4. List of Exhibits Filed in the Proceedings Under Appeal 2633

VOLUME 11

5. Judgment, dated February 11, 2022..2634

6. Notice of Appeal, dated March 14, 2022 2638

7. Judgments Appealed from 2646

a. Reasons for Judgment, dated October 21, 2021, 2021 MBQB 218 (Constitutionality of ss. 13 & 67)...................................2646

b. Reasons for Judgment, dated October 21, 2021, 2021 MBQB 219 (*Charter*, Administrative Law, Division of Powers)........2670

c. Order for Costs, dated February 1, 2022 2826

AB1320

File No. CI 20-01-29284

THE QUEEN'S BENCH
Winnipeg Centre

APPLICATION UNDER: *The Constitutional Questions Act*, C.C.S.M., c. 180

AND UNDER: The Court of Queen's Bench Rules, M.R. 553-88

IN THE MATTER OF: *The Public Health Act*, C.C.S.M. c. P210

B E T W E E N:

GATEWAY BIBLE BAPTIST CHURCH, PEMBINA VALLEY BAPTIST CHURCH, REDEEMING GRACE BIBLE CHURCH, THOMAS REMPEL, GRACE COVENANT CHURCH, SLAVIC BAPTIST CHURCH, CHRISTIAN CHURCH OF MORDEN, BIBLE BAPTIST CHURCH, TOBIAS TISSEN, ROSS MACKAY,

Applicants,

- and -

HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF MANITOBA and DR. BRENT ROUSSIN in his capacity as CHIEF PUBLIC HEALTH OFFICER OF MANITOBA, and DR. JAZZ ATWAL in his capacity as ACTING DEPUTY CHIEF OFFICER OF HEALTH OF MANITOBA

Respondents.

AFFIDAVIT OF JASON KINDRACHUK
AFFIRMED: MARCH 2, 2021

DEPARTMENT OF JUSTICE
Constitutional Law Branch
[redacted]

Per: Heather Leonoff

[redacted]

AB1321

File No. CI 20-01-29284

THE QUEEN'S BENCH
Winnipeg Centre

APPLICATION UNDER: *The Constitutional Questions Act*, C.C.S.M., c. 180

AND UNDER: The Court of Queen's Bench Rules, M.R. 553-88

IN THE MATTER OF: *The Public Health Act*, C.C.S.M. c. P210

B E T W E E N:

GATEWAY BIBLE BAPTIST CHURCH, PEMBINA VALLEY BAPTIST CHURCH, REDEEMING GRACE BIBLE CHURCH, THOMAS REMPEL, GRACE COVENANT CHURCH, SLAVIC BAPTIST CHURCH, CHRISTIAN CHURCH OF MORDEN, BIBLE BAPTIST CHURCH, TOBIAS TISSEN, ROSS MACKAY,

Applicants,

- and -

HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF MANITOBA and DR. BRENT ROUSSIN in his capacity as CHIEF PUBLIC HEALTH OFFICER OF MANITOBA, and DR. JAZZ ATWAL in his capacity as ACTING DEPUTY CHIEF OFFICER OF HEALTH OF MANITOBA

Respondents.

AFFIDAVIT OF JASON KINDRACHUK

I, JASON KINDRACHUK, of the City of Saskatoon, in the Province of Saskatchewan, **AFFIRM AS FOLLOWS:**

1. I have personal knowledge of the facts and matters hereinafter deposed to by me, except where same are stated to be based upon information and belief, and those I believe to be true.

2. I have a PhD in biochemistry, obtained in 2007, from the Univeristy of Saskatchewan. I am currently an Assistant Professor and Canada Research Chair in emerging viruses in the Department of Medical Microbiology & Infectious Diseases, University of Manitoba. My field of expertise is the investigation of emerging viruses, the infections they cause and their impact on global health. I am presently seconded as part of a 12-month research partnership agreement at the Vaccine and Infectious Disease Organization, University of Saskatchewan, Canada, where I am helping lead and facilitate national COVID-19 research response efforts. I have been engaged in research regarding coronavirus since 2013 following the emergence of Middle East respiratory syndrome coronavirus. My curriculum vitae is attached as Exhibit A.

3. At the request of Manitoba Justice, I have provided a report detailing my understanding of some of the important issues regarding the virus SARS-CoV- 2 and the disease it causes, namely COVID-19. I acknowledge that in preparing this report and providing expert evidence, legal counsel for the Government explained that my role is to assist the court to determine the matters in issue. I further acknowledge that it is my duty to provide evidence that is fair, objective and non-partisan and to opine only on matters that are within my area of expertise. This duty prevails over any obligation that I may owe to any party on whose behalf I am engaged. Attached as Exhibit B is a copy of my report.

4. I make this affidavit bona fide.

AFFIRMED before me in the City of Winnipeg, in the Province of Manitoba, through use of video conferencing as permitted by order under *The Emergency Measures Act*, this 2 day of March, 2021.

Heather Leff

A Barrister-at-law entitled to practice in and for the Province of Manitoba

JASON KINDRACHUK

This is Exhibit " A " referred to
in the Affidavit of Jason Kindrachuk
Affirmed before me this second
day of March A.D. 2021

Heather Leff

A Barrister-at-Law entitled to practice
in and for the Province of Manitoba

AB1324

Jason Kindrachuk, PhD
Laboratory of Emerging and Re-emerging Viruses
Department of Medical Microbiology & Infectious Diseases
University of Manitoba
[redacted]

EDUCATION

2002-2007 **Ph.D., Department of Biochemistry**
University of Saskatchewan, Saskatoon, SK, Canada
Supervisor: Dr. Scott Napper
Thesis Title: *Host and Pathogen Sensory Systems as Targets for Therapeutic Intervention*

1996-2001 **B.Sc. (Honors), Department of Biochemistry**
University of Saskatchewan, Saskatoon, SK, Canada

PROFESSIONAL EXPERIENCE

2017-present **Assistant Professor**
Canada Research Chair
Laboratory of Emerging and Re-Emerging Viruses
Department of Medical Microbiology and Infectious Diseases
University of Manitoba
Winnipeg, MB

Associate Professor
Department of Biochemistry
College of Medicine and Allied Health Sciences
University of Sierra Leone
Freetown, Sierra Leone

2014-2016 **Staff Scientist**
Critical Care Medicine Department
Clinical Center
National Institutes of Health, Bethesda, MD, USA

Sept 2014 **Scientific Lead – Field Diagnostics**
Ebola Virus Disease Outbreak Response Efforts
Centers for Disease Control/Department of Defense Joint Operations
Monrovia, Liberia

2013-2014 **Principal Research Scientist**
Battelle Memorial Institute
Integrated Research Facility
National Institutes of Allergy and Infectious Diseases

National Institutes of Health, Frederick, MD, USA

2009-2013 **Visiting Fellow**
Emerging Viral Pathogens Section
National Institutes of Allergy and Infectious Diseases
National Institutes of Health, Bethesda, MD, USA

2007-2009 **Postdoctoral Fellow**
Centre for Microbial Diseases and Immunity Research
Department of Microbiology and Immunology
University of British Columbia, Vancouver, BC, Canada

SCIENTIFIC AFFILIATIONS & COMMITTEE ACTIVITIES

Affiliations

2020-present **Visiting Scientist** – Vaccine and Infectious Disease Organization-International Vaccine Centre

2020-present **Science Contributor** – Forbes Media, LLC

2020-present **Volunteer, Regional Leader** – COVID-19 Resources Canada

2020-present **Volunteer, Infection Control Lead** – Heart to Heart International COVID-19 Preparedness and Response Efforts

2019-present **Visiting Researcher** – The International Center for Medical Research in Franceville, Gabon (CIRMF)

2018-present **Visiting Scientist** – Public Health Agency of Canada, Special Pathogens Section

2018-present **Visiting Scientist** – Canadian Food Inspection Agency, Special Pathogens Unit

2017-present **Investigator** – Children's Health Research Institute of Manitoba

Committees and Review Panels

2020 **Panel Member** – CIHR Institute of Infection and Immunity Consultation on Variant Strains of SARS-CoV-2

2020 **Member** – World Health Organization COVID-19 Solidarity Serology Study Group

2020 **Member** – World Health Organization Ad Hoc Committee on COVID-19 Animal Models

2020 **Session chair** – Tuberculosis and other Infectious Diseases, University of Nairobi HIV/AIDS Collaborative Conference

2019-present **Member** – Community for Emerging and Zoonotic Diseases, Canadian Network for Public Health Intelligence (CNPHI)

2019 **Member** – CIHR Strategic Planning Meeting

2019 **Review Panel Member** – New Frontiers in Research Fund Exploration Grant

2018-present **Director** – Canadian Society for Virology Executive Council

2018-present **Associate Member** – CIHR College of Reviewers

2018 **Co-Chair** – Emerging Viral Diseases and Global Preparedness Symposium

2018 **Organizing Committee Member** – Canada's Role in Global Public Health Conference

2017-present **Review Panel** – American Association for the Advancement of Science (AAAS) Research Competitiveness Program

2017-present **Reviewer** – Manitoba Poster Competition of the Canadian Student Health Research Forum

2017-present **Review Panel** – Research Manitoba PhD Scholarship Competition

2016 **External Reviewer** – National Science Centre, Poland (Narodowe Centrum Nauki – NCN) PRELUDIUM Funding scheme

2014 **Reviewer** – Alberta Livestock and Meat Agency (ALMA)

2012-2013 **Scientific Advisor** – World Health Organization Advisory Committee on Variola Virus Research (ACVVR): Provided updates and participated in critical discussions regarding ongoing variola virus research as a member of the US delegation

AWARDS & HONOURS

2018 Department of Medical Microbiology Faculty Educator Award

2018 National Institutes of Allergy and Infectious Diseases Merit Award

2017 Tier 2 Canada Research Chair Award

2015 National Institutes of Health Director's Award

2015 National Institutes of Health Clinical Center Summer Internship Program Best Mentor Award

2013 University of Maryland Integrated Life Sciences Honors College Mentor Award

2010-2013 National Institutes of Health Visiting Fellow Intramural Research Training Award

SCIENTIFIC JOURNAL ADVISORY BOARDS

2019-present **Guest Editor** – Viruses (Pathogenesis of Emerging Viruses Special Issue)

2019-present **Associate Editor** – Viruses

2019-present **Associate Editor** – Frontiers in Microbiology

2016-present **Associate Editor** – BMC Infectious Diseases

2014-present **Associated Review Editor** – Frontiers in Veterinary Science

PROFESSIONAL ASSOCIATIONS & MEMBERSHIPS

2019-present **Member** – Infectious Diseases Society of America

2017-present **Member** – Canadian Society for Virology

2017-present **Member** – Canadian Society of Microbiologists

2014-present **Member** – American Society for Microbiology

2014-present **Member** – American Society for Virology

PUBLICATIONS

1. Escandón, K., **Kindrachuk, J.**, Lee, R.S. and Rasmussen, A.L. (2020) Face masks, SARS-CoV-2 inoculum, COVID-19 severity, and immunity: is there any evidence to support a link? *Ann Intern Med*. [In Submission]
2. Webb, A.L., Schindell, B., Soule, G., Siddik, A.B., Abrenica, B., Memon, H., Su, R., Safronetz, D. and **Kindrachuk, J.** (2020) Sertoli cells remain viable and inhibit viral replication during Ebola virus infection. *Sci Rep*. [In Submission]
3. Francis, M.E., Richardson, B., McNeil, M., Rioux, M., Foley, M.K., Ge, A., Pechous, R.D., **Kindrachuk, J.**, Cameron, C.M., Richardson, C., Lew, J., Cameron, M.J., Gerdts, V., Falzarano, D. and Kelvin, A.A. Male sex and age biases viral burden, viral shedding, and type 1 and 2 interferon responses during SARS-CoV-2 infection in ferrets. *Sci Trans Med.* [In Submission]
4. Escandón, K., Rasmussen, A.L., Bogoch, I.I., Murray, E.J., Escandón, K. and **Kindrachuk, J.** (2020) COVID-19 and false dichotomies — a nuanced review of the evidence regarding public health, COVID-19 symptomatology, SARS-CoV-2 transmission, masks, and reinfection. *BMC Infect Dis.* [In Submission]
5. Forbes, K.M., Anzala, O., Carlson, C.J., Kelvin, A.A., Kuppalli, K., Leroy, E.M., Maganga, G.D., Masika, M.M., Mombo, I.M., Mwaengo, D.M., Niama, R.F., Nziza, J., Ogola, J., Pickering, B.S., Rasmussen, A.L., Sironen, T., Vapalahti, O., Webala, P.W., and **Kindrachuk, J.** (2020) Towards a coordinated strategy for intercepting human disease emergence in Africa. *Lancet Microbe*. [Accepted]
6. Schindell, B.*, Allardice, M.*, Lockman, S. and **Kindrachuk, J**. (2020) Drug Identification and Repurposing During a Novel Viral Pandemic (Invited Perspective). *ACS Infect Dis*. [Accepted]
7. Nickol, M.E., Lyle, S.M., Dennehy, B. and **Kindrachuk, J.** (2020) Dysregulated Host Responses Underlie 2009 Pandemic Influenza-Methicillin Resistant Staphylococcus aureus Coinfection Pathogenesis at the Alveolar-Capillary Barrier. *Cells*. 9: 2472
8. Connelly, M., Swerczek, J., **Kindrachuk, J.**, Vannella, K., Ramos-Benitez, M., Sun, J., Dougherty, E., Danner, R., Moore, I., Herbert, R. and Chertow, D.S. (2020) A Model of Prolonged Human Intensive Care and Recovery in Rhesus Macaques. *Sci Rep*. [Accepted]
9. Pascoe, C.D., Jha, A., Ryu, M.H., Ragheb, M., Basu, S., Stelmack, G., **Kindrachuk, J.**, Gaurveau, G.M., O'Byrne, P.M., Ravandi, A., Carlsten, C. and Halayko, A.J. (2020) Oxidized phosphatidylcholine are produced in response to allergen inhalation and promote inflammation. *Eur Respir J.* 3: 2000839
10. Cevik, M., Kuppalli, K., **Kindrachuk, J.** and Peris, M. (2020) Transmission and risk factors for severe acute respiratory syndrome coronavirus 2. *BMJ*. 371: m3862
11. Rashid, M, Zahedi-Amiri, A., Glover, K.K.M., Ang, G., Nickol, M.E., **Kindrachuk, J.**, Wilkins, J.A. and Coombs, K.M. (2020) Zika virus dysregulates human sertoli cell proteins involved in spermatogenesis with little effect on blood-testes tight junctions. *PLoS Negl Trop Dis*. 14: e0008335
12. Vanella, K.M., Stein, S., Connelly, M., Swerczek, J., Amaro-Carambot, E., Coyle, E.M., Babyak, A., Winkler, C.W., Saturday, G., Gai, N.D., Hammoud, D.A., **Kindrachuk, J.**, Peterson, K.E., Brenchley, J.M., Whitehead, S.S., Khurana, S., Herbert, R. and Chertow,

D.S. (2020) Nonhuman primates exposed to Zika virus *in utero* are not protected against viral re-challenge over one year postpartum. *Sci Trans Med*. 12: eaaz4997

13. Khurana, S., Ravichandran, S., Hahn, M., Coyle, E.M., Stonier, S.W., Zak, S.E., **Kindrachuk, J.**, Davey Jr., R.T., Dye, J.M. and Chertow, D.S. (2020) Longitudinal human antibody repertoire against complete viral proteome following acute Ebola virus infection reveals protective sites for vaccine design. *Cell Host Microbe*. 27: 262-276.e4

14. Ralph, R., Lew, J., Zeng, T., Francis, M., Bei, X., Roux, M., Toloue, M. Rubino, S., Daw, N., Al-Ahdal, M.N., Kelvin, D.J., Richardson, C., **Kindrachuk, J.**, Falzarano, D., and Kelvin, A.A. (2020) 2019-nCoV (Wuhan virus), A Novel Coronavirus, linked to Chinese Pneumonia Cases: Human-to-Human Transmission, Travel-Related Cases and Vaccine Readiness. *J Infect Dev Ctries*. 14: 3-17

15. Willman, M., Kobasa, D. and **Kindrachuk J**[¶]. (2019) A comparative analysis of factors influencing two outbreaks of Middle Eastern respiratory syndrome (MERS) in Saudi Arabia and South Korea. *Viruses*. 11: 1119.

16. Nickol, M.E., Ciric, J., Falcinelli, S.D., Chertow, D.S. and **Kindrachuk, J[¶].** (2019) Characterization of Host and Bacterial Contributions to Lung Barrier Dysfunction Following 2009 Pandemic Influenza-Methicillin Resistant Staphylococcus aureus Co-infection. *Viruses*. 11: 116.

17. Schindell, B.G., Webb, A.L. and **Kindrachuk, J[¶].** (2019) Persistence and Sexual Transmission of Filoviruses. *Viruses*. 10: 683.
**article highlighted in NBC News article "Ebola is back in the Congo — and America's Africa policies aren't helping contain its spread"*

18. Nickol, M.E. and **Kindrachuk, J[¶].** (2019) A Year of Terror and a Century of Reflection: Perspectives on the Great Influenza Pandemic of 1918-1919. *BMC Inf Dis*. 19: 117.

19. Kashem, M.A., Li, H., Toledo, N., Omange, R.W., Liang, B., Liu, L.R., Yuan, X., **Kindrachuk, J.**, Plummer, F.A. and Luo, M. (2019) Toll-like Interleukin 1 Receptor Regulator is an important modulator of inflammation responsive genes. *Front Immunol*. 10: 272.

20. Dyall, J., Gross, R., **Kindrachuk, J.**, Johnson, R.F., Olinger, G.G., Hensley, L.E., Frieman, M.B., and Jahrling, P.B. (2017) Middle East respiratory syndrome and severe acute respiratory syndrome: current therapeutic options and potential targets for novel therapies and vaccines. *Drugs*. 77: 1935-1966.

21. **Kindrachuk, J[¶].** (2017) Invited Editorial: Selective Inhibition of Host Cell Signaling for Rotavirus Antivirals: PI3K/Akt/mTOR-Mediated Rotavirus Pathogenesis. *Virulence*. 9: 5-8.

22. Barnes, K.G.*, **Kindrachuk, J.***, Lin, A.E.*, Wohl, S., Qu, J., Tostenson, S.D., Dorman, W.R., Busby, M., Siddle, K.J., Matranga, C.B., Davey, R.T., Sabeti, P.C, and Chertow, D.S. (2017) Evidence for replication and high concentration of ebola virus in semen of a patient recovering from severe disease. *Clin Infect Dis.* 65: 1400-1403.
*Authors contributed equally to this work

23. Kash, J.C.*, Walters, K.A.*, **Kindrachuk, J.**, Baxter, D., Scherler, K., Janosko, K.B., Adams, R.D., Herbert, A.S., James, R.M., Stonier, S.W., Memoli, M.J., Dye, J.M., Davey, R.T., Chertow, D.S., and Taubenberger, J.K. (2017) Peripheral blood transcriptional analysis of a severe ebola virus disease patient reveals dramatic transitions during critical illness and recovery. *Sci Transl Med.* 9: eaai9321.
*Authors contributed equally to this work

24. Falcinelli, S.D., Chertow, D.S., and **Kindrachuk, J[¶].** (2016) Integration of Global Analyses of Host Molecular Responses with Clinical Data to Evaluate Pathogenesis and Advance Therapies for Emerging and Re-Emerging Viral Infections. *ACS Infect Dis.* 2: 787-799.
25. Davis, S.A.*, Chertow, D.S.*, **Kindrachuk, J.**, Schwartzman, L.M., Suzich, J., Alsaaty, S., Logun, C., Shelhamer, J.H., and Taubenberger, J.K. (2016) 1918 Influenza Receptor Binding Domain Variants Bind and Replicate in Primary Human Airway Cells Regardless of Receptor Specificity. *Virology*. 493: 283-246.
*Authors contributed equally to this work
26. Chertow, D.S., **Kindrachuk, J.**, Sheng, Z.M., Pujanauski, L., Cooper, K., Nogee, D., St. Claire, M., Solomon, J., Perry, D., Sayre, P., Janosko, K.B., Lackemeyer, M.G., Bohannon, J.K., Hensley, L.E., Kash, J.C., Jahrling, P.B. and Taubenberger, J.K. (2016) An experimental model of lung injury in rhesus macaques following influenza and bacterial co-infection. *Antiviral Res.* 129: 120-9.
27. Walters, K.A., D'Agnillo, F., Sheng, Z.M., **Kindrachuk, J.**, Schwartzman, L.M., Keustner, R.E., Chertow, D.S., Golding, B., Taubenberger, J.K. and Kash, J.C. (2016) 1918 pandemic influenza virus and Streptococcus pneumoniae coinfection results in activation of coagulation and widespread pulmonary microvascular thrombosis in mice and humans. *J Pathol*. 238: 85-97.
28. Falcinelli, S., Gowen, B., Trost, B., Napper, S., Kusalik, A., Safronetz, D., Prescott, J., Johnson, R.F., Wahl-Jensen, V. Jahrling, P.B. and **Kindrachuk, J[¶]**. (2015) Characterization of the functional host response to Pichinde virus infection in the Syrian golden hamster. *Mol Cell Proteomics*. 14: 646-57.
29. **Kindrachuk, J.[¶]**, Ork, B., Hart, B., Holbrook, M., Frieman, M., Johnson, R.F., Dyall, J., Olinger, G.G., Hensley, L.E., Jahrling, P.B. (2015) Temporal kinome analysis demonstrates that MERS-CoV selectively modulates ERK/MAPK and PI3K/AKT/mTOR signaling. *Antimicrob Agents Chemother*. 59: 1088-99.
30. Kuhn, J.H., Andersen, K.G., Bào, Y., Bavari, S., Becker, S., Bennett, R.S., Bergman, N.H., Blinkova, O., Bradfute, S., Brister, J.R., Bukreyev, A., Chandran, K., Chepurnov, A.A., Davey, R.A., Dietzgen, R.G., Doggett, N.A., Dolnik, O., Dye, J.M., Enterlein, S., Fenimore, P.W., Formenty, P., Freiberg, A.N., Garry, R.F., Garza, N.L., Gire, S.K., Gonzalez, J.P., Griffiths, A., Happi, C.T., Hensley, L.E., Herbert, A.S., Hevey, M.C., Hoenen, T., Honko, A.N., Ignatyev, G.M., Jahrling, P.B., Johnson, J.C., Johnson, K.M., **Kindrachuk, J.**, et al. (2014) Filovirus RefSeq entries: evaluation and selection of filovirus type variants, type sequences, and names. *Viruses*. 6: 3663-82.
31. **Kindrachuk, J.[*¶]**, Wahl-Jensen, V.*, Safronetz, D., Arsenault, R., Hoenen, T., Traynor, D., Postnikova, E., Napper, S., Blaney, J.E., and Jahrling, P.B. (2014) Temporal systems kinomics demonstrates that Ebola virus infection selectively modulates transforming growth factor β signaling in hepatocytes. *J Virol.* 88: 9877-92.
*Authors contributed equally
32. Dyall, J., Coleman, C., Hart, B., Venkataraman, T., Holbrook, M., **Kindrachuk, J.**, Johnson, R.F., Olinger, G.G., Jahrling, P.B., Laidlaw, M., Johnson, L., Glass, P., Hensley, L.E., and Frieman, M. (2014) Discovery of FDA-approved inhibitors of Middle East respiratory syndrome coronavirus infection. *Antimicrob Agents Chemother.* 58: 4885-93.
33. Jahrling, P.B., Lauren, K., St. Claire, M., Johnson, R., Bollinger, L., Lackemeyer, M., Hensley, L., **Kindrachuk, J.**, and Kuhn, J.H. (2014) Medical management and imaging of animals infected with risk group 4 pathogens at the NIAID Integrated Research Facility at

Fort Detrick, Maryland. *Pathog Dis.* 71: 213-9.

34. **Kindrachuk, J.**[¶], Falcinelli, S., Wada, J., Kuhn, J.H., Hensley, L.E., and Jahrling, P.B. (2014) Systems kinomics: a new paradigm for characterizing host responses to high consequence pathogens at the NIH/NIAID Integrated Research Facility at Frederick, MD. *Pathog Dis.* 71: 190-98.

35. Lackemeyer, M.G., de Kok-Mercado, F., Wada, J., **Kindrachuk, J.**, Wahl-Jensen, V., Kuhn, J.H., and Jahrling, P.B. (2014) ABSL-4 aerobiology biosafety and technology at the NIH/NIAID Integrated Research Facility at Fort Detrick. *Viruses*. 6: 137-50.

36. Hart, B.J., Dyall, J., Postnikova, E., Zhou, H., **Kindrachuk, J.**, Johnson, R.F., Olinger, G.G., Jahrling, P.B. and Hensley, L. (2014) Interferon-beta and mycophenolic acid are potent inhibitors of MERS-CoV in cell-based assays. *J Gen Virol.* 95: 571-7.

37. Trost, B., **Kindrachuk, J.,** Maattanen, P., Napper, S., and Kusalik, A. (2013) PIIKA 2: novel tools for the analysis of kinome microarray data. *PLoS ONE*. 8: e80837.

38. Trost, B., **Kindrachuk, J.**, Scruten, E., Griebel, P., Kusalik, A. and Napper, S. (2013) Personalized profiles of cellular kinase activity: the kinotype. *BMC Genomics* 14: 854.

39. **Kindrachuk, J.**, Jenssen, H., Elliott, M., Nijnik, A., Fang, Y., Pistolic, J., Pasupuleti, M., Thorson, L., Ma, S., Easton, D., Bains, M., Arnusch, C.J., Finlay, B., Sahl, H.G., Breukink, E. and Hancock, R.E.W. (2013) Manipulation of innate immunity by a bacterial secreted peptide; the lantibiotic nisin Z is selectively immunomodulatory. *Innate Immun*. 19: 315-27.

40. Achtman, A.H., Pilat, S., Law, C.W., Lynn, D.J., Janot, L., Ma, S., **Kindrachuk, J.**, Finlay, B.B., Brinkman, F.S.L., Smyth, G.K., Hancock, R.E.W., and Schofield, L. (2012) Effective adjunctive therapy by an innate defense regulatory peptide in a preclinical model of severe malaria. *Sci Transl Med.* 4: 135ra64.

41. Steinstraesser, L., Hirsch, T., Schulte, M., Kueckelhaus, M., Jacobsen, F., Mersch, E., Al-Benna, S., Stricker, I., Afacan, N., Jenssen, H., Hancock, R.E. and **Kindrachuk, J.** (2012) Innate defense regulator peptide 1018 in wound healing and wound infection. *PLoS One.* 7: e39373.

42. **Kindrachuk, J[¶].**, Arsenault, R., Kusalik, T., Kindrachuk, K.N., Trost, B., Napper, S., Jahrling, P.B. and Blaney, J.E. (2012) Systems kinomics demonstrates Congo Basin Monkeypox virus infection selectively modulates host cell signaling responses as compared to West African Monkeypox virus. *Mol Cell Proteomics.*11: M.111.015701.

43. Gao, G.*, Cheng, J.T.*, **Kindrachuk, J.**, Hancock, R.E.W., Straus, S.K. and Kizhakkedathu, J. (2012) Biomembrane interactions reveal the mechanism of action of surface-immobilized host defense IDR-1010 peptide. *Chem Bio.* 19: 199-209.
*Authors contributed equally to this work

44. Gao, G., Yu, K., **Kindrachuk, J.**, Brooks, D.E., Hancock, R.E.W., and Kizhakkedathu, J.N. (2011) Antibacterial surfaces based on polymer brushes: Investigation on the influence of brush properties on antimicrobial peptide immobilization and antimicrobial activity. *Biomacromolecules*. 32: 3899-909.

45. Wahl-Jensen, V.*, Kurz, S.*, Buehler, L.K., **Kindrachuk, J.**, DeFilippis, V., da Silva, J., Fruh, K., Kuhn, J.H., Burton, D.R. and Feldmann, H. (2011) Ebola virion binding to and entry into human macrophages profoundly effects cellular gene expression prior to expression of virus proteins. *PLoS Negl Trop Dis.*5: e1359.
*Authors contributed equally to this work

46. Garlapati, S.*, Eng, N.F.*, Kiros, T., **Kindrachuk, J.**, Mutwiri, G.K., Hancock, R.E., Babiuk,

L.A. and Gerdts, V. (2011) Immunization with PCEP microparticles containing pertussis toxoid, CpG ODN and a synthetic innate defense regulator peptide induces protective immunity against pertussis. *Vaccine.* 29: 6540-8.
*Authors contributed equally to this work

47. McAndrew Lynn, M.A., **Kindrachuk, J.**, Jenssen, H., Pante, N., Elliott, M., Napper, S., Hancock, R.E.W., and McMaster, R. (2011) Effect of BMAP-28 antimicrobial peptides on Leishmania major promastigote and amastigote growth: role of leishmanolysin in parasite survival. *PLoS Negl Trop Dis.* 5: e1141.
48. Gao, G.*, Lange, D.*, Hilpert, K., **Kindrachuk, J.**, Zou, Y., Cheng, J.T., Kazemzadeh, M., Yu, K., Wang, R., Straus, S.K., Brooks, D.E., Chew, B.H., Hancock, R.E. and Kizhakkedathu, J.N. (2011) The biocompatibility and biofilm resistance of implant coatings based on hydrophilic polymer brushes conjugated with antimicrobial peptides. *Biomaterials*. 32: 3899-909.
*Authors contributed equally to this work
49. **Kindrachuk, J.**, Scruten, E., Attah-Poku, S., Bell, K., Potter, A., Babiuk, L.A., Griebel, P.J., and Napper, S. (2011) Stability, toxicity and biological activity of host defense peptide BMAP28 and its inversed and retro-inversed isomers. *Biopolymers*. 96: 14-24.
50. Cheng, J.T., Hale, J.D., **Kindrachuk, J.**, Jenssen, H., Elliott, M., Hancock, R.E. and Straus, S.K. (2010) Importance of residue 13 and the C-terminus for the structure and activity of the antimicrobial Peptide aurein 2.2. *Biophys J.* 99: 2926-35.
51. Kazemzadeh-Narbat, M., **Kindrachuk, J.**, Duan, K., Jenssen, H., Hancock, R.E., and Wang, R. (2010) Antimicrobial peptides on calcium phosphate-coated titanium for the prevention of implant-associated infections. *Biomaterials.* 31: 9519-26.
52. **Kindrachuk, J.***, Jenssen, H.*, Wieczorek, M.*, Scott, W.R.P., Elliott, M., Hilpert, K., Cheng, J.T.J., Hancock, R.E.W., and Straus, S.K. (2010) Structural studies of a peptide with immune modulating and direct antimicrobial activity. *Chem Biol.* 17: 970-80.
*Authors contributed equally to this work
53. Bommarius, B., Jenssen, H., Elliott, M., **Kindrachuk, J.**, Pasupuleti, M., Gieren, H., Jaeger, K.E., Hancock, R.E., and Kalman, D. (2010) Cost-effective expression and purification of antimicrobial and host defense peptides in *Escherichia coli*. *Peptides*. 31: 1957-65.
54. **Kindrachuk, J.** and Napper, S. (2010) Structure-activity relationships of multifunctional host defense peptides. *Mini Rev Med Chem.* 10: 596-614.
55. Scruten, E., Kovacs-Nolan, J., Griebel, P.J., Latimer, L., **Kindrachuk, J**., Potter, A., Babiuk, L.A., Little-van den Hurk, S.D., and Napper, S. (2010) Retro-inversion enhances the adjuvant and CpG co-adjuvant activity of host defense peptide Bac2A. *Vaccine* 28: 2945-56.
56. Nijnik, A., Madera, L., Ma, S., Waldbrook, M., Elliott, M.R., Easton, D.M., Mayer, M.L., Mullaly, S.C., **Kindrachuk, J.**, Jenssen, H., and Hancock, R.E. (2010) Synthetic cationic peptide IDR-1002 provides protection against bacterial infections through chemokine induction and enhanced leukocyte recruitment. *J Immunol.* 184: 2539-50.
57. Mookherjee, N., Lippert, D.N.D., Hamill, P., Falsafi, R., Nijnik, A., **Kindrachuk, J.**, Pistolic, J., Gardy, J., Miri, P., Naseer, M., Foster, L.J., and Hancock, R.E.W. (2009) Intracellular receptor for human host defense peptide LL-37 in monocytes. *J Immunol.* 183: 2688-96.
58. **Kindrachuk, J.**, Jenssen, H., Elliott, M., Townsend, R., Nijnik, A., Lee, S., Halperin, S., and Hancock, R.E.W. (2009) A novel vaccine adjuvant comprised of a synthetic innate defense regulator peptide and CpG oligonucleotide links innate and adaptive immunity. *Vaccine* 27:

4662-71.

59. Hilpert, K., Elliott, M., Jenssen, H., **Kindrachuk, J.**, Fjell, C.D., Korner, J., Winkler, D.F.H., Weaver, L.L., Henklein, P., Ulrich, A.S., Chiang, S.H.Y., Farmer, S.W., Pante, N., Volkmer, R., and Hancock, R.E.W. (2008) Screening and characterization of surface-tethered cationic peptides for antimicrobial activity. *Chem Biol*. 16: 58-69.

60. **Kindrachuk, J.**, Potter, J., Wilson, H.L., Griebel, P., Babiuk, L.A., and Napper, S. (2008) Activation and regulation of toll-like receptor 9: CpGs and beyond. *Mini Rev Med Chem.* 8: 590-600.

61. **Kindrachuk, J.**, Paur, N., Reiman, C., Scruten, E., and Napper, S. (2007) The PhoQ-activating potential of antimicrobial peptides contributes to antimicrobial efficacy and is predictive of the induction of bacterial resistance. *Antimicrob Agents Chemother*. 51: 4374-81.

62. **Kindrachuk, J.**, Potter, J.E., Brownlie, R., Ficzycz, A.D., Griebel, P.J., Mookherjee, N., Mutwiri, G.K., Babiuk, L.A., and Napper, S. (2007) Nucleic acids exert a sequence-independent cooperative effect on sequence-dependent activation of toll-like receptor 9. *J Biol Chem.* 282: 13944-13953.

63. Jalal, S., **Kindrachuk, J.**, and Napper, S. (2007) Phosphoproteome and Kinome Analysis: Unique Perspectives on the Same Problem. *Curr Anal Chem.* 3: 1-15.

64. **Kindrachuk, J.**, Parent, J., Davies, G.F., Dinsmore, M., Attah-Poku, S., and Napper, S. (2003) Overexpression of L-isoaspartate O-methyltrasferase in Escherichia coli increases heat shock survival by a mechanism independent of methyltransferase activity. *J Biol Chem*. 278: 50880-50886.

65. Napper, S., **Kindrachuk, J.**, Olson, D.J., Ambrose, S.J., Dereniwsky, C., Ross, A.R. (2003) Selective extraction and characterization of a histidine-phosphorylated peptide using immobilized copper (II) ion affinity chromatography and matrix-assisted laser desorption/ionization time-of-flight mass spectrometry. *Anal Chem.* 75: 1741-1747.

66. Napper, S., Wolanin, P.M., Webre, D.J., **Kindrachuk, J.**, Waygood, B., and Stock, J.B. (2003) Intramolecular rearrangements as a consequence of the dephosphorylation of phosphoaspartate residues in proteins. *FEBS Lett*. 538: 77-80.

67. Athmer, L., **Kindrachuk, J.**, Georges, F., and Napper, S. (2002) The influence of protein structure on the products emerging from succinimide hydrolysis. *J Biol Chem.* 277: 30502-30507.

68. Napper, S., Brokx, S.J., Pally, E., **Kindrachuk, J.**, Delbaere, L.T., and Waygood, E.B. (2001) Substitution of aspartate and glutamate for active center histidines in the *Escherichia coli* phosphoenolpyruvate:sugar phosphotransferase system maintain phosphotransfer potential. *J Biol Chem.* 276: 41588-41593.

BOOK CHAPTERS

1. Chertow, D.S. and **Kindrachuk, J.** (2019) Respiratory Viruses: Influenza, Measles, SARS, MERS, and Smallpox. In: Highly Infectious Diseases in Critical Care: A Comprehensive Clinical Guide. Springer New York.

2. Falcinelli, S.D., Ciric, J., **Kindrachuk, J.** (2018) Variola Virus: Clinical, Molecular and Bioterrorism Perspectives. In: Defense Against Biological Attacks. Springer New York.

3. Jahrling, P.B., Goff, A.J., Johnston, S.C., **Kindrachuk, J.**, Lin, K.L., Huggins, J.W., Ibrahim, S., Lawler, J.V., Martin, J.W. (2016) Chapter 11: Smallpox and Related Orthopoxviruses. In: Textbooks of Military Medicine: Medical Aspects of Biological Warfare.
4. **Kindrachuk, J.**, Kuhn, J.H. and Jahrling, P.B. (2015) The role of viral protein phosphorylation during filovirus infection. In: Global Virology. Springer New York.
5. **Kindrachuk, J.** and Napper, S. (2013) Sample Preparation and Profiling: Probing the kinome for biomarkers and therapeutic targets: peptide arrays for global phosphorylation-mediated signal transduction. In: Comprehensive Biomarker Discover and Validation for Clinical Application. Royal Society of Chemistry.
6. Petersen, P.D., **Kindrachuk, J.**, Jenssen, H. (2012) Immune modulation for treatment of herpes simplex virus. In: Herpes Simplex Virus: Prevention, Recognition and Management. In: Advances in Medicine and Biology. Nova Science Publishers.
7. **Kindrachuk, J.**, Nijnik, A. and Hancock, R.E.W. (2009) Ch. 5.07 Host Defense Peptides: Bridging Antimicrobial and Immunomodulatory Activities. In: Mander, L., and Liu, H.W. Comprehensive Natural Products Chemistry II. Oxford: Elsevier.

NON-PEER REVIEWED PUBLICATIONS

1. Why Early Wins Over Covid-19 Do Not Mean Victory: Canada's Cautionary Tale. *Forbes.* https://www.forbes.com/sites/coronavirusfrontlines/2020/11/04/why-early-wins-over-covid-19-do-not-mean-victory-canadas-cautionary-tale/?sh=740b94722041
2. The Realities of Biomedical Research During a Pandemic. *Forbes.* https://www.forbes.com/sites/coronavirusfrontlines/2020/09/17/a-virologist-explains-the-realities-of-biomedical-research-during-a-pandemic/#62d6a66111a2
3. A Virologist Explains Why It Is Unlikely COVID-19 Escaped from A Lab. *Forbes*. https://www.forbes.com/sites/coronavirusfrontlines/2020/04/17/a-virologist-explains-why-it-is-unlikely-covid-19-escaped-from-a-lab/#58bd5fb63042
4. How The Coronavirus Pandemic Has Impacted International Research Programs: A Personal Perspective. *Forbes.* https://www.forbes.com/sites/coronavirusfrontlines/2020/06/06/how-the-coronavirus-pandemic-has-impacted-international-research-programs-a-personal-perspective/#b10049750bbf
5. Repurposing Drugs Is Key to Fighting the Coronavirus Pandemic, This Virologist Explains. *Forbes*. https://www.forbes.com/sites/coronavirusfrontlines/2020/05/08/repurposing-drugs-is-key-to-fighting-the-coronavirus-pandemic-this-virologist-explains/#5c9efd1217ce
6. No Mercy for the Coronas. *La Liberté*. https://www.lalibertesciencesmagjunior.ca/
7. The Value of Social Media Now. *New York Times*. https://www.nytimes.com/2020/03/27/opinion/letters/iran-sanctions.html
8. How social media is changing research and reactions to coronavirus outbreak. *The Conversation*. http://theconversation.com/how-social-media-is-changing-research-and-reactions-to-coronavirus-outbreak-130748
9. Ebola survivors can pass on the virus: we're trying to understand what role sex plays. *The*

Conversation Africa. https://theconversation.com/ebola-survivors-can-pass-on-the-virus-were-trying-to-understand-what-role-sex-plays-124015

REPORTS

1. CIHR-PHAC-CADTH – Best Brains Exchange – Transmission Routes for COVID-19: Implications for Public Health. Canadian Institutes of Health Research (CIHR); 2020 October. https://cihr-irsc.gc.ca/e/52238.html
2. Heating, Ventilation and Air Conditioning Systems in Public Spaces. Ottawa: Canadian Agency for Drugs and Technologies in Health (CADTH); 2020 June. (CADTH technology review).
3. Public statement for collaboration on COVID-19 vaccine development. World Health Organization. 13 April 2020. https://www.who.int/news-room/detail/13-04-2020-public-statement-for-collaboration-on-covid-19-vaccine-development
4. WHO Advisory Committee on Variola Virus Research, 15th Meeting. Report of the Fourteenth Meeting, Geneva, Switzerland, 24-24 September 2013. WHO/HSE/PED/CED/2013.2
5. WHO Advisory Committee on Variola Virus Research, 14th Meeting. Report of the Fourteenth Meeting, Geneva, Switzerland, 16-17 October 2012. WHO/HSE/PED/CED/2013.1

FUNDING

1. Tier 2 Canada Research Chair in the molecular pathogenesis of emerging and re-emerging viruses
   Funding Sources:
   2017-2022 Canada Research Chairs Program
   Total Funding – 500,000 (Canadian dollar)
   Principal Investigator
2. Identification of the molecular determinants underlying asymptomatic Ebola virus testicular infections and long-term effects on reproductive health
   Funding Sources:
   2020-2025 Canadian Institutes of Health Research Project Grant
   Total Funding – 950,000 (Canadian dollar)
   Principal Investigator
3. Animal models for SARS-CoV-2: vaccines and immune enhancement
   Funding Sources:
   2020-2022 Canadian Institutes of Health 2019 Novel Coronavirus (COVID-19) Rapid Research Funding
   Total Funding – 999,793 (Canadian dollar)
   Co-Applicant
4. Scalable, Customizable, Digital Health Communication Materials to Help Canada Address the COVID19 Pandemic
   Funding Sources:
   Canadian Institutes of Health COVID-19 Rapid Research - Social Policy and Public Health Responses
   Total Funding – 311,296 (Canadian dollar)

Co-Applicant

5. Broad Spectrum CoV Therapeutic; rhACE2 Immunoadhesin to treat COVID19
   Funding Sources:
   MITACS Accelerate
   Total Funding – 90,000 (Canadian dollar)
   Principal Applicant
6. Prairie Infectious Immunology Network 2020
   Funding Sources:
   2020-2021 Canadian Institutes of Health Research Planning and Dissemination Grant
   Total Funding – 10,000 (Canadian dollar)
   Co-Principal Investigator
7. Characterization of the molecular pathogenesis of severe influenza and influenza-bacterial infections at the alveolar-capillary barrier
   Funding Sources:
   2018-2020 Research Manitoba New Investigator Operating Grant
   Total Funding – 130,000 (Canadian dollar)
   Principal Investigator
8. Investigation of kinase-mediated cell signaling pathway modulation at the vector pathogen-livestock interface in vector-borne livestock diseases
   Funding Sources:
   2018/4 - 2023/3 Natural Sciences and Engineering Research Council of Canada (NSERC) Discovery Grant
   Total Funding - 165,000 (Canadian dollar)
   Principal Investigator
9. Establishment of a high-throughput molecular dynamics facility
   Co-applicant: Denice Bay
   Funding Sources:
   2017/11 - 2022/11 Canada Foundation for Innovation (CFI) John R. Evans Leaders Fund
   Total Funding - 609,191 (Canadian dollar)
   Principal Investigator
10. Deciphering the bat kinome by immunometabolic peptide kinome arrays: critical insights for emerging viral diseases
    Funding Sources:
    2018/7 - 2019/6 University of Manitoba Dr. Paul H. T. Thorlakson Foundation Fund
    Total Funding - 30,000 (Canadian dollar)
    Principal Investigator
11. Characterizing the molecular mechanisms of Ebola virus persistence at the blood-testis barrier
    Funding Sources:
    2018/8 - 2019/4 University of Manitoba Tri-Agency Bridge Funding
    Total Funding - 60,000 (Canadian dollar)
    Principal Investigator
12. Characterizing the molecular mechanisms of Ebola virus persistence in a 3D co-culture model of the blood-testis barrier
    Funding Sources:
    2018/3 - 2019/3 Manitoba Medical Service Foundation (MMSF) Operating Grant
    Total Funding - 19,219 (Canadian dollar)

Principal Investigator

13. Capacity Building Projects in an Institution of Higher Learning in the Developing World
Funding Sources:
2018/1 - 2019/10 University of Manitoba International Program and Partnership Seed
Total Funding – 5,000 (Canadian dollar)
Principal Investigator

INVITED PRESENTATIONS

1. Covid-19: Current state of knowledge. **Wastewater Epidemiology Group**. Public Health Agency of Canada. Virtual. 2021
2. Covid-19: Current state of knowledge. **Covid-19 Genome Sequencing Group**. Public Health Agency of Canada. Virtual. 2021
3. Vaccines & Therapeutics for COVID-19. **Café Scientifique**. Virtual. 2021
4. Balancing science and disinformation during Covid-19. Stem Skills for the 21st Century. **Bioscience Association of Manitoba**. Virtual. 2021
5. Eleven Covid months equals one decade - Emerging virus research during a pandemic. **Quebec Centre for Advanced Materials (QCAM)**. Virtual. 2020
6. Emerging Virus Research in the Time of Covid. Global Health Seminar Series. **Tel Aviv University**. Virtual. 2020
7. COVID-19 Transmission: Current state of virology knowledge. **Community-based aerosol transmission of Covid-19 and HVAC systems**. Canadian Agency for Drugs and Technologies in Health (CADTH). Virtual. 2020
8. Transmission Routes for COVID-19: Implications for Public Health. **CIHR-PHAC-CADTH – Best Brains Exchange**. Canadian Institutes of Health Research (CIHR). Virtual. 2020
9. Heating, Ventilation and Air Conditioning Systems in Public Spaces. Ottawa: **Canadian Agency for Drugs and Technologies in Health (CADTH)**. Virtual. 2020
10. 2020 Fall Member Forum: What's Next? The Aftermath of the COVID-19 Crisis. **Western Transportation Advisory Council (WESTAC)**. Virtual. 2020
11. Basic, Translational and Public Health Research During a Novel Pandemic. **School of Public Health, University of Saskatchewan**. Virtual. 2020
12. Characterizing tissue-barrier specific pathogenesis of epidemic and pandemic emerging viruses. **Infectious Disease, Microbiome, and Public Health Conference**. Virtual. 2020
13. COVID-19: Early Assessments of the First Coronavirus Pandemic. **Value Partners Annual General Meeting**. Virtual. 2020
14. COVID-19 and infection, prevention and control. **Canadian Dental Association**. Virtual. 2020
15. COVID-19: The Emergence and Spread of a Pandemic in the Age of Social Media. **UM Learning for Life Program**. University of Manitoba. Virtual. 2020
16. COVID-19: Monitoring the Emergence and Pandemic Spread of SARS-CoV-2 in Real Time. **International Life Sciences Institute – North America**. Virtual. 2020

17. Characterizing Emerging Virus Circulation and Spillovers in West and Central Africa. **Society of Clinical Research Associates**. Winnipeg, Canada. 2020
18. The Real Hot Zone: Studying Emerging Virus Circulation and Spillover in the Lab and the Field. **Department of Microbiology, Immunology & Infectious Diseases, University of Calgary**. 2020
19. COVID-19: An Emerging Public Health and Economic Crisis. **Manitoba Young Presidents Organization**. Winnipeg, Canada. 2020
20. Characterizing emerging virus circulation and spillovers in West and Central Africa. **Annual University of Nairobi HIV/AIDS Collaborative Conference**. Nairobi, Kenya. 2020
21. Identifying the molecular determinants underlying Ebola virus persistence in incidental and reservoir hosts. **KAVI Institute for Clinical Research**. University of Nairobi, Nairobi, Kenya. 2020
22. Characterizing the molecular determinants underlying severe Ebola virus disease and post-recovery persistence. **International Infection, Immunity and Inflammation Conference (I4C)**, Vancouver, Canada. 2019
23. Investigating the molecular pathogenesis of emerging and re-emerging viruses at the interface of basic and clinical research. **Manitoba Chemistry Symposium**, Winnipeg, Canada. 2018
24. Navigating the Storm: merging basic research with clinical information for (re)emerging infectious diseases. **Canadian Society of Microbiologists Annual Meeting**, Winnipeg, Canada. 2018
25. Are We Ready for the Next Pandemic? Reflections from the laboratory and the field**. CPD Medicine Program: Trends & Challenges in Virology**, Winnipeg, Canada. 2017
26. Investigating Interactions between the Host and High-Consequence Pathogens with Systems Kinomics. **University of Delaware Graduate Student Seminar Series**. University of Delaware, DE. 2015.
27. Characterizing High-Consequence Pathogens through Systems Kinome Analysis. **NICBR Exploring Careers in a Scientific Environment Symposium (NECSES)**. Fort Detrick, Frederick, MD, 2014.
28. Species-Specific Kinome Analysis for the Investigation of the Molecular Pathogenesis of High-Consequence Pathogen and Identification of Novel Therapeutic Targets. **American Society of Virology**. Fort Collins, CO, 2014.
29. Temporal kinome analysis demonstrates Ebola virus selectively modulates transforming growth factor β signaling. **6th International Symposium on Filoviruses**. Galveston, TX, 2014.
30. Use of live variola virus in systems kinomics for identification of host targets for therapeutic intervention. **15th Meeting of the WHO Advisory Committee on Variola Virus Research.** Geneva, Switzerland, 2013.
31. Systems kinome analysis of differential host responses to variola virus and monkeypox virus. **US Delegation to WHO.** Eisenhower Office Building, Washington, DC, 2013.
32. Ebola virus selectively modulates transforming growth factor-β signaling as demonstrated by temporal kinome analysis. **American Society of Virology.** Pennsylvania State University, PA, 2013.

33. Investigating high-consequence viral pathogenesis under (negative) pressure. **Vaccine and Infectious Disease Organization (VIDO).** Saskatoon, SK, 2012.
34. Use of live variola virus in systems kinomics for identification of host targets for therapeutic intervention. **14th Meeting of the WHO Advisory Committee on Variola Virus Research.** Geneva, Switzerland, 2012.
35. Temporal kinome analysis of Ebola virus molecular pathogenesis. **Centers for Disease Control (CDC): Special Pathogens Branch.** Atlanta, GA, 2012.
36. Temporal systems kinomics analysis of host cell responses to Ebola virus. **Keystone Symposium: Cell Biology of Virus Entry, Replication and Pathogenesis (X7).** Whistler, BC, 2012.
37. Kinome analysis reveals differential host cell responses to west african and congo basin monkeypox virus. **Gordon Research Conference – Chemical and Biological Terrorism Defense.** Ventura, CA, 2011.

CONSULTING

1. Covid-19 infection prevention and control procedures – Winnipeg Blue Bombers
2. Covid-19 expert advice – Young Presidents Organization (Winnipeg Chapter)
3. Covid-19 transmission – Manitoba Government

PATENT SUBMISSIONS

1. Small Cationic Anti-biofilm and IDR Peptides.
   United States. PCT/US2014/052993. 2014/08/27.
   Patent Status: Pending
2. Combination adjuvant formulation.
   United States. US9408908 B2. 2013/02/15.
   Patent Status: Granted/Issued
   Year Issued: 2016
3. Immunomodulatory compositions and methods for treating disease with modified host defense peptides.
   United States. US9102754 B2. 2008/06/27.
   Patent Status: Granted/Issued
   Year Issued: 2015

AB1339

This is Exhibit " B " referred to
in the Affidavit of Jason Kindrachuk
Affirmed before me this second
day of March A.D. 2021

Heath Luff

A Barrister-at-Law entitled to practice
in and for the Province of Manitoba

AB1340

REPORT PREPARED FOR MANITOBA JUSTICE ON

SARS-COV- 2 AND COVID – 19

Jason Kindrachuk, PhD
Laboratory of Emerging and Re-emerging Viruses
Department of Medical Microbiology and Infectious Diseases
University of Manitoba
Winnipeg, Manitoba, Canada

February 26, 2021

1. Background

I am an Assistant Professor and Canada Research Chair in emerging viruses in the Department of Medical Microbiology & Infectious Diseases, University of Manitoba. My field of expertise is the investigation of emerging viruses, the infections they cause and their impact on global health. I am engaged in multiple international scientific outreach activities with regional partners across Africa including Sierra Leone, Gabon and Kenya. I am currently seconded as part of a 12-month research partnership agreement at the Vaccine and Infectious Disease Organization, University of Saskatchewan, Canada, where I am helping lead and facilitate national COVID-19 research response efforts. I also serve as an Associate Professor in the College of Medicine and Allied Health Sciences at the University of Sierra Leone and as a Visiting Scientist at the Centre International de Recherches Medicales de Franceville in Gabon, one of two biosafety level 4 facilities in Africa. I have also served in a volunteer capacity as an infection prevention and control expert for Heart to Heart International, an international disaster response agency, throughout the Covid-19 pandemic. Heart to Heart International, founded in 1992, has shipped more than $1.7 billion in humanitarian aid across more than 130 countries. It is a global humanitarian organization that focuses on improving public health and responding to the victims of disaster worldwide.

My education is as follows. I completed my undergraduate and graduate training at the University of Saskatchewan and completed my PhD in 2007 in the Department of Biochemistry. Following this, I participated in and led several projects as a postdoctoral fellow in Dr. Robert E.W. Hancock's laboratory, Centre for Microbial Diseases and Immunity Research, University of British Columbia. Here, my work focused on the design and development of novel anti-infective therapeutics and vaccine adjuvants, which are substances that are added to vaccine formulations to help amplify the immune response to the vaccine, for emerging pathogens. During this fellowship, the focus of my research was the investigation of emerging and re-emerging pathogens of importance to global public health, notably antibiotic resistant bacteria. These investigations fostered my commitment to both basic scientific research approaches and application of this research to public health in developed and developing nations. In 2009, I joined the National Institutes of Health (NIH) in Bethesda, MD, USA, as a Visiting Fellow to expand my expertise in the molecular mechanisms that underlie severe infections focusing on emerging and re-emerging viruses. Following this fellowship, I served in multiple senior scientific and leadership capacities, including Principal Research Scientist (NIH Integrated Research Facility-Frederick) and Staff Scientist (Critical Care Medicine Department, NIH). I also volunteered as a Scientific Lead in diagnostic support for the Centers for Disease Control/Department of Defense joint operations in Monrovia, Liberia during the 2014 Ebola virus disease outbreak.

Research History

My research has contributed to our understanding of the complex mechanisms underlying emerging viruses, their transmission and the infections they cause. Research in my laboratory focuses on the circulation, transmission and clinical aspects of emerging viruses that pose the greatest threat to global human and animal health. My current Covid-19 research includes:

1) Characterization of how SARS-CoV-2 manipulates human immune responses to cause severe disease in high-risk patient populations

2) Investigation of repurposed drugs as SARS-CoV-2 therapeutics through kinome analysis

3) Characterization of neurological and reproductive health complications in animal models of SARS-CoV-2 infections. Further, the animal models we are developing will allow us to inform how neurological manifestations associated with Covid-19 occur in humans.

Prior to my work on SARS-CoV-2 and Covid-19, my research focused on viruses that pose the greatest threat to global human and animal health. These included Ebola virus, Middle East respiratory syndrome coronavirus (MERS-CoV) and influenza viruses. A summary of these research activities follows below.

1) Ebola virus research (basic and clinical) & support efforts.

I have conducted extensive research into Ebola (Wahl-Jensen, Kurz et al. 2011, Kindrachuk, Wahl-Jensen et al. 2014, Falcinelli, Chertow et al. 2016, Barnes, Kindrachuk et al. 2017, Kash, Walters et al. 2017, Schindell, Webb et al. 2018, Khurana, Ravichandran et al. 2020) and received a 2018 National Institute of Allergy and Infectious Diseases (NIAID, NIH, Bethesda, MD, USA) Merit Award for my work. In 2014, I served as Scientific Diagnostics Lead in Liberia during the Ebola virus disease epidemic in West Africa. I provided daily situation reports and recommendations to local and international officials. I received a National Institutes of Health Director's Award in 2014 for these efforts. I have also recently received a five-year project grant from the Canadian Institutes for Health Research for my work on Ebola virus persistence, sexual transmission and long-term reproductive health impacts in Ebola virus disease survivors.

2) MERS-CoV efforts.

My work on coronaviruses began in 2013 following the emergence of Middle East respiratory syndrome coronavirus. This work culminated in multiple peer reviewed publications on therapeutic screening and identification as well as characterization of molecular pathogenesis (Dyall, Coleman et al. 2014, Hart, Dyall et al. 2014, Kindrachuk, Ork et al. 2015, Falcinelli, Chertow et al. 2016, Dyall, Gross et al. 2017, Willman, Kobasa et al. 2019).

3) Variola virus and monkeypox virus pathogenesis.

I developed and led collaborations with the US Centers for Disease Control and Prevention to investigate variola virus pathogenesis, the etiologic agent of human smallpox. This work demonstrated that kinome analysis could be used as a predictive drug repurposing tool for orthopoxviruses. Based on this, I was invited to serve as a member of the US delegation at the World Health Organization Advisory Committee of Variola Virus Research. Meeting reports, including overviews of my work, are publicly available (WHO 2012, WHO 2013). My work on monkeypox virus was the first to identify how the West African and Congo Basin virus behave differently at the cellular level and may explain the differences in case fatality rates between the two clades (Kindrachuk, Arsenault et al. 2012).

4) Influenza viruses.

I have investigated influenza virus pathogenesis extensively with a focus on influenza-bacterial co-infections (Chertow, Kindrachuk et al. 2016, Davis, Chertow et al. 2016, Walters, D'Agnillo et al. 2016). This included pandemic and seasonal strains, including 1918 H1N1 virus. My work provided increased clarity regarding the mechanisms employed by pandemic and seasonal influenza viruses to infect cells as well as assessing the role of aerosol infection in acute respiratory distress during influenza virus infection in Rhesus macaques, with or without bacterial co-infection. Recently, my group published findings on 2009 pandemic H1N1-*Staphylococcus aureus* co-infections and provided perspectives on the 1918-1919 influenza pandemic (Nickol, Ciric et al. 2019, Nickol and Kindrachuk 2019).

I have been actively engaged in emerging infectious disease research and response efforts throughout my research career. In 2014, I was as a Scientific Lead in diagnostic support for the Centers for Disease Control/Department of Defense joint operations in Monrovia, Liberia, during the West African Ebola virus disease outbreak. I continue to work with local communities and perform research on the African continent. I have an active research program in Sierra Leone where I am leading investigations that focus on the long-term reproductive health impacts found in Ebola virus disease survivors. Here, we are working with local survivor advocacy groups to identify complications that are faced by survivors through anonymous surveys. My research group is also collaborating with similar advocacy groups and researchers in Liberia on this work. I have also co-founded the Consortium for Intercepting Emerging Diseases in Africa (CIEDA) with Dr. Kris Forbes (University of Arkansas) which brings together partners from North America, Europe and Africa to increase surveillance and identification of emerging infectious diseases that could impact global human and animal health. This work began through my research partnership with the Interdisciplinary Centre of Medical Research of Franceville, Gabon, where I am a Visiting Scientist. I also have emerging infectious disease collaborations at the University of Nairobi Institute for Tropical Infectious Diseases, Kenya, where I have led emerging virus training programs for trainees and staff.

Covid-19 and SARS-CoV-2 Grants, Reports and Committee Appointments

My research group is currently examining the effects of respiratory virus co-infection on disease outcome during SARS-CoV-2 infection in hamsters. I was a co-applicant on a grant funded by the Canadian Institutes for Health Research (CIHR) entitled "Animal models for SARS-CoV-2: vaccines and immune enhancement" in Spring, 2020. I have also received funding as a co- or lead-applicant for two additional grants: i) Scalable, Customizable, Digital Health Communication Materials to Help Canada Address the COVID19 Pandemic (CIHR); and ii) Broad Spectrum CoV Therapeutic; rhACE2 Immunoadhesin to treat COVID19 (MITACS Accelerate).

My work on SARS-CoV-2 began in early January of 2020 following the identification of the emergent virus in Wuhan, China, as a novel coronavirus. Following the emergence of SARS-CoV-2, I have been involved in various research investigations that have included development of animal models of infection, characterization of biological variables on disease severity, novel drug development and behavioral assessments of Covid-19 infection prevention and control messaging. In addition, I am currently investigating the differences in molecular pathogenesis in respiratory cells from patients with no underlying respiratory complications and those with chronic obstructive pulmonary disorder. My work on SARS-CoV-2 began in early January of 2020 when I co-authored a publication with other Canadian emerging virus experts on the emergence of a new virus (then called 2019-nCoV).

I have published two peer reviewed manuscripts on SARS-CoV-2, including as a co-author on a peer-reviewed clinical review of Covid-19 for *The BMJ* (Cevik, Kuppalli et al. 2020, Ralph, Lew et al. 2020), and three additional manuscripts that are currently in submission or revision. I have subsequently been involved in three additional manuscripts on Covid-19 that are currently in submission or in revision, two of which are available as pre-prints (Escandon K 2020, Francis, Richardson et al. 2021). I have also been involved in two publicly available reports from national committees on Covid-19 transmission as well as multiple national and international Covid-19 committees. These are outlined below.

Published Reports on Covid-19 Transmission:

i. CIHR-PHAC-CADTH – Best Brains Exchange – Transmission Routes for COVID-19: Implications for Public Health. Canadian Institutes of Health Research (CIHR); 2020 October. https://cihr-irsc.gc.ca/e/52238.html

ii. Heating, Ventilation and Air Conditioning Systems in Public Spaces. Ottawa: Canadian Agency for Drugs and Technologies in Health (CADTH); 2020 June. (CADTH technology review). Heating, Ventilation, and Air Conditioning Systems in Public Spaces (cadth.ca)

National and International Covid-19 Committees:

i. Panel Member – CIHR Institute of Infection and Immunity Consultation on Variant Strains of SARS-CoV-2
ii. Panel Member – CIHR-PHAC-CADTH – Best Brains Exchange – Transmission Routes for COVID-19: Implications for Public Health. Canadian Institutes of Health Research (CIHR); 2020 October. https://cihr-irsc.gc.ca/e/52238.html
iii. Panel Member – Heating, Ventilation and Air Conditioning Systems in Public Spaces. Ottawa: Canadian Agency for Drugs and Technologies in Health (CADTH); 2020 June. (CADTH technology review). Heating, Ventilation, and Air Conditioning Systems in Public Spaces (cadth.ca)
iv. Member – World Health Organization COVID-19 Solidarity Serology Study Group
v. Member – World Health Organization Ad Hoc Committee on COVID-19 Animal Models

2. Current Knowledge of Covid-19 Severity and SARS-CoV-2 Transmission

There has been extensive investigation into the relation between biological risk factors and Covid-19 disease severity. Severe disease, including intensive care unit admission and fatal disease, are associated with older age, race/ethnicity, gender and socioeconomic status. The US Centers for Disease Control and Prevention outlined and ranked the risks for severe Covid-19 based on supportive published evidence including case series, cohort studies, cross-sectional studies, meta-analyses and systematic reviews (CDC 2021). While older age is convincingly linked to severe Covid-19, the outlined risks were not limited to those in high age groups. Factors strongly linked to severe disease in adults include cancer, chronic kidney disease, COPD, cardiovascular disease, obesity, pregnancy, sickle cell disease, smoking, organ transplantation and type 2 diabetes. In Manitoba, Covid-19 case numbers were highest in the 20-29 age group with nearly equal proportions of males and females based on the province's updated data as of 19 February 2021 from their publicly available data (Manitoba 2021). This was followed by the 40-49, 50-59 and 10-19 age groups, respectively. As of 19 February 2021, total hospitalizations, intensive care unit admissions and deaths were 2,177, 405 and 879, respectively. Province-wide, the greatest proportion of hospitalizations have been found in the 65-79 age group. However, hospital admitted cases including the 35-49 and 50-64 age groups were greater than those in the 65-79 age group. Cases admitted to the intensive care unit were similar between the 65-79 and 50-64 age groups (Figure 6 Age Distribution of Severe COVID-19 Cases Compared to All Cases, Manitoba, 2020 – 2021; (Manitoba 2021)). The Manitoba numbers have similar trends with those in other jurisdictions, including the US, and demonstrate that younger age groups are susceptible to moderate or severe illness and at risk for hospitalization and intensive care unit admission.

There has been considerable insight regarding SARS-CoV-2 and Covid-19 over the past 14 months. Notably, this has included identification of the pathogen as a novel coronavirus, the likely origin of the virus, mechanisms of human-to-human transmission, the susceptibility of additional animal species as incidental hosts for SARS-CoV-2 (including cats, dogs and mink), characterization of clinical disease and supportive care management (including high-risk groups), therapeutic management for clinical disease, and the design, development and licensure of multiple vaccines as well as dozens currently in various phases of clinical trials.

Of particular concern to public health officials and governments is the current state of knowledge regarding SARS-CoV-2 transmission. Early assessments for SARS-CoV-2 transmission identified respiratory droplets, aerosols and fomites (inanimate objects such as surfaces that can harbor infectious virus) as primary drivers of virus transmission. This was based largely on prior analysis of respiratory viruses, including the original SARS-CoV in 2002-2004, as there was a need to identify appropriate non-pharmaceutical interventions to reduce transmission and community spread. Prior observations from SARS- and MERS-CoV had showed limited community transmission with virus being spread primarily in healthcare settings through close contacts. Scientific evidence strongly supports that SARS-CoV-2 transmission is primarily driven by respiratory droplets and aerosols. While fomites are still considered as a potential route of infection, they are not considered as a driver of transmission in the pandemic. Respiratory droplets (>5–10 μm in diameter) remain suspended for short periods of time and are transmitted over short distances though this can be dependent on airflow. Small-particle aerosols (<5 μm) can disperse quickly and remain airborne while traveling longer distances. Current research has largely focused on the role of small-particle aerosol transmission in SARS-CoV-2 infections. Epidemiological data suggests that close contact, defined as anyone who has shared an indoor space with a case for a cumulative total of 15 minutes over a 24 hour period (Canada 2020), or enclosed settings is a major driver for SARS-CoV-2 transmission (Leclerc, Fuller et al. 2020, Qian, Miao et al. 2020). Recent animal model investigations (Chan, Yuan et al. 2020, Kim, Kim et al. 2020, Richard, Kok et al. 2020, Sia, Yan et al. 2020) and epidemiological studies (Cai, Sun et al. 2020, Jang, Han et al. 2020, Lu and Yang 2020, Park, Kim et al. 2020) suggest that small-particle aerosol transmission can occur during prolonged exposure in enclosed settings with reduced ventilation.

There has been considerable scientific investigation into the role of pre-symptomatic (prior to onset of symptoms) and asymptomatic (no symptom development though infected) transmission for Covid-19. Of central focus has been characterizing how the viral load (amount of virus) within the respiratory tract of an infected individual changes throughout the course of infection, both prior to symptom onset and following symptom resolution. The presence (viral load) and duration (kinetics) of virus within the respiratory tract are important determinants for the duration of infectiousness and thus transmission. Cevik and colleagues recently published a systematic review that incorporated data from 5,340 individuals across 79 studies (Cevik, Tate et al. 2021). Prior assessments of viral loads in the respiratory tract through repeated sampling suggests that peak viral loads occurred either just prior to (pre-symptomatic phase), or coincident with, symptom onset (Kim, Chin et al. 2020, Wolfel, Corman et al. 2020, Zou, Ruan et al. 2020). In the systematic review by Cevik et al., the authors identified 12 reports that provided temporal viral load data for individuals with asymptomatic infections. Viral loads in the reports were found to be similar to (four reports) or lower than (two reports) those from symptomatic patients. However, viral clearance appeared faster in asymptomatic patients based on observations from six reports. This review provided temporal evidence for viral accumulation and clearance in asymptomatic patients. These observations are in good agreement with prior contact tracing studies where the highest risk of transmission fell from a few days prior to symptom onset to five days post-onset.

The contributions of asymptomatic and pre-symptomatic infections to SARS-CoV-2 transmission have been broadly investigated. An early study in April 2020 by Kimball and colleagues investigated an outbreak of Covid-19 in a long-term care facility in King County, Washington, US (Kimball, Hatfield et al. 2020). Following the initial identification of a Covid-19 case in the facility, broad testing was employed 16 days later and demonstrated rapid spread of the virus had occurred with positive tests found in 30.3% of residents. Early adoption of infection prevention and control measures had been instituted following the identification of the first case. Nearly half of the residents that had positive test results were not symptomatic at the time of testing and the authors concluded that the evidence suggested transmission from asymptomatic and pre-symptomatic residents may have contributed to spread. Wang and colleagues performed a retrospective cohort study of 335 people in 124 families and with at least one laboratory confirmed Covid-19 case and provide strong evidence for the importance of the pre-symptomatic transmission of SARS-CoV-2 (Wang, Tian et al. 2020). Further, they found that face mask use by the primary case and family contacts prior to symptom onset in the primary case was 79% effective in reducing transmission. In a prospective study, Cheng and colleagues demonstrated that secondary transmission was higher among individuals with initial exposures to index cases within 5 days of symptom onset as compared to day 6 or later (Cheng, Jian et al. 2020). This study also found that transmission was similar whether contacts only had pre-symptomatic or post-symptomatic exposure to index cases. In the four clusters for which the date of exposure could be determined, pre-symptomatic transmission occurred 1-3 days before symptom onset in the pre-symptomatic source case. Clinical and epidemiological assessment of 243 Covid-19 cases, between January 23, 2020 - March 26, 2020, were reviewed to identify potential cases of pre-symptomatic transmission of SARS-CoV-2. Out of 243 cases, 157 were locally acquired (Wei, Li et al. 2020). The authors found seven epidemiologic clusters where pre-symptomatic transmission likely occurred and ten of the cases within these clusters were attributed to pre-symptomatic transmission, accounting for 6.4% of the 157 locally acquired cases.

There have been a growing number of investigations that have focused on delineating true asymptomatic and pre-symptomatic infections to help provide additional context regarding transmission potentials across the clinical disease spectrum and infectious period. Johansson and colleagues employed a decision analytical model to examine virus transmission from pre-symptomatic, symptomatic and asymptomatic individuals (Johansson, Quandelacy et al. 2021). Model assumptions were that peak viral transmission occurred at the median of symptom onset, 30% of infected individuals were true asymptomatic infections and were 75% as infectious as symptomatic individuals. The model suggested that 59% of all infections occurred from those without symptoms of disease where 35% were patients that were in the pre-symptomatic stage of disease and 24% had asymptomatic infections. Buitrago-Garcia and colleagues recently examined asymptomatic and pre-symptomatic SARS-CoV-2 infections and transmission through a systematic review (Buitrago-Garcia, Egli-Gany et al. 2020). Using data from 94 studies, the authors calculated the overall estimate of true asymptomatic infection was 20% with the balance of 80% being those with pre-symptomatic infections. However, the authors also stated that most studies included in the review were not designed to estimate asymptomatic infection proportions and thus combination non-pharmaceutical interventions will continue to be needed to help curb virus transmission. These sentiments were also echoed by Byambasuren and colleagues in their recent systematic review of asymptomatic Covid-19 (Byambasuren O 2020). The authors reviewed 13 studies and the asymptomatic proportion of described cases ranged from 4-41% with a corresponding overall proportion of asymptomatic infections as 17% exclusive of pre-symptomatic infections based on their meta-analysis. The authors stated that this remained sufficient to warrant policy attention. A recent systematic review and meta-analysis by Buitrago-Garcia and colleagues assessed 79 studies found that 20% of infected individuals remained asymptomatic throughout the course of infection (Buitrago-Garcia, Egli-Gany et al. 2020). In seven of the studies with defined populations, asymptomatic infections rose to 31%. The secondary attack rate, and thus indication of transmission potential, was lower for asymptomatic infection as compared to symptomatic infection with a relative risk ratio of 0.35, suggesting that there is greater risk for transmission from those with symptomatic disease; however, risk of transmission remains from those with asymptomatic infections. Interestingly, the authors also found that the relative risk ratio of pre-symptomatic transmission as compared to symptomatic transmission was 0.63, further demonstrating that transmission in the absence of symptoms presents a risk. Moreover, the authors state that based on the contributions of asymptomatic and symptomatic infections in virus transmission, “combination prevention measures, with enhanced hand hygiene, masks, testing tracing, and isolation strategies and social distancing, will continue to be needed”. A recent investigation by Li et al assessed household transmission rates in Wuhan through a retrospective observational study (Li, Li et al. 2021). The authors assessed 29,578 primary cases, 27,101 households and 57,581 household contacts in their analysis. The odds ratio for infection from asymptomatic individuals was lower than from symptomatic cases (0.21), similar to those reported by Liu et al (Liu, Chu et al. 2020). Importantly, the odds ratio for infection from pre-symptomatic cases was higher than from post-symptom onset cases (1.42). Thus, while true asymptomatic transmission may occur less frequently than during symptomatic transmission, there was a greater likelihood of transmission before symptom onset (pre-symptomatic) than post-symptom onset. The authors concluded that pre-symptomatic cases were more infectious than symptomatic cases and individuals with asymptomatic infection less infectious than their symptomatic counterparts. Qiu and colleagues recently conducted a critical assessment of available secondary attack rate data from individuals with asymptomatic, pre-symptomatic and symptomatic SARS-CoV-2 infection. Eighty studies were included for their analysis and in agreement with other investigations, secondary attack rates (defined as the probability that an infected individual will transmit the disease to a susceptible individual) from asymptomatic cases were found to be lower than symptomatic cases (Qiu, Nergiz et al. 2021). Importantly, their analysis demonstrated that secondary attack rates were similar between pre-symptomatic and symptomatic cases. The authors did not include a review from Madewell et al. (Madewell, Yang et al. 2020) as the study included only household contacts and data up to July 29, 2020. Overall, while SARS-CoV-2 transmission is likely lower from individuals with asymptomatic infections as compared to symptomatic cases, those in the pre-symptomatic phase of disease appear to be able to transmit the virus similarly to symptomatic individuals.

There have been numerous investigations on the relation between viral load, transmission and biological characteristics including age, sex and disease severity. A recent systematic review by Koopmans et al. reviewed data from 26 studies to determine the relation between viral load dynamics and Covid-19 severity, age and sex (Chen PZ 2021). Higher viral loads were found in those with severe disease as compared to those with non-severe infections. Interestingly, viral load within those with symptomatic infections was not altered by age or sex as children had similar viral loads following symptom onset as their non-severe adult counterparts. While severe Covid-19 has largely been linked to age and underlying health comorbidities, there is growing appreciation that children can be infected and transmit SARS-CoV-2. Recent reports have suggested that transmission is efficient in children ≥10 years old (Park, Choe et al. 2020, Szablewski, Chang et al. 2020). In the conclusion of the analysis of SARS-CoV-2 transmission at the summer camp in Georgia (Szablewski, Chang et al. 2020), Szablewski et al suggested that asymptomatic infection was common amongst the cases and could have contributed to undetected transmission as suggested in additional studies (Dong, Mo et al. 2020, Gotzinger, Santiago-Garcia et al. 2020, Huang, Zhang et al. 2020, Team 2020). More recently, a case report from Lopez and colleagues investigated Covid-19 outbreaks at childcare facilities in Utah (Lopez, Hill et al. 2020). Twelve children (mean age 7 years; range 0.2-16 years) were found to have acquired SARS-CoV-2 in the facilities and transmitted the virus to 12 of 46 non-facility contacts that were assessed. Importantly, three of 12 children had asymptomatic infection (25%) and two transmitted the virus.

Taken together, there is strong scientific evidence for SARS-CoV-2 transmission to primarily occur from a few days prior to symptom onset up to ~5 days post-onset. Direct assessments of viral loads and the kinetics of viral shedding, when virus is released from infected cells in the respiratory tract, are in agreement with this and contact tracing studies in household cohort studies provide direct evidence for asymptomatic and pre-symptomatic transmission of SARS-CoV-2. Further, additional epidemiological studies of SARS-CoV-2 suggest that similar patterns of asymptomatic and pre-symptomatic transmission likely occur within children as with adults.

3. Exposure time and virus particle transmission

Exposure risk guidance is primarily based on the relation between exposure time and SARS-CoV-2 infection. By Health Canada guidelines, a high risk exposure (close contact) includes anyone that has shared an indoor space with a positive Covid-19 case for a prolonged period (a period of 15 cumulative minutes over 24 hours) without adhering to appropriate mitigation measures (Canada 2020). This also includes anyone with a close-range contact with a positive Covid-19 case or anyone that has been in settings where that person engaged in singing, shouting or heavy breathing (including exercise). Given the role of aerosol exposure in transmission, the accumulation of virus-laden aerosol particles in the air of an enclosed setting could result in continued exposure of individuals to virus over a prolonged period.

There have been multiple super-spreader events during the Covid-19 pandemic that have been linked to close contacts in enclosed settings, including faith-based settings or places of worship. Most notably, infection of 53 of 61 attendees (33 confirmed and 20 probable cases) from a single symptomatic individual occurred during a 2.5-hour choir practice in Skagit County, Washington, USA (Hamner, Dubbel et al. 2020). Three of those infected during the practice were hospitalized and two succumbed to infection. A similar super-spreader event occurred in Arkansas where 35 of 92 church attendees were infected, three fatally, during a five-day period (March 6-11) (James, Eagle et al. 2020). Additionally, contact tracing found at least 26 additional Covid-19 cases among community members that had reported contacts with church attendees and had likely been infected during those contacts, including a fatal disease case. The index cases, a husband (pastor at the church) and his spouse, were likely infected during a two-day period (March 6-8) with potential pre-symptomatic transmission from the pastor to others during a group event on March 11. Of the 61 total identified cases (35 church attendees and 26 contacts), eight were hospitalized and four had fatal infections. These observations have not been limited to North America. A super-spreading event linked to a service at Shinchunji Church of Jesus, Daegu, South Korea is postulated to have resulted in >3,900 secondary Covid-19 cases (Shim, Tariq et al. 2020) and choir-related outbreaks have been reported in Berlin and Amsterdam (Bahl, de Silva et al. 2020).

Alsved et al. recently examined exhaled respiratory particle generation during breathing, talking and singing (Alsved M 2020). The generation of aerosol particles, as determined by particle number emission rates, were highest from those singing loudly with exaggerated diction followed by loud singing alone, normal singing, loud talking, normal talking and breathing. Addition of a face mask to those singing loudly reduced particle emission rates to levels found during normal talking. The authors examined SARS-CoV-2 release from those with confirmed Covid-19 during singing and talking. While virus was not detected, the authors identified several limitations in the study including variations in patient viral loads, test positivity versus infectious virus presence in the respiratory tract, and dilution steps in the sample preparation method.

These observations are in line with prior studies looking at respiratory viruses and aerosol particle emission. Previously, Lindsley and colleagues examined the release of influenza virus in aerosol particles during coughing and exhalation (Lindsley, Blachere et al. 2016). The authors collected aerosol particles produced during coughing or exhalation from 61 patients with influenza-like illness. Aerosol particles with infectious virus were collected from 28 (53%) patients while coughing and 22 (42%) patients from exhalation. These results demonstrated that normal exhalation can generate virus-laden infectious particles which could potentially lead to virus accumulation over extended periods of exposure in an enclosed setting.

Previous investigations have also assessed droplet and aerosol emission during common vocal activities. An investigation by Bahl et al. examined the spread of droplet and aerosol generation during singing (Bahl, de Silva et al. 2020). This was done using a detailed flow visualization of aerosols and droplets emitted during singing of a major scale using an image-based flow diagnostic system. The authors found that droplets generated by singing did not settle rapidly suggesting high aerosol generation which could saturate the indoor environment in the absence of adequate ventilation. Further, the direction of the generated droplets suggested that they could pose a potential infectious risk for other members arranged in multiple adjacent and distant rows. Recommendations from the authors to reduce droplet and aerosol exposure included reduction in group numbers, greater physical distancing between members, softer singing and shorter duration, and the implementation of face masks. Of interest, prior investigations of particle emission patterns during normal speech by Asadi and colleagues demonstrated that particle emission during normal speech is correlated with the loudness of vocalization, is highly heterogeneous and could amplify respiratory pathogen transmission (Asadi, Wexler et al. 2019). A similar study from Mürbe and colleagues assessed the release of aerosol emissions from adolescents: four boys and four girls aged 13-15 (Murbe, Kriegel et al. 2021). Overall, while the emission spectrum reflected that found in adults (highest during shouting followed by singing and speaking) the emission of aerosol particles was lower during singing than adults. However, particle emission was within the same order of magnitude between the two groups during speaking.

Taken together, there is accumulating evidence and historical data demonstrating that SARS-CoV-2 emission from infected individuals is likely positively correlated with vocal activities and increases with the volume and exaggeration of vocalizations. Importantly, the emission of aerosol particles is of particular importance given that they can accumulate in the air of enclosed spaces over time based on their physical characteristics and increasing the potential for infection beyond proximal contacts (at 2 m or less in distance away). This highlights the importance of reducing emissions through non-pharmaceutical interventions including masking and social distancing.

4. Infection Prevention Measures

The use of face masks as an additive preventative measure against Covid-19 has been widely discussed and debated since early 2020. Evidence for the use of masks as an infection prevention and control measure must account for setting, population, mask type and design. Medical masks and filtering facepiece respirators have been demonstrated to reduce respiratory viral infections in healthcare settings (Jefferson, Del Mar et al. 2011, MacIntyre and Chughtai 2015, Offeddu, Yung et al. 2017, Chou, Dana et al. 2020, Garcia Godoy, Jones et al. 2020, MacIntyre and Chughtai 2020). Medical masks have also been demonstrated to have an infection prevention benefit within the community including in households, educational settings and pilgrimages; however, there is less evidence for the use of cloth masks to prevent transmission or contracting infection (Chughtai AA 2013, MacIntyre and Chughtai 2015, Barasheed, Alfelali et al. 2016). A single randomized control trial cautioned against the use of cloth masks compared to medical masks for healthcare workers (MacIntyre, Seale et al. 2015). However, it should be appreciated that exposure to high viral loads and extended exposure times are more common within healthcare settings. Among cloth masks, hybrid and cotton-made multi-layer masks seem to perform best in terms of both filtration efficacy and wearing comfort. The efficacy of medical masks in reducing influenza virus and common cold coronaviruses for limiting respiratory emissions from symptomatic individuals, as well as for the wearer, has been demonstrated through mechanistic studies (Johnson, Druce et al. 2009, Makison Booth, Clayton et al. 2013, Milton, Fabian et al. 2013, Leung, Chu et al. 2020). Observational studies on the use of masks for reducing SARS-CoV-2 transmission have demonstrated a benefit in community settings (Chen, He et al. 2020, Hendrix, Walde et al. 2020, Hong, Lin et al. 2020, Nir-Paz, Grotto et al. 2020, Payne, Smith-Jeffcoat et al. 2020, Wang, Tian et al. 2020). A recent randomized control trial from Bundgaard et al. examined masks and SARS-CoV-2 infection (Bundgaard, Bundgaard et al. 2020). The primary findings from the authors were that mask use did not reduce the SARS-CoV-2 infection rate among wearers by more than 50% in a community with modest infection rates, some degree of social distancing, and uncommon general mask use. However, the authors also state that their findings were inconclusive based on their large confidence intervals. In addition, this analysis was performed in a setting where mask mandates were not in effect and thus only provide potential assessments on the degree of protection mask wearers might encounter in a setting where others were not wearing masks. The authors also stated that the findings should not be used to conclude that a recommendation for everyone to wear masks in the community would not be effective in reducing SARS-CoV-2 infections, because the trial did not test the role of masks in source control of infection.

Ueki et al. recently employed aerosol simulation to assess masking and demonstrated that cotton, surgical and N95 masks all provided a protective effect against SARS-CoV-2 transmission and their simulations suggested that protection was most efficient when masks were worn by an infected individual (virus spreader vs receiver). Use of a mask during exposure to virus resulted in decreased uptake of virus by the receiver across all mask types. A cotton mask reduced virus uptake by 20-40% compared to the use of no mask. Addition of a mask (cloth or surgical) to the virus spreader reduced transmission by >50%. At high concentrations of released virus from a non-masked spreader (10^8 pfu), beneficial reductions in transmitted virus were lost with use of a cloth mask on the receiver. These results provide support for the use of masks across populations whether infected or not.

More recently, Brooks and colleagues assessed cloth and surgical mask fit for reducing SARS-CoV-2 transmission (Brooks, Beezhold et al. 2021). Their results demonstrated that the use of unknotted surgical masks or cloth masks alone blocked 56.1% and 51.4% of particles from a simulated cough, respectively. The authors highlighted that these results used only a single style of cloth masks and may not be generalizable to all cloth or surgical masks. However, these results compliment other investigations of mask use as a preventative measure for SARS-CoV-2 transmission. Importantly, the authors also suggested that masking is beneficial for reducing SARS-CoV-2 transmission in addition to other non-pharmaceutical interventions, including distancing, avoidance of groups in poorly ventilated enclosed spaces and hygiene. In January 2021, Rader and colleagues assessed the effects of masks, and mask mandates, as well as physical distancing on SARS-CoV-2 transmission in the US (Rader, White et al. 2021). More than 350,000 individuals aged 13 years or older responded to the authors' random survey from June-July 2020. Multivariate logistic regression modeling demonstrated that communities with high incidence of mask wearing and distancing had the highest predicted probability of SARS-CoV-2 transmission control. Conversely, the authors found an inverse relationship between the percentage of reported mask wearers and R_t, the effective reproduction number, which describes average number of secondary cases per primary case at a particular time. This effect was sustained with adjustment for demographic variables, distancing and peak transmissibility during the first Covid-19 wave. Further, the recommendation for mask use was echoed in late 2020 by Howard and colleagues which suggested that mask wearing by infectious people in addition to mask wearing by susceptible people would have benefits at the population level during the pandemic (Howard, Huang et al. 2021). Thus, the accumulating evidence regarding face masks as a non-pharmaceutical intervention for SARS-CoV-2 transmission provides strong support for the usefulness of masks in this regard while it is also dependent on mask factors such as quality and proper fit.

While the benefits of face masks as a non-pharmaceutical intervention have been well described it must be appreciated that these interventions are not standalone fail safes but rather a multi-faceted approach that includes multiple synergistic infection prevention and control measures. Haug and colleagues recently examined the implementation of non-pharmaceutical interventions across the globe and ranked these based on reported effectiveness (Haug, Geyrhofer et al. 2020). The study utilized a comprehensive, hierarchically-coded dataset of >6,000 non-pharmaceutical interventions across 79 territories from March-April 2020. The least effective interventions were found to be government actions to provide or receive international help, measures to enhance testing capacity or improve case detection strategy, tracing and tracking measures, land border and airport health checks and environmental cleaning. Overall, the authors found that no single non-pharmaceutical intervention would act as a single failsafe measure to reduce SARS-CoV-2 transmission. Perhaps unsurprisingly, curfews, lockdowns and closing/restriction of congregation areas for small or large groups were the most effective strategies to reduce R_t. Restriction of individual movement also ranked high though the adverse social consequences of such measures were recognized by the authors. These results argue for a combination of approaches that implement multiple non-pharmaceutical interventions at the level of both individuals as well as populations. A recent review by Perra posited that modeling of non-pharmaceutical interventions overwhelmingly demonstrated the importance of interventions to curb SARS-CoV-2 transmission and that the success of these interventions in controlling transmission was related to their early implementation (Perra 2021). Further, the author also concluded that many investigations demonstrated that face mask implementation was beneficial.

5. Issues Requiring Continued Research

The roles of virological and biophysical factors (including the minimum infectious dose, virus concentrations and viability in indoor and outdoor settings) in SARS-CoV-2 transmission remain elusive. Detailed investigations of the relative contribution of these factors to transmission are needed though will likely extend beyond the current public health emergency. Thus, adherence to established non-pharmaceutical interventions should remain the focus of the global response pending further research.

Long-term complications in Covid-19 recoverees

There is a growing appreciation that Covid-19 can result in extended health complications and abnormalities, independent of disease severity and age (Rubin 2020). These include extended fatigue, shortness of breath, joint and chest pain, and neurological complications. A recent study from Italy suggested that 44% of recovered patients reported a worsened quality of life post-Covid-19 (Carfi, Bernabei et al. 2020). A US study by Tenforde et al. reported that 35% of surveyed patients had not returned to their normal state of health two to three weeks following a positive Covid-19 test result with 20% of those surveyed being 18-34 years of age with no underlying chronic medical conditions at the time of survey (Tenforde, Kim et al. 2020).

Reproductive health concerns

Recent data has suggested that severe Covid-19 can result in reproductive tissue damage in males. An investigation by Ma et al. assessed pathology in the testes from males with fatal disease and found strong signs of germ cell damage and may indicate the potential for reproductive health impairment in severe disease (Ma, Guan et al. 2021). Yang and colleagues had similar observations for reproductive tissue damage in deceased male Covid-19 patients including seminiferous tubular injury, reduced Leydig cell populations and mild lymphocytic inflammation (Yang, Chen et al. 2020). There have also been recent insights regarding the potential for Covid-19-related complications during pregnancy. Yang et al. provide evidence that

SARS-CoV-2 infection during late pregnancy is associated with increased risks of adverse birth outcomes (Yang, Mei et al. 2020). Kotlyar et al. also recently provided evidence for vertical transmission of SARS-CoV-2 in the third trimester (Kotlyar, Grechukhina et al. 2021). These data suggest that SARS-CoV-2 infections may have impacts on both reproductive health and pregnancy that could have detrimental impacts on younger populations.

Variants of concern

The recent emergence of SARS-CoV-2 variants of concern, which includes B.1.1.7 (first identified in the UK), B.1.351 (first identified in South Africa) and P.1 (first identified in Brazil), has resulted in new concerns regarding the global burden of Covid-19. Concerningly, B.1.1.7 has increased transmissibility ranging from 30-70% over circulating non-variants of concern and has been associated with increased risk of severe and fatal disease in hospitalized patients (Horby P 2021). While less is known regarding B.1.351 and P.1, shared mutations within the spike protein have been related to immune evasion and enhanced transmission. The selective pressures that mitigate these changes have yet to be determined. The emergence of B.1.1.7 in the UK resulted in the overtaking of circulating SARS-CoV-2 strains within a few months, a trend echoed in additional countries including Ireland and Denmark. The enhanced transmissibility associated with this variant have resulted in renewed public messaging regarding the importance of infection prevention and control measures, including mask use and social distancing, to curb community transmission of these variants of concern and others that may emerge. There have also been concerns regarding the potential for re-infections with B.1.351 and P.1 due to their adoption of mutations associated with immune evasion and decreased ability for antibodies from convalescent Covid-19 patients or vaccinees to neutralize these variants. Thus, decreased community transmission will reduce the potential for additional emergence of variants of concern that could have better immune escape mechanisms that could have detrimental impacts on global vaccination programs.

Herd Immunity

There have been rampant discussions regarding the potential of natural herd immunity, dictated by broad infections in the community, as a mechanism to curb global transmission of SARS-CoV-2. While focused protection has been raised as a mechanism to protect those at highest risk for severe disease while allowing the virus to transmit in the absence of broad employment of non-pharmaceutical interventions, there are serious concerns regarding the public health outcome of such a strategy. In particular, the resurgence of Covid-19 in Manaus, Brazil, provides a cautionary tale for a natural infection-based herd immunity-style approach. Manaus was devastated by the first wave of the pandemic with 4.5-fold excess mortality (Orellana, Cunha et al. 2020). A serological assessment of antibodies in Manaus suggested that between 44-66% of the population was infected with SARS-CoV-2 by July 2020, which followed the epidemic peak (Buss, Prete et al. 2021). This rate rose to 76% by October 2020, surpassing the theoretical herd immunity threshold for Covid-19 of 67%. However, virus transmission continued with a devastating second surge of SARS-CoV-2 infections by mid-January 2021 (Sabino, Buss et al. 2021). The authors provided four potential explanations for their observations. First, attack rates could have been overestimated during the first wave. However, as the authors suggest, even with an upwards bias there should have still been a larger effect of population immunity given the breadth of the first wave in 2020. Second, the authors raised concerns regarding the potential impacts of waning immunity in those that were previously infected. Could decreasing protective immunity in individuals infected during the first wave have resulted in a resurgence of Covid-19 due to reinfections in this population? Such a phenomenon would be devastating for an infection-based herd immunity strategy as the threshold for sustained herd immunity to curb virus transmission would be impeded. Third, the emergence of virus variants that might evade immunity generated from prior SARS-CoV-2 infection. Two virus variants, P.1 and P.2, have been identified in Brazil that possess a mutation in the spike protein that has been associated with immune evasion. Reinfections have been identified in Brazil for both P.1 and P.2 (Naveca F 2021, Resende PC 2021, Vasques Nonaka 2021). And fourth, new SARS-CoV-2 variants circulating in Manaus may have higher transmissibility than currently circulating strains. While the emergence and spread of the B.1.1.7 variant of concern has been associated with increased transmissibility (Horby P 2021) there is no current data for other variants of concern to suggest that they have a competitive transmission advantage over circulating strains in their regions of emergence. Indeed, the recent emergence of the variants of concern (B.1.1.7, B.1.351 and P.1) serve as a reminder that continued transmission of the virus results in mutations within the viral genome that could lead to increased rates of infection.

Overall, the current data from Brazil provides supportive evidence that a herd immunity approach through natural infections could have devastating impacts on public health. The recent resurgence of infections in January 2021 with a seropositivity that surpassed the proposed threshold for herd immunity highlights the dangers of such a strategy. Further, the recent emergence of variants of concern with mutations associated with immune evasion mechanisms, and the reduced ability of antibodies from convalescent patients to neutralize these variants, adds questions regarding the potential for reinfections in those with natural immunity leading to further sustained community transmission.

6. Conclusion

In conclusion, the current data overwhelmingly suggests that both asymptomatic transmission and pre-symptomatic transmission contribute to SARS-CoV-2 transmission with increasing reports suggesting that pre-symptomatic transmission in particular plays an important role in these events. Given this, there is an inherent need to utilize non-pharmaceutical interventions including, but not limited to face masks, to reduce transmission events from those in our communities that are unaware that they are infected and contagious. Primary points of consideration include:

- **Morbidity and mortality**: while much of the pandemic has centered around the increasing fatalities nationally and globally, there has been less discussion regarding the effects of Covid-19 associated morbidity. Hospitalization data demonstrates that this disease can have health impacts on individuals across multiple age groups and adds significant stress on national healthcare systems and capacity.
- **SARS-CoV-2 transmission routes**: there is growing appreciation for the role of aerosols in SARS-CoV-2 transmission in addition to respiratory droplets. Aerosols have the potential for broader transmission within enclosed settings in the absence of multiple non-pharmaceutical interventions (including face masks, distancing, ventilation) and data demonstrates that aerosols may be an important factor in pre-symptomatic transmission of the virus.
- **Non-pharmaceutical interventions**: while there is strong evidence that face masks provide a benefit for reducing SARS-CoV-2 transmission they are not a single failsafe intervention measure. This requires a multi-faceted approach that includes multiple interventions due the synergistic effects these measures.
- **Virus variants and herd immunity**: the recent emergence of SARS-CoV-2 variants of concern that have increased transmissibility and the immune evasion characteristics supports the need to curb transmission in the global community quickly prior to further variant emergence. The emergence of P.1 in Brazil has suggested that new variants may be able to circulate even in populations that have exceeded the proposed herd immunity threshold with potentially devastating public health consequences. Thus, approaches that combine non-pharmaceutical interventions in addition to expanding vaccination campaigns will have the greatest opportunity to curb community transmission of the virus expediently.

References

Alsved M, M. A., Bohlin R, Richter M, Bengtsson P-E, Fraenkel C-J, Medstrand P, Londahl J (2020). "Exhaled respiratory particles during singing and talking." Aerosol Sci Technol **54**: 1245-1248.

Asadi, S., A. S. Wexler, C. D. Cappa, S. Barreda, N. M. Bouvier and W. D. Ristenpart (2019). "Aerosol emission and superemission during human speech increase with voice loudness." Sci Rep **9**(1): 2348.

Bahl, P., C. de Silva, S. Bhattacharjee, H. Stone, C. Doolan, A. A. Chughtai and C. R. MacIntyre (2020). "Droplets and Aerosols generated by singing and the risk of COVID-19 for choirs." Clin Infect Dis.

Barasheed, O., M. Alfelali, S. Mushta, H. Bokhary, J. Alshehri, A. A. Attar, R. Booy and H. Rashid (2016). "Uptake and effectiveness of facemask against respiratory infections at mass gatherings: a systematic review." Int J Infect Dis **47**: 105-111.

Barnes, K. G., J. Kindrachuk, A. E. Lin, S. Wohl, J. Qu, S. D. Tostenson, W. R. Dorman, M. Busby, K. J. Siddle, C. Y. Luo, C. B. Matranga, R. T. Davey, P. C. Sabeti and D. S. Chertow (2017). "Evidence of Ebola Virus Replication and High Concentration in Semen of a Patient During Recovery." Clin Infect Dis **65**(8): 1400-1403.

Brooks, J. T., D. H. Beezhold, J. D. Noti, J. P. Coyle, R. C. Derk, F. M. Blachere and W. G. Lindsley (2021). "Maximizing Fit for Cloth and Medical Procedure Masks to Improve Performance and Reduce SARS-CoV-2 Transmission and Exposure, 2021." MMWR Morb Mortal Wkly Rep **70**(7): 254-257.

Buitrago-Garcia, D., D. Egli-Gany, M. J. Counotte, S. Hossmann, H. Imeri, A. M. Ipekci, G. Salanti and N. Low (2020). "Occurrence and transmission potential of asymptomatic and presymptomatic SARS-CoV-2 infections: A living systematic review and meta-analysis." PLoS Med **17**(9): e1003346.

Bundgaard, H., J. S. Bundgaard, D. E. T. Raaschou-Pedersen, C. von Buchwald, T. Todsen, J. B. Norsk, M. M. Pries-Heje, C. R. Vissing, P. B. Nielsen, U. C. Winslow, K. Fogh, R. Hasselbalch, J. H. Kristensen, A. Ringgaard, M. Porsborg Andersen, N. B. Goecke, R. Trebbien, K. Skovgaard, T. Benfield, H. Ullum, C. Torp-Pedersen and K. Iversen (2020). "Effectiveness of Adding a Mask Recommendation to Other Public Health Measures to Prevent SARS-CoV-2 Infection in Danish Mask Wearers : A Randomized Controlled Trial." Ann Intern Med.

Buss, L. F., C. A. Prete, Jr., C. M. M. Abrahim, A. Mendrone, Jr., T. Salomon, C. de Almeida-Neto, R. F. O. Franca, M. C. Belotti, M. Carvalho, A. G. Costa, M. A. E. Crispim, S. C. Ferreira, N. A. Fraiji, S. Gurzenda, C. Whittaker, L. T. Kamaura, P. L. Takecian, P. da Silva Peixoto, M. K. Oikawa, A. S. Nishiya, V. Rocha, N. A. Salles, A. A. de Souza Santos, M. A. da Silva, B. Custer, K. V. Parag, M. Barral-Netto, M. U. G. Kraemer, R. H. M. Pereira, O. G. Pybus, M. P. Busch, M. C. Castro, C. Dye, V. H. Nascimento, N. R. Faria and E. C. Sabino (2021). "Three-quarters attack rate of SARS-CoV-2 in the Brazilian Amazon during a largely unmitigated epidemic." Science **371**(6526): 288-292.

Byambasuren O, C. M., Bell K, Clark J, McLaws M-L, Glasziou P (2020). "stimating the extent of asymptomatic COVID-19 and its potential for community transmission: Systematic review and meta-analysis." JAMMI **5**: 223-234.

Cai, J., W. Sun, J. Huang, M. Gamber, J. Wu and G. He (2020). "Indirect Virus Transmission in Cluster of COVID-19 Cases, Wenzhou, China, 2020." Emerg Infect Dis **26**(6): 1343-1345.

Canada, G. o. (2020, December 23, 2020). "Public health management of cases and contacts associated with COVID-19." from https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals/interim-guidance-cases-contacts.html.

Carfi, A., R. Bernabei, F. Landi and C.-P.-A. C. S. G. Gemelli Against (2020). "Persistent Symptoms in Patients After Acute COVID-19." JAMA **324**(6): 603-605.

CDC, U. (2021, 2 November 2020). "Evidence used to update the list of underlying medical conditions that increase a person’s risk of severe illness from COVID-19."   Retrieved 22

February, 2021, from https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/evidence-table.html.

Cevik, M., K. Kuppalli, J. Kindrachuk and M. Peiris (2020). "Virology, transmission, and pathogenesis of SARS-CoV-2." BMJ **371**: m3862.

Cevik, M., M. Tate, O. Lloyd, A. E. Maraolo, J. Schafers and A. Ho (2021). "SARS-CoV-2, SARS-CoV, and MERS-CoV viral load dynamics, duration of viral shedding, and infectiousness: a systematic review and meta-analysis." Lancet Microbe **2**(1): e13-e22.

Chan, J. F., S. Yuan, A. J. Zhang, V. K. Poon, C. C. Chan, A. C. Lee, Z. Fan, C. Li, R. Liang, J. Cao, K. Tang, C. Luo, V. C. Cheng, J. P. Cai, H. Chu, K. H. Chan, K. K. To, S. Sridhar and K. Y. Yuen (2020). "Surgical Mask Partition Reduces the Risk of Noncontact Transmission in a Golden Syrian Hamster Model for Coronavirus Disease 2019 (COVID-19)." Clin Infect Dis **71**(16): 2139-2149.

Chen, J., H. He, W. Cheng, Y. Liu, Z. Sun, C. Chai, Q. Kong, W. Sun, J. Zhang, S. Guo, X. Shi, J. Wang, E. Chen and Z. Chen (2020). "Potential transmission of SARS-CoV-2 on a flight from Singapore to Hangzhou, China: An epidemiological investigation." Travel Med Infect Dis **36**: 101816.

Chen PZ, B. N., Premji Z, Koopmans M, Fisman DN, Gu FX (2021). "SARS-CoV-2 Shedding Dynamics Across the Respiratory Tract, Sex, and Disease Severity for Adult and Pediatric COVID-19." medRxiv.

Cheng, H. Y., S. W. Jian, D. P. Liu, T. C. Ng, W. T. Huang, H. H. Lin and C.-O. I. T. Taiwan (2020). "Contact Tracing Assessment of COVID-19 Transmission Dynamics in Taiwan and Risk at Different Exposure Periods Before and After Symptom Onset." JAMA Intern Med **180**(9): 1156-1163.

Chertow, D. S., J. Kindrachuk, Z. M. Sheng, L. M. Pujanauski, K. Cooper, D. Nogee, M. S. Claire, J. Solomon, D. Perry, P. Sayre, K. B. Janosko, M. G. Lackemeyer, J. K. Bohannon, J. C. Kash, P. B. Jahrling and J. K. Taubenberger (2016). "Influenza A and methicillin-resistant Staphylococcus aureus co-infection in rhesus macaques - A model of severe pneumonia." Antiviral Res **129**: 120-129.

Chou, R., T. Dana, R. Jungbauer, C. Weeks and M. S. McDonagh (2020). "Masks for Prevention of Respiratory Virus Infections, Including SARS-CoV-2, in Health Care and Community Settings : A Living Rapid Review." Ann Intern Med **173**(7): 542-555.

Chughtai AA, S. H., MacIntyre CR (2013). "Use of cloth masks in the practice of infection control – evidence and policy gaps." Int J Infect Control **9**(3): 1-12.

Davis, A. S., D. S. Chertow, J. Kindrachuk, L. Qi, L. M. Schwartzman, J. Suzich, S. Alsaaty, C. Logun, J. H. Shelhamer and J. K. Taubenberger (2016). "1918 Influenza receptor binding domain variants bind and replicate in primary human airway cells regardless of receptor specificity." Virology **493**: 238-246.

Dong, Y., X. Mo, Y. Hu, X. Qi, F. Jiang, Z. Jiang and S. Tong (2020). "Epidemiology of COVID-19 Among Children in China." Pediatrics **145**(6).

Dyall, J., C. M. Coleman, B. J. Hart, T. Venkataraman, M. R. Holbrook, J. Kindrachuk, R. F. Johnson, G. G. Olinger, Jr., P. B. Jahrling, M. Laidlaw, L. M. Johansen, C. M. Lear-Rooney, P.

AB1360

J. Glass, L. E. Hensley and M. B. Frieman (2014). "Repurposing of clinically developed drugs for treatment of Middle East respiratory syndrome coronavirus infection." Antimicrob Agents Chemother **58**(8): 4885-4893.

Dyall, J., R. Gross, J. Kindrachuk, R. F. Johnson, G. G. Olinger, Jr., L. E. Hensley, M. B. Frieman and P. B. Jahrling (2017). "Middle East Respiratory Syndrome and Severe Acute Respiratory Syndrome: Current Therapeutic Options and Potential Targets for Novel Therapies." Drugs **77**(18): 1935-1966.

Escandon K, R. A., Bogoch II, Murray EJ, Escandon K, Kindrachuk J (2020). "COVID-19 and false dichotomies — A nuanced review of the evidence regarding public health, COVID-19 symptomatology, SARS-CoV-2 transmission, masks, and reinfection." OSF.

Falcinelli, S. D., D. S. Chertow and J. Kindrachuk (2016). "Integration of Global Analyses of Host Molecular Responses with Clinical Data To Evaluate Pathogenesis and Advance Therapies for Emerging and Re-emerging Viral Infections." ACS Infect Dis **2**(11): 787-799.

Francis, M. E., B. Richardson, M. McNeil, M. Rioux, M. K. Foley, A. Ge, R. D. Pechous, J. Kindrachuk, C. M. Cameron, C. Richardson, J. Lew, M. J. Cameron, V. Gerdts, D. Falzarano and A. A. Kelvin (2021). "Male sex and age biases viral burden, viral shedding, and type 1 and 2 interferon responses during SARS-CoV-2 infection in ferrets." bioRxiv.

Garcia Godoy, L. R., A. E. Jones, T. N. Anderson, C. L. Fisher, K. M. L. Seeley, E. A. Beeson, H. K. Zane, J. W. Peterson and P. D. Sullivan (2020). "Facial protection for healthcare workers during pandemics: a scoping review." BMJ Glob Health **5**(5).

Gotzinger, F., B. Santiago-Garcia, A. Noguera-Julian, M. Lanaspa, L. Lancella, F. I. Calo Carducci, N. Gabrovska, S. Velizarova, P. Prunk, V. Osterman, U. Krivec, A. Lo Vecchio, D. Shingadia, A. Soriano-Arandes, S. Melendo, M. Lanari, L. Pierantoni, N. Wagner, A. G. L'Huillier, U. Heininger, N. Ritz, S. Bandi, N. Krajcar, S. Roglic, M. Santos, C. Christiaens, M. Creuven, D. Buonsenso, S. B. Welch, M. Bogyi, F. Brinkmann, M. Tebruegge and C.-S. G. ptbnet (2020). "COVID-19 in children and adolescents in Europe: a multinational, multicentre cohort study." Lancet Child Adolesc Health **4**(9): 653-661.

Hamner, L., P. Dubbel, I. Capron, A. Ross, A. Jordan, J. Lee, J. Lynn, A. Ball, S. Narwal, S. Russell, D. Patrick and H. Leibrand (2020). "High SARS-CoV-2 Attack Rate Following Exposure at a Choir Practice - Skagit County, Washington, March 2020." MMWR Morb Mortal Wkly Rep **69**(19): 606-610.

Hart, B. J., J. Dyall, E. Postnikova, H. Zhou, J. Kindrachuk, R. F. Johnson, G. G. Olinger, M. B. Frieman, M. R. Holbrook, P. B. Jahrling and L. Hensley (2014). "Interferon-beta and mycophenolic acid are potent inhibitors of Middle East respiratory syndrome coronavirus in cell-based assays." J Gen Virol **95**(Pt 3): 571-577.

Haug, N., L. Geyrhofer, A. Londei, E. Dervic, A. Desvars-Larrive, V. Loreto, B. Pinior, S. Thurner and P. Klimek (2020). "Ranking the effectiveness of worldwide COVID-19 government interventions." Nat Hum Behav **4**(12): 1303-1312.

Hendrix, M. J., C. Walde, K. Findley and R. Trotman (2020). "Absence of Apparent Transmission of SARS-CoV-2 from Two Stylists After Exposure at a Hair Salon with a Universal Face Covering Policy - Springfield, Missouri, May 2020." MMWR Morb Mortal Wkly Rep **69**(28): 930-932.

Hong, L. X., A. Lin, Z. B. He, H. H. Zhao, J. G. Zhang, C. Zhang, L. J. Ying, Z. M. Ge, X. Zhang, Q. Y. Han, Q. Y. Chen, Y. H. Ye, J. S. Zhu, H. X. Chen and W. H. Yan (2020). "Mask wearing in pre-symptomatic patients prevents SARS-CoV-2 transmission: An epidemiological analysis." Travel Med Infect Dis **36**: 101803.

Horby P, H. C., Davies N, Edmunds J, Ferguson N, Medley G, Semple C (2021). NERVTAG paper on COVID-19 variant of concern B.1.1.7 New and Emerging Respiratory Virus Threats Advisory Group.

Howard, J., A. Huang, Z. Li, Z. Tufekci, V. Zdimal, H. M. van der Westhuizen, A. von Delft, A. Price, L. Fridman, L. H. Tang, V. Tang, G. L. Watson, C. E. Bax, R. Shaikh, F. Questier, D. Hernandez, L. F. Chu, C. M. Ramirez and A. W. Rimoin (2021). "An evidence review of face masks against COVID-19." Proc Natl Acad Sci U S A **118**(4).

Huang, L., X. Zhang, X. Zhang, Z. Wei, L. Zhang, J. Xu, P. Liang, Y. Xu, C. Zhang and A. Xu (2020). "Rapid asymptomatic transmission of COVID-19 during the incubation period demonstrating strong infectivity in a cluster of youngsters aged 16-23 years outside Wuhan and characteristics of young patients with COVID-19: A prospective contact-tracing study." J Infect **80**(6): e1-e13.

James, A., L. Eagle, C. Phillips, D. S. Hedges, C. Bodenhamer, R. Brown, J. G. Wheeler and H. Kirking (2020). "High COVID-19 Attack Rate Among Attendees at Events at a Church - Arkansas, March 2020." MMWR Morb Mortal Wkly Rep **69**(20): 632-635.

Jang, S., S. H. Han and J. Y. Rhee (2020). "Cluster of Coronavirus Disease Associated with Fitness Dance Classes, South Korea." Emerg Infect Dis **26**(8): 1917-1920.

Jefferson, T., C. B. Del Mar, L. Dooley, E. Ferroni, L. A. Al-Ansary, G. A. Bawazeer, M. L. van Driel, S. Nair, M. A. Jones, S. Thorning and J. M. Conly (2011). "Physical interventions to interrupt or reduce the spread of respiratory viruses." Cochrane Database Syst Rev(7): CD006207.

Johansson, M. A., T. M. Quandelacy, S. Kada, P. V. Prasad, M. Steele, J. T. Brooks, R. B. Slayton, M. Biggerstaff and J. C. Butler (2021). "SARS-CoV-2 Transmission From People Without COVID-19 Symptoms." JAMA Netw Open **4**(1): e2035057.

Johnson, D. F., J. D. Druce, C. Birch and M. L. Grayson (2009). "A quantitative assessment of the efficacy of surgical and N95 masks to filter influenza virus in patients with acute influenza infection." Clin Infect Dis **49**(2): 275-277.

Kash, J. C., K. A. Walters, J. Kindrachuk, D. Baxter, K. Scherler, K. B. Janosko, R. D. Adams, A. S. Herbert, R. M. James, S. W. Stonier, M. J. Memoli, J. M. Dye, R. T. Davey, Jr., D. S. Chertow and J. K. Taubenberger (2017). "Longitudinal peripheral blood transcriptional analysis of a patient with severe Ebola virus disease." Sci Transl Med **9**(385).

Khurana, S., S. Ravichandran, M. Hahn, E. M. Coyle, S. W. Stonier, S. E. Zak, J. Kindrachuk, R. T. Davey, Jr., J. M. Dye and D. S. Chertow (2020). "Longitudinal Human Antibody Repertoire against Complete Viral Proteome from Ebola Virus Survivor Reveals Protective Sites for Vaccine Design." Cell Host Microbe **27**(2): 262-276 e264.

Kim, E. S., B. S. Chin, C. K. Kang, N. J. Kim, Y. M. Kang, J. P. Choi, D. H. Oh, J. H. Kim, B. Koh, S. E. Kim, N. R. Yun, J. H. Lee, J. Y. Kim, Y. Kim, J. H. Bang, K. H. Song, H. B. Kim, K. H. Chung, M. D. Oh and C. Korea National Committee for Clinical Management of (2020).

AB1362

"Clinical Course and Outcomes of Patients with Severe Acute Respiratory Syndrome Coronavirus 2 Infection: a Preliminary Report of the First 28 Patients from the Korean Cohort Study on COVID-19." J Korean Med Sci **35**(13): e142.

Kim, Y. I., S. G. Kim, S. M. Kim, E. H. Kim, S. J. Park, K. M. Yu, J. H. Chang, E. J. Kim, S. Lee, M. A. B. Casel, J. Um, M. S. Song, H. W. Jeong, V. D. Lai, Y. Kim, B. S. Chin, J. S. Park, K. H. Chung, S. S. Foo, H. Poo, I. P. Mo, O. J. Lee, R. J. Webby, J. U. Jung and Y. K. Choi (2020). "Infection and Rapid Transmission of SARS-CoV-2 in Ferrets." Cell Host Microbe **27**(5): 704-709 e702.

Kimball, A., K. M. Hatfield, M. Arons, A. James, J. Taylor, K. Spicer, A. C. Bardossy, L. P. Oakley, S. Tanwar, Z. Chisty, J. M. Bell, M. Methner, J. Harney, J. R. Jacobs, C. M. Carlson, H. P. McLaughlin, N. Stone, S. Clark, C. Brostrom-Smith, L. C. Page, M. Kay, J. Lewis, D. Russell, B. Hiatt, J. Gant, J. S. Duchin, T. A. Clark, M. A. Honein, S. C. Reddy, J. A. Jernigan, S. Public Health, C. King and C. C.-I. Team (2020). "Asymptomatic and Presymptomatic SARS-CoV-2 Infections in Residents of a Long-Term Care Skilled Nursing Facility - King County, Washington, March 2020." MMWR Morb Mortal Wkly Rep **69**(13): 377-381.

Kindrachuk, J., R. Arsenault, A. Kusalik, K. N. Kindrachuk, B. Trost, S. Napper, P. B. Jahrling and J. E. Blaney (2012). "Systems kinomics demonstrates Congo Basin monkeypox virus infection selectively modulates host cell signaling responses as compared to West African monkeypox virus." Mol Cell Proteomics **11**(6): M111 015701.

Kindrachuk, J., B. Ork, B. J. Hart, S. Mazur, M. R. Holbrook, M. B. Frieman, D. Traynor, R. F. Johnson, J. Dyall, J. H. Kuhn, G. G. Olinger, L. E. Hensley and P. B. Jahrling (2015). "Antiviral potential of ERK/MAPK and PI3K/AKT/mTOR signaling modulation for Middle East respiratory syndrome coronavirus infection as identified by temporal kinome analysis." Antimicrob Agents Chemother **59**(2): 1088-1099.

Kindrachuk, J., V. Wahl-Jensen, D. Safronetz, B. Trost, T. Hoenen, R. Arsenault, F. Feldmann, D. Traynor, E. Postnikova, A. Kusalik, S. Napper, J. E. Blaney, H. Feldmann and P. B. Jahrling (2014). "Ebola virus modulates transforming growth factor beta signaling and cellular markers of mesenchyme-like transition in hepatocytes." J Virol **88**(17): 9877-9892.

Kotlyar, A. M., O. Grechukhina, A. Chen, S. Popkhadze, A. Grimshaw, O. Tal, H. S. Taylor and R. Tal (2021). "Vertical transmission of coronavirus disease 2019: a systematic review and meta-analysis." Am J Obstet Gynecol **224**(1): 35-53 e33.

Leclerc, Q. J., N. M. Fuller, L. E. Knight, C. C.-W. Group, S. Funk and G. M. Knight (2020). "What settings have been linked to SARS-CoV-2 transmission clusters?" Wellcome Open Res **5**: 83.

Leung, N. H. L., D. K. W. Chu, E. Y. C. Shiu, K. H. Chan, J. J. McDevitt, B. J. P. Hau, H. L. Yen, Y. Li, D. K. M. Ip, J. S. M. Peiris, W. H. Seto, G. M. Leung, D. K. Milton and B. J. Cowling (2020). "Respiratory virus shedding in exhaled breath and efficacy of face masks." Nat Med **26**(5): 676-680.

Li, F., Y. Y. Li, M. J. Liu, L. Q. Fang, N. E. Dean, G. W. K. Wong, X. B. Yang, I. Longini, M. E. Halloran, H. J. Wang, P. L. Liu, Y. H. Pang, Y. Q. Yan, S. Liu, W. Xia, X. X. Lu, Q. Liu, Y. Yang and S. Q. Xu (2021). "Household transmission of SARS-CoV-2 and risk factors for susceptibility and infectivity in Wuhan: a retrospective observational study." Lancet Infect Dis.

Lindsley, W. G., F. M. Blachere, D. H. Beezhold, R. E. Thewlis, B. Noorbakhsh, S. Othumpangat, W. T. Goldsmith, C. M. McMillen, M. E. Andrew, C. N. Burrell and J. D. Noti (2016). "Viable influenza A virus in airborne particles expelled during coughs versus exhalations." Influenza Other Respir Viruses **10**(5): 404-413.

Liu, Z., R. Chu, L. Gong, B. Su and J. Wu (2020). "The assessment of transmission efficiency and latent infection period in asymptomatic carriers of SARS-CoV-2 infection." Int J Infect Dis **99**: 325-327.

Lopez, A. S., M. Hill, J. Antezano, D. Vilven, T. Rutner, L. Bogdanow, C. Claflin, I. T. Kracalik, V. L. Fields, A. Dunn, J. E. Tate, H. L. Kirking, T. Kiphibane, I. Risk and C. H. Tran (2020). "Transmission Dynamics of COVID-19 Outbreaks Associated with Child Care Facilities - Salt Lake City, Utah, April-July 2020." MMWR Morb Mortal Wkly Rep **69**(37): 1319-1323.

Lu, J. and Z. Yang (2020). "COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, 2020." Emerg Infect Dis **26**(11): 2791-2793.

Ma, X., C. Guan, R. Chen, Y. Wang, S. Feng, R. Wang, G. Qu, S. Zhao, F. Wang, X. Wang, D. Zhang, L. Liu, A. Liao and S. Yuan (2021). "Pathological and molecular examinations of postmortem testis biopsies reveal SARS-CoV-2 infection in the testis and spermatogenesis damage in COVID-19 patients." Cell Mol Immunol **18**(2): 487-489.

MacIntyre, C. R. and A. A. Chughtai (2015). "Facemasks for the prevention of infection in healthcare and community settings." BMJ **350**: h694.

MacIntyre, C. R. and A. A. Chughtai (2020). "A rapid systematic review of the efficacy of face masks and respirators against coronaviruses and other respiratory transmissible viruses for the community, healthcare workers and sick patients." Int J Nurs Stud **108**: 103629.

MacIntyre, C. R., H. Seale, T. C. Dung, N. T. Hien, P. T. Nga, A. A. Chughtai, B. Rahman, D. E. Dwyer and Q. Wang (2015). "A cluster randomised trial of cloth masks compared with medical masks in healthcare workers." BMJ Open **5**(4): e006577.

Madewell, Z. J., Y. Yang, I. M. Longini, Jr., M. E. Halloran and N. E. Dean (2020). "Household Transmission of SARS-CoV-2: A Systematic Review and Meta-analysis." JAMA Netw Open **3**(12): e2031756.

Makison Booth, C., M. Clayton, B. Crook and J. M. Gawn (2013). "Effectiveness of surgical masks against influenza bioaerosols." J Hosp Infect **84**(1): 22-26.

Manitoba, G. o. (2021). "Covid-19 Updates." Retrieved 22 February 2021, from https://www.gov.mb.ca/covid19/updates/cases.html.

Milton, D. K., M. P. Fabian, B. J. Cowling, M. L. Grantham and J. J. McDevitt (2013). "Influenza virus aerosols in human exhaled breath: particle size, culturability, and effect of surgical masks." PLoS Pathog **9**(3): e1003205.

Murbe, D., M. Kriegel, J. Lange, L. Schumann, A. Hartmann and M. Fleischer (2021). "Aerosol emission of adolescents voices during speaking, singing and shouting." PLoS One **16**(2): e0246819.

Naveca F, d. C. C., Nascimento V et al. (2021, 17 January 2021). "SARS-CoV-2 reinfection by the new Variant of Concern (VOC) P.1 in Amazonas, Brazi." Virological from https://virological.org/t/sars-cov-2-reinfection-by-the-new-variant-of-concern-voc-p-1-in-amazonas-brazil/596.

Nickol, M. E., J. Ciric, S. D. Falcinelli, D. S. Chertow and J. Kindrachuk (2019). "Characterization of Host and Bacterial Contributions to Lung Barrier Dysfunction Following Co-infection with 2009 Pandemic Influenza and Methicillin Resistant Staphylococcus aureus." Viruses **11**(2).

Nickol, M. E. and J. Kindrachuk (2019). "A year of terror and a century of reflection: perspectives on the great influenza pandemic of 1918-1919." BMC Infect Dis **19**(1): 117.

Nir-Paz, R., I. Grotto, I. Strolov, A. Salmon, M. Mandelboim, E. Mendelson and G. Regev-Yochay (2020). "Absence of in-flight transmission of SARS-CoV-2 likely due to use of face masks on board." J Travel Med **27**(8).

Offeddu, V., C. F. Yung, M. S. F. Low and C. C. Tam (2017). "Effectiveness of Masks and Respirators Against Respiratory Infections in Healthcare Workers: A Systematic Review and Meta-Analysis." Clin Infect Dis **65**(11): 1934-1942.

Orellana, J. D. Y., G. M. D. Cunha, L. Marrero, B. L. Horta and I. D. C. Leite (2020). "Explosion in mortality in the Amazonian epicenter of the COVID-19 epidemic 19." Cad Saude Publica **36**(7): e00120020.

Park, S. Y., Y. M. Kim, S. Yi, S. Lee, B. J. Na, C. B. Kim, J. I. Kim, H. S. Kim, Y. B. Kim, Y. Park, I. S. Huh, H. K. Kim, H. J. Yoon, H. Jang, K. Kim, Y. Chang, I. Kim, H. Lee, J. Gwack, S. S. Kim, M. Kim, S. Kweon, Y. J. Choe, O. Park, Y. J. Park and E. K. Jeong (2020). "Coronavirus Disease Outbreak in Call Center, South Korea." Emerg Infect Dis **26**(8): 1666-1670.

Park, Y. J., Y. J. Choe, O. Park, S. Y. Park, Y. M. Kim, J. Kim, S. Kweon, Y. Woo, J. Gwack, S. S. Kim, J. Lee, J. Hyun, B. Ryu, Y. S. Jang, H. Kim, S. H. Shin, S. Yi, S. Lee, H. K. Kim, H. Lee, Y. Jin, E. Park, S. W. Choi, M. Kim, J. Song, S. W. Choi, D. Kim, B. H. Jeon, H. Yoo, E. K. Jeong, E. Covid-19 National Emergency Response Center and T. Case Management (2020). "Contact Tracing during Coronavirus Disease Outbreak, South Korea, 2020." Emerg Infect Dis **26**(10): 2465-2468.

Payne, D. C., S. E. Smith-Jeffcoat, G. Nowak, U. Chukwuma, J. R. Geibe, R. J. Hawkins, J. A. Johnson, N. J. Thornburg, J. Schiffer, Z. Weiner, B. Bankamp, M. D. Bowen, A. MacNeil, M. R. Patel, E. Deussing, C. C.-S. L. Group and B. L. Gillingham (2020). "SARS-CoV-2 Infections and Serologic Responses from a Sample of U.S. Navy Service Members - USS Theodore Roosevelt, April 2020." MMWR Morb Mortal Wkly Rep **69**(23): 714-721.

Perra, N. (2021). "Non-pharmaceutical interventions during the COVID-19 pandemic: A review." Phys Rep.

Qian, H., T. Miao, L. Liu, X. Zheng, D. Luo and Y. Li (2020). "Indoor transmission of SARS-CoV-2." Indoor Air.

Qiu, X., A. I. Nergiz, A. E. Maraolo, Bogoch, II, N. Low and M. Cevik (2021). "Defining the role of asymptomatic and pre-symptomatic SARS-CoV-2 transmission - a living systematic review." Clin Microbiol Infect.

Rader, B., L. F. White, M. R. Burns, J. Chen, J. Brilliant, J. Cohen, J. Shaman, L. Brilliant, M. U. G. Kraemer, J. B. Hawkins, S. V. Scarpino, C. M. Astley and J. S. Brownstein (2021). "Mask-wearing and control of SARS-CoV-2 transmission in the USA: a cross-sectional study." Lancet Digit Health.

Ralph, R., J. Lew, T. Zeng, M. Francis, B. Xue, M. Roux, A. Toloue Ostadgavahi, S. Rubino, N. J. Dawe, M. N. Al-Ahdal, D. J. Kelvin, C. D. Richardson, J. Kindrachuk, D. Falzarano and A. A. Kelvin (2020). "2019-nCoV (Wuhan virus), a novel Coronavirus: human-to-human transmission, travel-related cases, and vaccine readiness." J Infect Dev Ctries **14**(1): 3-17.

Resende PC, B. J., de Vasconcelos RH et al. (2021, 10 January 2021). "Spike E484K mutation in the first SARS-CoV-2 reinfection case confirmed in Brazil, 2020." Virological, from https://virological.org/t/spike-e484k-mutation-in-the-first-sars-cov-2-reinfection-case-confirmed-in-brazil-2020/584.

Richard, M., A. Kok, D. de Meulder, T. M. Bestebroer, M. M. Lamers, N. M. A. Okba, M. Fentener van Vlissingen, B. Rockx, B. L. Haagmans, M. P. G. Koopmans, R. A. M. Fouchier and S. Herfst (2020). "SARS-CoV-2 is transmitted via contact and via the air between ferrets." Nat Commun **11**(1): 3496.

Rubin, R. (2020). "As Their Numbers Grow, COVID-19 "Long Haulers" Stump Experts." JAMA.

Sabino, E. C., L. F. Buss, M. P. S. Carvalho, C. A. Prete, Jr., M. A. E. Crispim, N. A. Fraiji, R. H. M. Pereira, K. V. Parag, P. da Silva Peixoto, M. U. G. Kraemer, M. K. Oikawa, T. Salomon, Z. M. Cucunuba, M. C. Castro, A. A. de Souza Santos, V. H. Nascimento, H. S. Pereira, N. M. Ferguson, O. G. Pybus, A. Kucharski, M. P. Busch, C. Dye and N. R. Faria (2021). "Resurgence of COVID-19 in Manaus, Brazil, despite high seroprevalence." Lancet **397**(10273): 452-455.

Schindell, B. G., A. L. Webb and J. Kindrachuk (2018). "Persistence and Sexual Transmission of Filoviruses." Viruses **10**(12).

Shim, E., A. Tariq, W. Choi, Y. Lee and G. Chowell (2020). "Transmission potential and severity of COVID-19 in South Korea." Int J Infect Dis **93**: 339-344.

Sia, S. F., L. M. Yan, A. W. H. Chin, K. Fung, K. T. Choy, A. Y. L. Wong, P. Kaewpreedee, R. Perera, L. L. M. Poon, J. M. Nicholls, M. Peiris and H. L. Yen (2020). "Pathogenesis and transmission of SARS-CoV-2 in golden hamsters." Nature **583**(7818): 834-838.

Szablewski, C. M., K. T. Chang, M. M. Brown, V. T. Chu, A. R. Yousaf, N. Anyalechi, P. A. Aryee, H. L. Kirking, M. Lumsden, E. Mayweather, C. J. McDaniel, R. Montierth, A. Mohammed, N. G. Schwartz, J. A. Shah, J. E. Tate, E. Dirlikov, C. Drenzek, T. M. Lanzieri and R. J. Stewart (2020). "SARS-CoV-2 Transmission and Infection Among Attendees of an Overnight Camp - Georgia, June 2020." MMWR Morb Mortal Wkly Rep **69**(31): 1023-1025.

Team, C. C.-R. (2020). "Coronavirus Disease 2019 in Children - United States, February 12-April 2, 2020." MMWR Morb Mortal Wkly Rep **69**(14): 422-426.

Tenforde, M. W., S. S. Kim, C. J. Lindsell, E. Billig Rose, N. I. Shapiro, D. C. Files, K. W. Gibbs, H. L. Erickson, J. S. Steingrub, H. A. Smithline, M. N. Gong, M. S. Aboodi, M. C. Exline, D. J. Henning, J. G. Wilson, A. Khan, N. Qadir, S. M. Brown, I. D. Peltan, T. W. Rice, D. N. Hager, A. A. Ginde, W. B. Stubblefield, M. M. Patel, W. H. Self, L. R. Feldstein, I. V. Y. N. Investigators, C. C.-R. Team and I. V. Y. N. Investigators (2020). "Symptom Duration and

Risk Factors for Delayed Return to Usual Health Among Outpatients with COVID-19 in a Multistate Health Care Systems Network - United States, March-June 2020." MMWR Morb Mortal Wkly Rep **69**(30): 993-998.

Vasques Nonaka, C. K. M. F., M.; Gräf, T.; Almeida Mendes, A.V.; Santana de Aguiar, R.; Giovanetti, M.; Solano de Freitas Souza, B. (2021). "Genomic Evidence of a Sars-Cov-2 Reinfection Case With E484K Spike Mutation in Brazil." Preprints.

Wahl-Jensen, V., S. Kurz, F. Feldmann, L. K. Buehler, J. Kindrachuk, V. DeFilippis, J. da Silva Correia, K. Fruh, J. H. Kuhn, D. R. Burton and H. Feldmann (2011). "Ebola virion attachment and entry into human macrophages profoundly effects early cellular gene expression." PLoS Negl Trop Dis **5**(10): e1359.

Walters, K. A., F. D'Agnillo, Z. M. Sheng, J. Kindrachuk, L. M. Schwartzman, R. E. Kuestner, D. S. Chertow, B. T. Golding, J. K. Taubenberger and J. C. Kash (2016). "1918 pandemic influenza virus and Streptococcus pneumoniae co-infection results in activation of coagulation and widespread pulmonary thrombosis in mice and humans." J Pathol **238**(1): 85-97.

Wang, Y., H. Tian, L. Zhang, M. Zhang, D. Guo, W. Wu, X. Zhang, G. L. Kan, L. Jia, D. Huo, B. Liu, X. Wang, Y. Sun, Q. Wang, P. Yang and C. R. MacIntyre (2020). "Reduction of secondary transmission of SARS-CoV-2 in households by face mask use, disinfection and social distancing: a cohort study in Beijing, China." BMJ Glob Health **5**(5).

Wei, W. E., Z. Li, C. J. Chiew, S. E. Yong, M. P. Toh and V. J. Lee (2020). "Presymptomatic Transmission of SARS-CoV-2 - Singapore, January 23-March 16, 2020." MMWR Morb Mortal Wkly Rep **69**(14): 411-415.

WHO (2012). Report of the Fourteenth Meeting. W. A. C. o. V. V. Research. Geneva, Switzerland, WHO.

WHO (2013). Report of the Fifteenth Meeting. W. A. C. o. V. V. Research. Geneva, Switzerland, WHO.

Willman, M., D. Kobasa and J. Kindrachuk (2019). "A Comparative Analysis of Factors Influencing Two Outbreaks of Middle Eastern Respiratory Syndrome (MERS) in Saudi Arabia and South Korea." Viruses **11**(12).

Wolfel, R., V. M. Corman, W. Guggemos, M. Seilmaier, S. Zange, M. A. Muller, D. Niemeyer, T. C. Jones, P. Vollmar, C. Rothe, M. Hoelscher, T. Bleicker, S. Brunink, J. Schneider, R. Ehmann, K. Zwirglmaier, C. Drosten and C. Wendtner (2020). "Virological assessment of hospitalized patients with COVID-2019." Nature **581**(7809): 465-469.

Yang, M., S. Chen, B. Huang, J. M. Zhong, H. Su, Y. J. Chen, Q. Cao, L. Ma, J. He, X. F. Li, X. Li, J. J. Zhou, J. Fan, D. J. Luo, X. N. Chang, K. Arkun, M. Zhou and X. Nie (2020). "Pathological Findings in the Testes of COVID-19 Patients: Clinical Implications." Eur Urol Focus **6**(5): 1124-1129.

Yang, R., H. Mei, T. Zheng, Q. Fu, Y. Zhang, S. Buka, X. Yao, Z. Tang, X. Zhang, L. Qiu, Y. Zhang, J. Zhou, J. Cao, Y. Wang and A. Zhou (2020). "Pregnant women with COVID-19 and risk of adverse birth outcomes and maternal-fetal vertical transmission: a population-based cohort study in Wuhan, China." BMC Med **18**(1): 330.

AB1367

Zou, L., F. Ruan, M. Huang, L. Liang, H. Huang, Z. Hong, J. Yu, M. Kang, Y. Song, J. Xia, Q. Guo, T. Song, J. He, H. L. Yen, M. Peiris and J. Wu (2020). "SARS-CoV-2 Viral Load in Upper Respiratory Specimens of Infected Patients." N Engl J Med **382**(12): 1177-1179.

AB1368

File No. CI 20-01-29284

THE QUEEN'S BENCH
Winnipeg Centre

APPLICATION UNDER: *The Constitutional Questions Act*, C.C.S.M., c. 180

AND UNDER: The Court of Queen's Bench Rules, M.R. 553/88

IN THE MATTER OF: *The Public Health Act*, C.C.S.M. c. P210

B E T W E E N:

GATEWAY BIBLE BAPTIST CHURCH, PEMBINA VALLEY BAPTIST CHURCH, REDEEMING GRACE BIBLE CHURCH, THOMAS REMPEL, GRACE COVENANT CHURCH, SLAVIC BAPTIST CHURCH, CHRISTIAN CHURCH OF MORDEN, BIBLE BAPTIST CHURCH, TOBIAS TISSEN, ROSS MACKAY

Applicants,

- and -

HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF MANITOBA, DR. BRENT ROUSSIN in his capacity as CHIEF PUBLIC HEALTH OFFICER OF MANITOBA, and DR. JAZZ ATWAL in his capacity as ACTING DEPUTY CHIEF OFFICER OF HEALTH OF MANITOBA

Respondents.

AFFIDAVIT OF CARLA LOEPPKY
AFFIRMED: March 4th, 2021

DEPARTMENT OF JUSTICE
Constitutional Law Branch
[redacted]

[redacted]

[redacted]

File No. CI 20-01-29284

THE QUEEN'S BENCH
Winnipeg Centre

APPLICATION UNDER: *The Constitutional Questions Act*, C.C.S.M., c. 180

AND UNDER: The Court of Queen's Bench Rules, M.R. 553/88

IN THE MATTER OF: *The Public Health Act*, C.C.S.M. c. P210

B E T W E E N:

GATEWAY BIBLE BAPTIST CHURCH, PEMBINA VALLEY BAPTIST CHURCH, REDEEMING GRACE BIBLE CHURCH, THOMAS REMPEL, GRACE COVENANT CHURCH, SLAVIC BAPTIST CHURCH, CHRISTIAN CHURCH OF MORDEN, BIBLE BAPTIST CHURCH, TOBIAS TISSEN, ROSS MACKAY

Applicants,

- and -

HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF MANITOBA, DR. BRENT ROUSSIN in his capacity as CHIEF PUBLIC HEALTH OFFICER OF MANITOBA, and DR. JAZZ ATWAL in his capacity as ACTING DEPUTY CHIEF OFFICER OF HEALTH OF MANITOBA

Respondents.

AFFIDAVIT OF CARLA LOEPPKY

I, CARLA LOEPPKY, of the City of Winnipeg, in the Province of Manitoba, **AFFIRM AS FOLLOWS:**

1. I have personal knowledge of the facts and matters hereinafter deposed to by me, except where same are stated to be based upon information and belief, and those I believe to be true.

2. I have a PhD. from the University of Manitoba in Community Health Sciences, obtained in 2009. I am currently employed as the Director and Lead Epidemiologist in the Epidemiology and Surveillance Unit in the Department of Health, Seniors and Active Living, Government of Manitoba. I have held this position since 2013. Prior to that I was a senior epidemiologist with Manitoba Health from 2011-2013. I am also an Assistant Professor in the Department of Community Health Sciences, Max Rady College of Medicine, University of Manitoba and have held that position since 2009. My curriculum vitae is attached as Exhibit A.

3. Epidemiology is a branch of medical science that deals with the incidence, distribution and control of diseases within a population. It looks at how many people have a disease or disorder and how those numbers are changing. It is a cornerstone of public health and provides data and analysis to help shape policy decisions regarding healthcare. While historically epidemiology dealt with epidemic diseases, it now covers all health matters including diseases such as cancer, as well as health-related issues such as hypertension and obesity.

4. The Epidemiology and Surveillance Unit generally has a staff of approximately 30 individuals consisting of epidemiologists, statistical analysts, student trainees, and surveillance personnel. On the epidemiology side, we have five PhD. trained senior epidemiologists and two masters-level epidemiologists. We also have three epidemiologists on our team from the Public Health Agency of Canada. Our numbers have been increased in response to the COVID-19 pandemic. We now have approximately surveillance thirty clerks completing data entry. Dr. Luiz Guidolin is our senior epidemiologist with a speciality in mathematical modelling and computer simulations of infectious diseases.

5. Part of my responsibilities is to represent the Province of Manitoba on a number of national committees. Both I and my senior epidemiologists are in regular contact with our counterparts across the country in regard to our experiences with COVID-19 so that we can share our experiences and learn from each other. I am aware that Manitoba is following a similar and consistent approach as the other provinces in an attempt to control the COVID-19 pandemic. This includes testing to identify people that have been exposed to the virus, rigorous contact tracing to identify potentially infected individuals, isolation of those at risk of spreading the disease, and public health measures to limit certain activities, particularly those involving gatherings for extended time periods.

6. In order for the Epidemiology and Surveillance Unit to assist in the provincial response to the pandemic, the Unit is alerted when a person has a positive lab test for the SARS-CoV-2 virus which causes COVID-19. The information of the positive test is entered by surveillance clerks into the provincial Public Health Information Management System (PHIMS). The relevant lab details are then sent to the appropriate regional health authority or responsible organization to contact the individual (a COVID-19 positive case) and begin the process of contact tracing. Contact tracing is foundational to public health and is critical to reduce the burden and spread of disease. Without contact tracing, infectious diseases are more prone to rapid spread. To date, Manitoba has been able to run an effective contact tracing program for COVID-19, meaning the staff is able to keep up with the volume, because the system has directed adequate resources into this vital public health process. Under provincial guidelines, a person who tests positive is contacted within 24 hours of the test result and 80% of contacts within one day.

7. As people are contacted for the public health investigation, the information they provide is entered into PHIMS. The provincial epidemiologists then analyse the data. This is a fluid and iterative process. All of the data relates to unique individuals and unique circumstances. Some of the information provided relates to demographic data, symptomology, possible locations where disease was contracted and co-morbidity risks. It is the role of the epidemiologist to assess and analyse the data so as to produce useful reports for a range of users.

8. As the COVID-19 pandemic has unfolded, the epidemiologists have developed a number of extracts and reports in order to provide evidence for decision makers. First, they will generate a list of new cases from the data entry of the previous day. This case list will then be transformed into a number of different epidemiological products. For example, each week day, a situational report is produced and distributed to approximately 75 internal users both in government and in the regional health authorities. Attached hereto and marked as Exhibit B is a copy of the situational report for January 14, 2021. A summary of this report is placed on the government's COVID-19 website each day and is distributed to the media.

9. In addition, the Unit also prepares a severe outcomes report bi-weekly. A severe outcome is defined as a death or hospitalization due to COVID-19. Attached hereto and marked as Exhibit C is a copy of the severe outcomes report for January 11, 2021. As of January 11th, Manitoba had 741 deaths from COVID-19; 1841 people had been hospitalized and 350 of those

hospitalized patients had been admitted to the intensive care unit. The data also shows that 7.0% of people diagnosed with COVID-19 require hospitalization and 1.3% will require ICU care. These figures are very important in assessing hospital resources and needs.

10. In addition to the province-wide reports, the Epidemiology and Surveillance Unit tailors reports for various stakeholder groups. For example, we provide each health region with a regular situational report and epidemiologists attend operational meetings to contribute additional epidemiological intelligence. There are also regular reports focused on First Nations data which are sent to First Nations' leadership for decision making. There are also specific reports with a focus on Correctional Facilities, healthcare workers and schools which are provided to the relevant and associated sector stakeholders.

11. By reviewing the data on COVID-19 cases and contacts, the epidemiologists are able to identify trends and clusters of activity. This allows for a targeted approach to controlling specific cluster outbreaks or more general approaches for outbreak management. For example, the team has identified clusters in a meat packing plant, on Hutterite colonies, in personal care homes and on certain First Nations. We have also identified a cluster in people employed in the trucking industry. Regardless of whether the individual who tested positive is himself or herself symptomatic or infectious, all of the data collected is used by the epidemiologists to understand important matters such as the timing of infections, where people are possibly getting infected and the spread of infections from pre-symptomatic and asymptomatic individuals as well as the likely extent of community transmission.

12. The Epidemiology and Surveillance Unit is also monitoring the impacts of the COVID-19 pandemic on various Manitoba health indictors. This will continue to be an area of study for a significant period of time post-pandemic. Our initial report based on data from January 1, 2019-August 31, 2020 is attached as Exhibit D. We are also interested in the impacts of COVID-19 as they relate to certain risk factors and characteristics. For example, our data helps us explore whether COVID-19 impacts children differently than adults, or if people with chronic conditions have different outcomes. Similarly, I am currently involved in a national study looking at the effects of COVID-19 on pregnant women.

13. All reports are distributed to the Office of the Chief Public Health Officer for consideration towards the public health measures.

14. Based on the accumulated data, the Unit has identified ten clusters associated with attendance at faith-based events, including services, choir practices and funerals. A summary of these events is as follows:

- Winnipeg Regional Health Authority – September 2020 – Church choir practice
  Four cases were identified. The choir consisted of five or six members and an organist. Social distancing was being practiced.

- Winnipeg Regional Health Authority – November 1-15, 2020 – Church services, volunteer activities and a church meeting
  Nineteen primary cases and at least seven secondary cases were identified. The church service on November 8th was attended by between 45-67 people.

- Winnipeg Regional Health Authority – Late October to early November 2020- Services, band practice and a meeting
  Fourteen confirmed cases and one case from another region identified as the possible index case. Three individuals were admitted to hospital from this cluster and two died (ages 60 and 32).

- Winnipeg Regional Health Authority – November 2020 – Choir practice
  Six cases and twenty-one secondary cases were identified.

- Winnipeg Regional Health Authority and others – November 2020 – Funeral
  Four primary cases and two secondary cases were identified across several health regions as people came to the funeral from several areas.

- Prairie Mountain Health – August 2020 – Church service
  Twelve cases were confirmed out of approximately fifteen attendees. Four individuals attended the service while infectious.

- Southern Health – Late October through November, 2020 – Church activities
  A cluster of nineteen individuals was linked to a church in the Steinbach area. Several church members, including the pastor, continued to carry-on their church activities while symptomatic.

- Northern Health Region – First Nation Reserve – February 2021- Funeral and wake
  A large gathering of over one hundred people attended a funeral and wake, as well as a birthday party on the following day. Fifty-four infections were identified in people who attended one of these events. Subsequently the case count on the reserve was over 300 cases with over 100 households impacted.

- Northern Health Region – First Nation Reserve – November 2020 – Funeral and wake
Twenty-five confirmed cases of people who attended the funeral and wake. This resulted in further community spread. One child, age four, required hospitalization in Winnipeg.
- Interlake Eastern Regional Health Authority – October 2020 – Church service
There were fourteen confirmed cases related to a church service held in mid-October. Three people from this cohort were hospitalized and one of them died (age 81).

15. The Unit also prepares modelling projections. The model that we use has been specifically designed by Dr. Luiz Guidolin for Manitoba. The model uses an agent-based approach and models the behaviours of the 1.4 million Manitoba residents. The data for the model is regularly updated. It predicts the outcomes of four scenarios that range from a best case to a worst case scenario. In the best case scenario there are highly restrictive public health measures and the public complies. In the worst case scenario there are inadequate public health measures and individuals do not adjust their behaviours in the face of the pandemic. The quality and accuracy of the model has been proven by comparing the predictions to the actual outcomes that have occurred over time.

16. Manitoba's COVID-19 case numbers stayed quite small through the spring and summer of 2020. The numbers began to steadily rise through September and October. By October, the contact tracing data showed that COVID-19 was spreading within the community and that the number of cases was doubling every two weeks. The modelling data estimated that for the week of October 19-24 the number of new cases of COVID-19 could range between 217-1299. Manitoba's actual new case count for that week was 1,038, at the higher end of the projected range. The modelling data also indicated that cases were expected to continue rising. The data suggested that without interventions the rise in infections could soon overwhelm the acute care system. The epidemiological analysis also provided information on potential acquisition settings, the most commonly identified being retail establishments and food service establishments, followed by congregate settings and learning institutions. The Unit report for October 15, 2020 which was sent to Dr. Roussin and other government officials is attached as Exhibit E.

17. On November 10, 2020, Dr. Guidolin and I presented an epidemiology and modelling report to Dr. Brent Roussin and other health and government officials. The report is attached as Exhibit

F to this affidavit. At the time of this report, Manitoba's COVID-19 case numbers were dramatically increasing and the health care system was in danger of reaching its limit of intensive care hospital beds within two weeks. On the date of the presentation there were only 8 ICU beds available in Manitoba. The evidence was clearly identifying significant community transmission of the SARS-CoV-2 virus. Manitoba's COVID-19 cases were doubling every two weeks which was putting the effectiveness of the contact tracing program in jeopardy. The number of deaths and hospitalizations was rising. The impact on the older population and on First Nations was very concerning.

18. Our presentation contained a summary of our modelling data. The modelling data showed that Manitoba was tracking along the worst case scenario and that case numbers were expected to rise to between 400-1000 new cases each day by December, 2020 (graph, p. 32). The modelling data also showed that COVID-19 patients could require 100% of Manitoba's clinical hospital beds by December 14, 2020 (graph, p.39) leaving no hospital beds for any other patients. The model also predicted that COVID-19 patients could require 100% of the province's intensive care beds as soon as November 23rd (graph p.44). The number of deaths was also expected to increase rapidly, with an estimated range of 219-597 deaths by December 10th (p. 46). Ultimately, as of December 10th, Manitoba had experienced 478 deaths, at the higher end of the projected range.

19. The report also modelled the effects of various public health measures as a means to change the trajectory of the number of diagnosed cases. The modelling data predicted that strict public health interventions would have the effect of changing the trajectory of diagnosed cases.

20. The report regarding Manitoba's COVID-19 cases to January 21, 2021 is attached as Exhibit G. The data shows that Manitoba's weekly COVID-19 case numbers have been decreasing since November 12, 2020. This date coincides with the date that the entire province was put under Level Red (critical) restrictions and is ten days following the imposition of Level Red (critical) restrictions in the Winnipeg area. The declining numbers is consistent with what was predicted in the model in Exhibit F, pages 50 and 51 and by the revised model in Exhibit G. The modelling predicts that if Manitoba continues to maintain the restrictions in effect on November 12th and there is good public compliance the numbers will continue to decline (graph p. 17). On the other hand, removing restrictions and permitting the public wide latitude would

potentially result in the numbers rising again (graph p. 17). The range of effects of different levels of restrictions and associated public compliance levels are presented (graph p. 15).

21. A summary of the province's most recent COVID-19 statistics is attached as Exhibit H.

22. An important conclusion that can be drawn from the data is that the current public health measures and the public's compliance with those measures has changed the trajectory of the diagnosed cases and has eased the pressure on acute care resources.

23. I make this affidavit bona fide.

AFFIRMED before me in the City)
of Winnipeg, in the Province)
of Manitoba, this 4th day of)
March, 2021.)

A Barrister-at-law entitled to practice)
in and for the Province of Manitoba)

CARLA LOEPPKY

This is Exhibit " A" referred to
in the Affidavit of Carla Loeppky
Affirmed before me this 4
day of March A.D. 2021

A Barrister-at-Law entitled to practice
in and for the Province of Manitoba

Education

Certificate in Public Sector Management, Government of Manitoba / University of Manitoba, 2014

I was selected to participate in this management trainee program which is provided to a small cohort of civil servants who show potential as leaders. Over the course of 1.5 years, I completed the following courses at University of Manitoba: Organizational Behaviour for Public Sector Management; Politics and Public Policy; Public Finance and Budgeting; Current Issues in Public Sector Management; Case Studies in Public Sector Management. I also completed a number of internal courses towards the completion of the certificate: Assertive Communication Skills; Creative Thinking for Problem Solving; Facilitation Strategies; Managing Projects for Results; Managing Under the Collective Agreement; Media Training; Respectful Workplace: Managers' Toolbox.

Post-Doctoral Training, Manitoba Centre for Health Policy (MCHP), Faculty of Medicine, University of Manitoba, 2009

MCHP is world-renown for the way it conducts quantitative research with linked administrative data sets. I was provided a scholarship to study here and focused my research on early childhood education; literacy programs for young children; and developmental disorders. MCHP also offered me the opportunity to engage and network with decision-makers within the provincial government and really was the start of my career as a civil servant.

Advisors: Drs. Marni Brownell and Noralou Roos

Doctor of Philosophy, Community Health Sciences, Faculty of Medicine, University of Manitoba, 2009

Community Health Sciences (CHS) was an excellent fit for my doctoral work. I was able to blend my interests in end-of-life care, adult education, and international health in a unique program of study. I completed two years of coursework and one year of exams and research preparation in Winnipeg. The final year of my program was spent in South Africa which created an amazing experience for myself academically but also my young (at that time) family. Throughout the course of my studies, I was well supported by scholarships.

Dissertation: *Hospice and palliative care in South Africa: The confluence of context and education*

Advisor: Dr. Harvey Max Chochinov

Field work completed at the University of Cape Town, South Africa, 2007

Masters of Science, Family Social Sciences, Faculty of Human Ecology, University of Manitoba, 2003

During a maternity leave from teaching, I began my Masters program at University of Manitoba. It was intended to be for personal interest but instead sparked significant long term study goals which culminated in completing a PhD.

Thesis: *Death anxiety in adolescents: The function of religiosity and bereavement*

Advisor: Dr. John Bond

Bachelors of Education and Human Ecology, University of Manitoba, 1998

These undergraduate degrees provided an excellent foundation with focused training in the fields of human development across the lifespan and human nutritional sciences.

Work Experience

Director and Lead Epidemiologist, Manitoba Health, Seniors and Active Living, 2013- Present

Several key aspects of this position include:

- *Leading a staff of approximately 30 individuals including epidemiologists, statistical analysts, student trainees (including from Red River College, University of Manitoba, and University of Winnipeg), and surveillance personnel.* I manage the staffing and operations of the unit with a budget of approximately $1.5 million consisting of both external and internal funds. I also maintain learning plans for each staff member, ensuring appropriate professional development opportunities are in place and aligned with the learning plans.
- *Knowledge translation and communicating evidence for intended public health action.* Communication in this role requires professionalism, diplomacy and the ability to translate scientific ideas to a lay audience. I am adept at preparing presentations for a range of audiences, preparing a host of written materials, and providing and receiving feedback. Working in the field of communicable diseases is incredibly demanding and requires quick and accurate responses. I use evidence generated by my team to support decision-making within the department, respond to media requests, and improve health outcomes of Manitobans.
- *Project management of large and small scale initiatives*. I am currently the Team Lead on a project which will transform the Surveillance Unit into a paperless environment; we will achieve a full return on investment within three years. We are on budget ($675,000) to complete the work by the end of the fiscal year 2020. Over the last five years I have upgraded my skillset in the field of project management through internal courses offered by the government and during the Certificate for Public Sector Management which has provided me both the confidence and competence to lead initiatives within the civil service.
- *Exploring new and innovative ways to conduct surveillance and epidemiological analyses with fewer resources and heightened expectations*. Change management is a significant part of my work as when we bring on new technologies there is a critical period of training, stakeholder engagement and communication. With change also comes the role of maintaining and improving quality of our products whether it relates to data entry, reporting, or analytical tools.
- *Championing innovation in a resource constrained environment*. This takes creativity and skills to "think outside the box" in order to achieve high and ever-changing standards. Innovation also relies on the strength of my internal and external networks which I work to nurture and expand regularly. I have excellent working relationships with academic centres, researchers, and experts in areas of population and public health epidemiology
- *Applying metrics to the epidemiological cycle to plan, design / develop, implement and evaluate our surveillance systems and the outputs used by internal and external stakeholders.*
- *Engaging stakeholders in strategic visioning processes to guide provincial public health broadly and surveillance of communicable diseases more specifically.* There are significant transformations occurring in the department and civil service which require thoughtful attention to both the strategic planning as well as the accompanying operational planning. This work relies on strong interpersonal skills, collaboration, and the ability to work effectively on a team.
- *Mentoring students and trainees in collaboration with the community medicine program or other relevant graduate programs.* In 2017, I developed a student training program for the summer students hired in Public Health to ensure students have an excellent learning experience as well

as develop opportunities to network. In 2018, I expanded the curriculum to include learning about the Truth and Reconciliation Commission.

- *Conducting applied public health research to enhance understanding of population-level issues in Manitoba both with a range of stakeholders and from an equity perspective.*
- *Representing Manitoba on provincial and national committees in areas such as HIV, communicable disease surveillance, poison control and health equity.*

Interim Executive Director, Cadham Provincial Laboratory, Manitoba Health, Seniors and Active Living, October-December, 2016

Cadham Provincial Laboratory (CPL) had been without an Executive Director (ED) for a lengthy period of time; I provided bridge services while CPL was conducting a search for a new ED. During my time at CPL, I explored potential mechanisms to streamline public health services between the lab and the provincial public health team; co-produced (with Dr. Paul VanCaeseele) a Value for Money document relating to the need for a new laboratory; and reviewed HR processes and competitions. I have translated one of CPL's daily check in processes to my surveillance team with great result.

Director, Curriculum Renewal (CuRe) Clerkship for Community Health Sciences, Faculty of Medicine, University of Manitoba, 2012-2014

In 2012 the Faculty of Medicine overhauled the undergraduate curriculum for medical students. All departments hired a Clerkship Director to lead the curriculum renewal process and to represent the needs of their departments. In this role I evaluated how Community Health Sciences (CHS) contributed to the "old" medical curriculum and then identified what the department ultimately wanted to have embedded. In the new curriculum, I was successful in negotiating a three-fold increase in the number of contact hours; a new approach to teaching CHS curriculum; and a stronger focus on public and population health. During this time I was also highly involved in the Faculty of Medicine's Inter-professional Education programming.

Senior Epidemiologist, Manitoba Health, 2011-2013

In this role I conducted provincial-level analyses of communicable diseases, prepared reports for internal or public dissemination, and provided leadership in the field of knowledge translation.

Assistant Professor (part-time) Community Health Sciences, University of Manitoba, 2009-Present

I have had the opportunity to be a part-time Assistant Professor (nil-salaried) with CHS for the last decade. This has given me the ability to apply for grants as a lead investigator or support other grant applications in a co-investigator role. As an Assistant Professor, I am also a part of CHS' Departmental Council and as such am involved in the decision-making and priority setting for the department. In 2019 I took on a new role as the Director of Research for the Public Health Residents. I also supervise students in their Masters programs and participate as a committee member for those students who are working on their PhDs. As a faculty member, I am familiar with the wide range of University regulations and policies and endeavour to apply them consistently in my professional role. Being in this role concurrently as the Director of Epidemiology and Surveillance has created meaningful partnerships which have benefitted both organizations.

Research Associate, Manitoba FASD Centre, University of Manitoba, 2009-2011

I was the first Research Associate hired by the Manitoba Fetal Alcohol Spectrum Disorder (FASD) Centre. My primary goal was to conduct research using the clinical data collected by the Centre.

My secondary objective was to support and nurture research being conducted by the other clinicians involved in the Centre. During my time I completed a research study in The Pas relating to telehealth and Fetal Alcohol Spectrum Disorder assessment. I also worked with four of the clinicians to complete their analysis and support their research priorities.

Program Evaluator, Healthy Child Manitoba, Healthy Living, Youth and Seniors, 2010-2011

I was hired on contract by Healthy Child Manitoba to complete a program evaluation of CHOICES an intervention designed to either change drinking or contraceptive behaviours to ultimately reduce babies born with FASD.

Student Supervision and Teaching Experience

Post-graduate student supervision through CHS

- Committee member for PhD student Leigh McClarty- expected date of completion September 2020. Dissertation focuses on HIV trajectory of Care in Manitoba.
- Committee member for MSc student Alexandrea Andersen—expected date of completion September 2020.
- Lead advisor for MSc student Dr. Davinder Singh- completed October 2017. Thesis focused on Influenza outbreaks in Manitoba institutions.
- Lead advisor for MPH student Aimee Bowcott- graduated October 2016. Project focused on knowledge translation of surveillance analyses.
- Committee member for MSc Student Maria Fernanda Medina- graduated October 2015. Thesis focused on Life Story Board and healing post-trauma.

CHS Faculty Involvement (2009-present)

As both a doctoral student and part-time faculty member, I have been highly engaged in the Faculty of CHS. Some of the activities I have been involved in are:

- Providing support to the Public Health Residents as their Research Advisor
- Providing lectures on knowledge translation, equity, and health literacy
- Training tutors to deliver new Scholarship in Medicine Curriculum
- Teaching the graduate course *Research Methods in Health Care*
- Leading tutorial sessions for small groups (different topics covered)
- Providing leadership as an Inter-Professional Education Faculty Trainer

Extended Education Faculty Involvement 2010

- I developed the curriculum for and taught *Human Development in the Family* in the Aboriginal Focus Program. This course was delivered in The Pas to a group of about 30 adult learners completing their Aboriginal Child and Family Services Diploma.

Family Social Sciences Faculty Involvement (2005 to 2011)

I both developed the curriculum for and taught the following sessional courses while involved in the Faculty of Human Ecology throughout my graduate student years:

- *Integration of Health Determinants for Canada and World*, 2008
- *Developmental Health*, 2007 & 2008
- *Death and the Family*, 2004 & 2005
- *Families in the Later Years*, 2004 & 2005

School of Medical Rehabilitation Faculty Involvement (2002-2004)

- Sessional lecturer in the areas of human development, death and dying.

Junior and Senior High Teacher, 1996-2004

- I spent a number of years as a teacher both in McCreary and Winnipeg, Manitoba, teaching courses such as Foods and Nutrition, Family Studies, English, Physical Education, and History to junior and senior high students.

Committee Memberships (current)

Multi-sectoral/National

- Health Information Management Advisory Committee—*Red River College*
- Steering Committee Member of the *Living with HIV Research Team*
- Provincial Representative on the *Multi-Lateral Information Sharing Agreement (MLISA)* Network
- Member of the *Canadian Surveillance System for Poison Information (CSSPI)*
- Member of *Manitoba HIV Collective Impact Network Stewardship Committee*

Manitoba Health, Seniors and Active Living

- Member *Department Renewal Committee*
- Member of *Public Health Management Committee*
- Member of the *Department Council Community Health Sciences*
- Advisory Committee Member for *Manitoba Centre for Health Policy Deliverable relating to Tuberculosis in Manitoba*
- *Advisory Committee Member* for Manitoba Centre for Health Policy Deliverable relating to Diabetes in Manitoba
- Member of the *Community Health Assessment Network*

Volunteer Experience

- 2015 to present: member of the Tavern Crew (Winnipeg Folk Festival)
- 2018 to present: Board of Directors for Candace House
- 2008 to present: volunteer for many school and sporting activities
- 2012 to present: volunteer for Boston Terrier and Pug Rescue of Southern Manitoba

Scholarships & Awards

PhD Fellowship- Social Sciences and Humanities Research Council
Doctoral Research Award- International Development Research Council
Duff Roblin Scholarship- University of Manitoba

David G. Fish Memorial Scholarship- University of Manitoba
Dissertation Award- Manitoba Health Research Council
Studentship- Western Regional Training Centre
UMSU Scholarship
Mary E. Lamont Scholarship
U of M Graduate Fellowship
Silver Jubilee Scholarship
Ruth Binnie Scholarship
Anthony J. Besarabowicz Award

Scholarly Activities-- Highlights[1]

Refereed Publications and Book Chapters

Bullard, J.; Funk, D; Dust, K., Garnett, L., Tran, K, Bellow, A., Strong, J., Lee, S., Waruk, J., Hedley, A, Alexander, J, Van Caeseele, P., **Loeppky, C.,** & Poliquin, G. (under review). Evaluation of Infectious Severe Acute Respiratory Syndrome Coronavirus 2 in Children with Coronavirus Disease 2019 from Diagnostic Samples. JAMA Peds.

McClarty, L., Kasper, K., Ireland, L, **Loeppky, C**., Blanchard, J. & Becker, M. (2021) The HIV care cascade in Manitoba, Canada: Methods, measures and estimates to meet local needs. Journal of Clinical Epidemiology (132; 26-33).

Singh, D., VanCaeseele, P., Depeeng, J. & **Loeppky,** C. (2019) T*he effect of timing of oseltamivir chemoprophylaxis in control influenza B outbreaks in long term care facilities in Manitoba, Canada, 2017-2018: A retrospective cohort study*. The Canadian Journal of Infection Control.

Thompson, L., Nugent, Z, Wylie, J., **Loeppky, C.,** VanCaeseele, P., Blanchard, J. & Yu, N. (2019). Laboratory Detection of First and Repeat Chlamydia Cases Influenced by Testing Patterns. Microbiology Insights. https://doi.org/10.1177/1178636119827975

Rosella, L.C., Bornbaum, C, Kornas, K, Lebenbaum, M, Peirson, L., Fransoo, R., **Loeppky, C**, Gardner, C. & Mowat, D. (2018). Evaluating the Process and Outcomes of a Knowledge Translation Approach to Supporting Use of the Diabetes Population Risk Tool (DPoRT) in Public Health Practice 2018 *Canadian Journal of Program Evaluation,* 33.1 (Spring / printemps), 21–48 doi: 10.3138/cjpe.31160

Singh, D., VanCaeseele, P., Depeeng, J. & **Loeppky,** C. (2018). The effect of timing of oseltamivir chemoprophylaxis in controlling influenza A H3N2 outbreaks in long term care facilities in Manitoba, Canada, 2014-2015: A retrospective cohort study. Infection Control & Hospital Epidemiology. 0, 1–6, doi:10.1017/ice.2018.115

Plourde, P., Bertram-Farough, A., Wang, R., **Ens, C.,** Yu, BN. (2016). LTBI treatment completion and risk factors for non-completion in an urban city of western Canada: a population-based study. International Journal of Tuberculosis and Lung Disease (IJTLD). S2399 EP-233-29.

Shaw, S., Ireland, L, McClarty, L., **Loeppky, C.,** Yu, N., Wylie, J., Bullard, J., Van Caeseele, P., Keynan, Y., Kasper, K., Blanchard, J., & Becker, M. (2016) Prior history of testing for syphilis, hepatitis B and hepatitis C among a population-based cohort of HIV-positive individuals and their HIV-negative controls, AIDS Care.

Yu, BN, Klassen, P, Wang, R., **Ens, C**. (2016). Increasing trends of COPD in persons living with diabetes: A population-based matched cohort study, 1984-2013. International Journal of Tuberculosis and Lung Disease (IJTLD). S266, OA-414-28.

Thompson, L., Nugent, Z., Blanchard, J., **Ens, C.,** & Yu, B.N. (2016). Increasing incidence of anogenital warts with an urban–rural divide among males in Manitoba, Canada, 1990–2011. BMC Public Health.

Christianson, S., Sharma, M., Yu, N., **Ens, C.** and Wolfe, J. (2015). Molecular Epidemiology of *Mycobacterium tuberculosis* in Manitoba (2003-2013): A Population-based Study

Yu, N., Christianson, S., Sharma, M., Fast, M., Wang, R., Soliman, G., Moores, A. and **Ens, C.** Secular trends and characteristics of Tuberculosis genotype clusters in Manitoba: A population-based study. The International Union Against Tuberculosis and Lung Disease, North American Region, 2015-02-25.

[1] Many of the references will be under the surname "Ens"; I have since elected to use my name at birth "Loeppky"

Rosella, L., Peirson, L., Bornbaum, C., Kotnowski, K., Lebenbaum, M, Fransoo R., Martens, P, Caetano, P., **Ens, C.,** Gardner, C, Mowat, D., and for the DPoRT knowledge-to-action team. Supporting collaborative use of the diabetes population risk tool (DPoRT) in health-related practice: a multiple case study research protocol, *Implementation Science* 2014, 9:35.

Stenekes, S., **Ens, C.,** Chochinov, H, & Harlos, M. (in press). A descriptive study evaluating perinatal health care providers' perspectives of palliative programming. Journal of Perinatal and Neonatal Nursing

Proven, S., **Ens, C.** & Beaudin, P. (2014). The Language Profile of School Age Children with Fetal Alcohol Spectrum Disorder (FASD*). Canadian Journal of Speech-Language Pathology and Audiology*.

Ens, C., Hanlon-Dearman, A., Longstaffe, S. & Cox-Millar, M. (2010). Using Telehealth for Assessment of Fetal Alcohol Spectrum Disorder (FASD): The Experience of Two Canadian Rural and Remote Communities. *Telemedicine and e-Health*.

Ens, C., Chochinov, H.M., Gwyther, E., Moses, S., Jackson, C., Thompson, G. & Harding, R. (2010). Post-graduate palliative care education: Evaluation of a South African programme. *South African Medical Journal*.

Thompson, G., **Ens, C.,** & Chochinov, H. (2010). Patient Centred Supportive and Palliative Care in Elwood M, Sutcliffe S (eds) *Cancer Control,* Oxford University Press, Oxford.

Ens, C., Gwyther, L., Chochinov, H.M., Moses, S., Jackson, C. & Harding, R. (2008). A Qualitative Exploration of Referral and Access to Hospice Care: Multi-Professional Specialist Perspectives in the Western Cape, South Africa. *International Journal of Palliative Nursing, 14* (4), 169-174.

Ens, C., Chochinov, H.M., Berard, J., Harlos, M., Stenekes, S. & Wowchuk, S.M (2008). Pediatric palliative care online: The views of health care providers. *Journal of Palliative Care,24* (1), 41-48.

Ens, C. & Bond, J.B. (2007). Death Anxiety in Adolescents: The contributions of bereavement and religiosity. *OMEGA: The Journal of Death and Dying, 55* (3), 169-184.

Ens, C. & Bond, J.B. (2005). Death anxiety and personal growth in adolescents experiencing the death of a grandparent**.** *Death Studies, 29,* 171-178**.**

Oral Conference Presentations

Bozat-Emre, S., **Ens, C.** & Guidolin, L. (2016). Modelling Hep C in Manitoba, Canada. Canadian Association of Drugs and Health Therapies (Ottawa, Ontario)

Yu, N., Klassen, P, Wang, R., **Ens, C.** Increasing trends of COPD in persons living with Diabetes: A population-based matched cohort study (1984-2013). The 47th Union World conference on Lung Health

Ens, C. (on behalf of Epi and Surveillance) (2014). TB surveillance in Manitoba: A journey through the past decade. TB Forum, University of Manitoba.

Ens, C. (on behalf of Partners in Planning). (2013). Conceptualizing Manitoba's Adult Risk Factor Survey (ARFS) 2013 Canadian Society for Epidemiology and Biostatistics Biennial Conference: From Genes to Global Public Health:Advancing Methods Across The Spectrum (St. Johns Newfoundland)

Ens, C. & Shafto, K. (2011). Public Reporting of Immunization Rates by First Nations Status: Striving to Improve Accuracy. *First Nations, Metis and Inuit Health Research Symposium* (Winnipeg).

Ens, C. (2011). Congenital Anomaly Surveillance in Manitoba: A Gap Analysis. *Ninth Congenital Anomalies Surveillance Network Scientific Meeting* (Ottawa).

Ens, C. & Hanlon-Dearman, A. (2011). Profiling 10 years of FASD diagnostic assessments in Manitoba, Canada. *4th International Conference on Fetal Alcohol Spectrum Disorder* (Vancouver).

Ens, C. & Hanlon-Dearman, A. (2011). Using Telehealth for FASD Assessments and Follow-ups in Manitoba: The Experience of 3 Rural & Remote Communities. *4th International Meeting on Indigenous Child Health* (Vancouver).

Ens, C., Brownell, M., Roos, N. & Au, W. (2009). Applying the EDI's measurement of language and cognition to Reading Recovery: Is there predictive potential? *The Early Development Imperative* (Winnipeg).

Ens, C., Brownell, M. & Roos, N. (2009). Manitoba's At-Risk Child Population: From Info to Action. *Manitoba Children's Agenda, Children and Youth Health Data Seminar* (Winnipeg).

Ens, C. (2007). A Review of Methods to Evaluate Palliative Care Education Programs in Developing Countries*. Faculty of Health Sciences 2007 Education Research Day- University of Cape Town* (South Africa).

Gwyther, E. & **Ens, C.** (2007). South African Physicians and the Provision of Palliative End-of-Life Care: An Evaluation of Perceived Roles, Competencies and the Influence of Distance Education in Addressing these Needs. (Work In Progress*). Faculty of Health Sciences 2007 Education Research Day- University of Cape Town* (South Africa).

Ens, C. (2007). The University of Cape Town's Palliative Care Distance Education Program: An evaluation from the perspective of current and former students. *African Palliative Care Association Conference* (Kenya).

Abstracts

Ens, C. & Chochinov, H.M. (2008). Evaluation of a Distance Education Palliative Care Course in Cape Town, South Africa. *Stem Cells: From Embryos to Ethics*.

Ens, C., Chochinov, H., Harlos, M. & Stenekes, S. (2007). Canadian Hospice and Palliative Care Conference. *Journal of Palliative Care,* Autumn; 23(3): 231.

Ens, C., Stern, A., Berard, J., Harlos, M. & Chochinov, H., Stenekes, S., Wowchuk, S., & Peters-Watral, B. (2006). *Health and Aging Conference Report*.

Ens, C., Harlos, M., Chochinov, H., Stern, A., & Berard, J. (2006). Online communication and pediatric palliative care: A needs assessment for the Canadian Virtual Hospice. *Palliative Medicine*; 20(3): 283.

Ens, C. (2005). Online communication and pediatric palliative care: A needs assessment for the Canadian Virtual Hospice. *Infection Immunity and Health Conference Report*.

Invited Lectures, Presentations, and Media

06/2011: *"It can be complicated at times":* Perspectives on Providing Perinatal Palliative Care. Saskatoon General Hospital.

04/2010: Telehealth and FASD. Presentation to the Standing Committee. Manitoba Metis Federation.

03/2010: Published two articles (*Manitoba FASD Centre Conducts Exciting New Research* & *Telehealth for FASD Assessment and Follow-up in Manitoba*) in the Coalition for Alcohol and Pregnancy (C.A.P.) March 2010 Newsletter.

11/2009: "FASD Research Initiatives at the MB FASD Centre" for the Coalition for Alcohol and Pregnancy (co-presented with Dr. Ana Hanlon-Dearman) (Rehab Centre for Children).

05/2008: "South Africa" Quality of Life (QOL) Meeting (Winnipeg).

11/2007: "South African Hospices and Research. Do the two belong together?" Hospice Association of the Western Cape (Paarl Hospice, South Africa).

10/2006: "European Association of Palliative Care Conference" A lecture for the WRTC Program.

05/2006: "Aging, dying and death" A lecture in Family Social Sciences.

04/2006: "Canadian Virtual Hospice: WRTC Field Placement" Community Health Sciences Symposium.

03/2006: "Canadian Virtual Hospice: Playground or Minefield" Family Social Science Symposium.

12/2003: "Death Anxiety in Adolescents: The Function of Religiosity and Bereavement" Dafoe Library Lecture Series at University of Manitoba.

04/2002: "Education and preparation" panel presentation the Family Studies Symposium.

11/2002: "Grief and bereavement" lecture for Med Rehab, University of Manitoba.

04/2001: "Health Care Expenditures and the Elderly" for the Family Studies Symposium.

01/2010: Podcast entitled "Hospice Care In South Africa: Improving Access For Patients Through Education And Standardisation" for the International Program of Psycho-Social Health Research (CQ University in Australia) http://www.ipp-shr.cqu.edu.au/podcasts/.

Posters

Anderson, A., Wei, J., Kurbis, C., Hossack, I., **Ens, C.** & Bozat-Emre, S. (2016). HPV Immunization Among 17 year old Females in Manitoba. Canadian Undergraduate Conference on Healthcare

Bozat-Emre, S., **Ens, C.** & Guidolin, L. (2016). Modelling Hep C in Manitoba, Canada. Canadian Association of Drugs and Health Therapies (Ottawa, Ontario)

Yu, N., Christianson, S., Sharma, M, Fast, M, Wang, R, Guirgas, S., Moore, A., Ens, C. (2015). Secular trends and characteristics of Tuberculosis genotype clusters in Manitoba: A population based study.

Christianson, S., Sharma, M., Yu, N., **Ens, C.** and Wolfe, J. (2015). Molecular Epidemiology of *Mycobacterium tuberculosis* in Manitoba (2003-2013): A Population-based Study

Russnack-Redden, T., Hopfner, T, Wylie, J. **Ens, C**. (2015). The Application of Social Network Analysis during an Active Public Health Investigation of an HIV Outbreak.

Caetano, P & **Ens, C.** (2013). Translating epidemiology and surveillance information into knowledge. 2013 Canadian Society for Epidemiology and Biostatistics Biennial Conference: From Genes to Global Public Health: Advancing Methods Across The Spectrum (St. Johns Newfoundland)

Ens, C. (2011). Congenital Anomaly Surveillance in Manitoba: A Gap Analysis. *Ninth Congenital Anomalies Surveillance Network Scientific Meeting,* (Ottawa).

Ens, C. & Hanlon-Dearman, A. (2011). FASD and the Aboriginal experience: What does the literature tell us? *4th International Conference on Fetal Alcohol Spectrum Disorder,* (Vancouver).

Ens, C. & Hanlon-Dearman A. (2011). The Use of Telehealth for the Diagnosis and Follow-up of Individuals with Fetal Alcohol Spectrum Disorders (FASD) in Three Manitoba Communities: Norway House, The Pas / Flin Flon and Brandon. *4th International Conference on Fetal Alcohol Spectrum Disorder,* (Vancouver).

Ens, C., Cox-Millar, M., Hanlon-Dearman, A. & Longstaffe, S. (2010). The Use of Telehealth for the Diagnosis and Follow-up of Individuals with FASD in Three Manitoba Communities: Norway House, The Pas / Flin Flon, and Brandon. *Manitoba eHealth Conference*, (Winnipeg).

Stenekes, S., **Ens, C.,** Harlos, M., Chochinov, H.M. & Kuhling, S. (2010). Providing Palliative Care With and Without a Formal Palliative Care Service: The View of Health Care Providers (Work in Progress). *International Palliative Care Conference,* (Montreal).

Harlos, M., Stenekes, S., Lambert, D., Hohl, C., Chochinov, H.M. & **Ens, C.** (2010). Use of Intranasal Fentanyl in Palliative Care of Newborns and Infants. *International Palliative Care Conference*, (Montreal).

Ens, C., Gwyther, L., Chochinov, H.M., Moses, S., Jackson, C. & Harding, R. (2010). Interpretive Description in Palliative Care Research: An Example from South Africa. *European Association of Palliative Care,* (United Kingdom).

Ens, C., Cox-Millar, M., Hanlon-Dearman, A. & Longstaffe, S. (2010). The Use of Telehealth for the Diagnosis and Follow-up of Individuals with FASD in Three Manitoba Communities: Norway House, The Pas / Flin Flon, and Brandon. *Fourth National Biennial Conference on Adolescents and Adults with Fetal Alcohol Spectrum Disorder,* (Vancouver).

Ens, C., Brownell, M., Roos, N. & Au, W. (2009). Applying the EDI's measurement of language and cognition to Reading Recovery: Is there predictive potential? *The Early Development Imperative Conference,* (Winnipeg).

Ens, C., Thompson, G., Chochinov, H., & Gwyther, E. (2008). The University of Cape Town's Palliative Care Distance Education Program: An Evaluation from the Perspective of Graduates. *Canadian Palliative Care Association Conference,* (Montreal).

Ens, C., Thompson, G., Chochinov, H., & Gwyther, E. (2008). A qualitative exploration of referral and access to hospice care in South Africa: Multi-professional specialist perspectives. *Canadian Palliative Care Association Conference,* (Montreal).

Ens, C. & Chochinov, H.M. (2008). Evaluation of a Distance Education Palliative Care Course in Cape Town, South Africa. *Canadian Student Health Research Forum: Stem Cells- From Embryos to Ethics,* (Winnipeg).

Ens, C., Chochinov, H.M., Harlos, M. & Stenekes, S. (2007). Pediatric palliative pare online: The views of health care professionals . *Canadian Palliative Care Association Conference,* (Montreal).

Ens, C., Jackson, K, Gwyther, L. (2007). Referral to Hospices in the Western Cape Province of South Africa: Themes from a Qualitative Study of Health Care Professionals *African Palliative Care Association Nairobi,* (Kenya).

Ens, C., Berard, J., Chochinov, H., Harlos, M., Peters-Watral, B., Stenekes, S., Stern, A., & Wowchuk, S. (2006). Canadian Virtual Hospice and Children. A Needs Assessment. *Palliative Care Congress,* (Montreal).

Ens, C., Berard, J., Chochinov, H., Harlos, M., Peters-Watral, B., Stenekes, S., Stern, A., & Wowchuk, S. (2006). Canadian Virtual Hospice and Children. A Needs Assessment. *Canadian Student Health Research Forum: Health and Aging,* (Winnipeg).

AB1387

Ens, C., Stern, A., Berard, J., Harlos, M. & Chochinov, H., Stenekes, S., Wowchuk, S., & Peters-Watral, B. (2006). Online communication and pediatric palliative care: A needs assessment for the Canadian Virtual Hospice. *European Association for Palliative Care,* (Italy).

Ens, C. (2005). Online communication and pediatric palliative care: A needs assessment for the Canadian Virtual Hospice- work in progress. *Canadian Student Health Research Forum: Infection, Immunity and Health,* (Winnipeg).

AB1388

This is Exhibit " B " referred to
in the Affidavit of Carla Loeppky
Affirmed before me this 4
day of March A.D. 2021

A Barrister-at-Law entitled to practice
in and for the Province of Manitoba

AB1389

*******FOR INTERNAL USE ONLY*******

COVID-19: MHSAL EPIDEMIOLOGICAL SITUATION REPORT

Key Points

- As of 14JAN21, there are a total of **26954 cases of COVID-19** reported in Manitoba.
- There are **261 new cases and 259 net new cases** today. (see table 1 below).
- There are **2886 active cases** today.
- There have been **755** deaths related to COVID-19.
- There have been **226** cases with unknown acquisition in the last 7 days.
- There have been 13475 cases reported in females and 13462 in males.
- Among female cases, 281 women reported being pregnant at time of diagnosis.
- Person-person spread in Manitoba began around March 24th and in-community spread appears to have begun around March 27th.
- Data collected from 26954 case reports shows that 23029 individuals reported any symptoms and 3925 reported asymptomatic infection.
- Our current data is showing that approximately 17% of named contacts become infected with COVID-19.
- Since July 1, 2020 there have been 15784 cases in Winnipeg and 820 are active
- Since July 1, 2020 there have been 1746 cases in PMH and 218 are active

*****FOR INTERNAL USE ONLY*****

COVID-19: MHSAL EPIDEMIOLOGICAL SITUATION REPORT

POSITIVE AND ACTIVE CASES IN MANITOBA BY REGION

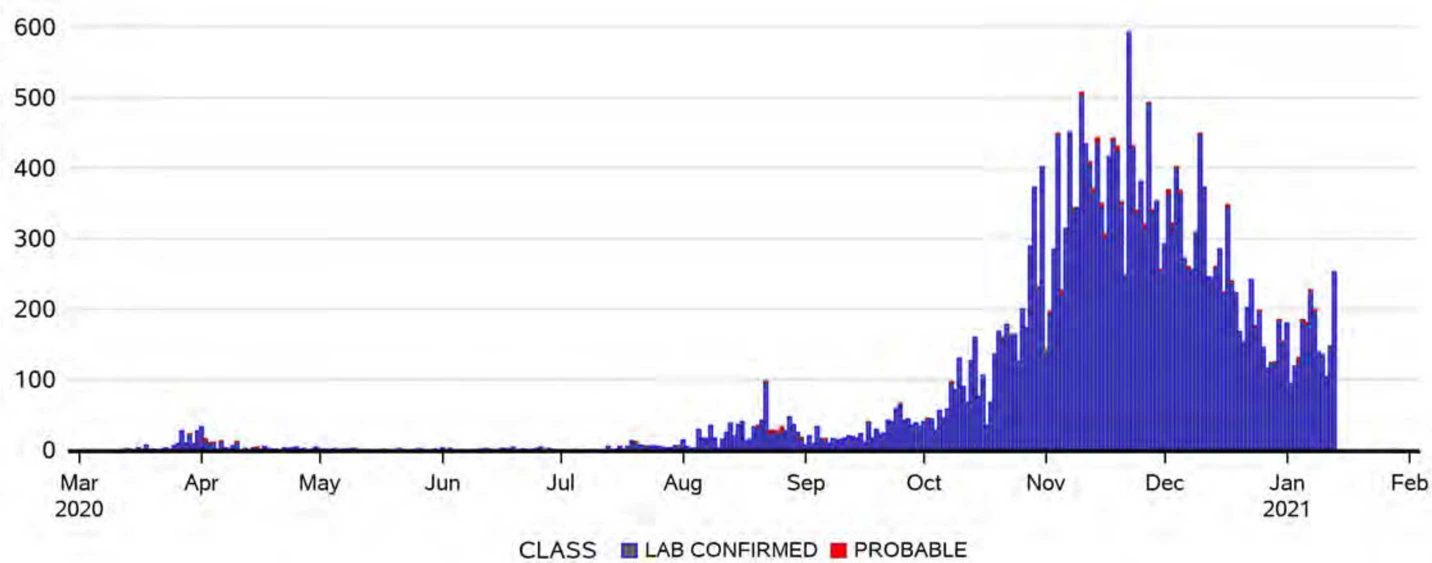
Figure 1. Map of Positive and Active Cases in Manitoba by RHA

Region	# of Positive Cases	# of Positive FNIHB Cases	# of Active Cases	# of Active FNIHB Cases	# of New Cases	# of New FNIHB Cases
Prairie Mountain Health	1772	127	218	74	23	1
Interlake-Eastern Health	1979	816	337	272	11	8
Northern Health	2687	1528	1297	1070	139	71
Southern Health - Sante Sud	4496	155	214	125	13	5
Winnipeg Health	16020	186	820	96	75	2

EPIDEMIC CURVE OF COVID-19 IN MANITOBA

The Epidemic curve below shows the case counts for cases on the dates that they were reported to the Manitoba Health Surveillance Unit (MHSU).

Figure 2. Epidemic curve of COVID-19 in Manitoba



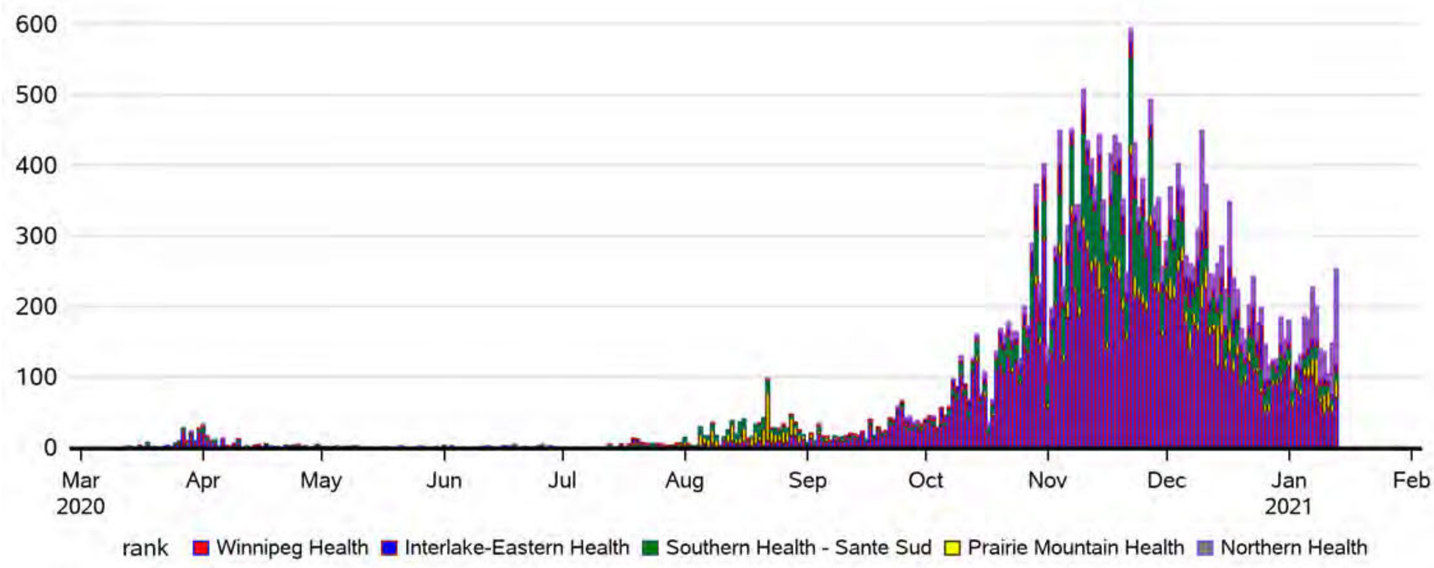
^See the case definitions in the Appendix

EPIDEMIC CURVE OF COVID-19 IN MANITOBA

AB1391

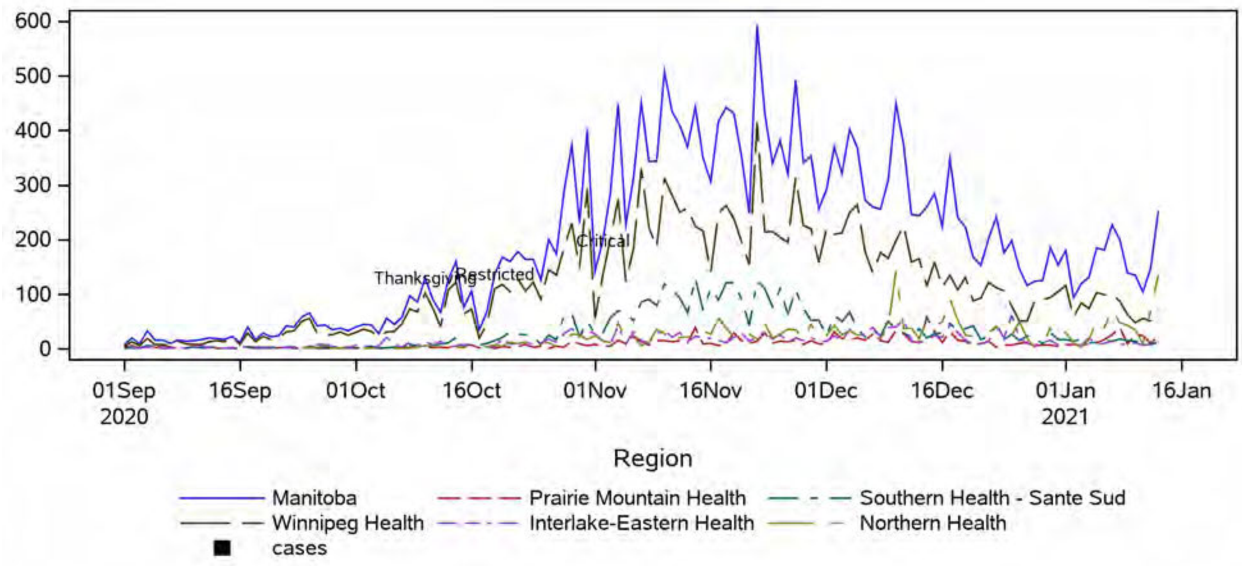
The Epidemic curve below shows the case counts for cases on the dates that they were reported to the Surveillance Unit (MHSU).

Figure 3. Epidemic curve of COVID-19 in Manitoba by RHA



^See the case definitions in the Appendix

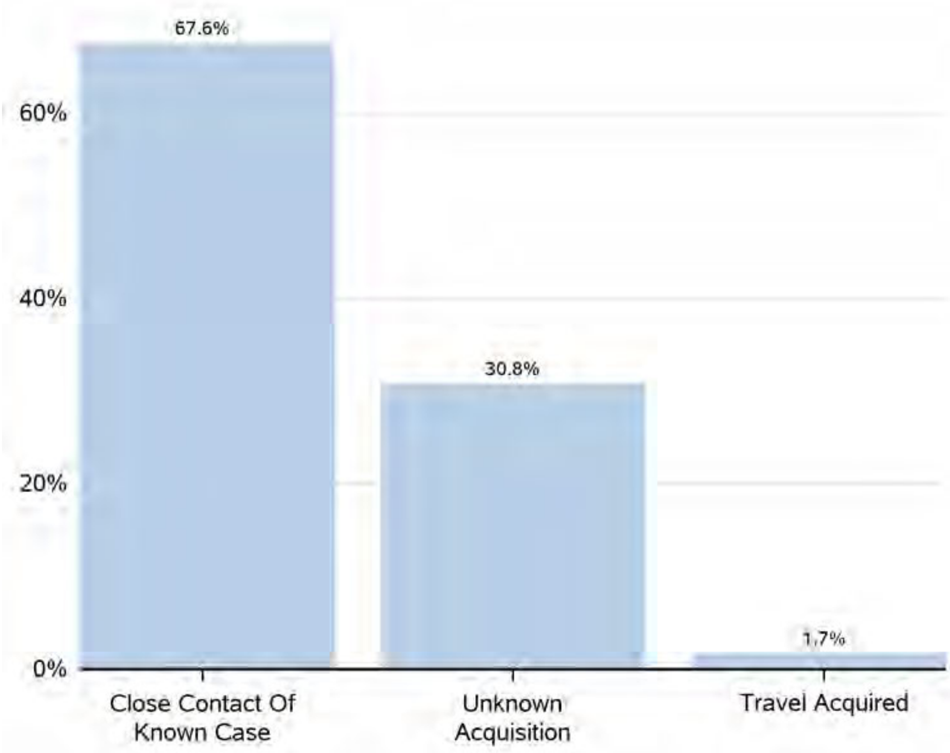
Figure 4. Regional COVID-19 cases in Manitoba



MOST LIKELY SOURCE OF INFECTION OF COVID-19 IN MANITOBA

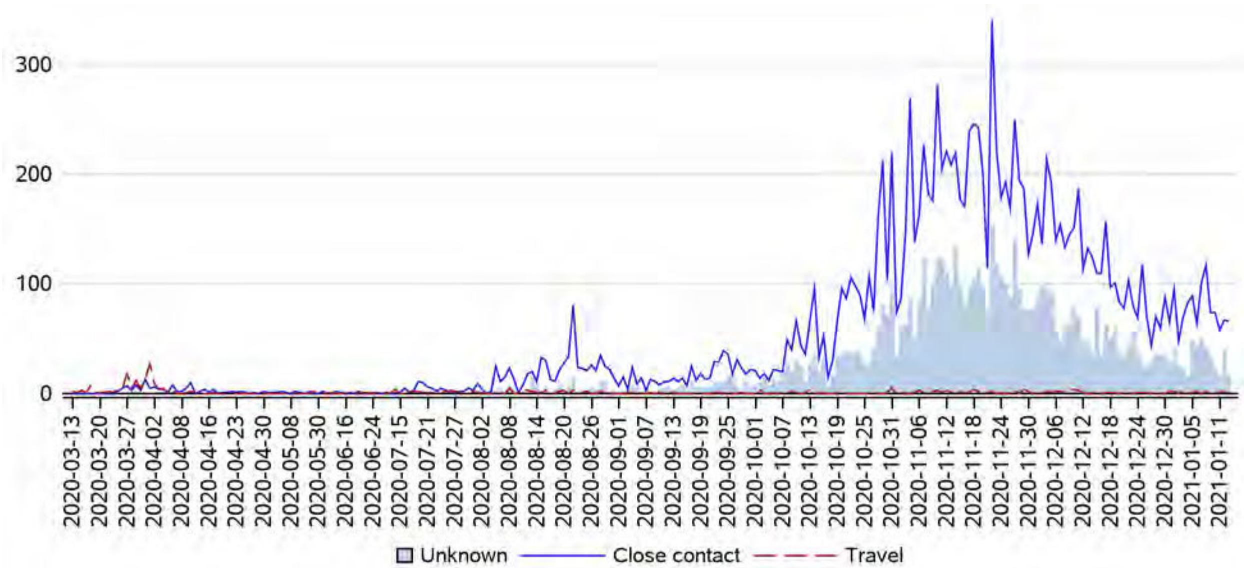
The chart below the curve shows the proportions of infections attributed to close contact of a case, travel, unknown source of infection, and pending further investigation.

Figure 5. Acquisition type for COVID-19 cases in Manitoba



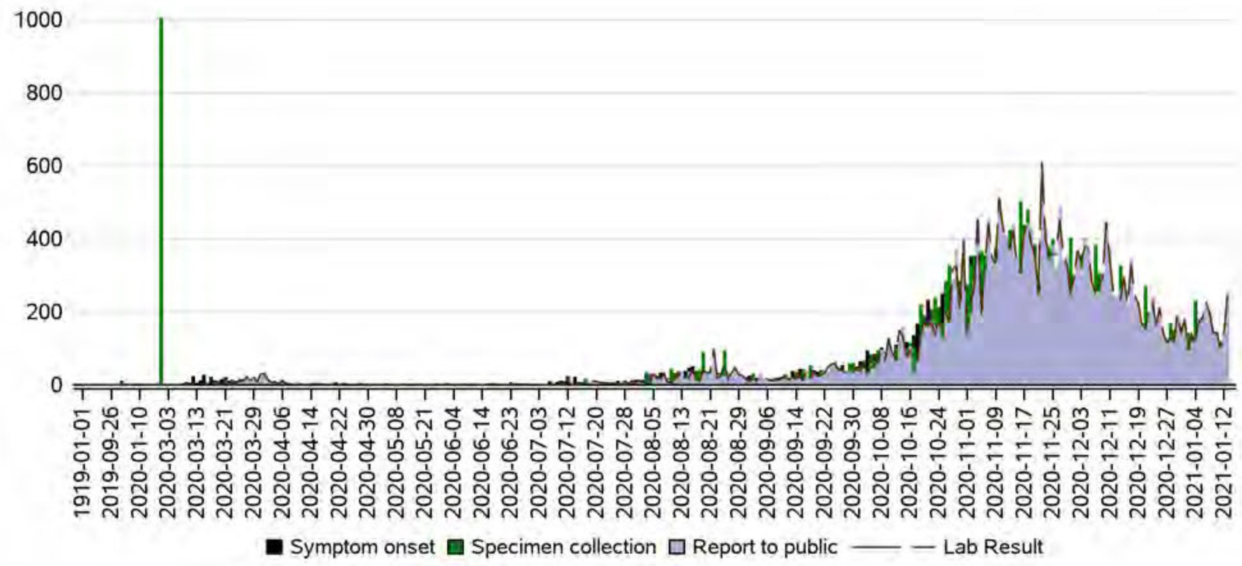
The timeline below indicates that known person-person spread in Manitoba began around March 24th and in-community spread may have begun around March 27th.

Figure 6. Timeline of infection acquisition type for COVID-19 cases in Manitoba



When looking at the timeline of cases from symptom onset date,through specimen collection, lab test result, and reported date,we can see the reflection of reported cases backward. The same surge we saw with case counts after March 27 are apparent also in the specimen collection and symptom onset date.

Figure 7. Timeline of COVID-19 in Manitoba

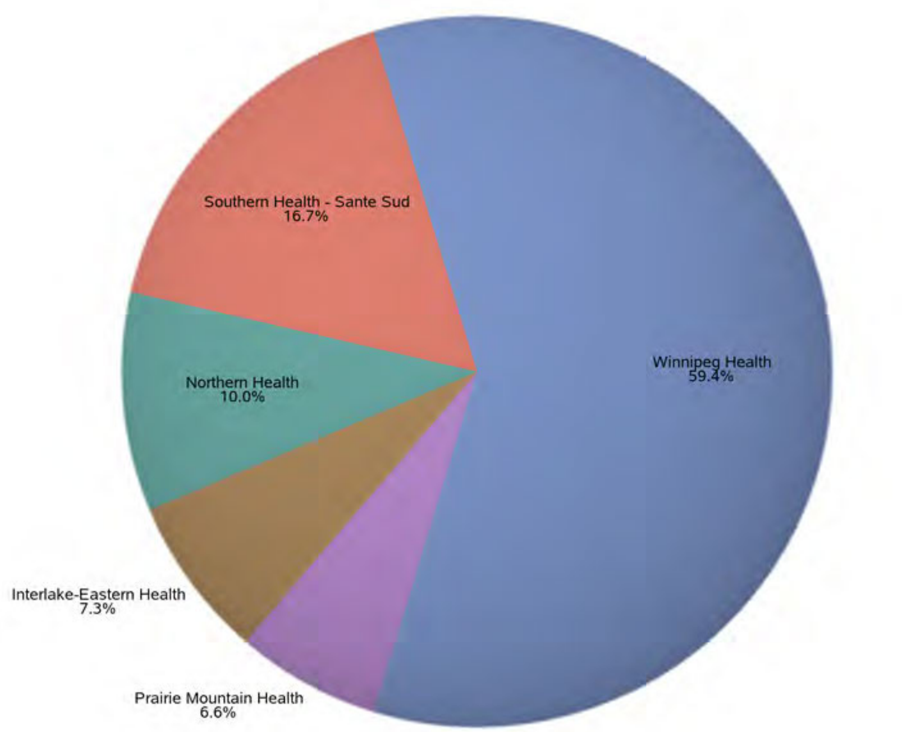


COVID-19 CASE COUNTS BY REGION (RESPONSIBLE ORGANIZATION)

Table 4. COVID-19 case counts by region

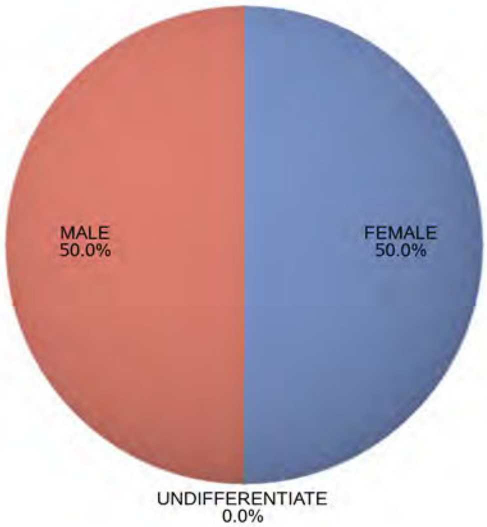
	Interlake-Eastern Health	Northern Health	Prairie Mountain Health	Southern Health - Sante Sud	Winnipeg Health
Lab Confirmed	1962	2664	1747	4415	15997
Probable	17	23	25	81	23
Total	1979	2687	1772	4496	16020

Figure 8. COVID-19 cases by Region



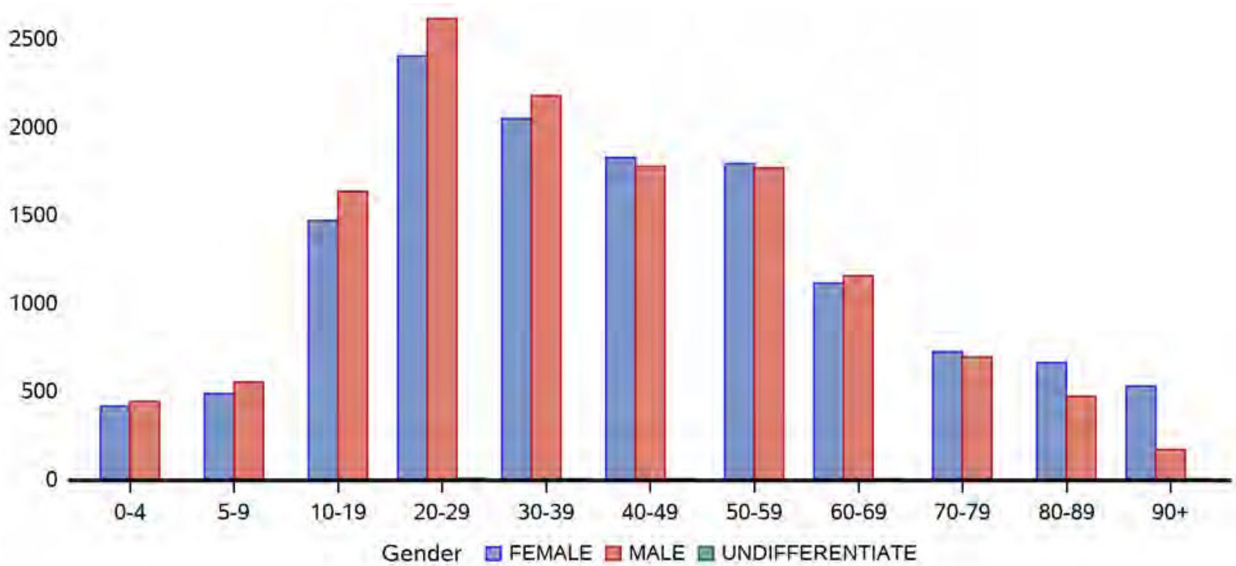
COVID-19 CASE DEMOGRAPHICS N=26954

Figure 9. Case counts in females versus males



Among female cases, 281 women reported being pregnant at time of diagnosis.

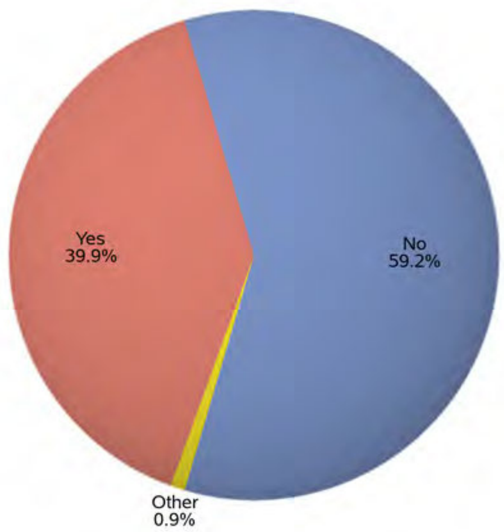
Figure 10. Case counts separated by both sex and age



UNDERLYING ILLNESS N=7469

18726 reports were received of which, 7469 reports indicated an underlying illness. These included comorbidities such as cardiac, pulmonary, kidney, and liver disease, diabetes, hypertension, asthma,and any immunocompromised status.

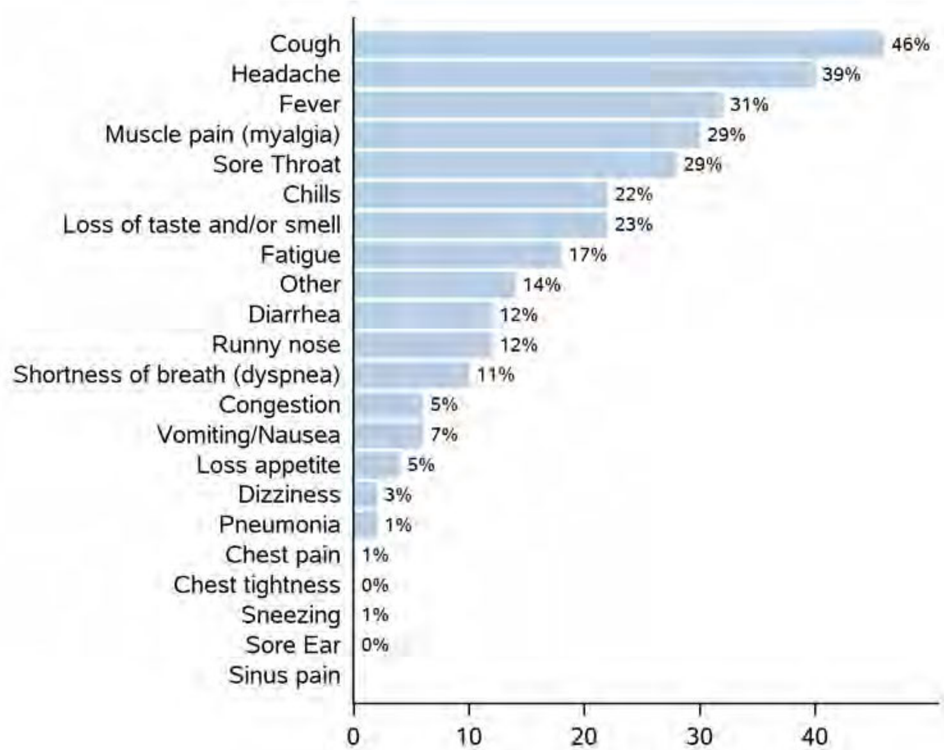
Figure 11. Presence of an underlying illness in COVID-19 cases in Manitoba



COVID-19 CASE SYMPTOMS N=23029

We have received 26954 reports, of which 23029 reported any symptoms and 3925 reported asymptomatic infection.

Figure 12. Symptoms in Manitoban COVID-19 cases



COVID-19 CONTACTS SUMMARY

AB1398

Region	Active Cases	Median # of Contacts	Minimum # of Contacts	Maximum # of Contacts
Interlake-Eastern Health	337	0	0	13
Northern Health	1,297	0	0	20
Prairie Mountain Health	218	1	0	30
Southern Health - Sante Sud	214	0	0	9
Winnipeg Health	820	1	0	28

COVID-19 CONTACTS SUMMARY -LAST 2 WEEKS

AB1399

Region	Active Cases	Total Contacts	Median # of Contacts	Minimum # of Contacts	Maximum # of
Interlake-Eastern Health	98	88	0	0	13
Northern Health	493	999	0	0	20
Prairie Mountain Health	147	470	2	0	30
Southern Health - Sante Sud	114	162	0	0	9
Winnipeg Health	650	1,666	2	0	28

Includes all unique contacts, including contacts that have turned into a case

APPENDIX: SURVEILLANCE CASE DEFINITIONS

Surveillance case definitions are provided for the purpose of standardized case classification and reporting. They are based on the current level of epidemiological evidence and uncertainty, and public health responsegoals, and are subject to change as new information becomes available.

These surveillance case definitions are not intended to replace clinician or public health practitioner judgment inindividual patient management or testing, or for the purpose of infection control triage. For current screeningand testing advice, please refer to https://manitoba.ca/asset_library/en/coronavirus/screening_tool.pdf

Probable case â€“ A person who:

- has a fever (> 38Â°C), **AND/OR**
- has new onset of (or exacerbation of chronic) cough or difficulty breathing, **AND**
- meets exposure criteria, **AND**
- for whom laboratory diagnosis of COVID-19 is:
- inconclusive (inconclusive is defined as a positive test on a single real-time PCRtarget or a positive test with an assay that has limited performance data available),
- NAATs must be validated for detection of the virus that causes COVID-19.
- An indeterminate result on a real-time PCR assay is defined as a lateamplification signal in a real-time PCR reaction at a predetermined high cycle threshold value. This may be due to low viral target quantity in theclinical specimen approaching the limit of detection (LOC) of the assay, or may represent nonspecific reactivity (false signal) in the specimen. When clinically relevant, indeterminate samples should be investigated further in the laboratory (e.g. by testing for an alternate gene target using a validated real-time PCR or nucleic acid sequencing that is equally or more sensitive than the initial assay or method used) or by collection and testing of anothersample from the patient with initial indeterminate result.
- A (un-tested) person with:
- Fever (over 38 degrees Celsius), **AND/OR**
- Cough (new or exacerbated chronic), **AND**
- Close contact1 with a confirmed case of COVID-19, **OR**
- Lived in or worked in a closed facility known to be experiencing an outbreak of COVID-19 (e.g., long-term care facility, correctional facility)

Confirmed case â€“ A person with a laboratory confirmation of infection with the virus that causes COVID-19 performed at a community, hospital or reference laboratory (NML or a provincial public health laboratory) running a validated assay. This consists of detection of at least one specific genetarget by a NAAT assay (e.g. real-time PCR or nucleic acid sequencing).

Note:

- NUCLEIC ACID AMPLIFICATION TESTS MUST BE VALIDATED FOR DETECTION OF THE VIRUS THAT CAUSES COVID-19 POSITIVE LABORATORY TESTS DURING EARLY STAGES OF TESTING (E.G. FIRST 10POSITIVE TESTS) AT A NON-REFERENCE LABORATORY REQUIRE ADDITIONAL TESTING AT A REFERENCELABORATORY FOR CONFIRMATION.
- LABORATORY TESTS ARE EVOLVING FOR THIS EMERGING PATHOGEN, AND LABORATORY TESTING RECOMMENDATIONS WILL CHANGE ACCORDINGLY AS NEW ASSAYS ARE DEVELOPED AND VALIDATED.

Table 1. Summary of new cases of COVID-19 in Manitoba

AB1401

AB1402

Region	Age group	Gender	Cases
Interlake-Eastern Health	10-19	Female	1
Interlake-Eastern Health	10-19	Male	1
Interlake-Eastern Health	30-39	Female	3
Interlake-Eastern Health	40-49	Female	2
Interlake-Eastern Health	40-49	Male	2
Interlake-Eastern Health	50-59	Male	2
Northern Health	0-4	Female	13
Northern Health	0-4	Male	6
Northern Health	10-19	Female	10
Northern Health	10-19	Male	12
Northern Health	20-29	Female	17
Northern Health	20-29	Male	19
Northern Health	30-39	Female	14
Northern Health	30-39	Male	8
Northern Health	40-49	Female	4
Northern Health	40-49	Male	5
Northern Health	5-9	Female	5
Northern Health	5-9	Male	8
Northern Health	50-59	Female	3
Northern Health	50-59	Male	3
Northern Health	60-69	Female	3
Northern Health	60-69	Male	3
Northern Health	70-79	Female	4
Northern Health	70-79	Male	1
Northern Health	80-89	Female	1
Prairie Mountain Health	10-19	Female	3
Prairie Mountain Health	10-19	Male	2
Prairie Mountain Health	20-29	Female	3
Prairie Mountain Health	20-29	Male	1
Prairie Mountain Health	30-39	Male	3
Prairie Mountain Health	40-49	Female	1
Prairie Mountain Health	5-9	Female	1
Prairie Mountain Health	50-59	Female	1
Prairie Mountain Health	50-59	Male	2
Prairie Mountain Health	60-69	Male	2
Prairie Mountain Health	70-79	Female	2
Prairie Mountain Health	70-79	Male	1
Prairie Mountain Health	80-89	Male	1
Southern Health - Sante Sud	10-19	Male	2
Southern Health - Sante Sud	20-29	Female	1
Southern Health - Sante Sud	30-39	Female	4
Southern Health - Sante Sud	30-39	Male	1
Southern Health - Sante Sud	40-49	Male	1
Southern Health - Sante Sud	60-69	Female	1

AB1403

Southern Health - Sante Sud	70-79	Female	1
Southern Health - Sante Sud	70-79	Male	1
Southern Health - Sante Sud	90+	Female	1
Winnipeg Health	0-4	Female	1
Winnipeg Health	0-4	Male	1
Winnipeg Health	10-19	Female	3
Winnipeg Health	10-19	Male	4
Winnipeg Health	20-29	Female	6
Winnipeg Health	20-29	Male	12
Winnipeg Health	30-39	Female	7
Winnipeg Health	30-39	Male	4
Winnipeg Health	40-49	Female	2
Winnipeg Health	40-49	Male	5
Winnipeg Health	5-9	Female	4
Winnipeg Health	50-59	Female	5
Winnipeg Health	50-59	Male	3
Winnipeg Health	60-69	Female	7
Winnipeg Health	60-69	Male	2
Winnipeg Health	70-79	Female	4
Winnipeg Health	70-79	Male	2
Winnipeg Health	80-89	Female	2
Winnipeg Health	90+	Male	1

DEATHS DUE TO COVID-19 IN MANITOBA

AB1404

The table below shows the demographics for deaths related to COVID-19

Table 2. Deaths due to COVID-19 in Manitoba

AB1405

Date of death	Gender	Age	Region
.	Male	84	Winnipeg Health
.	Male	69	Winnipeg Health
.	Female	71	Winnipeg Health
March 26, 2020	Female	66	Winnipeg Health
April 2, 2020	Male	54	Winnipeg Health
April 6, 2020	Male	66	Winnipeg Health
April 9, 2020	Male	73	Winnipeg Health
April 13, 2020	Female	69	Prairie Mountain Health
April 20, 2020	Female	85	Winnipeg Health
May 4, 2020	Male	74	Southern Health - Sante Sud
July 22, 2020	Male	76	Southern Health - Sante Sud
August 14, 2020	Male	88	Southern Health - Sante Sud
August 15, 2020	Male	84	Southern Health - Sante Sud
August 16, 2020	Male	92	Southern Health - Sante Sud
August 17, 2020	Male	65	Southern Health - Sante Sud
August 23, 2020	Female	99	Southern Health - Sante Sud
August 26, 2020	Female	94	Southern Health - Sante Sud
September 1, 2020	Female	85	Southern Health - Sante Sud
September 2, 2020	Female	90	Southern Health - Sante Sud
September 20, 2020	Female	80	Prairie Mountain Health
September 20, 2020	Male	85	Southern Health - Sante Sud
September 21, 2020	Female	98	Winnipeg Health
September 26, 2020	Male	73	Prairie Mountain Health
September 29, 2020	Male	70	Winnipeg Health
October 1, 2020	Female	86	Winnipeg Health
October 3, 2020	Male	50	Winnipeg Health
October 4, 2020	Female	78	Prairie Mountain Health
October 5, 2020	Male	74	Winnipeg Health
October 6, 2020	Male	69	Interlake-Eastern Health
October 6, 2020	Female	99	Winnipeg Health
October 7, 2020	Female	80	Winnipeg Health
October 8, 2020	Female	88	Winnipeg Health
October 8, 2020	Female	97	Winnipeg Health
October 8, 2020	Female	74	Winnipeg Health
October 9, 2020	Female	87	Winnipeg Health
October 10, 2020	Female	101	Winnipeg Health
October 11, 2020	Male	71	Southern Health - Sante Sud
October 11, 2020	Male	42	Winnipeg Health
October 12, 2020	Male	83	Winnipeg Health
October 13, 2020	Male	49	Southern Health - Sante Sud
October 13, 2020	Female	70	Winnipeg Health
October 14, 2020	Female	76	Winnipeg Health
October 16, 2020	Male	74	Winnipeg Health
October 17, 2020	Female	89	Winnipeg Health

AB1406

October 17, 2020	Male	73	Winnipeg Health
October 18, 2020	Male	89	Winnipeg Health
October 20, 2020	Male	88	Interlake-Eastern Health
October 20, 2020	Male	88	Winnipeg Health
October 20, 2020	Male	85	Winnipeg Health
October 21, 2020	Male	78	Winnipeg Health
October 21, 2020	Male	89	Winnipeg Health
October 21, 2020	Male	74	Winnipeg Health
October 22, 2020	Female	77	Winnipeg Health
October 23, 2020	Female	95	Winnipeg Health
October 23, 2020	Female	79	Winnipeg Health
October 24, 2020	Female	81	Winnipeg Health
October 24, 2020	Male	54	Winnipeg Health
October 25, 2020	Male	49	Interlake-Eastern Health
October 25, 2020	Female	89	Interlake-Eastern Health
October 25, 2020	Female	84	Winnipeg Health
October 25, 2020	Female	68	Winnipeg Health
October 25, 2020	Male	85	Winnipeg Health
October 26, 2020	Female	86	Winnipeg Health
October 27, 2020	Male	89	Winnipeg Health
October 27, 2020	Male	86	Winnipeg Health
October 27, 2020	Female	90	Winnipeg Health
October 28, 2020	Male	82	Southern Health - Sante Sud
October 28, 2020	Female	93	Winnipeg Health
October 29, 2020	Female	89	Winnipeg Health
October 30, 2020	Female	69	Interlake-Eastern Health
October 30, 2020	Female	83	Winnipeg Health
October 30, 2020	Female	89	Winnipeg Health
October 30, 2020	Female	94	Winnipeg Health
October 30, 2020	Female	53	Winnipeg Health
October 30, 2020	Male	82	Winnipeg Health
October 30, 2020	Male	66	Winnipeg Health
October 31, 2020	Male	53	Southern Health - Sante Sud
October 31, 2020	Female	86	Winnipeg Health
October 31, 2020	Male	75	Winnipeg Health
October 31, 2020	Female	87	Winnipeg Health
October 31, 2020	Female	74	Winnipeg Health
October 31, 2020	Male	82	Winnipeg Health
October 31, 2020	Female	65	Winnipeg Health
October 31, 2020	Male	86	Winnipeg Health
November 1, 2020	Female	59	Winnipeg Health
November 1, 2020	Female	64	Winnipeg Health
November 1, 2020	Female	90	Winnipeg Health
November 2, 2020	Female	83	Winnipeg Health
November 2, 2020	Male	82	Winnipeg Health

AB1407

November 2, 2020	Male	80	Winnipeg Health
November 2, 2020	Male	90	Winnipeg Health
November 2, 2020	Female	94	Winnipeg Health
November 2, 2020	Male	83	Winnipeg Health
November 2, 2020	Female	99	Winnipeg Health
November 3, 2020	Female	55	Southern Health - Sante Sud
November 3, 2020	Male	93	Winnipeg Health
November 3, 2020	Female	73	Winnipeg Health
November 3, 2020	Female	71	Winnipeg Health
November 4, 2020	Female	79	Winnipeg Health
November 4, 2020	Female	80	Winnipeg Health
November 4, 2020	Female	88	Winnipeg Health
November 4, 2020	Female	69	Winnipeg Health
November 4, 2020	Male	79	Winnipeg Health
November 5, 2020	Female	46	Northern Health
November 5, 2020	Male	91	Winnipeg Health
November 5, 2020	Male	82	Winnipeg Health
November 5, 2020	Female	98	Winnipeg Health
November 5, 2020	Male	92	Winnipeg Health
November 5, 2020	Male	88	Winnipeg Health
November 5, 2020	Female	89	Winnipeg Health
November 5, 2020	Female	92	Winnipeg Health
November 5, 2020	Male	85	Winnipeg Health
November 6, 2020	Male	74	Southern Health - Sante Sud
November 6, 2020	Male	58	Winnipeg Health
November 6, 2020	Male	73	Winnipeg Health
November 6, 2020	Male	89	Winnipeg Health
November 6, 2020	Male	60	Winnipeg Health
November 6, 2020	Male	90	Winnipeg Health
November 6, 2020	Female	80	Winnipeg Health
November 6, 2020	Female	97	Winnipeg Health
November 6, 2020	Female	82	Winnipeg Health
November 6, 2020	Female	69	Winnipeg Health
November 7, 2020	Female	93	Winnipeg Health
November 7, 2020	Female	85	Winnipeg Health
November 8, 2020	Male	76	Southern Health - Sante Sud
November 8, 2020	Male	90	Southern Health - Sante Sud
November 8, 2020	Male	74	Southern Health - Sante Sud
November 8, 2020	Female	82	Winnipeg Health
November 8, 2020	Female	91	Winnipeg Health
November 8, 2020	Female	97	Winnipeg Health
November 8, 2020	Male	84	Winnipeg Health
November 8, 2020	Male	74	Winnipeg Health
November 8, 2020	Female	88	Winnipeg Health
November 9, 2020	Male	66	Winnipeg Health

November 9, 2020	Female	80	Winnipeg Health
November 9, 2020	Male	85	Winnipeg Health
November 9, 2020	Female	93	Winnipeg Health
November 9, 2020	Female	83	Winnipeg Health
November 10, 2020	Female	74	Interlake-Eastern Health
November 10, 2020	Female	66	Northern Health
November 10, 2020	Male	72	Winnipeg Health
November 10, 2020	Male	72	Winnipeg Health
November 10, 2020	Male	68	Winnipeg Health
November 10, 2020	Female	88	Winnipeg Health
November 10, 2020	Male	79	Winnipeg Health
November 10, 2020	Female	89	Winnipeg Health
November 10, 2020	Male	83	Winnipeg Health
November 11, 2020	Male	75	Northern Health
November 11, 2020	Male	82	Southern Health - Sante Sud
November 11, 2020	Male	80	Winnipeg Health
November 11, 2020	Male	91	Winnipeg Health
November 11, 2020	Male	88	Winnipeg Health
November 11, 2020	Female	75	Winnipeg Health
November 11, 2020	Female	58	Winnipeg Health
November 11, 2020	Male	88	Winnipeg Health
November 11, 2020	Male	87	Winnipeg Health
November 11, 2020	Female	86	Winnipeg Health
November 12, 2020	Female	61	Interlake-Eastern Health
November 12, 2020	Male	87	Winnipeg Health
November 12, 2020	Female	46	Winnipeg Health
November 12, 2020	Male	68	Winnipeg Health
November 12, 2020	Female	89	Winnipeg Health
November 13, 2020	Male	84	Southern Health - Sante Sud
November 13, 2020	Male	76	Southern Health - Sante Sud
November 13, 2020	Female	78	Southern Health - Sante Sud
November 13, 2020	Male	72	Southern Health - Sante Sud
November 13, 2020	Male	88	Winnipeg Health
November 13, 2020	Female	92	Winnipeg Health
November 13, 2020	Female	92	Winnipeg Health
November 14, 2020	Male	93	Southern Health - Sante Sud
November 14, 2020	Male	85	Southern Health - Sante Sud
November 14, 2020	Male	74	Southern Health - Sante Sud
November 14, 2020	Female	86	Winnipeg Health
November 14, 2020	Female	91	Winnipeg Health
November 14, 2020	Male	89	Winnipeg Health
November 14, 2020	Male	105	Winnipeg Health
November 15, 2020	Male	80	Southern Health - Sante Sud
November 15, 2020	Male	81	Southern Health - Sante Sud
November 15, 2020	Male	93	Southern Health - Sante Sud

AB1409

November 15, 2020	Male	95	Winnipeg Health
November 15, 2020	Female	92	Winnipeg Health
November 15, 2020	Male	74	Winnipeg Health
November 15, 2020	Female	96	Winnipeg Health
November 15, 2020	Male	86	Winnipeg Health
November 16, 2020	Female	38	Interlake-Eastern Health
November 16, 2020	Male	81	Southern Health - Sante Sud
November 16, 2020	Male	86	Southern Health - Sante Sud
November 16, 2020	Male	89	Southern Health - Sante Sud
November 16, 2020	Female	70	Winnipeg Health
November 16, 2020	Male	77	Winnipeg Health
November 16, 2020	Male	93	Winnipeg Health
November 16, 2020	Male	81	Winnipeg Health
November 17, 2020	Male	72	Interlake-Eastern Health
November 17, 2020	Male	71	Interlake-Eastern Health
November 17, 2020	Female	81	Prairie Mountain Health
November 17, 2020	Male	79	Southern Health - Sante Sud
November 17, 2020	Female	50	Southern Health - Sante Sud
November 17, 2020	Male	85	Southern Health - Sante Sud
November 17, 2020	Male	60	Winnipeg Health
November 17, 2020	Female	99	Winnipeg Health
November 18, 2020	Female	51	Northern Health
November 18, 2020	Female	93	Prairie Mountain Health
November 18, 2020	Male	64	Southern Health - Sante Sud
November 18, 2020	Female	72	Winnipeg Health
November 18, 2020	Female	88	Winnipeg Health
November 18, 2020	Female	83	Winnipeg Health
November 18, 2020	Male	100	Winnipeg Health
November 18, 2020	Male	65	Winnipeg Health
November 18, 2020	Male	72	Winnipeg Health
November 18, 2020	Male	90	Winnipeg Health
November 19, 2020	Female	64	Interlake-Eastern Health
November 19, 2020	Male	84	Prairie Mountain Health
November 19, 2020	Male	68	Southern Health - Sante Sud
November 19, 2020	Male	85	Southern Health - Sante Sud
November 19, 2020	Female	72	Winnipeg Health
November 19, 2020	Female	62	Winnipeg Health
November 19, 2020	Male	73	Winnipeg Health
November 19, 2020	Female	89	Winnipeg Health
November 20, 2020	Male	65	Northern Health
November 20, 2020	Female	100	Prairie Mountain Health
November 20, 2020	Male	84	Southern Health - Sante Sud
November 20, 2020	Female	85	Southern Health - Sante Sud
November 20, 2020	Male	39	Winnipeg Health
November 20, 2020	Male	90	Winnipeg Health

AB1410

November 20, 2020	Male	75	Winnipeg Health
November 20, 2020	Female	84	Winnipeg Health
November 20, 2020	Male	85	Winnipeg Health
November 20, 2020	Female	91	Winnipeg Health
November 20, 2020	Male	72	Winnipeg Health
November 20, 2020	Female	87	Winnipeg Health
November 21, 2020	Male	66	Winnipeg Health
November 21, 2020	Male	83	Winnipeg Health
November 21, 2020	Female	91	Winnipeg Health
November 21, 2020	Female	79	Winnipeg Health
November 21, 2020	Male	70	Winnipeg Health
November 21, 2020	Male	41	Winnipeg Health
November 21, 2020	Female	88	Winnipeg Health
November 21, 2020	Male	57	Winnipeg Health
November 21, 2020	Male	93	Winnipeg Health
November 21, 2020	Female	95	Winnipeg Health
November 22, 2020	Female	94	Southern Health - Sante Sud
November 22, 2020	Male	73	Southern Health - Sante Sud
November 22, 2020	Female	85	Winnipeg Health
November 22, 2020	Female	62	Winnipeg Health
November 22, 2020	Female	94	Winnipeg Health
November 22, 2020	Female	83	Winnipeg Health
November 22, 2020	Male	66	Winnipeg Health
November 23, 2020	Female	78	Northern Health
November 23, 2020	Female	81	Northern Health
November 23, 2020	Male	93	Prairie Mountain Health
November 23, 2020	Male	72	Southern Health - Sante Sud
November 23, 2020	Male	75	Southern Health - Sante Sud
November 23, 2020	Female	69	Southern Health - Sante Sud
November 23, 2020	Male	94	Southern Health - Sante Sud
November 23, 2020	Female	99	Southern Health - Sante Sud
November 23, 2020	Female	76	Winnipeg Health
November 23, 2020	Male	88	Winnipeg Health
November 23, 2020	Male	60	Winnipeg Health
November 23, 2020	Male	97	Winnipeg Health
November 23, 2020	Male	67	Winnipeg Health
November 24, 2020	Male	74	Interlake-Eastern Health
November 24, 2020	Female	89	Southern Health - Sante Sud
November 24, 2020	Female	93	Southern Health - Sante Sud
November 24, 2020	Female	57	Southern Health - Sante Sud
November 24, 2020	Male	85	Southern Health - Sante Sud
November 24, 2020	Female	91	Southern Health - Sante Sud
November 24, 2020	Male	81	Southern Health - Sante Sud
November 24, 2020	Female	76	Winnipeg Health
November 24, 2020	Female	100	Winnipeg Health

AB1411

November 24, 2020	Male	46	Winnipeg Health
November 24, 2020	Male	63	Winnipeg Health
November 24, 2020	Female	89	Winnipeg Health
November 24, 2020	Female	83	Winnipeg Health
November 24, 2020	Male	90	Winnipeg Health
November 24, 2020	Female	97	Winnipeg Health
November 24, 2020	Male	87	Winnipeg Health
November 25, 2020	Female	79	Interlake-Eastern Health
November 25, 2020	Female	85	Southern Health - Sante Sud
November 25, 2020	Male	59	Southern Health - Sante Sud
November 25, 2020	Female	82	Winnipeg Health
November 25, 2020	Male	65	Winnipeg Health
November 25, 2020	Male	90	Winnipeg Health
November 25, 2020	Male	90	Winnipeg Health
November 25, 2020	Male	91	Winnipeg Health
November 25, 2020	Male	81	Winnipeg Health
November 25, 2020	Male	94	Winnipeg Health
November 26, 2020	Female	93	Prairie Mountain Health
November 26, 2020	Male	76	Southern Health - Sante Sud
November 26, 2020	Female	83	Southern Health - Sante Sud
November 26, 2020	Male	92	Southern Health - Sante Sud
November 26, 2020	Male	84	Winnipeg Health
November 26, 2020	Male	49	Winnipeg Health
November 26, 2020	Female	93	Winnipeg Health
November 26, 2020	Female	82	Winnipeg Health
November 26, 2020	Male	70	Winnipeg Health
November 26, 2020	Female	92	Winnipeg Health
November 26, 2020	Male	55	Winnipeg Health
November 26, 2020	Male	59	Winnipeg Health
November 27, 2020	Male	69	Interlake-Eastern Health
November 27, 2020	Male	86	Prairie Mountain Health
November 27, 2020	Female	92	Prairie Mountain Health
November 27, 2020	Male	74	Prairie Mountain Health
November 27, 2020	Female	96	Southern Health - Sante Sud
November 27, 2020	Female	85	Southern Health - Sante Sud
November 27, 2020	Female	82	Winnipeg Health
November 27, 2020	Male	89	Winnipeg Health
November 27, 2020	Male	86	Winnipeg Health
November 27, 2020	Male	94	Winnipeg Health
November 27, 2020	Male	79	Winnipeg Health
November 27, 2020	Male	8	Winnipeg Health
November 28, 2020	Female	88	Prairie Mountain Health
November 28, 2020	Male	89	Southern Health - Sante Sud
November 28, 2020	Female	88	Winnipeg Health
November 28, 2020	Male	89	Winnipeg Health

AB1412

November 28, 2020	Female	82	Winnipeg Health
November 28, 2020	Female	90	Winnipeg Health
November 28, 2020	Male	63	Winnipeg Health
November 28, 2020	Female	71	Winnipeg Health
November 29, 2020	Male	86	Prairie Mountain Health
November 29, 2020	Male	94	Southern Health - Sante Sud
November 29, 2020	Female	90	Southern Health - Sante Sud
November 29, 2020	Female	89	Winnipeg Health
November 29, 2020	Female	90	Winnipeg Health
November 29, 2020	Female	87	Winnipeg Health
November 29, 2020	Male	32	Winnipeg Health
November 29, 2020	Male	84	Winnipeg Health
November 29, 2020	Female	97	Winnipeg Health
November 29, 2020	Male	90	Winnipeg Health
November 29, 2020	Male	93	Winnipeg Health
November 29, 2020	Female	47	Winnipeg Health
November 30, 2020	Female	101	Prairie Mountain Health
November 30, 2020	Male	84	Prairie Mountain Health
November 30, 2020	Male	73	Southern Health - Sante Sud
November 30, 2020	Female	83	Southern Health - Sante Sud
November 30, 2020	Male	83	Southern Health - Sante Sud
November 30, 2020	Female	70	Southern Health - Sante Sud
November 30, 2020	Male	72	Southern Health - Sante Sud
November 30, 2020	Female	85	Southern Health - Sante Sud
November 30, 2020	Male	56	Southern Health - Sante Sud
November 30, 2020	Female	28	Winnipeg Health
November 30, 2020	Female	70	Winnipeg Health
November 30, 2020	Female	80	Winnipeg Health
November 30, 2020	Female	84	Winnipeg Health
November 30, 2020	Female	87	Winnipeg Health
November 30, 2020	Male	66	Winnipeg Health
November 30, 2020	Female	75	Winnipeg Health
November 30, 2020	Female	101	Winnipeg Health
November 30, 2020	Male	74	Winnipeg Health
November 30, 2020	Female	93	Winnipeg Health
December 1, 2020	Male	79	Southern Health - Sante Sud
December 1, 2020	Female	93	Winnipeg Health
December 1, 2020	Male	79	Winnipeg Health
December 1, 2020	Female	87	Winnipeg Health
December 1, 2020	Female	85	Winnipeg Health
December 1, 2020	Female	91	Winnipeg Health
December 1, 2020	Male	79	Winnipeg Health
December 1, 2020	Male	95	Winnipeg Health
December 1, 2020	Female	89	Winnipeg Health
December 1, 2020	Female	95	Winnipeg Health

December 1, 2020	Female	44	Winnipeg Health
December 1, 2020	Male	67	Winnipeg Health
December 1, 2020	Female	93	Winnipeg Health
December 2, 2020	Male	38	Interlake-Eastern Health
December 2, 2020	Male	54	Northern Health
December 2, 2020	Female	99	Prairie Mountain Health
December 2, 2020	Female	93	Prairie Mountain Health
December 2, 2020	Female	78	Southern Health - Sante Sud
December 2, 2020	Female	78	Southern Health - Sante Sud
December 2, 2020	Male	90	Southern Health - Sante Sud
December 2, 2020	Male	99	Winnipeg Health
December 2, 2020	Female	90	Winnipeg Health
December 2, 2020	Male	90	Winnipeg Health
December 3, 2020	Female	54	Interlake-Eastern Health
December 3, 2020	Female	105	Southern Health - Sante Sud
December 3, 2020	Female	86	Southern Health - Sante Sud
December 3, 2020	Male	74	Southern Health - Sante Sud
December 3, 2020	Male	86	Winnipeg Health
December 3, 2020	Male	75	Winnipeg Health
December 3, 2020	Female	70	Winnipeg Health
December 3, 2020	Female	84	Winnipeg Health
December 3, 2020	Female	86	Winnipeg Health
December 3, 2020	Female	86	Winnipeg Health
December 3, 2020	Female	93	Winnipeg Health
December 3, 2020	Female	92	Winnipeg Health
December 4, 2020	Female	65	Northern Health
December 4, 2020	Male	94	Northern Health
December 4, 2020	Female	94	Southern Health - Sante Sud
December 4, 2020	Female	93	Southern Health - Sante Sud
December 4, 2020	Male	91	Winnipeg Health
December 4, 2020	Male	76	Winnipeg Health
December 4, 2020	Female	103	Winnipeg Health
December 4, 2020	Male	96	Winnipeg Health
December 4, 2020	Female	70	Winnipeg Health
December 4, 2020	Female	93	Winnipeg Health
December 4, 2020	Male	81	Winnipeg Health
December 4, 2020	Male	84	Winnipeg Health
December 4, 2020	Male	78	Winnipeg Health
December 4, 2020	Female	74	Winnipeg Health
December 4, 2020	Male	70	Winnipeg Health
December 5, 2020	Male	75	Interlake-Eastern Health
December 5, 2020	Male	90	Prairie Mountain Health
December 5, 2020	Male	73	Southern Health - Sante Sud
December 5, 2020	Female	83	Southern Health - Sante Sud
December 5, 2020	Male	82	Winnipeg Health

AB1414

December 5, 2020	Female	98	Winnipeg Health
December 5, 2020	Male	90	Winnipeg Health
December 5, 2020	Female	75	Winnipeg Health
December 5, 2020	Female	84	Winnipeg Health
December 5, 2020	Male	24	Winnipeg Health
December 5, 2020	Female	80	Winnipeg Health
December 5, 2020	Male	84	Winnipeg Health
December 5, 2020	Male	66	Winnipeg Health
December 5, 2020	Female	96	Winnipeg Health
December 5, 2020	Female	62	Winnipeg Health
December 5, 2020	Male	74	Winnipeg Health
December 5, 2020	Male	87	Winnipeg Health
December 5, 2020	Male	75	Winnipeg Health
December 5, 2020	Male	86	Winnipeg Health
December 6, 2020	Female	71	Interlake-Eastern Health
December 6, 2020	Female	85	Northern Health
December 6, 2020	Male	76	Prairie Mountain Health
December 6, 2020	Female	65	Southern Health - Sante Sud
December 6, 2020	Female	71	Southern Health - Sante Sud
December 6, 2020	Female	84	Winnipeg Health
December 6, 2020	Female	96	Winnipeg Health
December 6, 2020	Female	88	Winnipeg Health
December 6, 2020	Male	79	Winnipeg Health
December 6, 2020	Female	76	Winnipeg Health
December 6, 2020	Female	81	Winnipeg Health
December 7, 2020	Male	86	Southern Health - Sante Sud
December 7, 2020	Female	93	Winnipeg Health
December 7, 2020	Female	89	Winnipeg Health
December 7, 2020	Female	96	Winnipeg Health
December 7, 2020	Female	91	Winnipeg Health
December 7, 2020	Male	82	Winnipeg Health
December 7, 2020	Female	78	Winnipeg Health
December 7, 2020	Male	94	Winnipeg Health
December 7, 2020	Female	50	Winnipeg Health
December 8, 2020	Female	54	Northern Health
December 8, 2020	Female	83	Prairie Mountain Health
December 8, 2020	Female	100	Prairie Mountain Health
December 8, 2020	Male	88	Southern Health - Sante Sud
December 8, 2020	Male	64	Southern Health - Sante Sud
December 8, 2020	Female	53	Winnipeg Health
December 8, 2020	Male	85	Winnipeg Health
December 8, 2020	Female	78	Winnipeg Health
December 8, 2020	Female	89	Winnipeg Health
December 8, 2020	Male	89	Winnipeg Health
December 8, 2020	Female	84	Winnipeg Health

AB1415

December 8, 2020	Female	69	Winnipeg Health
December 8, 2020	Female	86	Winnipeg Health
December 8, 2020	Male	92	Winnipeg Health
December 8, 2020	Female	90	Winnipeg Health
December 8, 2020	Female	90	Winnipeg Health
December 8, 2020	Male	72	Winnipeg Health
December 8, 2020	Female	77	Winnipeg Health
December 8, 2020	Male	43	Winnipeg Health
December 9, 2020	Female	72	Southern Health - Sante Sud
December 9, 2020	Male	70	Southern Health - Sante Sud
December 9, 2020	Male	90	Southern Health - Sante Sud
December 9, 2020	Male	83	Winnipeg Health
December 9, 2020	Female	87	Winnipeg Health
December 9, 2020	Female	98	Winnipeg Health
December 9, 2020	Female	87	Winnipeg Health
December 9, 2020	Female	89	Winnipeg Health
December 9, 2020	Male	58	Winnipeg Health
December 9, 2020	Female	85	Winnipeg Health
December 9, 2020	Male	99	Winnipeg Health
December 9, 2020	Male	74	Winnipeg Health
December 9, 2020	Female	82	Winnipeg Health
December 10, 2020	Male	76	Interlake-Eastern Health
December 10, 2020	Male	88	Southern Health - Sante Sud
December 10, 2020	Female	90	Winnipeg Health
December 10, 2020	Female	92	Winnipeg Health
December 10, 2020	Male	96	Winnipeg Health
December 10, 2020	Male	79	Winnipeg Health
December 10, 2020	Male	80	Winnipeg Health
December 10, 2020	Female	85	Winnipeg Health
December 10, 2020	Male	82	Winnipeg Health
December 10, 2020	Male	55	Winnipeg Health
December 11, 2020	Female	77	Interlake-Eastern Health
December 11, 2020	Male	83	Southern Health - Sante Sud
December 11, 2020	Male	62	Winnipeg Health
December 11, 2020	Male	63	Winnipeg Health
December 11, 2020	Male	49	Winnipeg Health
December 11, 2020	Female	69	Winnipeg Health
December 11, 2020	Female	95	Winnipeg Health
December 11, 2020	Male	89	Winnipeg Health
December 11, 2020	Female	76	Winnipeg Health
December 11, 2020	Male	86	Winnipeg Health
December 11, 2020	Female	97	Winnipeg Health
December 11, 2020	Male	84	Winnipeg Health
December 11, 2020	Female	96	Winnipeg Health
December 11, 2020	Female	65	Winnipeg Health

AB1416

December 11, 2020	Female	86	Winnipeg Health
December 11, 2020	Female	72	Winnipeg Health
December 12, 2020	Female	69	Northern Health
December 12, 2020	Male	71	Prairie Mountain Health
December 12, 2020	Male	43	Winnipeg Health
December 12, 2020	Male	80	Winnipeg Health
December 12, 2020	Male	41	Winnipeg Health
December 12, 2020	Female	88	Winnipeg Health
December 12, 2020	Female	94	Winnipeg Health
December 12, 2020	Female	74	Winnipeg Health
December 12, 2020	Male	80	Winnipeg Health
December 12, 2020	Male	79	Winnipeg Health
December 12, 2020	Male	84	Winnipeg Health
December 12, 2020	Male	65	Winnipeg Health
December 13, 2020	Female	97	Prairie Mountain Health
December 13, 2020	Female	85	Winnipeg Health
December 13, 2020	Male	79	Winnipeg Health
December 13, 2020	Male	42	Winnipeg Health
December 13, 2020	Female	91	Winnipeg Health
December 13, 2020	Male	56	Winnipeg Health
December 13, 2020	Female	94	Winnipeg Health
December 13, 2020	Female	95	Winnipeg Health
December 13, 2020	Female	84	Winnipeg Health
December 13, 2020	Female	82	Winnipeg Health
December 14, 2020	Female	47	Interlake-Eastern Health
December 14, 2020	Female	91	Interlake-Eastern Health
December 14, 2020	Male	80	Prairie Mountain Health
December 14, 2020	Male	81	Southern Health - Sante Sud
December 14, 2020	Female	84	Winnipeg Health
December 14, 2020	Female	104	Winnipeg Health
December 14, 2020	Male	96	Winnipeg Health
December 14, 2020	Male	84	Winnipeg Health
December 14, 2020	Female	84	Winnipeg Health
December 14, 2020	Female	77	Winnipeg Health
December 14, 2020	Female	87	Winnipeg Health
December 14, 2020	Male	95	Winnipeg Health
December 14, 2020	Male	75	Winnipeg Health
December 14, 2020	Male	84	Winnipeg Health
December 15, 2020	Male	58	Interlake-Eastern Health
December 15, 2020	Male	81	Southern Health - Sante Sud
December 15, 2020	Female	91	Winnipeg Health
December 15, 2020	Male	63	Winnipeg Health
December 15, 2020	Female	79	Winnipeg Health
December 15, 2020	Male	79	Winnipeg Health
December 15, 2020	Male	93	Winnipeg Health

AB1417

December 15, 2020	Female	84	Winnipeg Health
December 15, 2020	Male	90	Winnipeg Health
December 15, 2020	Female	57	Winnipeg Health
December 15, 2020	Female	91	Winnipeg Health
December 15, 2020	Female	97	Winnipeg Health
December 15, 2020	Female	93	Winnipeg Health
December 15, 2020	Female	56	Winnipeg Health
December 16, 2020	Male	84	Interlake-Eastern Health
December 16, 2020	Female	57	Interlake-Eastern Health
December 16, 2020	Female	38	Southern Health - Sante Sud
December 16, 2020	Male	43	Southern Health - Sante Sud
December 16, 2020	Female	100	Winnipeg Health
December 16, 2020	Female	57	Winnipeg Health
December 16, 2020	Male	70	Winnipeg Health
December 16, 2020	Male	60	Winnipeg Health
December 16, 2020	Male	48	Winnipeg Health
December 16, 2020	Female	94	Winnipeg Health
December 16, 2020	Male	82	Winnipeg Health
December 16, 2020	Female	91	Winnipeg Health
December 16, 2020	Female	96	Winnipeg Health
December 17, 2020	Female	89	Interlake-Eastern Health
December 17, 2020	Female	69	Northern Health
December 17, 2020	Male	86	Prairie Mountain Health
December 17, 2020	Male	56	Southern Health - Sante Sud
December 17, 2020	Male	94	Southern Health - Sante Sud
December 17, 2020	Female	77	Southern Health - Sante Sud
December 17, 2020	Male	66	Southern Health - Sante Sud
December 17, 2020	Male	90	Southern Health - Sante Sud
December 17, 2020	Female	72	Southern Health - Sante Sud
December 17, 2020	Female	94	Winnipeg Health
December 17, 2020	Female	74	Winnipeg Health
December 17, 2020	Female	89	Winnipeg Health
December 17, 2020	Female	67	Winnipeg Health
December 18, 2020	Male	97	Prairie Mountain Health
December 18, 2020	Male	89	Winnipeg Health
December 18, 2020	Female	89	Winnipeg Health
December 18, 2020	Male	95	Winnipeg Health
December 19, 2020	Female	85	Prairie Mountain Health
December 19, 2020	Female	85	Prairie Mountain Health
December 19, 2020	Male	89	Southern Health - Sante Sud
December 19, 2020	Female	79	Winnipeg Health
December 19, 2020	Female	48	Winnipeg Health
December 19, 2020	Female	85	Winnipeg Health
December 19, 2020	Male	83	Winnipeg Health
December 19, 2020	Male	73	Winnipeg Health

December 19, 2020	Male	79	Winnipeg Health
December 19, 2020	Male	36	Winnipeg Health
December 19, 2020	Female	92	Winnipeg Health
December 20, 2020	Female	69	Southern Health - Sante Sud
December 20, 2020	Female	92	Winnipeg Health
December 20, 2020	Female	94	Winnipeg Health
December 20, 2020	Male	93	Winnipeg Health
December 20, 2020	Male	80	Winnipeg Health
December 21, 2020	Male	83	Interlake-Eastern Health
December 21, 2020	Female	83	Interlake-Eastern Health
December 21, 2020	Female	90	Prairie Mountain Health
December 21, 2020	Female	74	Southern Health - Sante Sud
December 21, 2020	Female	101	Southern Health - Sante Sud
December 21, 2020	Male	78	Southern Health - Sante Sud
December 21, 2020	Female	81	Winnipeg Health
December 21, 2020	Female	91	Winnipeg Health
December 21, 2020	Female	90	Winnipeg Health
December 21, 2020	Male	74	Winnipeg Health
December 21, 2020	Female	66	Winnipeg Health
December 21, 2020	Female	94	Winnipeg Health
December 21, 2020	Female	89	Winnipeg Health
December 21, 2020	Female	97	Winnipeg Health
December 21, 2020	Male	88	Winnipeg Health
December 22, 2020	Male	79	Interlake-Eastern Health
December 22, 2020	Female	79	Northern Health
December 22, 2020	Male	81	Southern Health - Sante Sud
December 22, 2020	Male	42	Winnipeg Health
December 22, 2020	Male	66	Winnipeg Health
December 22, 2020	Female	60	Winnipeg Health
December 22, 2020	Female	68	Winnipeg Health
December 22, 2020	Female	81	Winnipeg Health
December 22, 2020	Male	89	Winnipeg Health
December 22, 2020	Male	77	Winnipeg Health
December 22, 2020	Male	99	Winnipeg Health
December 23, 2020	Male	53	Northern Health
December 23, 2020	Male	88	Northern Health
December 23, 2020	Male	61	Northern Health
December 23, 2020	Female	82	Southern Health - Sante Sud
December 23, 2020	Female	35	Southern Health - Sante Sud
December 23, 2020	Female	82	Winnipeg Health
December 23, 2020	Male	82	Winnipeg Health
December 23, 2020	Male	77	Winnipeg Health
December 23, 2020	Male	69	Winnipeg Health
December 23, 2020	Female	95	Winnipeg Health
December 23, 2020	Female	53	Winnipeg Health

AB1419

December 23, 2020	Female	95	Winnipeg Health
December 23, 2020	Female	68	Winnipeg Health
December 23, 2020	Female	76	Winnipeg Health
December 24, 2020	Male	88	Interlake-Eastern Health
December 24, 2020	Female	97	Southern Health - Sante Sud
December 24, 2020	Male	68	Winnipeg Health
December 24, 2020	Female	66	Winnipeg Health
December 24, 2020	Male	66	Winnipeg Health
December 24, 2020	Female	102	Winnipeg Health
December 24, 2020	Male	82	Winnipeg Health
December 24, 2020	Female	100	Winnipeg Health
December 24, 2020	Male	82	Winnipeg Health
December 24, 2020	Female	30	Winnipeg Health
December 24, 2020	Male	79	Winnipeg Health
December 24, 2020	Female	96	Winnipeg Health
December 25, 2020	Male	71	Northern Health
December 25, 2020	Male	95	Southern Health - Sante Sud
December 25, 2020	Female	83	Southern Health - Sante Sud
December 25, 2020	Female	90	Winnipeg Health
December 26, 2020	Female	90	Northern Health
December 26, 2020	Female	86	Winnipeg Health
December 26, 2020	Female	90	Winnipeg Health
December 26, 2020	Female	87	Winnipeg Health
December 26, 2020	Male	86	Winnipeg Health
December 26, 2020	Male	88	Winnipeg Health
December 26, 2020	Female	76	Winnipeg Health
December 26, 2020	Male	83	Winnipeg Health
December 26, 2020	Male	84	Winnipeg Health
December 26, 2020	Female	86	Winnipeg Health
December 26, 2020	Female	73	Winnipeg Health
December 27, 2020	Female	91	Interlake-Eastern Health
December 27, 2020	Male	90	Prairie Mountain Health
December 27, 2020	Female	97	Winnipeg Health
December 27, 2020	Female	96	Winnipeg Health
December 27, 2020	Female	79	Winnipeg Health
December 27, 2020	Male	68	Winnipeg Health
December 28, 2020	Male	56	Northern Health
December 28, 2020	Female	88	Prairie Mountain Health
December 28, 2020	Female	96	Southern Health - Sante Sud
December 28, 2020	Male	87	Winnipeg Health
December 28, 2020	Female	83	Winnipeg Health
December 28, 2020	Female	71	Winnipeg Health
December 29, 2020	Female	79	Northern Health
December 29, 2020	Female	77	Prairie Mountain Health
December 29, 2020	Female	63	Southern Health - Sante Sud

AB1420

December 29, 2020	Female	87	Winnipeg Health
December 30, 2020	Male	88	Winnipeg Health
December 30, 2020	Female	86	Winnipeg Health
December 30, 2020	Female	70	Winnipeg Health
December 30, 2020	Female	98	Winnipeg Health
December 31, 2020	Male	87	Winnipeg Health
December 31, 2020	Male	73	Winnipeg Health
December 31, 2020	Male	85	Winnipeg Health
January 1, 2021	Male	65	Interlake-Eastern Health
January 1, 2021	Male	55	Northern Health
January 1, 2021	Male	75	Southern Health - Sante Sud
January 1, 2021	Female	81	Southern Health - Sante Sud
January 1, 2021	Female	85	Winnipeg Health
January 1, 2021	Male	90	Winnipeg Health
January 1, 2021	Female	88	Winnipeg Health
January 1, 2021	Male	74	Winnipeg Health
January 1, 2021	Female	98	Winnipeg Health
January 1, 2021	Female	93	Winnipeg Health
January 2, 2021	Female	36	Winnipeg Health
January 2, 2021	Male	32	Winnipeg Health
January 3, 2021	Female	44	Northern Health
January 3, 2021	Female	92	Prairie Mountain Health
January 3, 2021	Female	92	Winnipeg Health
January 3, 2021	Female	90	Winnipeg Health
January 3, 2021	Female	93	Winnipeg Health
January 3, 2021	Female	69	Winnipeg Health
January 4, 2021	Female	79	Southern Health - Sante Sud
January 4, 2021	Female	73	Winnipeg Health
January 4, 2021	Female	69	Winnipeg Health
January 4, 2021	Male	93	Winnipeg Health
January 4, 2021	Male	89	Winnipeg Health
January 4, 2021	Male	77	Winnipeg Health
January 4, 2021	Female	94	Winnipeg Health
January 4, 2021	Male	77	Winnipeg Health
January 4, 2021	Male	93	Winnipeg Health
January 5, 2021	Male	71	Interlake-Eastern Health
January 5, 2021	Male	35	Northern Health
January 5, 2021	Female	93	Prairie Mountain Health
January 5, 2021	Male	69	Prairie Mountain Health
January 5, 2021	Female	59	Winnipeg Health
January 5, 2021	Female	97	Winnipeg Health
January 5, 2021	Female	85	Winnipeg Health
January 5, 2021	Female	90	Winnipeg Health
January 5, 2021	Male	87	Winnipeg Health
January 5, 2021	Female	90	Winnipeg Health

AB1421

January 6, 2021	Female	75	Prairie Mountain Health
January 6, 2021	Female	95	Prairie Mountain Health
January 6, 2021	Female	61	Southern Health - Sante Sud
January 6, 2021	Female	80	Winnipeg Health
January 6, 2021	Female	87	Winnipeg Health
January 6, 2021	Female	87	Winnipeg Health
January 6, 2021	Female	78	Winnipeg Health
January 6, 2021	Female	91	Winnipeg Health
January 6, 2021	Female	67	Winnipeg Health
January 7, 2021	Female	85	Winnipeg Health
January 7, 2021	Female	93	Winnipeg Health
January 7, 2021	Female	102	Winnipeg Health
January 7, 2021	Female	53	Winnipeg Health
January 7, 2021	Male	53	Winnipeg Health
January 7, 2021	Male	58	Winnipeg Health
January 8, 2021	Male	57	Southern Health - Sante Sud
January 8, 2021	Female	92	Winnipeg Health
January 8, 2021	Male	49	Winnipeg Health
January 8, 2021	Female	88	Winnipeg Health
January 8, 2021	Female	84	Winnipeg Health
January 8, 2021	Male	63	Winnipeg Health
January 9, 2021	Male	80	Prairie Mountain Health
January 9, 2021	Male	93	Winnipeg Health
January 9, 2021	Female	88	Winnipeg Health
January 9, 2021	Female	80	Winnipeg Health
January 10, 2021	Male	60	Northern Health
January 10, 2021	Male	74	Winnipeg Health
January 10, 2021	Female	91	Winnipeg Health
January 11, 2021	Female	88	Interlake-Eastern Health
January 11, 2021	Female	75	Prairie Mountain Health
January 11, 2021	Male	76	Winnipeg Health
January 11, 2021	Male	84	Winnipeg Health
January 11, 2021	Female	93	Winnipeg Health
January 12, 2021	Male	95	Prairie Mountain Health
January 12, 2021	Male	87	Prairie Mountain Health
January 12, 2021	Male	74	Winnipeg Health

AB1422

This is Exhibit " C " referred to
in the Affidavit of Carla Loeppky
Affirmed before me this 4
day of March A.D. 2021

A Barrister-at-Law entitled to practice
in and for the Province of Manitoba

AB1423

DEMOGRAPHIC AND CLINICAL CHARACTERISTICS OF COVID-19 CASES WITH A SEVERE OUTCOME IN MANITOBA:

March 12 – January 11, 2021

CONFIDENTIAL

For internal use only

January 11, 2021

Epidemiology & Surveillance

Information Management & Analytics Branch

Resources and Performance Division

Manitoba Health, Seniors and Active Living

Government of Manitoba

Summary

- Of the 26,450 COVID-19 cases during March 12 – January 11, 2021 reporting period, 2,215 (8.4%) cases experienced a severe outcome (death/hospitalization) - 741 deaths with a case fatality rate of 2.8% deaths, 1,841 hospitalizations with a case hospitalization rate of 7.0%, and 350 ICU admissions with a case ICU rate of 1.3% (Table 1). *Note: Among fatal cases, there were 367 (49.5%) hospitalizations and 140 (18.9%) ICU admissions. Similarly, among hospitalized cases, there were 367 deaths (19.9%) and 350 (19.0%) ICU admissions.*

- Case fatality rate was higher in 60+ age group (12.1%), in Winnipeg Health (3.3%), and in those with an underlying condition (5.9%) – Table 1 & 2

- Case hospitalization rate was higher in 60+ age group (21.0%), in Southern Health (7.5%), in the lowest area level income quintile, i.e., Q1, (8.9%), and in those with an underlying condition (13.2%). - (Table 1 & 2)

- Case ICU rate was higher in in 60+ age group (3.7%), Interlake-Eastern Health region (1.8%), in the lowest area level income quintile, i.e., Q1, (2.0%), and in those with an underlying condition (2.6%). - Table 1&2

- Among all underlying conditions, those with chronic kidney disorder had the highest case fatality rate (21.0%), case hospitalization rate (39.2%), and case ICU rate (13.1%). – Table 2

- For the fatality outcome, average length of total hospital stay was 12 days, while the average length of ICU stay was 4 days. - Table 3

- Crude rate (per 100,000) of fatality in COVID-19 cases sharply increased to 7.3 per 100,000 in week 49-2020 (Nov 29-Dec 5, 2020) but steadily declined to 1.6 in week 53-2020 (Dec 27, 2020, Jan 02, 2021). In week 01-2021 (Jan 03-09, 2021), there was an increase noted (3.8 per 100,000) – Figure 1

- Crude rate (per 100,000) of hospitalization in COVID-19 cases sharply increased to 15.9 in week 48-2020 (Nov 22-28, 2020) but steadily declined to 4.9 in week 53-2020 (Dec 27, 2020, Jan 02, 2021). In week 01-2021 (Jan 03-09, 2021), there was an increase noted (7.3 per 100,000) – Figure 2

Figures/Tables

Table 1: Distribution of deaths, hospitalizations, ICU admissions, and severe (death/hospitalization) outcomes among COVID-19 cases in Manitoba by socio-demographic characteristics, March 12 – January 11, 2021 (N=26,450)

Characteristics	Deaths		Hospitalizations		ICU admissions		Severe outcomes*		Total
	Count	Case fatality rate (%)	Count	Case hospitalization rate (%)	Count	Case ICU rate (%)	Count	Case severity rate (%)	Count
Total	***741***	2.8	***1,841***	7.0	***350***	1.3	***2,215***	8.4	***26,450***
Age group (years)									
18 or younger	1	0.0	41	0.9	2	0.0	41	0.9	4388
19-59	73	0.4	647	3.9	147	0.9	664	4.0	16562
60+	667	12.1	1153	21.0	201	3.7	1510	27.5	5500
Median age (IQR)	83	(73-90)	67	(49-80)	62	(51-71)	71	(53-84)	38 (23-56)
Mean age (SD)	80	(14)	63	(21)	60	(15)	67	(21)	41 (23)
Sex									
Female	392	3.0	930	7.0	145	1.1	1147	8.7	13201
Male	349	2.6	911	6.9	205	1.5	1068	8.1	13232
Unknown	0	0.0	0	0.0	0	0.0	0	0.0	17
Health region of residence									
IERHA	34	1.7	118	6.0	35	1.8	133	6.8	1952
NRHA	24	1.0	168	6.8	27	1.1	173	7.0	2474
PMH	40	2.3	86	5.0	15	0.9	119	6.9	1716
SH-SS	121	2.7	335	7.5	48	1.1	376	8.4	4467
WRHA	522	3.3	1134	7.2	225	1.4	1414	8.9	15841
Area level income quintiles									
Q1 (lowest)	134	2.1	579	8.9	128	2.0	607	9.3	6525
Q2	93	1.9	333	7.0	59	1.2	368	7.7	4790
Q3	74	1.9	252	6.3	49	1.2	282	7.1	3985
Q4	110	2.4	295	6.5	58	1.3	342	7.5	4536
Q5 (highest)	57	1.7	170	5.0	28	0.8	192	5.6	3403
Unknown	273	8.5	212	6.6	28	0.9	424	13.2	3211

*Severe outcomes include death or hospitalizations

AB1426

Table 2: Distribution of deaths, hospitalizations, ICU admissions and severe (death/hospitalization) outcomes among COVID-19 cases in Manitoba by underlying medical conditions, March 12 – January 10, 2021 (N=26,450)

Characteristics	Deaths		Hospitalizations		ICU admissions		Severe outcomes*		Total
Underlying conditions	**Count**	**Case fatality rate (%)**	**Count**	**Case hospitalization rate (%)**	**Count**	**Case ICU rate (%)**	**Count**	**Case severity rate (%)**	**Count**
Cancer	49	16.5	89	30.0	16	5.4	106	35.7	297
Chronic circulatory disorders (exc: Hypertension)	447	15.0	728	24.4	134	4.5	970	32.6	2978
Chronic kidney disorder	74	21.0	138	39.2	46	13.1	168	47.7	352
Chronic liver disorder	17	10.4	40	24.4	17	10.4	43	26.2	164
Chronic neurological disorders	317	20.2	285	18.1	32	2.0	522	33.2	1573
Chronic respiratory disorders	333	6.2	647	12.0	116	2.2	822	15.3	5390
Chronic thyroid disorders	52	12.6	51	12.3	9	2.2	85	20.5	414
Diabetes	330	8.9	794	21.5	195	5.3	936	25.3	3698
Hypertension	623	9.4	1206	18.2	244	3.7	1528	23.0	6631
Mental health disorders	90	16.7	65	12.1	11	2.0	132	24.5	538
Musculoskeltal	486	11.2	882	20.3	164	3.8	1155	26.6	4342
Other chronic conditions*	63	9.4	125	18.6	26	3.9	159	23.7	671
Has a chronic condition									
No	21	0.1	247	1.7	34	0.2	253	1.8	14345
Yes	720	5.9	1594	13.2	316	2.6	1962	16.2	12105

*Severe outcomes include death or hospitalizations

Table 3: Distribution of length of total hospital stay and ICU stay among hospitalized COVID-19 cases in MB, March 12 – January 11, 2021

Characteristics	Deaths		Hospitalizations		ICU admissions	
Length of total hospital stay						
Mean (SD)	12	(9)	16	(16)	21	(16)
Median (IQR)	9	(5-17)	10	(5-21)	18	(10-25)
Length of ICU stay						
Mean (SD)	4	(7)	2	(7)	12	(13)
Median (IQR)	0	(0-6)	0	(0-0)	8	(4-15)

AB1427

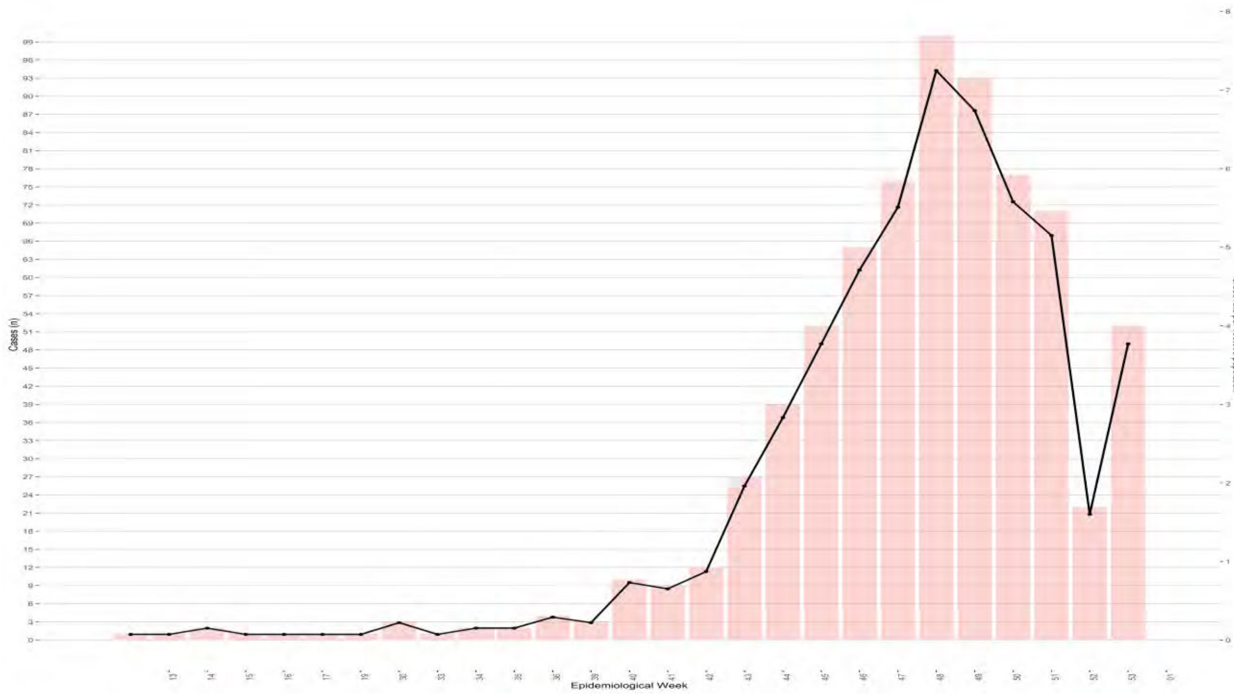


Figure 1: Weekly count and crude rate (per 100,000 population) of fatal COVID-19 cases in MB, March 12 – January 09, 2021

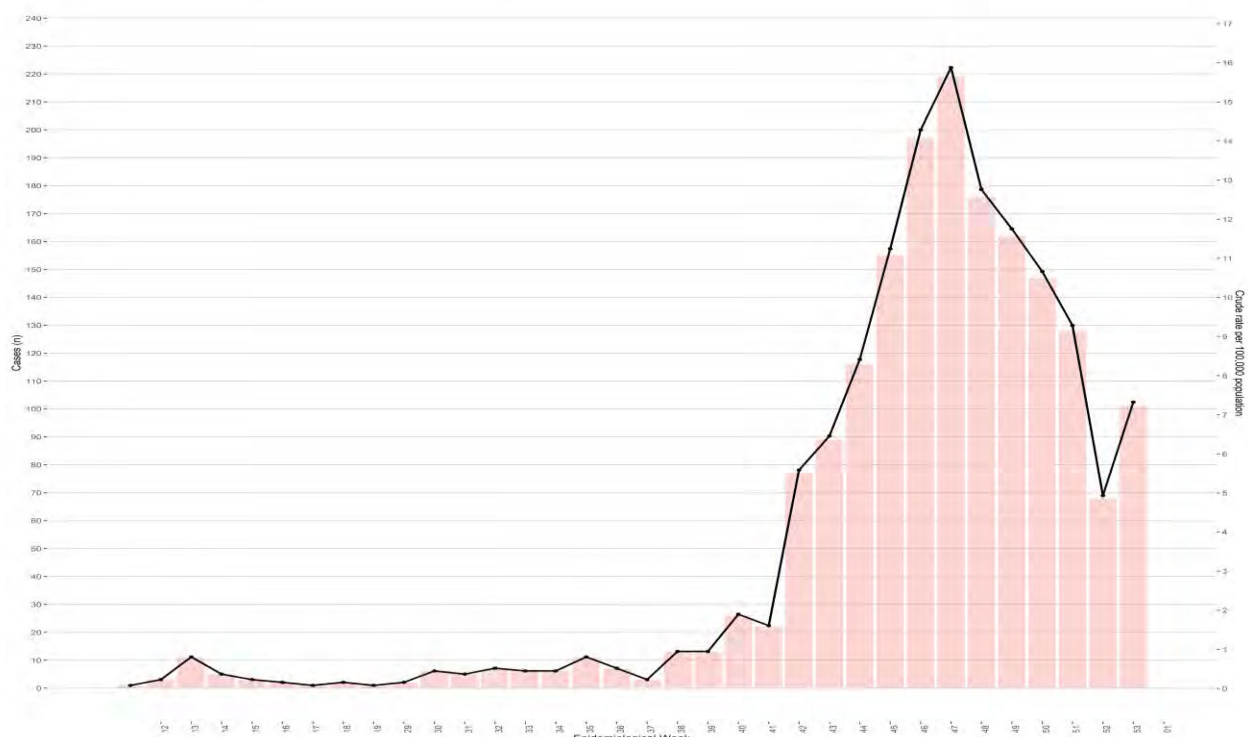


Figure 2: Weekly count and crude rate (per 100,000 population) of hospitalized COVID-19 cases in MB, March 12 – January 09, 2021

APPENDIX

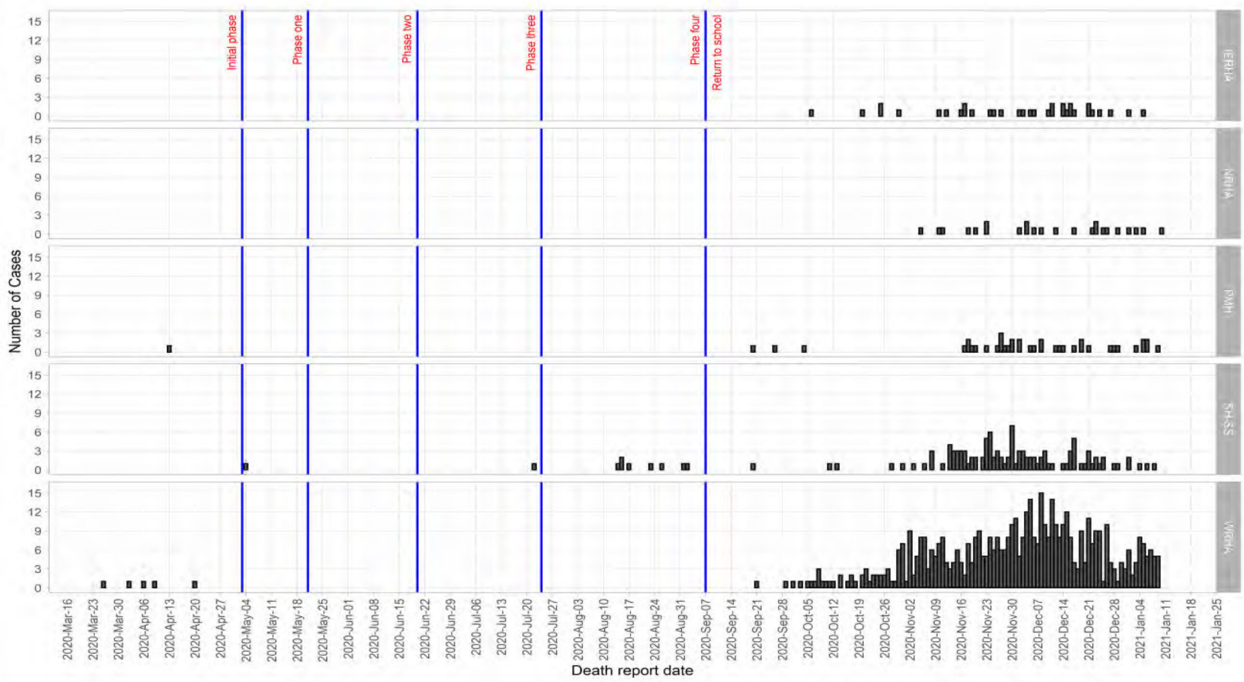


Figure 3: Epidemiological curve of deaths among COVID-19 cases in Manitoba by health region, March 12- January 10, 2021 (N=741)

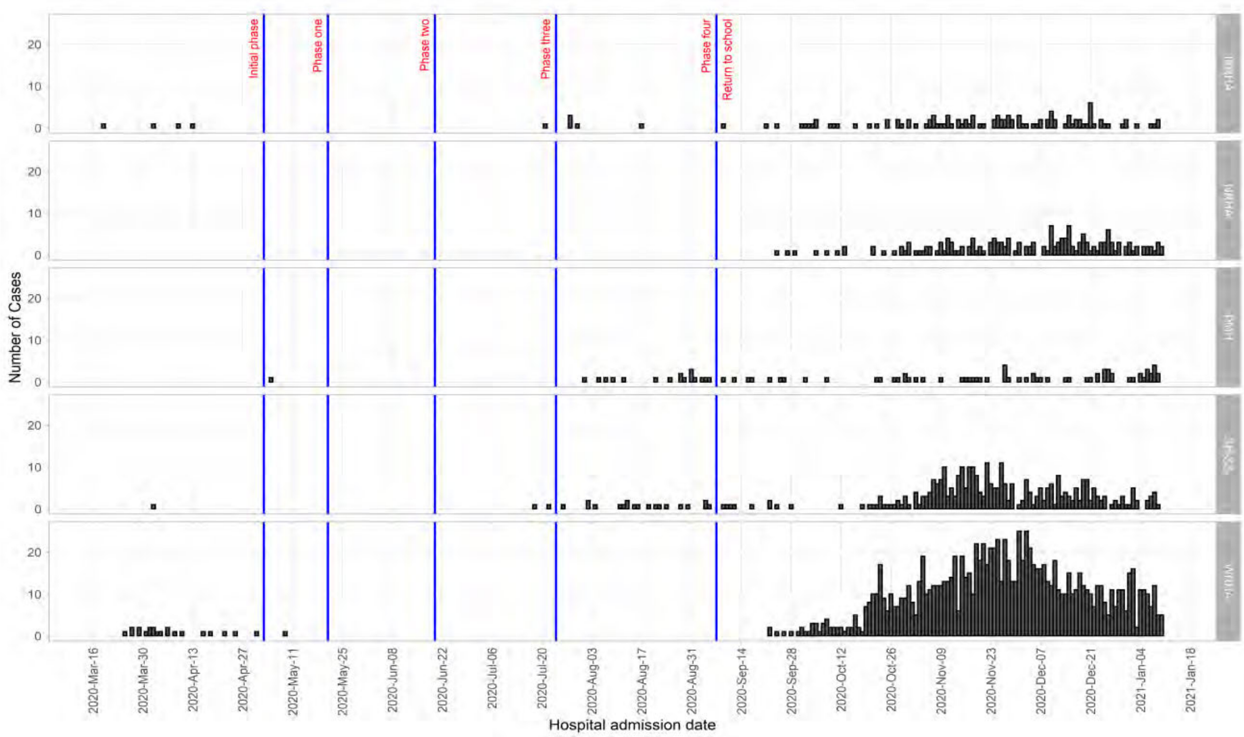


Figure 4: Epidemiological curve of hospital admissions among COVID-19 cases in Manitoba by health region, March 12- January 10, 2021 (N=1,841)

AB1429

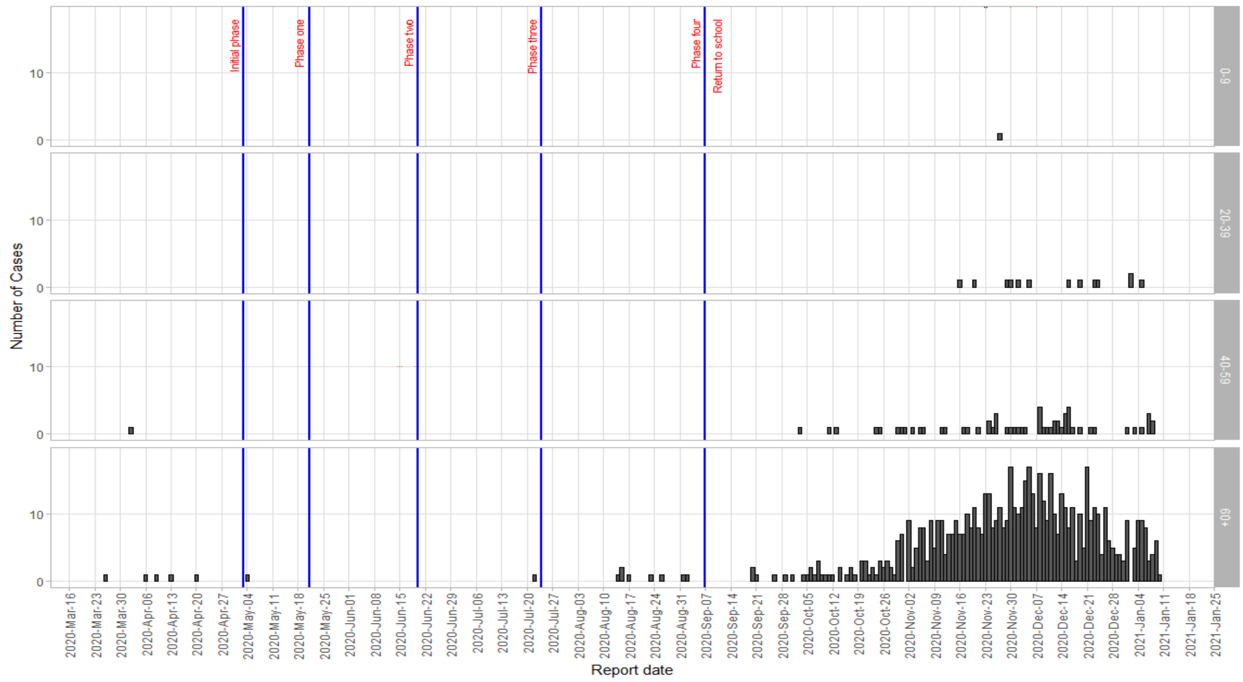


Figure 5: Daily number of fatal cases among COVID-19 cases in Manitoba by age group, March 12 - January 10, 2021 (N=741)

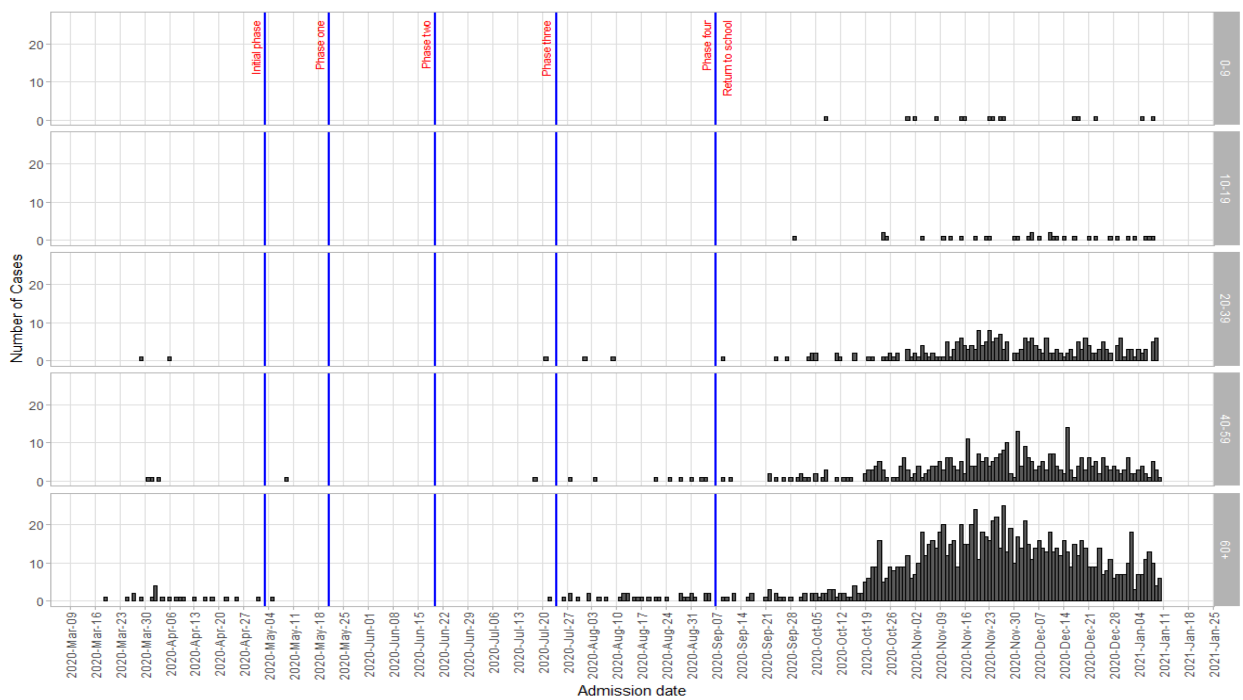


Figure 6: Daily number of hospitalizations among COVID-19 cases in Manitoba by age group, March 12 - January 10, 2021 (N=1,841)

Methods

Data sources

We used the Public Health Information Management System (PHIMS) to identify COVID-19 cases. Hospitalization related information obtained using MHSAL's population-based hospital admission, discharge, and transfer (ADT) database.

Case definitions

COVID-19 cases.

***Probable case* – A person who**

- has a fever (> 38°C), **AND/OR**
- has new onset of (or exacerbation of chronic) cough or difficulty breathing, AND
- meets exposure criteria, AND
- for whom laboratory diagnosis of COVID-19 is:
  - inconclusive (inconclusive is defined as a positive test on a single real-time PCR target or a positive test with an assay that has limited performance data available),
  - negative (if specimen quality or timing is suspect), or
  - positive but COVID-19 not confirmed by the National Microbiology Laboratory (NML) or a provincial public health laboratory by a validated nucleic acid amplification test (NAAT).

OR

- (un-tested)person with:
  - Fever (over 38 degrees Celsius), **AND/OR**
  - Cough (new or exacerbated chronic); **AND**
  - Close contact[1] with a confirmed case of COVID-19, **OR**
  - Lived in or worked in a closed facility known to be experiencing an outbreak of COVID-19 (e.g., long-term care facility, correctional facility)

***Confirmed case* - A person with**

- laboratory confirmation of infection with the virus that causes COVID-19 performed at a reference laboratory (NML or a provincial public health laboratory), and consists of positive nucleic acid amplification tests (NAAT) on at least two specific genome targets or a single positive target with nucleic acid sequencing.

[1] A close contact is defined as a person who provided care for the patient, including healthcare workers, family members or other caregivers, or who had other similar close physical contact or who lived with or otherwise had close prolonged contact with a probable or confirmed case while the case was ill.

Note:

- *nucleic acid amplification tests must be validated for detection of the virus that causes COVID-19*
- *laboratory tests are evolving for this emerging pathogen, and laboratory testing recommendations will change accordingly as new assays are developed and validated.*

Severe outcome.

Severe outcomes include hospitalization or death among infectious COVID-19 cases. It does not includes severe outcomes among recovered cases.

Chronic conditions.

We used validated algorithms developed by the Canadian Chronic Disease Surveillance System (shortly known as CCDSS) and PHIMS COVID-19 surveillance database to define the common chronic conditions of COVID-19 cases. Table 4 in Appendix describes the CCDSS algorithm used for each chronic condition included in our analysis.

Diagnosis date.

We used laboratory report date as the COVID-19 diagnosis date.

Table 4: Case definitions* of chronic conditions used in the analysis

Disease	Algorithm	Diagnostic codes	
	(Exclusion, if any)	ICD-9	ICD-10
Diabetes	1+ hospitalizations OR 2+ physician claims within 2 years (Excluded gestational diabetes)	250	E10-E14
Hypertension	1+ hospitalizations ever OR 2+ physician claims within 2 years (Excluded pregnancy-induced hypertension)	401; 402; 403; 404; 405	I10; I11; I12: I13; I15
Other CVDs			
Ischemic heart disease (IHD)	1+ hospitalizations or procedure code OR 2+ physician claims within 1 year.	410; 411; 412; 413; 414	I20; I21; I22; I23; I24; I25
Acute myocardial infarction (AMI)	1+ hospital inpatient admission	410	I21; I22 (Diagnostic fields – Most responsible dx, W, X, Y, 1, 2)
Heart failure	1+ hospitalizations OR 2+ physician claims within 1 year.	428	I50
Stroke	1+ hospitalizations OR 2+ physician claims within 1 year.	Hospital: 325, 362.3x, 430, 431, 432.9, 433.x1, 434 (or 434.x1), 435.x, 436, 437.6 Physician: 325, 430, 431, 432.9, 434, 435, 436, 437.6	G08, G45.x (exclude G45.4), H34.0, H34.1, I60.x, I61.x, I62.9, I63.x, I64, I67.6
Chronic respiratory conditions (COPD/Asthma)			

AB1433

Disease	Algorithm	Diagnostic codes	
Asthma	1+ hospitalizations ever OR 2+ physician claims within 2 years	493	J45; J46
Chronic obstructive pulmonary disease (COPD)	1+ hospitalizations OR 1+ physician claims ever	491; 492; 496	J41; J42; J43; J44
Musculoskeletal (Osteoporosis, OA, GCA, JIA)			
Osteoporosis	1+ hospitalizations or 1+ physician claim ever	Hospital: 733.0 Physician: 733	M80; M81
Osteoarthritis	1+ hospitalizations or 2+ physician claims (separated by at least 1 day) within 5 years	715	M15-M19
Gout and crystal arthropathies	1+ hospitalizations or 2+ physician claims (separated by at least 1 day) within 5 years	274, 712	M10, M11
Juvenile idiopathic arthritis (JIA)	1+ hospitalizations or 2+ physician claims (> 8 weeks apart) within 2 years	714; 720	M05; M06; M07.0; M07.1; M07.2; M07.3; M08; M45

*Canadian Chronic Disease Surveillance System (CCDSS) case definition

CVD: Cardiovascular Disease; COPD: Chronic Obstructive Pulmonary Disease; IHD: Ischemic Heart Disease; AMI: Acute Myocardial Infarction; GCA: Gout and Crystal Arthropathies; OA: Osteoarthritis;JIA: Juvenile Idiopathic Arthritis

This is Exhibit " D " referred to
in the Affidavit of Carla Loeppky
Affirmed before me this 4
day of March A.D. 2021

A Barrister-at-Law entitled to practice
in and for the Province of Manitoba

IMPACTS OF COVID-19 PUBLIC HEALTH MEASURES ON VARIOUS HEALTH INDICATORS IN MANITOBA

CONFIDENTIAL

For internal use only

November 1, 2020

Epidemiology & Surveillance
Provincial Information Management & Analytics Branch
Resources and Performance Division
Manitoba Health, Seniors and Active Living
Government of Manitoba

TO MEET THE HEALTH NEEDS OF INDIVIDUALS, FAMILIES AND THEIR COMMUNITIES BY LEADING A SUSTAINABLE, PUBLICLY ADMINISTERED HEALTH SYSTEM THAT PROMOTES WELL-BEING AND PROVIDES THE RIGHT CARE, IN THE RIGHT PLACE, AT THE RIGHT TIME.

— MANITOBA HEALTH, SENIORS AND ACTIVE LIVING

EPIDEMIOLOGY & SURVEILLANCE
PROVINCIAL INFORMATION MANAGEMENT & ANALYTICS BRANCH
RESOURCES AND PERFORMANCE DIVISION
MANITOBA HEALTH, SENIORS AND ACTIVE LIVING

PUBLICATION DATE: NOVEMBER 01, 2020

Suggested citation: Government of Manitoba, Manitoba Health, Seniors and Active Living, Resources and Performance Division, Epidemiology and Surveillance. (2020). Impacts of COVID-19 Public Health Measures on Health Care Use in Manitoba: January 1, 2019 – August 31, 2020.

Abbreviations

ADT	Admission, Discharge, and Transfer
COVID-19	Coronavirus disease of 2019
CCDSS	Canadian Chronic Disease Surveillance System
CTAS	Canadian Triage and Acuity Scale
DTaP-IPV-Hib	Diphtheria, Tetanus, Pertussis, Polio, Haemophilus influenzae type b
DRD	Drug-related death
ED	Emergency Department
EDIS	Emergency Department Information System
FY	Fiscal Year
ICD	International Classification of Diseases
ICU	Intensive Care Unit
MHSAL	Manitoba Health, Seniors and Active Living
MMRV	Measles, Mumps, Rubella, Varicella
PHIMs	Public Health Information Management System
PHAC	Public Health Agency of Canada
RHA	Regional Health Authority
UCC	Urgent Care Centre
WFPS	Winnipeg Fire and Paramedic Service
WPS	Winnipeg Police Service

Acknowledgements

In the spirit of honour, respect, and reconciliation, Manitoba Health, Seniors and Active Living (MHSAL) would like to acknowledge these provincial lands. We are in Treaty territories One through Five on the homelands of the Anishinaabeg Oji-Cree and Ojibwe, the Cree, Dakota, and Dené peoples, and on the homeland of the Métis Nation.

We kindly acknowledge the collaboration of the following organizations for providing the data for this report:

- Manitoba Poison Centre
- Winnipeg Fire and Paramedic Service, City of Winnipeg
- Winnipeg Police Service, City of Winnipeg

In addition, MHSAL would like to acknowledge the important efforts of public health professionals and health care providers across the province involved in COVID-19 response and reporting surveillance information to the provincial surveillance system. Without these continued efforts, this report would not be possible.

Highlights

Any medical conditions

- From April to August 2020, the monthly number of unique Manitobans who had a hospitalization or an emergency department/urgent care centre (ED/UCC) visit *due to any medical conditions* increased by 28% and 49%, respectively (Figure 1&2).

Mental and behavioural disorders

- A similar increasing trend during the same period was noted for hospitalizations, ED/UCC visits, and calls to Winnipeg Fire Paramedic Service (WFPS) due to *mental and behavioural disorders,* a 10%, 27%, and 16% increase, respectively.

Substance use disorders

- Monthly number of *substance use* related hospitalizations (Figure 7) and *naloxone administered* by WFPS (Figure 9) from April to August 2020 increased by 62% and 125%, respectively.
- In 2020, after a decline noted in March and April, the monthly number of *drug-related deaths* increased by 50% in May and by 14% in June from April (Figure 10).
- From April to August 2020, *alcohol-related* hospitalizations (Figure 11) and *opioid-related* ED/UCC visits (Figure 12) increased by 112% and 240%, respectively.

Intentional injuries

- Monthly number of unique Manitobans hospitalized or had ED/UCC visits due to *an intentional injury* sharply increased from April to August 2020 by 109% and 62% (Figure 13&14).

Accidental poisoning

- Number of unique Manitobans with an ED/UCC visit due to *accidental poisoning* increased from April to August 2020, a 55% increase (Figure 17)

Sexually transmitted and blood-borne infections

- From April to August 2020, the monthly number of cases diagnosed with *chlamydia, gonorrhea, HBV, and HCV* in Manitoba increased by 43%, 80%, 167%, and 81%, respectively (Figure 20&21); a 40% decrease was noted for *syphilis* during the same period.

Severe outcomes

- Among those with a chronic condition, *ICU admission and ED/UCC visits* from April to August 2020 increased by 22% and 41%, respectively (Figure 24 &25).

Prescription dispensation among Manitobans with a chronic condition

- In general, the monthly number of unique Manitobans with a chronic condition who dispensed a prescription for their condition increased in March and May 2020 followed with a decrease in June and July 2020 (Figure 26).

Immunization coverage

- During COVID-19 period, the monthly number of *MMRV immunization* doses administered in Manitoba increased from April to August by 103% (Figure 27).

Crimes reported by Winnipeg Police Service (WPS)

- Overall, a 28% increase from April to August 2020 was noted in the number of *service calls to WPS* (Figure 32), especially in following areas: traffic (an 85% increase), intoxicated persons (a 59% increase), and violence (a 55% increase) (Figure 30).

.

AB1441

Table of Contents

Abbreviations 3
Acknowledgements 4
Highlights 5
Background 11
Objective 11
Methods 11
  Case Definitions 11
  Data sources 14
Results 16
  Any medical conditions 16
  Mental and behavioural disorders 18
  Substance use disorders 19
  Intentional injuries 23
  Accidental poisoning 25
  Sexually transmitted and blood-borne infections 27
  Severe outcomes 28
  Prescription dispensation among Manitobans with a chronic condition 30
  Immunization coverage 31
  Crimes reported by Winnipeg Police Service 31
Conclusion 33
Appendix 34

List of Figures

Figure 1: Monthly number of unique Manitobans who had a hospitalization due to any medical conditions, January 01, 2019 – August 31, 2020 16
Figure 2: Monthly number of unique Manitobans who had an ED/UCC visit due to any medical conditions, January 01, 2019 – August 31, 2020 17
Figure 3: Weekly number of virtual physician visits due to any medical conditions received and processed by MHSAL, March 16 (week 12) – August 30 (week 35), 2020........ 17
Figure 4: Monthly number of unique Manitobans hospitalized due to a reason related to mental and behavioural disorders by sex, January 01, 2019 – August 31, 2020 18
Figure 5: Monthly number of unique Manitobans who had an ED/UCC visit due to mental and behavioural disorders by sex, January 01, 2019 – August 31, 2020........ 18
Figure 6: Monthly number of calls to Winnipeg Fire and Paramedic service where a patient was treated and/or transported for a mental health condition in Winnipeg by sex, January 01, 2019 – August 31, 2020 19
Figure 7: Monthly number of unique Manitobans hospitalized due to a reason related to substance use/misuse by sex, January 01, 2019 – August 31, 2020 20
Figure 8: Monthly number of unique Manitobans who had an ED/UCC visit due to substance use disorders by sex, January 01, 2019 – August 31, 2020 20
Figure 9: Monthly number of calls to WFPS where a patient received naloxone for suspected opioid overdose in Winnipeg by sex, January 01, 2019 – August 31, 2020........ 21
Figure 10: Number of drug-related deaths (DRDs) in Manitoba, January 01 – June 30, 2020. 21
Figure 11: Monthly number of unique Manitobans hospitalized due to a reason related to substance use/misuse by substance type, January 01, 2019 – August 31, 2020 22
Figure 12: Monthly number of unique Manitobans who had an ED/UCC due to substance use disorders by substance type, January 01, 2019 – August 31, 2020 22
Figure 13: Monthly number of unique Manitobans hospitalized due to a reason related to intentional injury by sex, January 01, 2019 – August 31, 2020........ 23
Figure 14: Monthly number of unique Manitobans with an ED/UCC visit due to a reason related to intentional injury, January 01, 2019 – August 31, 2020 23
Figure 15: Monthly number of unique Manitobans hospitalized due to a reason related to intentional injury by injury type, January 01, 2019 – August 31, 2020 24
Figure 16: Monthly number of unique Manitobans with an ED/UCC visit due to intentional injuries by injury type, January 01, 2019 – August 31, 2020 24
Figure 17: Monthly number of unique Manitobans who had an ED/UCC visit due to accidental poisoning, January 01, 2019 – August 31, 2020........ 25
Figure 18: Monthly number of accidental poisoning related calls to Winnipeg Fire and Paramedic Service by sex, January 01, 2019 – August 31, 2020 26
Figure 19: Monthly number of calls to Manitoba Poison Centre for improper use of bleach, chlorine gas, select disinfectants, and hand sanitizers, January 01, 2019 – August 31, 2020 26
Figure 20: Monthly number of unique Manitobans diagnosed with chlamydia and/or gonorrhea, January 01, 2019 – August 31, 2020 27
Figure 21: Monthly number of unique Manitobans diagnosed with HBV, HCV, HIV, or syphilis, January 01, 2019 – August 31, 2020 27
Figure 22: Monthly number of in-hospital deaths (due to any cause) in Manitoba by sex, January 01, 2019 - August 31, 2020 28

Figure 23: Monthly number of unique Manitobans with a chronic condition (as of 2018/19 FY) who died (due to any cause) in hospital by sex, January 01, 2019 – August 31, 2020 29
Figure 24: Monthly number of unique Manitobans with a chronic condition (as of 2018/19 FY) who had an ICU hospitalization by sex, January 01, 2019 – August 31, 2020 29
Figure 25: Monthly number of unique Manitobans with a chronic condition (as of 2018/19 FY) who had an ED/UCC visit (due to any medical conditions) by sex, January 01, 2019 – August 31, 2020.. 30
Figure 26: Monthly number of unique Manitobans with a chronic condition who dispensed a prescription for their condition, January 01, 2019 – August 31, 2020 30
Figure 27: Monthly number of DTaP-IPV-Hib and MMRV immunization doses administered in Manitoba, January 01, 2019 - August 31, 2020.. 31
Figure 28: Monthly number of calls for service to Winnipeg Police, January 01, 2017 – August 31, 2020.. 32
Figure 29: Monthly number of calls for service to Winnipeg Police by community area, January 01, 2017 – August 31, 2020... 32
Figure 30: Monthly number of calls for service to Winnipeg Police by service type, January 01, 2017 – August 31, 2020 33
Figure 31: Monthly number of unique Manitobans with an ED/UCC visit due to any medical health conditions by age group, January 01, 2019 - August 31, 2020....................................... 34
Figure 32: Monthly number of unique Manitobans with an ED/UCC visit due to any medical health conditions by health region of residence, January 01, 2019 - August 31, 2020 34
Figure 33: Proportion of unique Manitobans with an ED/UCC visit due to any medical health conditions by in-patient hospitalization status, January 01, 2019 - August 31, 2020................. 35
Figure 34: Monthly number of ED/UCC visits due to any medical conditions in Manitoba by Canadian Triage & Acuity Scale (CTAS), January 01, 2019 to August 31, 2020 35
Figure 35: Monthly number of unique Manitobans hospitalized due to a reason related to mental and behavioural disorders by age groups, January 01, 2019 – August 31, 2020............ 36
Figure 36: Monthly number of unique Manitobans who had an ED/UCC visit due to mental and behavioural disorders by age groups, January 01, 2019 – August 31, 2020........................ 36
Figure 37: Monthly numbers of Manitobans hospitalized due to a reason related to substance use/misuse by age group, January 01, 2019 – August 31, 2020 37
Figure 38: Monthly number of unique Manitobans who had an ED/UCC visit due to substance use disorders by age group, January 01, 2019 – August 31, 2020.. 37
Figure 39: Monthly number of unique Manitobans hospitalized due to a reason related to alcohol use by sex, January 01, 2019 – August 31, 2020 38
Figure 40: Monthly numbers of Manitobans hospitalized due to a reason related to alcohol use by age group, January 01, 2019 – August 31, 2020... 38
Figure 41: Monthly number of unique Manitobans hospitalized due to a reason related to intentional injury by age groups, January 01, 2019 – August 31, 2020 39
Figure 42: Monthly number of unique Manitobans with an ED/UCC visit due to intentional injury by age groups, January 01, 2019 - August 31, 2020 39
Figure 43: Monthly number of unique Manitobans who had an ED/UCC visit due to accidental poisoning by age group, January 01, 2019 – August 31, 2020... 40
Figure 44: Monthly number of in-hospital deaths (due to any cause) in Manitoba by age group, January 01, 2019 - August 31, 2020 40

Figure 45: Monthly number of unique Manitobans with a chronic condition (as of 2018/19 FY) who died in hospital by age group, January 01, 2019 – August 31, 2020 41
Figure 46: Monthly number of unique Manitobans with a chronic condition (as of 2018/19 FY) who had an ED/UCC visit by CTAS score, January 01, 2019 – August 31, 2020..................... 41
Figure 47: Monthly number of traffic related calls for service to Winnipeg Police by event type, January 01, 2017 – August 31, 2020... 42
Figure 48: Monthly number of violence related calls for service to Winnipeg Police by event type, January 01, 2017 – August 31, 2020... 42
Figure 49: Monthly number of property related calls for service to Winnipeg Police by event type, January 01, 2017 – August 31, 2020... 43
Figure 50: Monthly number of disturbances / danger related calls for service to Winnipeg Police by event type, January 01, 2017 – August 31, 2020 43
Figure 51: Monthly number of wellbeing check related calls for service to Winnipeg Police by event type, January 01, 2017 - August 31, 2020... 44
Figure 52: Monthly number of breaches and warrants related calls for service to Winnipeg Police by event type, January 01, 2017 – August 31, 2020 44

Background

On March 11, 2020 with 118,000 cases of coronavirus disease of 2019 (COVID-19) in 114 countries, including Canada, the World Health Organization (2020) declared a Pandemic. The next day, three presumptive cases were announced in Manitoba (all travel related). As of October 28th, 2020, Manitoba had 4,701 confirmed and probable COVID-19 cases (2,335 active + 2,305 recoveries + 61 deaths). As a response to COVID-19 public health management, Manitoba's chief provincial public health officer, with the approval of the Minister of Health, Seniors and Active Living, has ordered a number of public health measures such as declaring a province-wide state of emergency, practicing social distancing, suspending classes in Manitoba schools (Kindergarten to grade 12), etc.[1]

Manitoba's public health response to the pandemic, such as the shift of resources, physical distancing and isolation measures, and closing or adaptation of services has the potential for negative impact on health and social outcomes. While public health measures to contain the virus are critical and necessary, policy and decision makers must also be aware of the impacts of COVID-19 public health measures on people in Manitoba, and specific groups within the population.

Objective

The objective of this report is to describe the impacts of COVID-19 and responses on various health indicators in Manitoba, such as mental health, substance use disorders, etc.

Methods

Case Definitions

Health-related indicators.

Health services use.

We described the monthly number of unique Manitobans who had a virtual physician visit, hospital admission, and emergency department/urgent care centres (ED/UCC) visits due to any medical conditions, or due to certain conditions (i.e., mental health, substance use disorders, intentional injuries, and accidental poisoning) from January 01, 2019 to August 31, 2020. These indicators were measured using Admission, Discharge, and Transfer (ADT), Emergency Department Information System (EDIS), and Claims Processing Solution (CPS) virtual physician visit databases. Health services use made in the same month counted as one in the analysis.

In addition, we measured certain sexually transmitted blood-borne infections (STBBIs) reported in Public Health Information Management System (PHIMS) database. We described the monthly number of gonorrhea, chlamydia, hepatitis B (HBV), hepatitis C (HCV), HIV, and syphilis from January 01, 2019 to August 31, 2020.

In EDIS database, the following attributes were used to identify mental health conditions, substance use disorders, intentional injuries, and accidental poisoning related ED/UCC visits:

- *EDDischargeDxCode1* – using ICD-10 codes in Table 1

[1] Details of Manitoba's COVID-19 public health orders can be seen here: https://www.gov.mb.ca/bg/2020/04/covid19.html

- *EDDischargeDxCode2*– using ICD-10 codes in Table 1
- *EDChiefComplaint* – contains the presenting complaint(s) of the patient at time of triage
- *EDDischargeDxDescription1* – contains a text description of the ICD code in *EDDischargeDxCode1* field
- *EDVisitReason* – contains the reason(s) of the patient for ED visit

Table 1: ICD codes used in the analysis to identify health services use due to certain conditions

Medical condition	**ICD-9 codes**	**ICD-10 codes**
Accidental poisoning	E850-E869	X40-X49
Intentional injury	E950-E959, E960-E969	X60-Y09, Y87.0, Y87.1
Substance use disorders	291; 292; 303; 304; 305	F10-F19; F55; Z50.2; Z50.3
Mental and behavioural disorders	290-319	F00-F99

We focus the analysis on individuals with a Manitoba PHIN and those ED/UCC visit records with the Canadian Triage and Acuity Scale (CTAS) scores 1 - 5. Furthermore, following 15 ED/UCC sites in Manitoba were included in our analysis to measure the ED/UCC visits due to certain conditions because these ED/UCC sites are the only ones that submit discharge diagnosis and chief complaint information to EDIS.:

- Selkirk Regional Health Centre
- St. Anthony's General Hospital
- Flin Flon General Hospital
- Thompson General Hospital
- Brandon Regional Health Centre
- Bethesda Regional Health Centre
- Portage District General Hospital
- Dauphin Regional Health Centre
- Boundary Trails Health Centre
- Seven Oaks General Hospital
- St Boniface General Hospital
- Victoria General Hospital
- Grace Hospital
- Concordia Hospital
- Health Sciences Centre

In ADT database, we used the *IPVisitReason* attribute which contains health workers' reason for admitting the patient to identify mental health conditions, substance use disorders, intentional injuries, and accidental poisoning related in-patient hospital admissions.

In addition to describing the health services use for virtual physician visits, hospitalizations, and ED/UCC visits, we investigated the number of calls to Winnipeg Fire and Paramedic Service (WFPS) for opioid overdose, described by naloxone administration, mental health, and accidental poisoning during COVID-19 period (between March and August 2020).

Finally, health services use in those Manitobans with a chronic condition is also investigated. For this analysis, a study cohort with a chronic condition in 2018/19 FY was built using the validated algorithms developed by the Canadian Chronic Disease Surveillance System (shortly known as CCDSS). These can be found on the CCDSS website here.

Severe outcomes.

We described the in-hospital deaths due to any conditions in Manitoba from January 1, 2019 to August 31, 2020 using ADT database. Furthermore, using the same database, we measured the following indicators among the cohort with a chronic condition (as of 2018/19 FY): in-hospital deaths, ICU admissions, and ED/UCC visits (severity described by CTAS score).

Prescription dispensations for chronic conditions.

Prescription dispensation for chronic conditions listed in CCDSS was measured among the aforementioned cohort with a chronic condition. Table 2 presents ATC codes used to measure the drug dispensations for the treatment of each chronic condition.

Table 2: ATC codes used to measure the drug dispensation specific to each chronic condition included in the analysis

Chronic condition category	ATC code	Medication class
Cardiovascular diseases (i.e., heart failure, hypertension, ischemic heart disease, acute myocardial infarction, stroke	B01AA, B01AC, C	Cardiac agents (excl. ACE inhibitors) Cardiovascular system
Musculoskeletal (i.e., gout and crystal arthropathies, rheumatoid arthritis, juvenile idiopathic arthritis, osteoporosis related fractures)	M	Musculoskeletal system
Mental illnesses (i.e., mood and anxiety disorders, schizophrenia)	N05 N06	Psycholeptics Psychoanaleptics
Asthma/COPD	R	Respiratory system
Diabetes mellitus	A10	Drugs used in diabetes
Neurological conditions (i.e., dementia, epilepsy, multiple sclerosis, Parkinson's disease)	N06D N03 N04 L03A L04AA	Anti-dementia drugs Antiepileptics Anti-parkinson drugs immunostimulants Selective immunosuppressants

Immunization coverage.

We used Public Health Information Management System (PHIMS) database to describe the monthly number of Diphtheria, Tetanus, Pertussis, Polio, Haemophilus influenzae type b (DTaP-IPV-Hib) and Measles, Mumps, Rubella, Varicella (MMRV) immunization doses administered in Manitoba from January 01, 2019 to August 31, 2020. In Manitoba, DTaP-IPV-Hib vaccine is typically given to children aged 2, 4, 6, and 18 months; MMRV vaccine is typically given to children aged 12 months and 4-6 years.

Crimes reported by Winnipeg Police Service.
In addition to health indicators, we measured various crime indicators reported by Winnipeg Police Service.

Data sources
Epidemiology and Surveillance Unit of MHSAL has collaborated with a range of stakeholders to collect data to describe the short-term impact of COVID-19 in Manitoba. The following data sources were used to generate this report:

Emergency Department Information System (EDIS) data.
The EDIS database contains information on services received by a patient as (s)he progresses through an ED/UCC from the first point of entry at the triage desk through to discharge. The ED/UCC visits are triaged using CTAS scores 1 –Resuscitation, 2 –Emergent, 3 – Urgent, 4 – Less Urgent and 5 – Non Urgent. The ED/UCC visits can lead to an in-patient admission based on the state of the patient.

Admission, Discharge, and Transfer (ADT) data.
ADT is a patient-based records to provide information to monitor hospitalization in Manitoba. The ADT dataset does not include ICD-10 codes for the in-patient information. The in-patient visit reason attribute is based on the reason for the visit of the patient.

Claims Processing Solution (CPS) virtual physician visits data.
CPS virtual physician visits data includes a summary of the volume of claims for virtual visits that are provided in place of in-clinic visit services effective March 14, 2020. These services included virtual visits to patients by physicians in a number of areas of practice, as well as virtual psychotherapy, and consultations effective April 1st and 24th, 2020. Virtual tariffs included both fee-for-service and shadow-billing providers. Our analysis included the virtual visit claims received and processed by MHSAL between March 16th and August 30th, 2019. As there is a lag between when a service is provided, and when the physician submits a claim to the CPS which can be up to six months, this dataset may be incomplete for these service dates. We expect that these volumes will rise as more claims are submitted and paid through future pay runs.

Public Health Information Management System (PHIMS) data.
PHIMS is a confidential, integrated electronic public health records and developed to assist health practitioners in Manitoba to manage clients' public health surveillance records (such as immunization and communicable diseases). COVID-19 surveillance is included in PHIMS database.

Drug Program Information Network (DPIN) data.
DPIN is Manitoba's electronic, on-line, point-of-sale drug system. It links all community pharmacies (but not pharmacies in hospitals or nursing homes/personal care homes) and captures information about all Manitoba residents' drug dispensations. DPIN contains information such as date of drug dispensation, total day supply and dosage, unique pharmacy identification number, etc.

Manitoba Poison Centre data.

The Manitoba Poison Centre is a telephone toxicology consultation service that provides expert poison advice 24 hours a day to the public and healthcare professionals throughout Manitoba. We used the Manitoba Poison Centre data to describe the monthly number of calls due to improper use of cleaning and disinfecting products in Manitoba during January 01, 2019 to August 31, 2020.

Winnipeg Fire and Paramedic Service (WFPS) data.

Emergency response calls to WFPS where a patient was treated and/or transported for opioid overdose, mental health and accidental poisoning from January 2019 to August 2020 are included in the analysis. WFPS will administer naloxone when it is suspected (by objective clinical assessment of patient vital signs and presentation) that an opioid overdose has occurred. Monthly number of calls where a patient administered naloxone was extracted from electronic patient records. Specific information was located by filtering based on date and intervention text (i.e., naloxone). Similarly, for mental health related analysis, WFPS data was extracted from electronic patient records, and specific information was located by filtering based on date and primary impressions (mental health).

Accidental poisoning related emergency response calls to WFPS data was extracted from computer aided dispatch system records. Specific information was located by filtering based on date, incident type, and short description. The data set is limited to response to poisoning identified by the caller as ‘accidental.’ Due to the fact that data was extracted from the computer aided dispatch system instead of the patient records, it must be noted that validity of the data is limited.

Office of the Chief Medical Examiner’s data.

Office of the Chief Medical Examiner’s (OCME) mortality data is used to describe the drug-related deaths in Manitoba. Deaths that occurred in 2020 are still under review. The OCME data included in this report is based on available data at the time of report preparation. These data are preliminary numbers and are subject to change as toxicology results become available, and additional assessments are conducted.

Winnipeg Police calls for service data.

Winnipeg Police calls for service data consist of safety and unverified crime events reported by people in Winnipeg and by proactive events of officers. Data presented are based on call type categories established by the Winnipeg Police. The data include both safety and criminal events. The data are presented in generic categories for privacy reasons; including, but not limited to, calls respecting domestic violence, sexual offences and personal health. Call type categories displayed may not be the same as the categorization of the event after final investigation. All information is based on information provided from the public, as well as proactive policing, and therefore are preliminary and subject to change. Due to the complex nature of police investigations, the data may change over time.

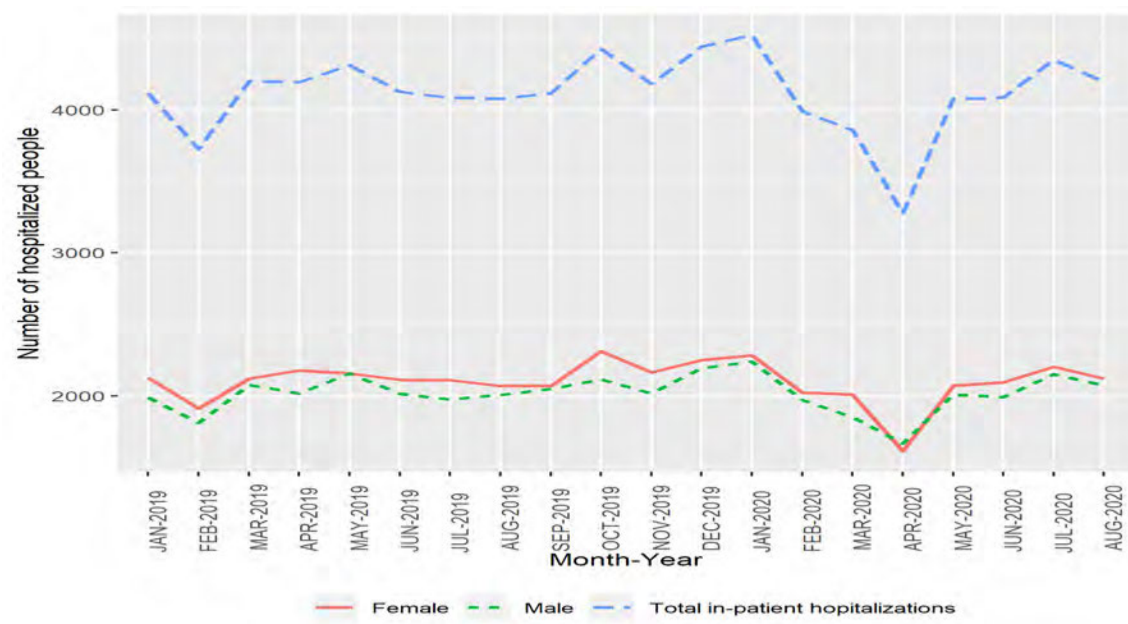
AB1450

Results

Any medical conditions

- The monthly number of unique Manitobans who had a hospitalization due to any medical conditions started to increase as of May 2020 after a decline noted in March and April 2020. For example, there were 3,279 people hospitalized in April 2020 compared with 4,197 people hospitalized in August 2020, a 28% increase (Figure 1).
- A similar trend was noted for ED/UCC visits; the monthly number of unique Manitobans who had an ED/UCC visit due to any medical conditions increased from 22,887 people in April 2020 to 34,138 people in August 2020, a 49% increase (Figure 2).
- Weekly number of virtual physician visit claims received and processed by MHSAL ranged from 7,954 virtual visits in week 12 to 83,276 virtual visits in week 19 (Figure 3). Average weekly number of virtual visits during March 16 (week 12) – August 30 (week 35), 2020 was 50,283, with a standard deviation of 18,946. *Note: As there is a lag between when a service is provided, and when the physician submits a claim to the CPS which can be up to six months, this dataset may be incomplete for these service dates. We expect that these volumes will rise as more claims are submitted and paid through future pay runs.*

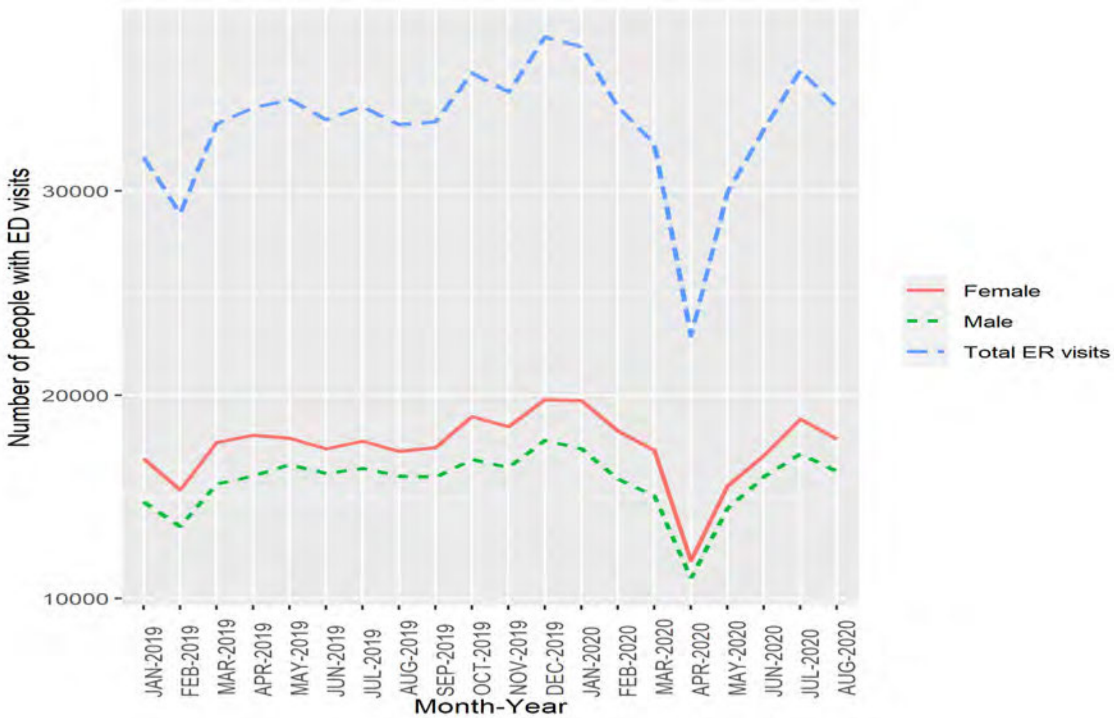
Note: Further details on ED/UCC visits by age group (Figure 31), health region (Figure 32), in-patient admission status (Figure 33), and CTAS scores (Figure 34) are presented in the Appendix.



Data source: Admissions, Discharge & Transfer (ADT)

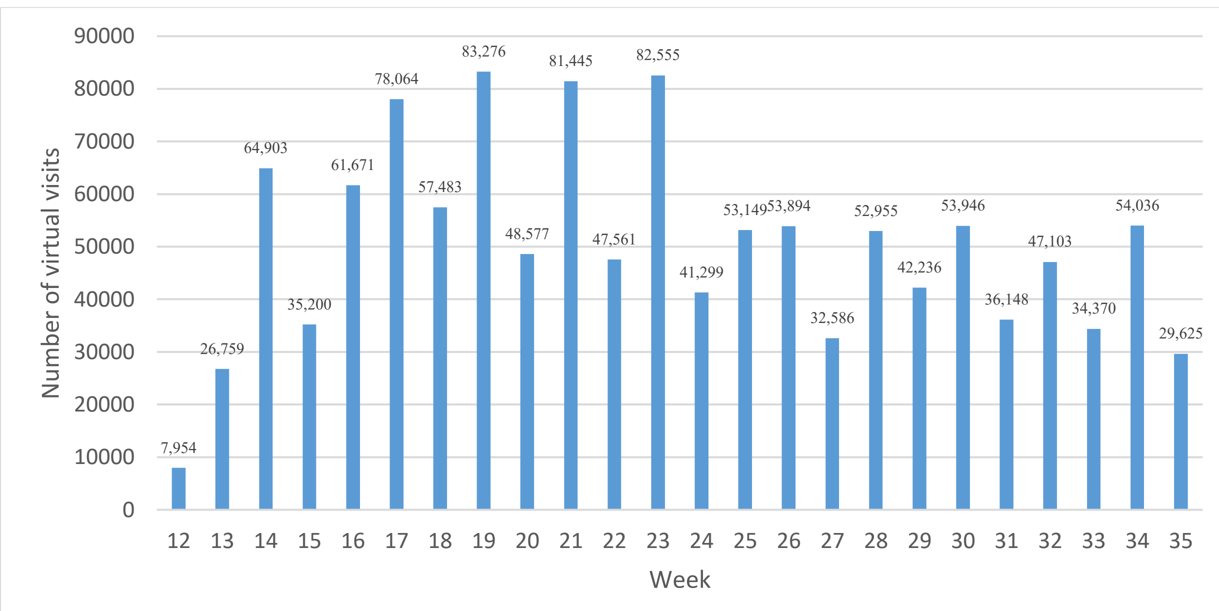
Figure 1: Monthly number of unique Manitobans who had a hospitalization due to any medical conditions, January 01, 2019 – August 31, 2020

AB1451



Data source: Emergency Department Information System (EDIS)

Figure 2: Monthly number of unique Manitobans who had an ED/UCC visit due to any medical conditions, January 01, 2019 – August 31, 2020



Data source: Claims Processing Solution (CPS) virtual physician visits data

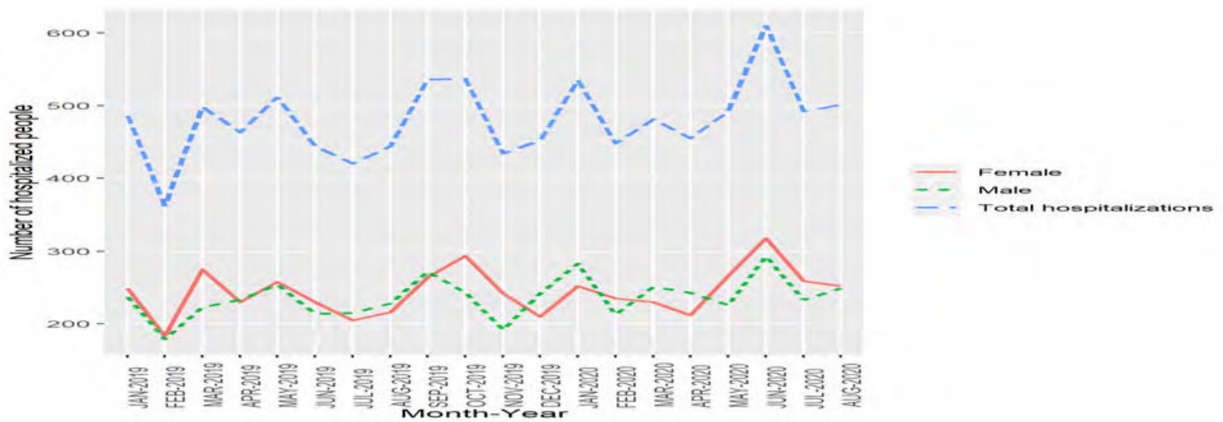
Figure 3: Weekly number of virtual physician visits due to any medical conditions received and processed by MHSAL, March 16 (week 12) – August 30 (week 35), 2020

AB1452

Mental and behavioural disorders

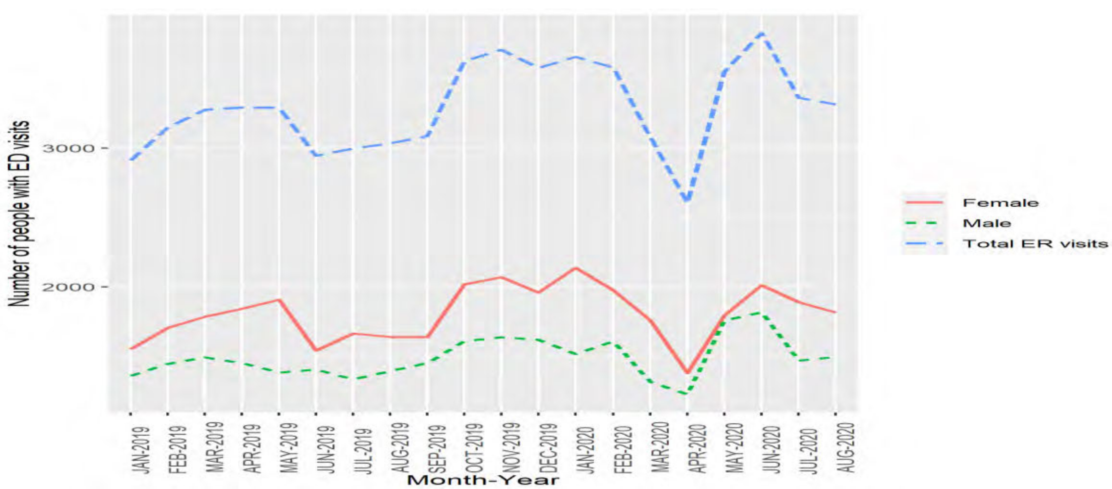
- After a decline noted from February to April 2020, the monthly number of unique Manitobans who had a hospitalization (Figure 4) or an ED/UCC visit (Figure 5) due to mental and behavioural disorders increased by 10% and 27% from April to August 2020, respectively. During COVID-19 pandemic, the highest number of hospitalization and ED/UCC visits for mental health disorders is noted in June 2020.
- A similar pattern was noted for the monthly number of calls to WFPS where a patient was treated and/or transported due to a mental health condition, 16% increase from April (n= 262) to August (n=305) 2020, with the highest increase in May 2020 (n=348) (Figure 6).

Note: Further details on hospitalization (Figure 35) and ED/UCC visits (Figure 36) for mental and behavioral disorders by age group are presented in the Appendix.



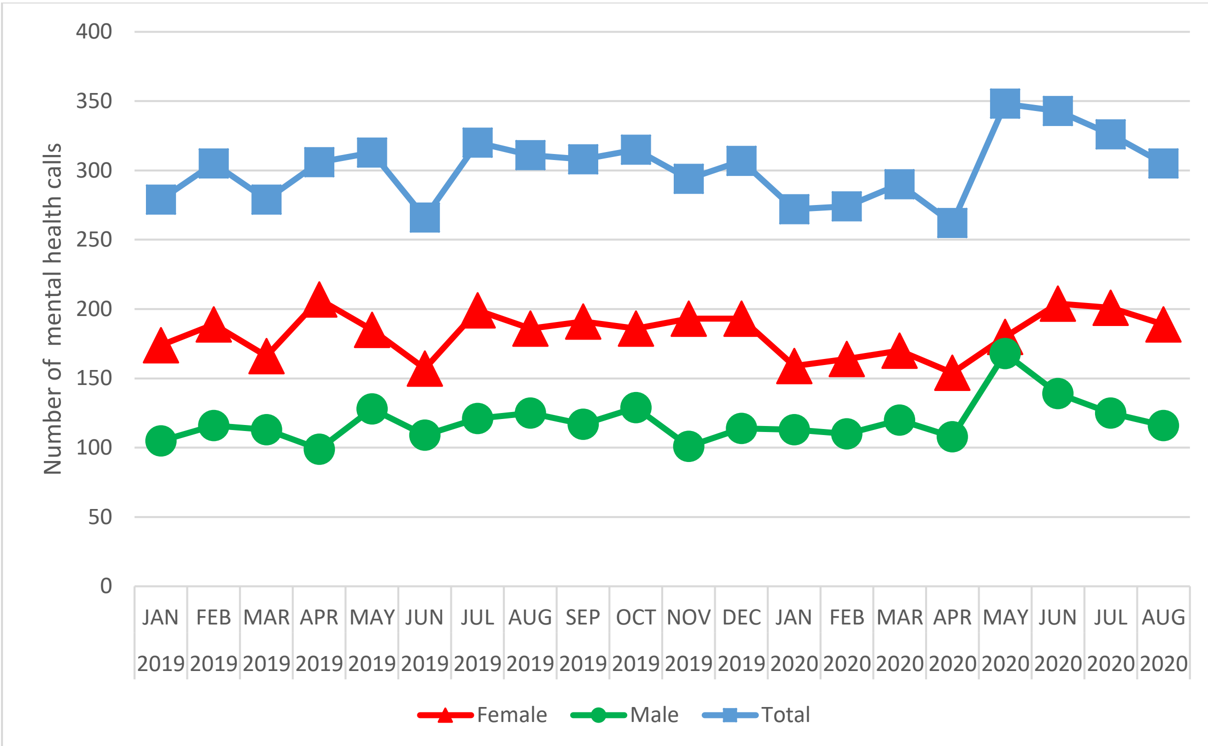
Data source: Admissions, Discharge & Transfer (ADT)

Figure 4: Monthly number of unique Manitobans hospitalized due to a reason related to mental and behavioural disorders by sex, January 01, 2019 – August 31, 2020



Data source: Emergency Department Information System (EDIS)

Figure 5: Monthly number of unique Manitobans who had an ED/UCC visit due to mental and behavioural disorders by sex, January 01, 2019 – August 31, 2020



Data source: Winnipeg Fire and Paramedic Service, City of Winnipeg

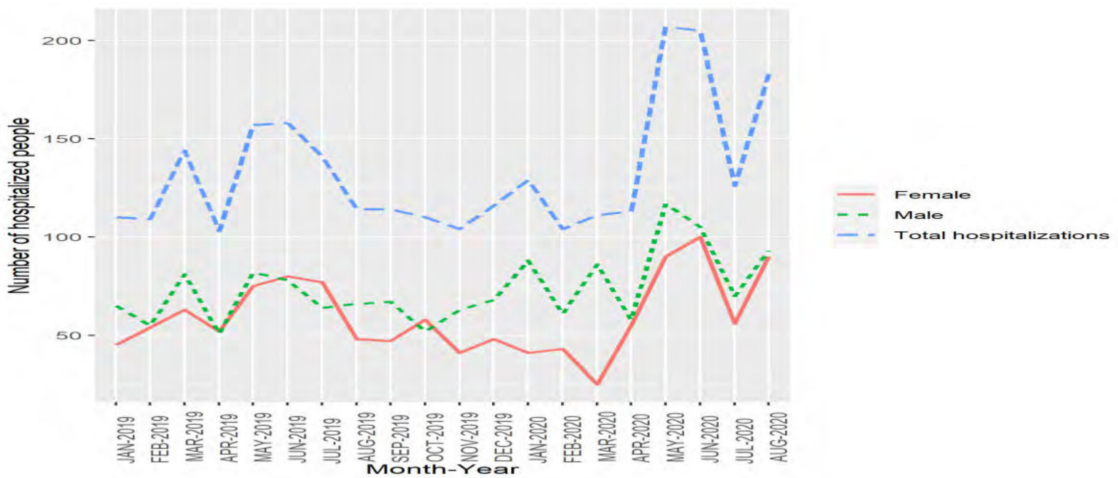
Figure 6: Monthly number of calls to Winnipeg Fire and Paramedic service where a patient was treated and/or transported for a mental health condition in Winnipeg by sex, January 01, 2019 – August 31, 2020

Substance use disorders

- Overall, the monthly number of substance use related hospitalizations (Figure 7), ED/UCC visits (Figure 8), and naloxone administered by WFPS (Figure 9) increased by 62%, 7%, and 125%, respectively, from April to August 2020.
- During COVID-19 pandemic, the highest number of substance use related events occurred in May and June 2020 for hospitalizations (n= 207 and 205, respectively) and in July 2020 for ED visits (n = 3,150) and for naloxone administered by WFPS (n= 225).
- There were 138 drug-related deaths in Manitoba from January to June 2020 (Figure 10). During this time period, there were 83 drug related deaths with at least one opioid present, 16 with fentanyl noted as a contributor, 10 with methamphetamine present, and 7 with cocaine present. *Note: These are preliminary numbers and are subject to change as toxicology results become available, and additional assessments are conducted.*
- After a decline noted in March (n=21) and April 2020 (n=22), the monthly number of drug-related deaths increased to 33 in May 2020 and 25 in June 2020, a 50% and 14% increase from April 2020, respectively (Figure 10)
- The number of fentanyl-related deaths has risen steadily over the years with 14 deaths in 2017, 24 deaths in 2018, 41 deaths in 2019, and 54 deaths in the first six months of 2020 (Figurer 10).

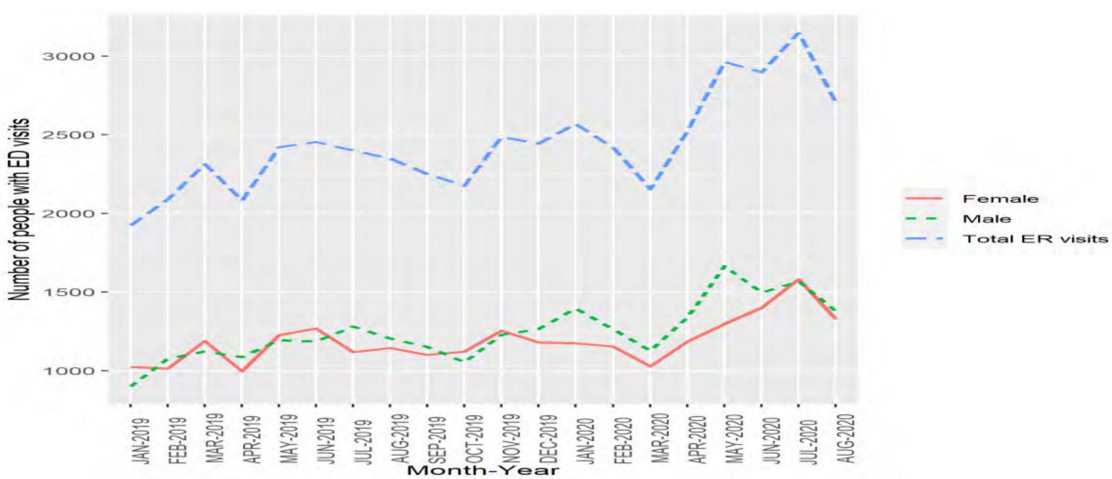
- In 2020, alcohol-related hospitalizations sharply increased from 67 people in April to 142 people in May, a 112% increase (Figure 11). After a decline noted in June (n=133) and July (n=98) 2020, an increasing trend was noted again in August 2020 (n=127), a 90% increase from April to August 2020. This increasing trend was especially noted in 25-44 years age group (Figure 40 in Appendix).
- Opioid associated ED/UCC visits increased by 240% from April (n=68) to August (n=231) 2020 (Figure 12).

Note: Figures presenting the monthly number of unique Manitobans hospitalized (Figure 37) or had an ED/UCC visit (Figure 38) due to substance use by age group, alcohol-related hospitalization by sex (Figure 39) and age groups (Figure 40) are presented in the Appendix.



Data source: Admissions, Discharge & Transfer (ADT)

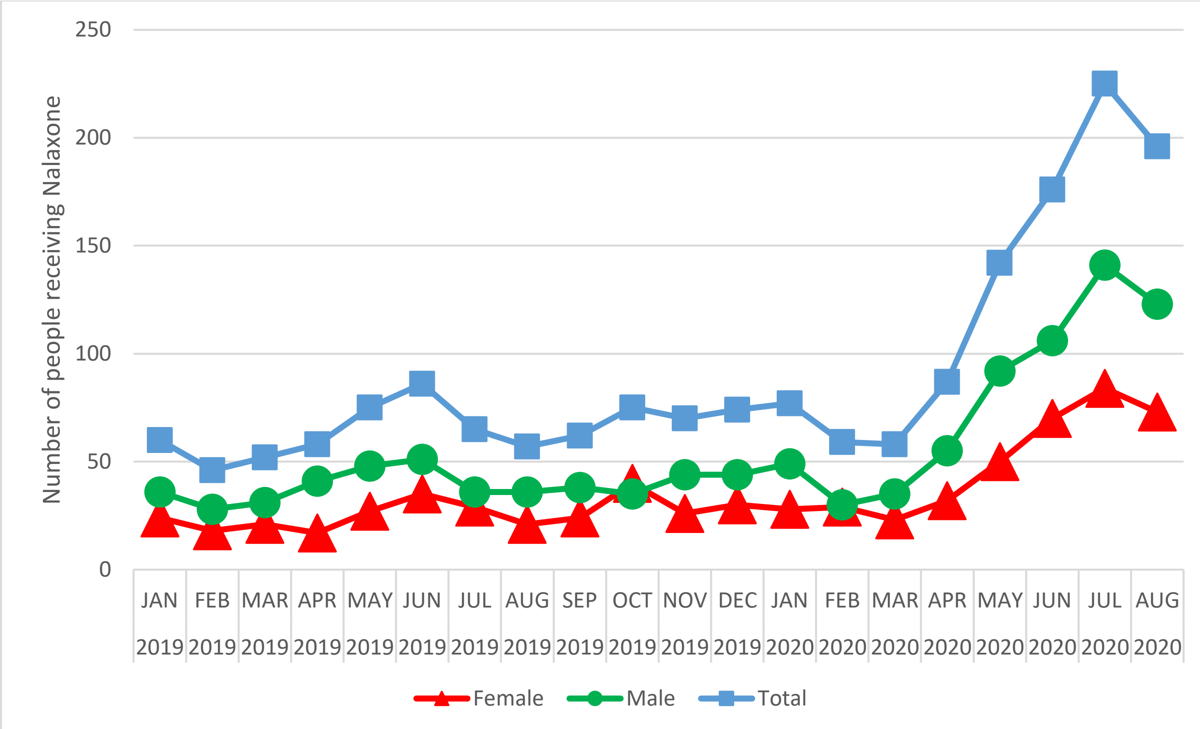
Figure 7: Monthly number of unique Manitobans hospitalized due to a reason related to substance use/misuse by sex, January 01, 2019 – August 31, 2020



Data source: Emergency Department Information System (EDIS)

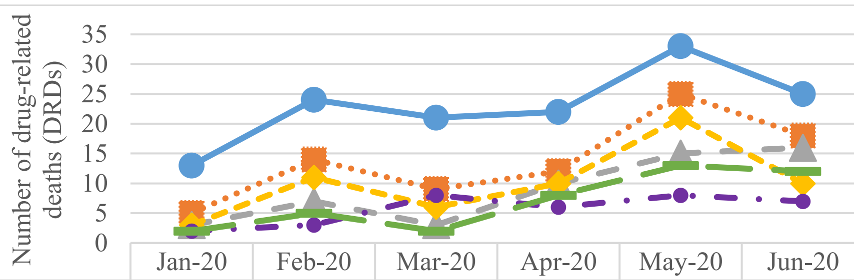
Figure 8: Monthly number of unique Manitobans who had an ED/UCC visit due to substance use disorders by sex, January 01, 2019 – August 31, 2020

AB1455



Data source: Winnipeg Fire and Paramedic Service (WFPS), City of Winnipeg

Figure 9: Monthly number of calls to WFPS where a patient received naloxone for suspected opioid overdose in Winnipeg by sex, January 01, 2019 – August 31, 2020

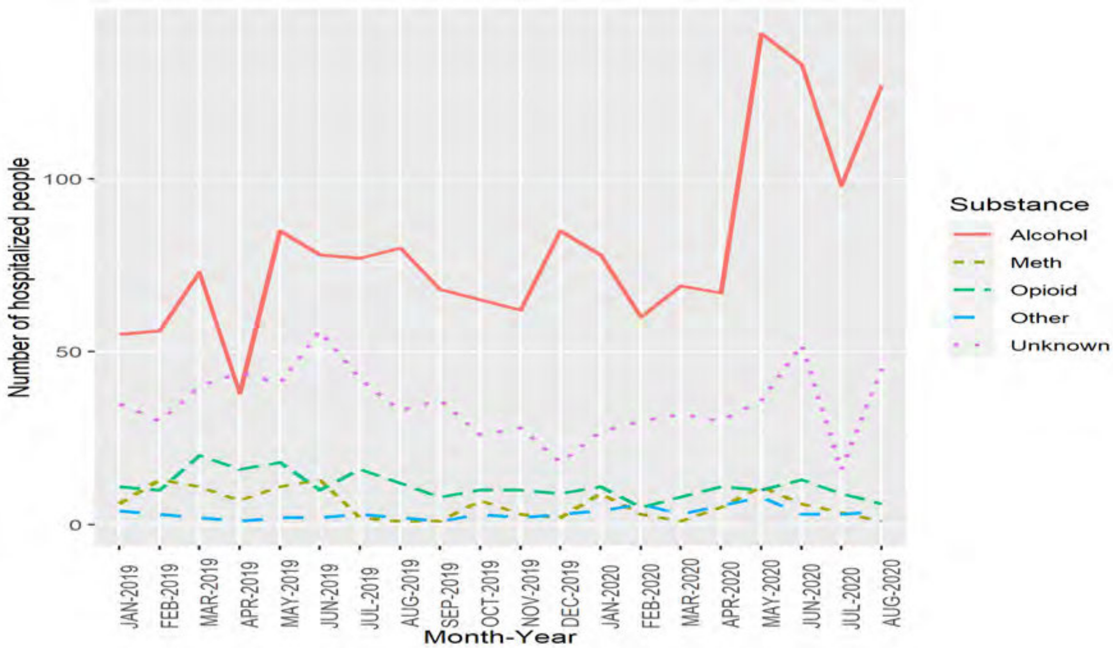


	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20
Total DRDs	13	24	21	22	33	25
DRD with at least 1 opioid (including fentanyl) present	5	14	9	12	25	18
DRD with fentanyl contributing	3	7	3	10	15	16
DRD with methamphetamine present	3	11	6	10	21	10
DRD with cocaine present	2	3	8	6	8	7
Fentanyl-related deaths with methamphetamine and/or cocaine present	2	5	2	8	13	12

Data source: Manitoba Office of Medical Examiners

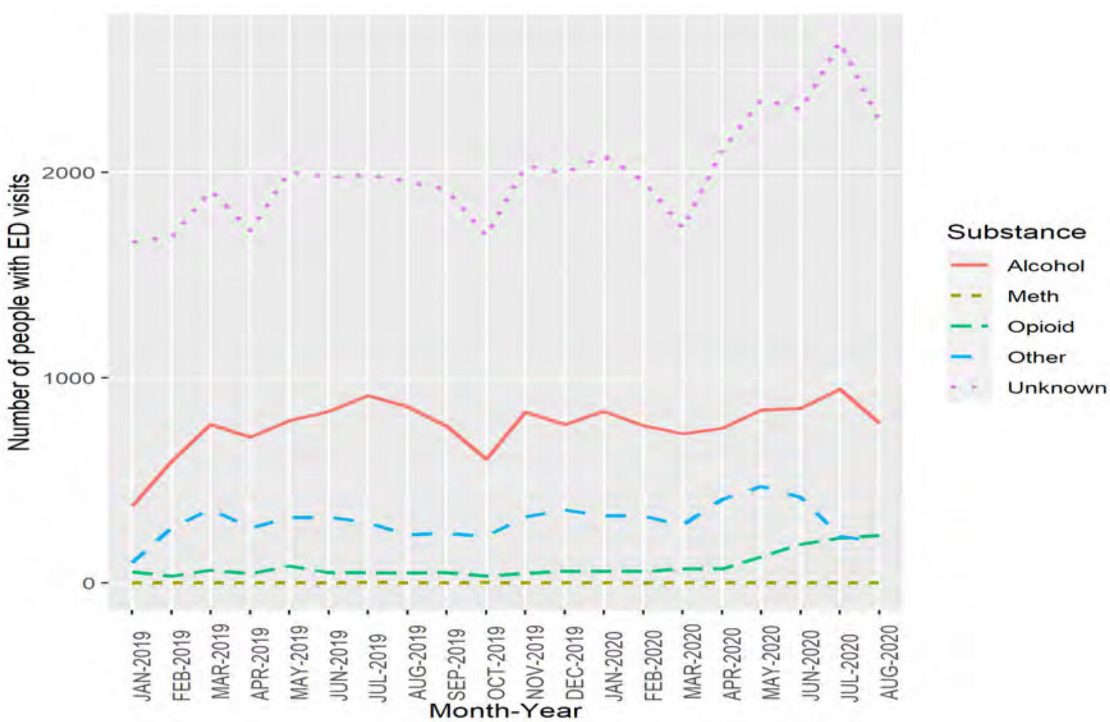
Figure 10: Number of drug-related deaths (DRDs) in Manitoba, January 01 – June 30, 2020

AB1456



Data source: Admissions, Discharge & Transfer (ADT)

Figure 11: Monthly number of unique Manitobans hospitalized due to a reason related to substance use/misuse by substance type, January 01, 2019 – August 31, 2020



Data source: Emergency Department Information System (EDIS)

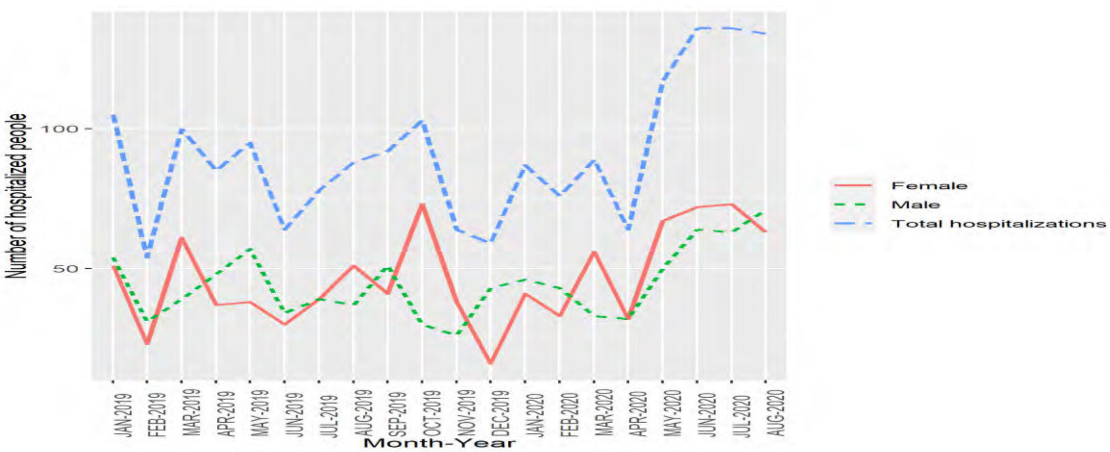
Figure 12: Monthly number of unique Manitobans who had an ED/UCC due to substance use disorders by substance type, January 01, 2019 – August 31, 2020

AB1457

Intentional injuries

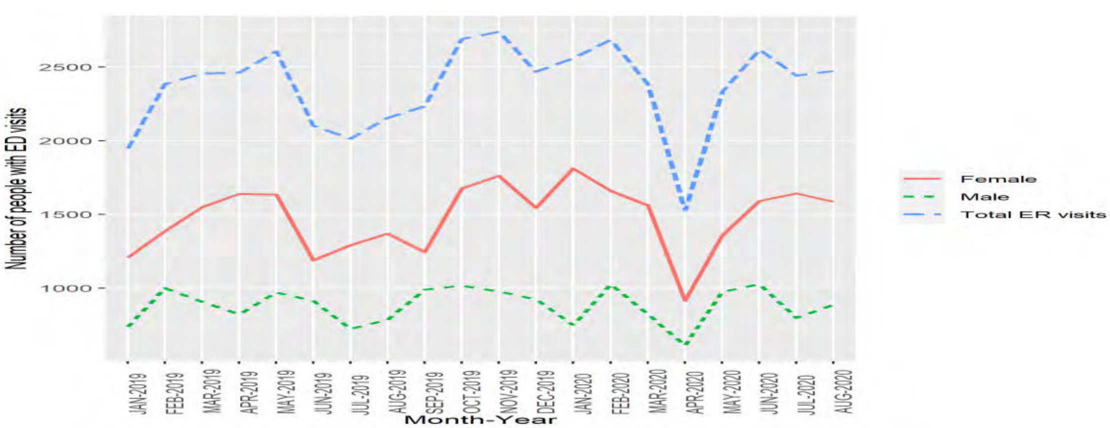
- Monthly number of unique Manitobans hospitalized due to an intentional injury sharply increased from 64 in April 2020 to 134 in August 2020, a 109% increase (Figure 13).
- A similar increasing trend from April to August 2020 was noted for related ED/UCC visits – a 62% increase (Figure 14).
- During COVID-19 period, for both hospitalizations and ED/UCC visits, the highest numbers of people with an intentional injury was noted in June 2020(Figure 13 & 14).
- An increasing trend was especially noted for self-harm related hospitalizations and ED/UCC visits, for stabbing related hospitalizations, and for assault related ED/UCC visits (Figure 15 & 16).

Note: Further details on hospitalization (Figure 41) and ED/UCC visits (Figure 42) for intentional injuries by age group are presented in the Appendix.



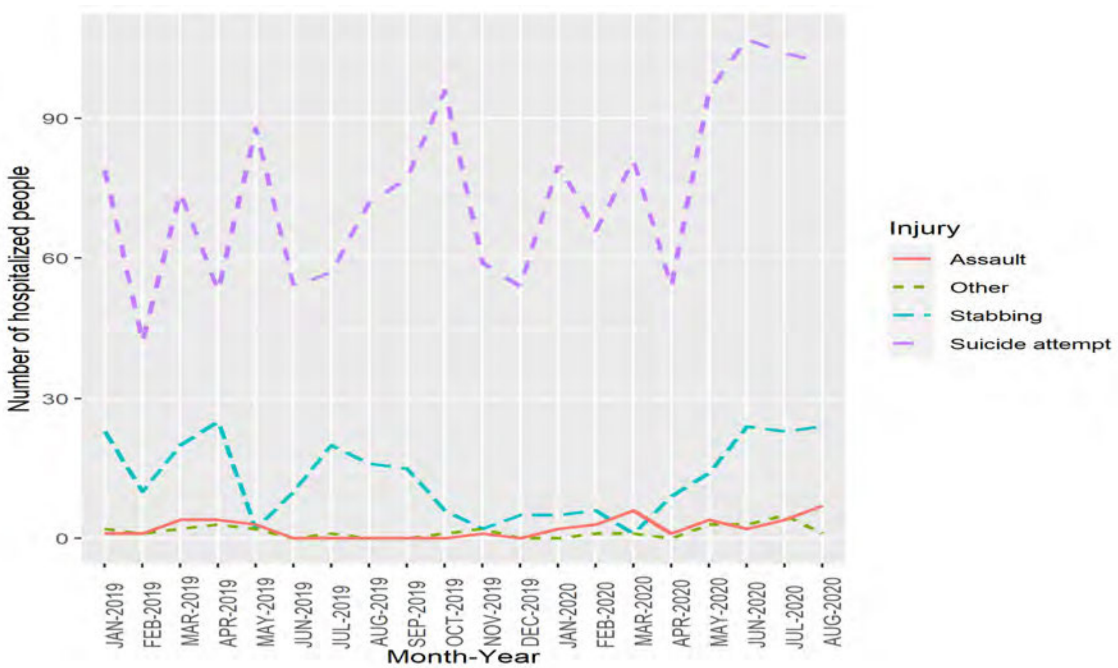
Data source: Admissions, Discharge & Transfer (ADT)

Figure 13: Monthly number of unique Manitobans hospitalized due to a reason related to intentional injury by sex, January 01, 2019 – August 31, 2020



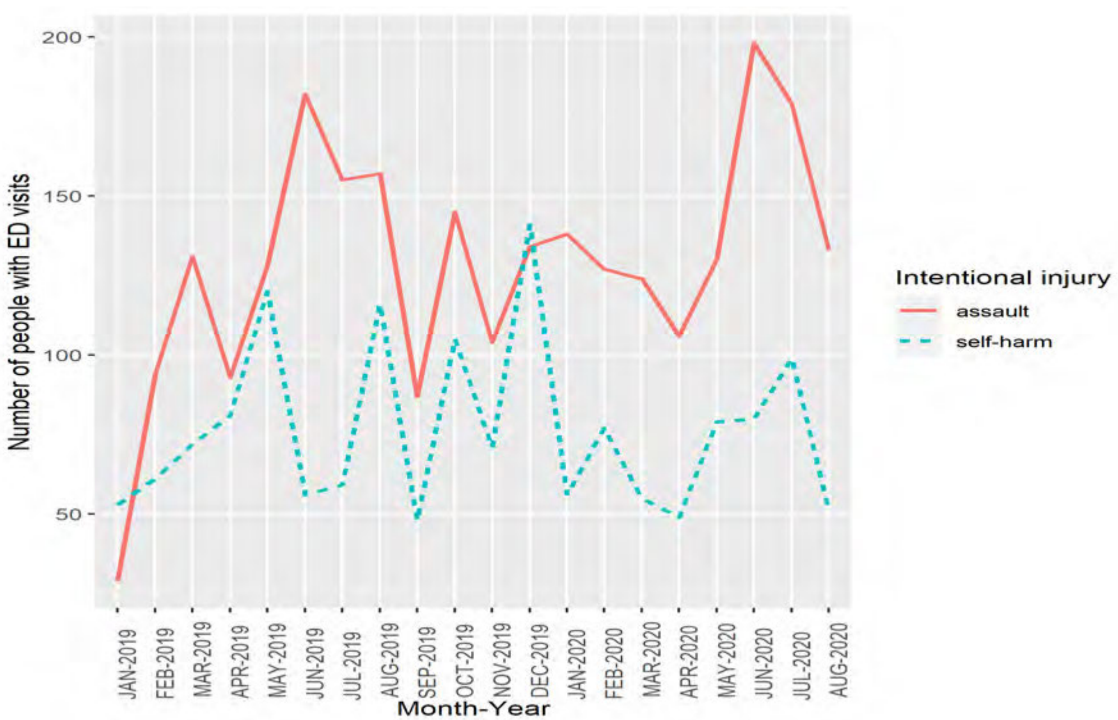
Data source: Emergency Department Information System (EDIS)

Figure 14: Monthly number of unique Manitobans with an ED/UCC visit due to a reason related to intentional injury, January 01, 2019 – August 31, 2020



Data source: Admissions, Discharge & Transfer (ADT)

Figure 15: Monthly number of unique Manitobans hospitalized due to a reason related to intentional injury by injury type, January 01, 2019 – August 31, 2020



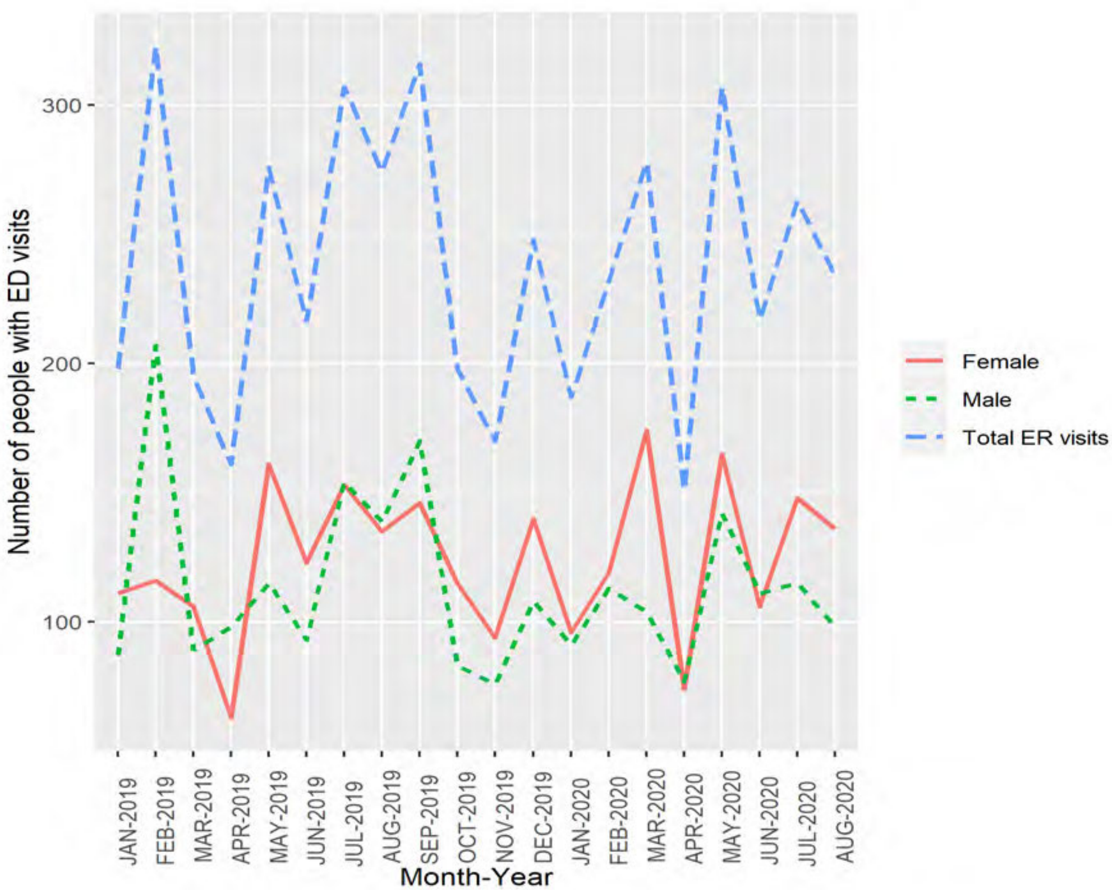
Data source: Emergency Department Information System (EDIS)

Figure 16: Monthly number of unique Manitobans with an ED/UCC visit due to intentional injuries by injury type, January 01, 2019 – August 31, 2020

Accidental poisoning

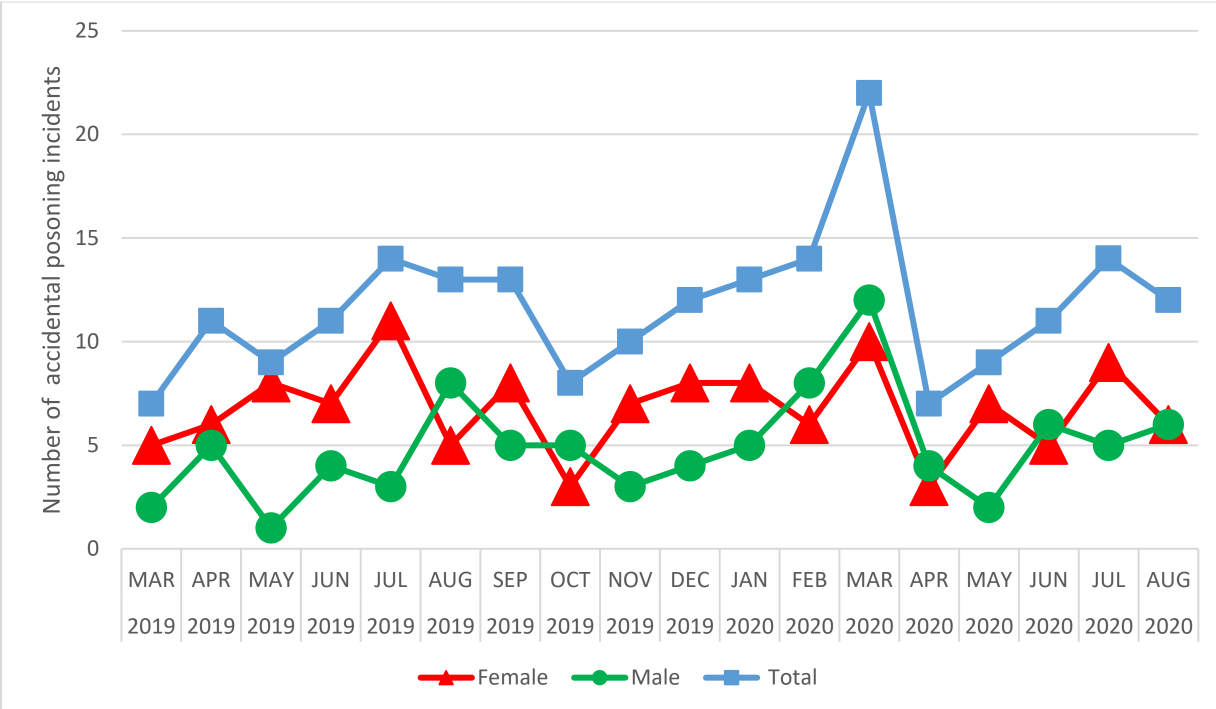
- During COVID-19 period, after a two times increase from April (n=151) to May (n=307), the number of unique Manitobans with an ED/UCC visit due to accidental poisoning decreased to 217 in June, 263 in July, and 234 in August 2020 (Figure 17)
- The corresponding data for accidental poisoning calls to WFPS fluctuated from 22 calls in March to 7 calls in April, 14 calls in July and 12 calls in August 2020 (Figure 18).
- During COVID-19 period, the number of poisoning calls to Manitoba Poison Centre due to improper use of cleaning and disinfecting products was at the highest in March 2020 (n=42) but it declined to 28 in July 2020 (Figure 19). In August 2020, the number of poisoning calls increased back to 39, especially due to hand sanitizer related accidental poisoning calls.

Note: Further details on ED/UCC visits for accidental poisoning by age group is presented in the Appendix (Figure 43).



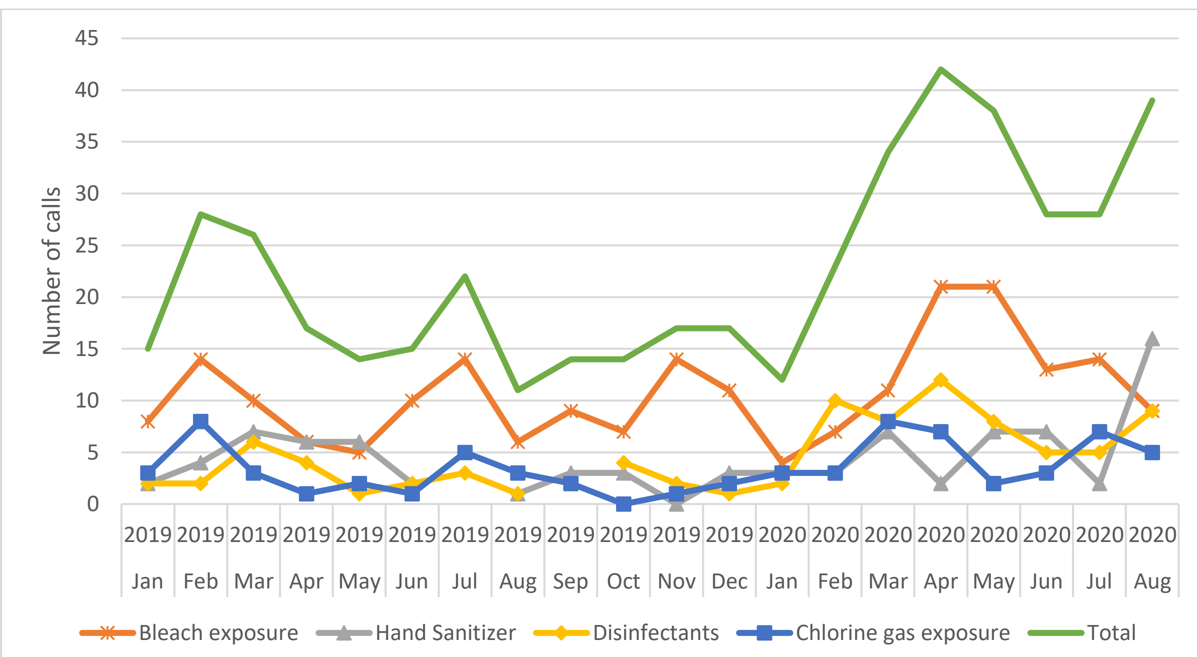
Data source: Emergency Department Information System (EDIS)

Figure 17: Monthly number of unique Manitobans who had an ED/UCC visit due to accidental poisoning, January 01, 2019 – August 31, 2020



Data source: Winnipeg Fire and Paramedic Service (WFPS), City of Winnipeg

Figure 18: Monthly number of accidental poisoning related calls to Winnipeg Fire and Paramedic Service by sex, January 01, 2019 – August 31, 2020

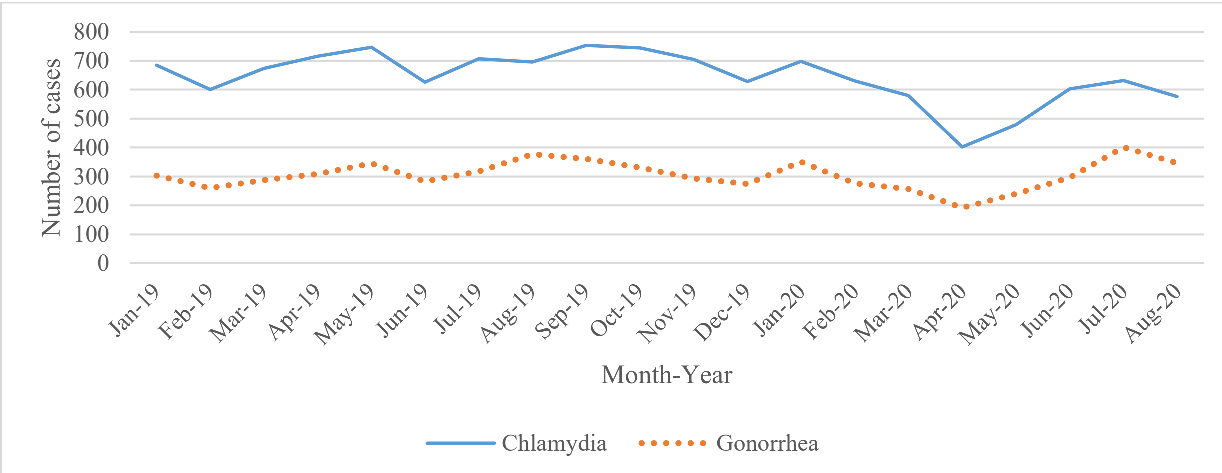


Data source: Manitoba Poison Centre

Figure 19: Monthly number of calls to Manitoba Poison Centre for improper use of bleach, chlorine gas, select disinfectants, and hand sanitizers, January 01, 2019 – August 31, 2020

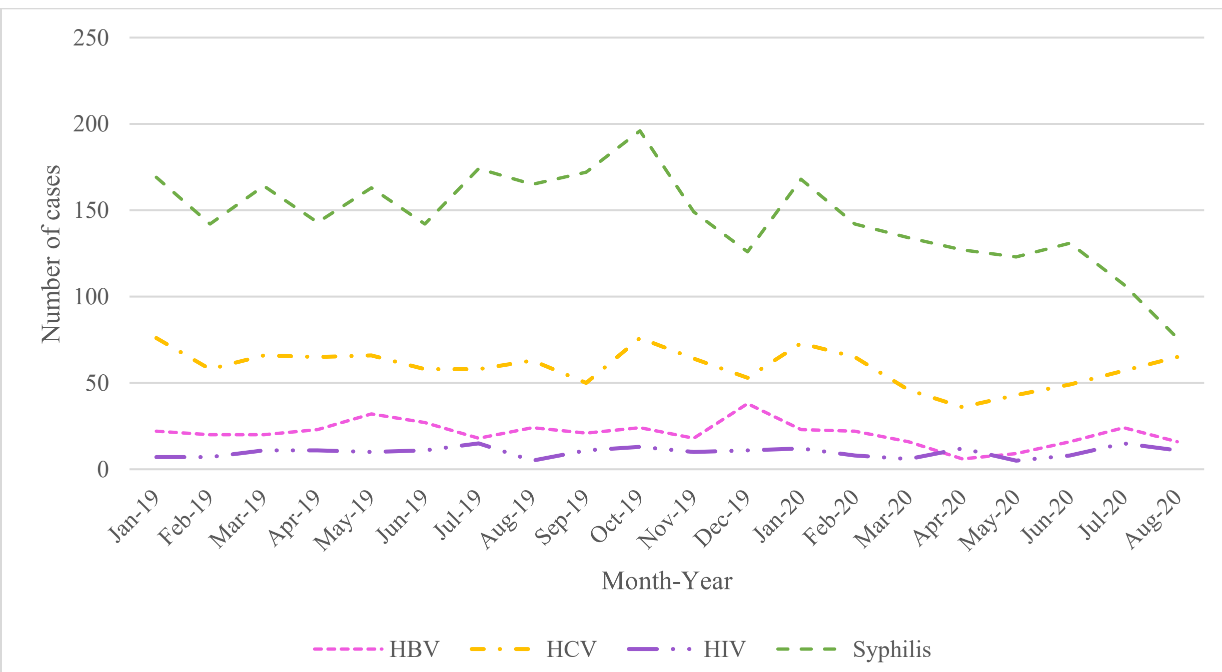
Sexually transmitted and blood-borne infections

- The monthly number of chlamydia and gonorrhea in Manitoba increased by 43% and 80% from April to August 2020, respectively (Figure 20).
- A similar increasing trend from April to July 2020 was noted for HBV (a 167% increase) and HCV (an 81% increase). Conversely, a 40% decrease was noted for syphilis during the same period (Figure 21).



Data source: Public Health Information Management System (PHIMS)

Figure 20: Monthly number of unique Manitobans diagnosed with chlamydia and/or gonorrhea, January 01, 2019 – August 31, 2020



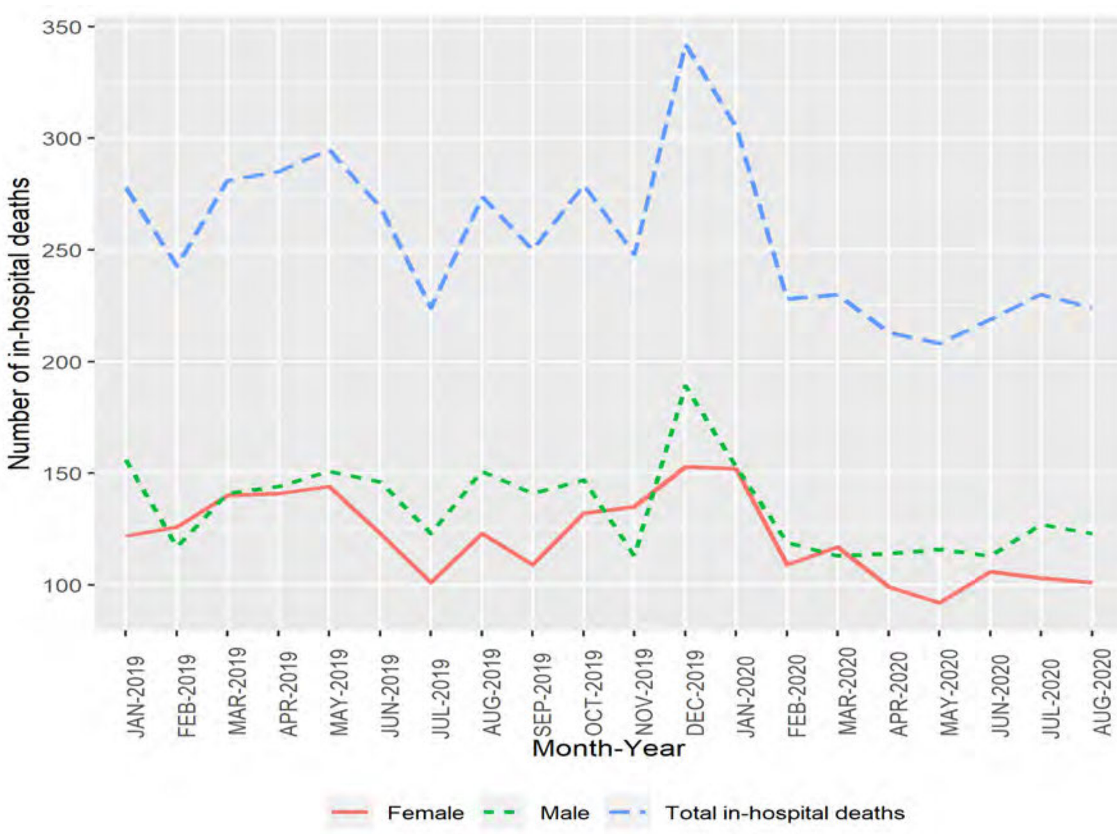
Data source: Public Health Information Management System (PHIMS)

Figure 21: Monthly number of unique Manitobans diagnosed with HBV, HCV, HIV, or syphilis, January 01, 2019 – August 31, 2020

Severe outcomes

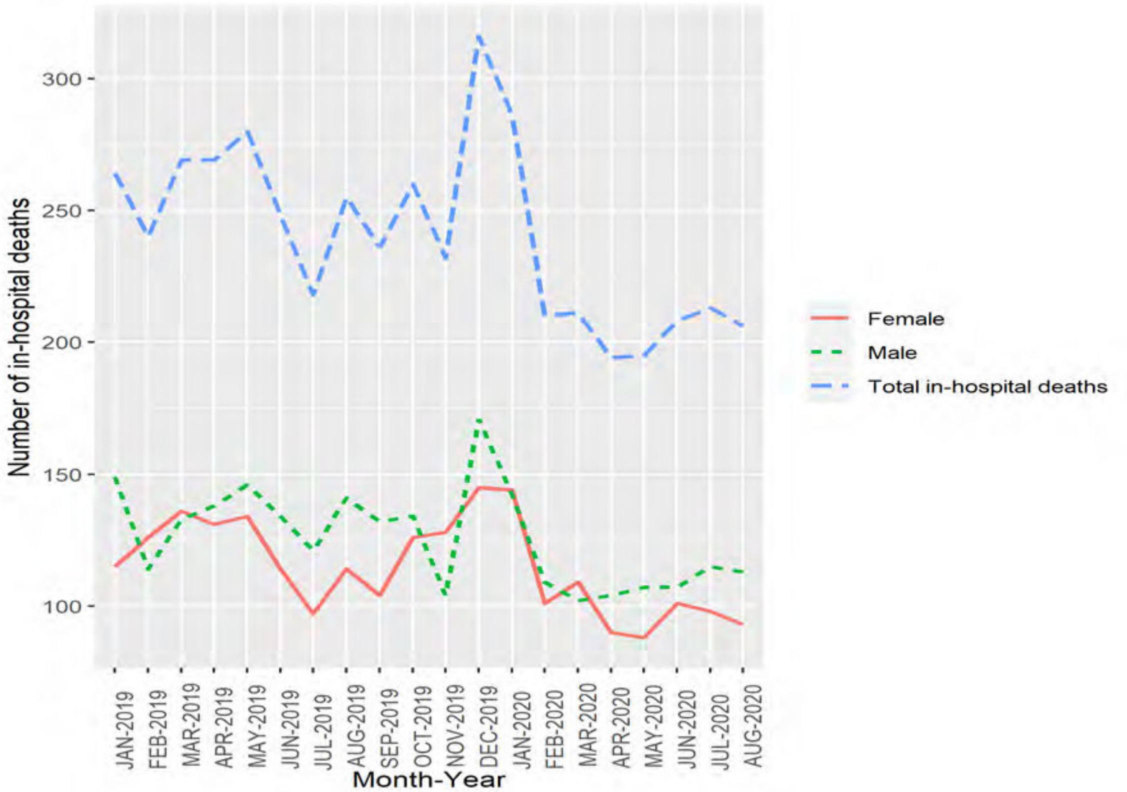
- In 2020, after the monthly number of in-hospital deaths (due to any cause) decreased slightly in April (n=213) and May 2020 (n=208), it increased to 230 in July and 224 in August, a 5% increase from April to August (Figure 22).
- A similar trend for in-hospital deaths was noted in those with a chronic condition (as of 2018/19 FY) with a decline in April and May and a 6% increase from April to August (Figure 23).
- In 2020, the monthly number of unique Manitobans with chronic condition who had an ICU admission increased from 85 events in April to 111 events in July and 104 events in August, a 22% increase in August vs April, especially in males (Figure 24).
- Similar increasing trend from April to August 2020 visits in the chronic condition population was noted for ED/UCCs, a 41% increase (Figure 25).

Note: Monthly number of in-hospital deaths (due to any cause) in Manitoba's general population by age group is presented in the Appendix (Figure 44). In addition, in-hospital deaths in Manitoba's chronic condition population by age group (Figure 45) and ED/UCC visits in the chronic condition population by CTAS score (Figure 46) are presented in Appendix.



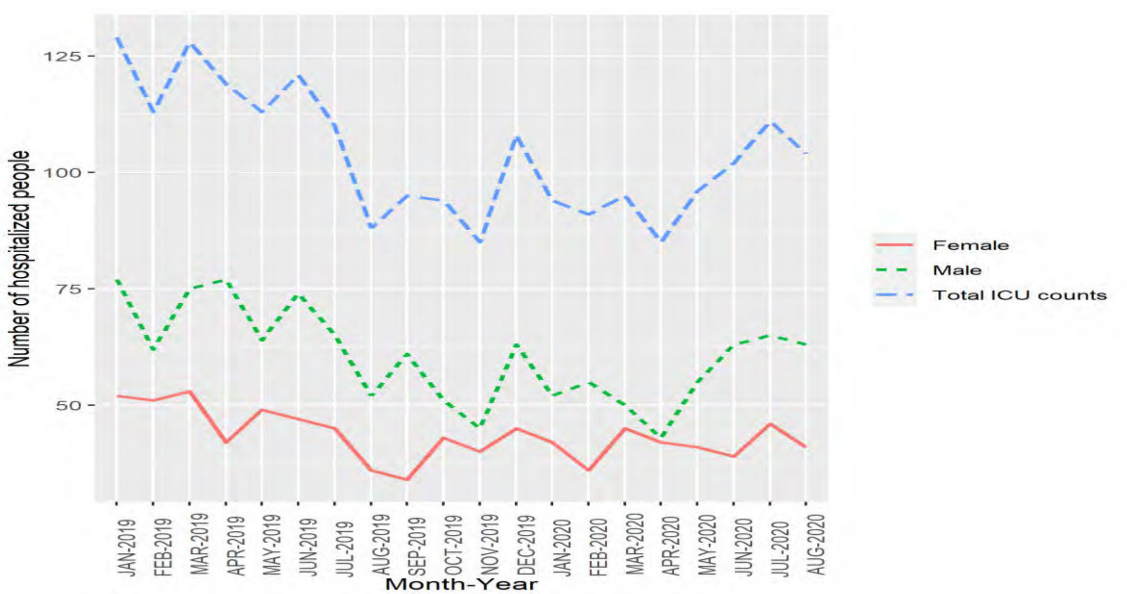
Data source: Admissions, Discharge & Transfer (ADT)

Figure 22: Monthly number of in-hospital deaths (due to any cause) in Manitoba by sex, January 01, 2019 - August 31, 2020



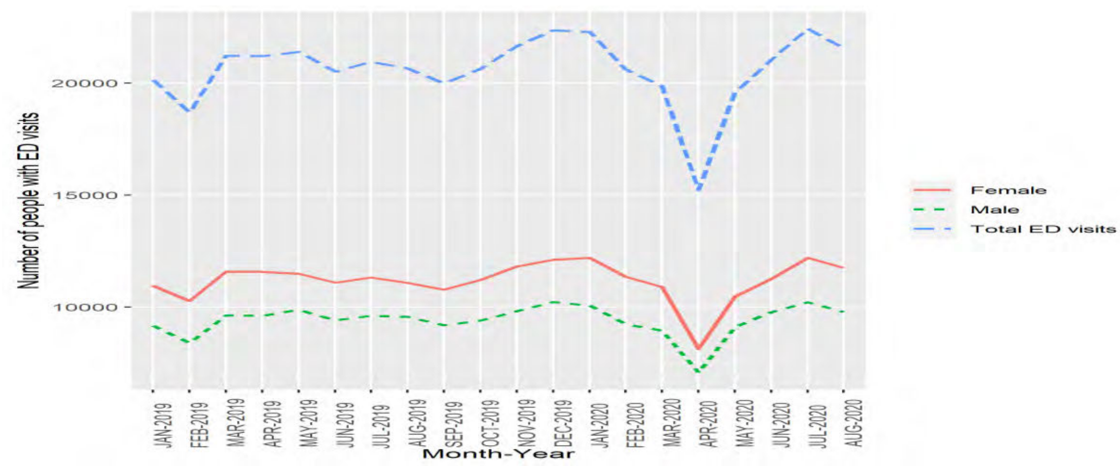
Data source: Admissions, Discharge & Transfer (ADT)

Figure 23: Monthly number of unique Manitobans with a chronic condition (as of 2018/19 FY) who died (due to any cause) in hospital by sex, January 01, 2019 – August 31, 2020



Data source: Admissions, Discharge & Transfer (ADT)

Figure 24: Monthly number of unique Manitobans with a chronic condition (as of 2018/19 FY) who had an ICU hospitalization by sex, January 01, 2019 – August 31, 2020

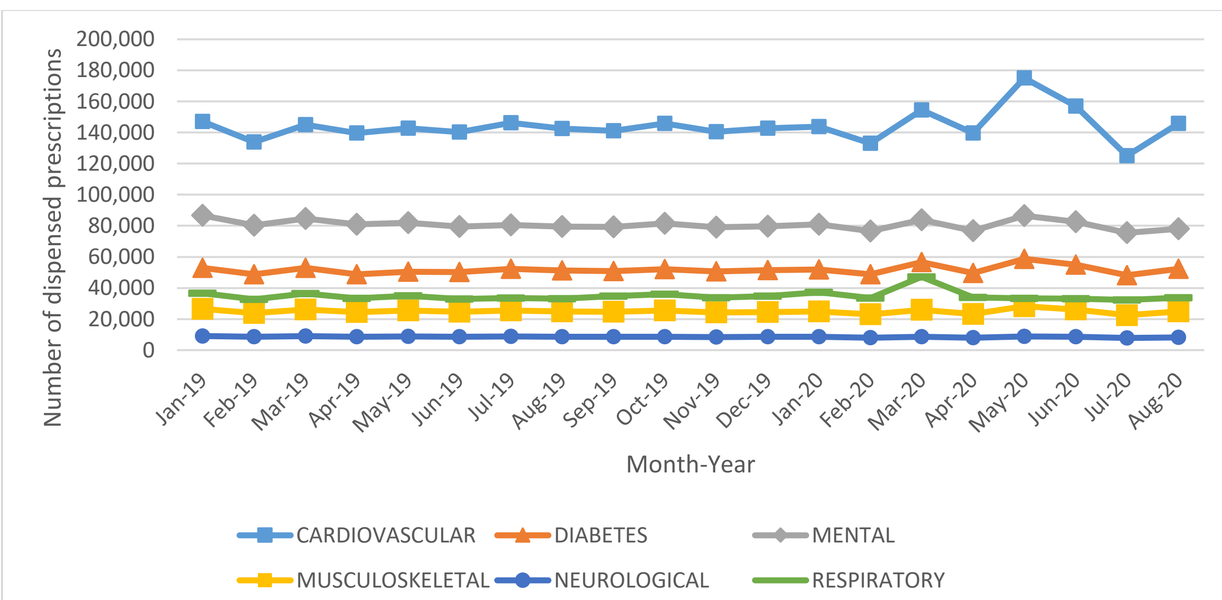


Data source: Emergency Department Information System (EDIS)

Figure 25: Monthly number of unique Manitobans with a chronic condition (as of 2018/19 FY) who had an ED/UCC visit (due to any medical conditions) by sex, January 01, 2019 – August 31, 2020

Prescription dispensation among Manitobans with a chronic condition

- In general, the monthly number of unique Manitobans with a chronic condition who dispensed a prescription for their condition increased in March and May 2020 followed with a decrease in June and July 2020 (Figure 26). *Note: This trend corresponds with the drug dispensation policy during COVID-19 where in March 2020, the province placed a one-month limit on prescription drugs; in May 2020, those restrictions have been lifted to get three months worth of prescriptions — as long as the drugs aren't in short supply.*

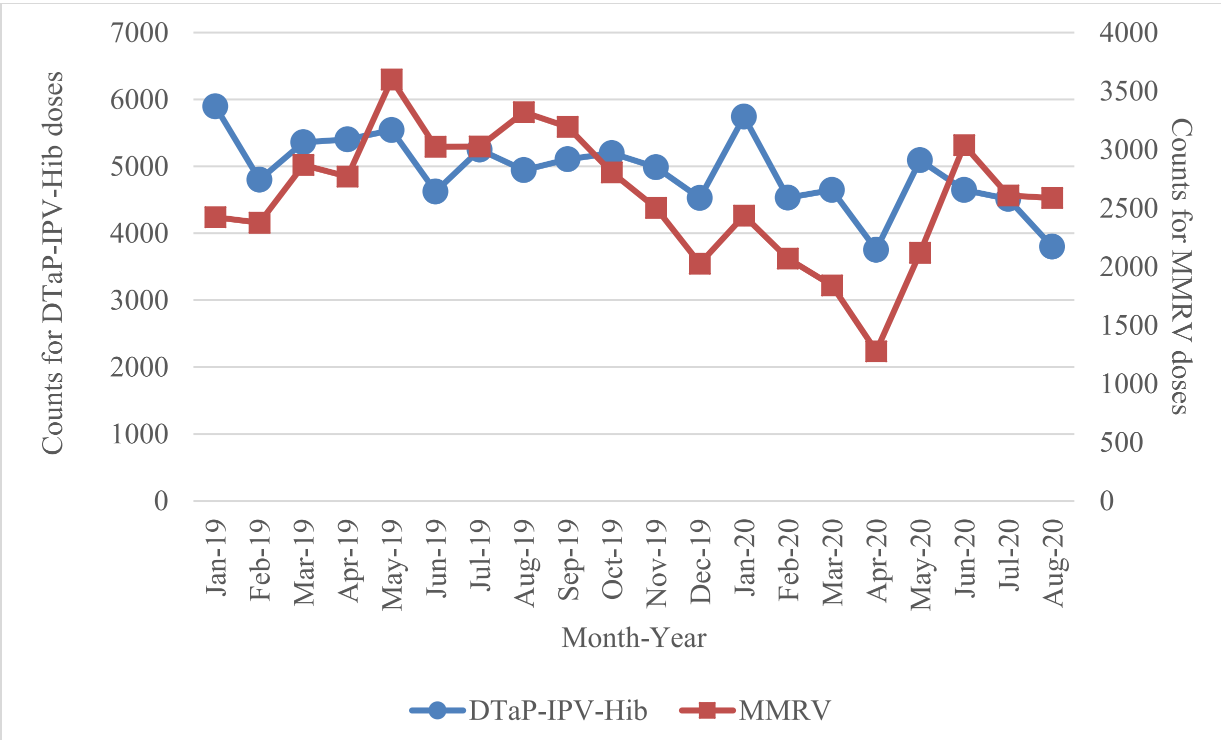


Data source: Drug Program Information Network (DPIN)

Figure 26: Monthly number of unique Manitobans with a chronic condition who dispensed a prescription for their condition, January 01, 2019 – August 31, 2020

Immunization coverage

- During COVID-19 period, monthly number of MMRV immunization doses administered in Manitoba increased from 1,278 doses in April to 2,588 doses in August, a 103% increase. The corresponding data was at the highest in June 2020 with 3,038 MMRV doses (Figure 27).
- For DTaP-IPV-Hib immunization doses, there was an increase from 3,754 doses in April to 5,091 doses in May 2020 but it gradually decreased to 3,802 in August 2020.



Data source: Public Health Information Management System (PHIMS)

DTaP - IPV – Hib: Diphtheria, Tetanus, acellular Pertussis, Polio and Haemophilus influenzae type b; MMRV: Measles, Mumps, Rubella, and Varicella

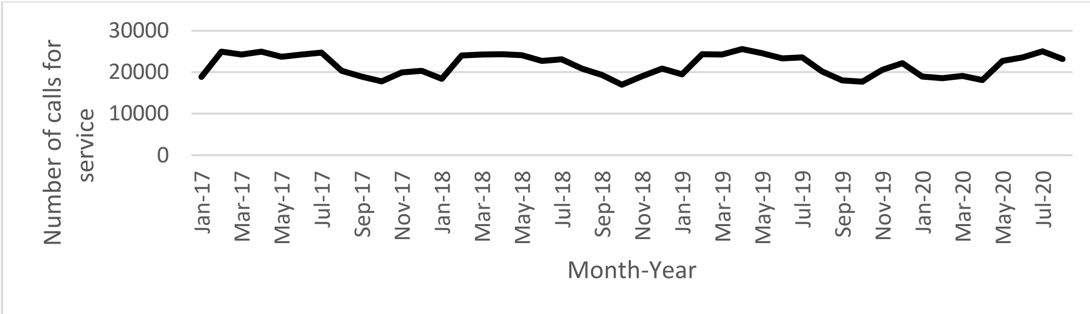
Figure 27: Monthly number of DTaP-IPV-Hib and MMRV immunization doses administered in Manitoba, January 01, 2019 - August 31, 2020

Crimes reported by Winnipeg Police Service

- Overall, the number of crime calls for WPS stayed stable in March 2020 (n=19,109) and April 2020 (n=18,078) but increased to 23,172 in August 2020, a 28% increase from April to August 2020 (Figure 32).
- This increase was noted in all Winnipeg community areas but especially in Downtown and Point Douglas community areas (Figure 29).
- From April to August 2020, the top three crime categories saw the highest increase were traffic (an 85% increase), intoxicated persons (a 59% increase), and violence (a 55% increase) (Figure 30).

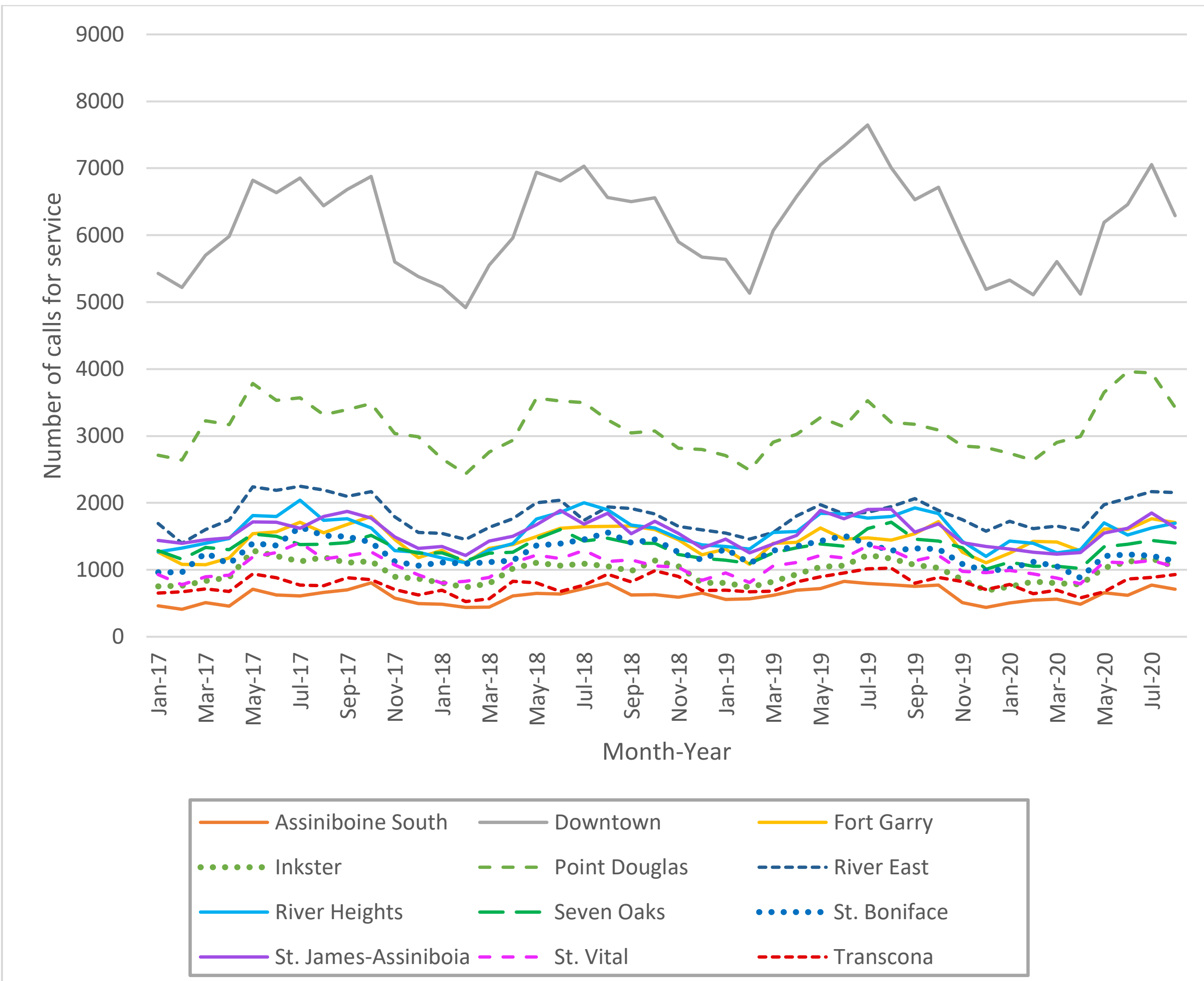
Note: Monthly number of service calls to Winnipeg Police by event type in each service category is presented in Appendix (Figure 46 – Figure 52).

AB1466



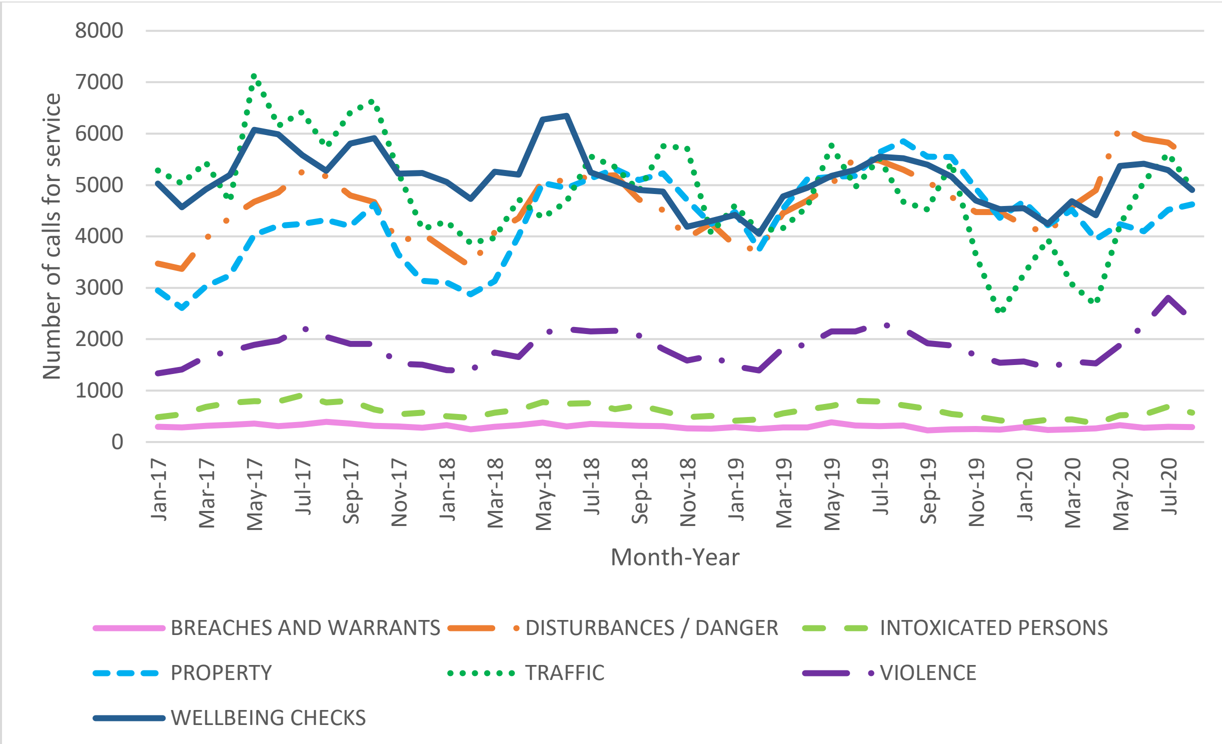
Data source: Winnipeg Police calls for service data.

Figure 28: Monthly number of calls for service to Winnipeg Police, January 01, 2017 – August 31, 2020



Data source: Winnipeg Police calls for service data.

Figure 29: Monthly number of calls for service to Winnipeg Police by community area, January 01, 2017 – August 31, 2020



Data source: Winnipeg Police calls for service data.

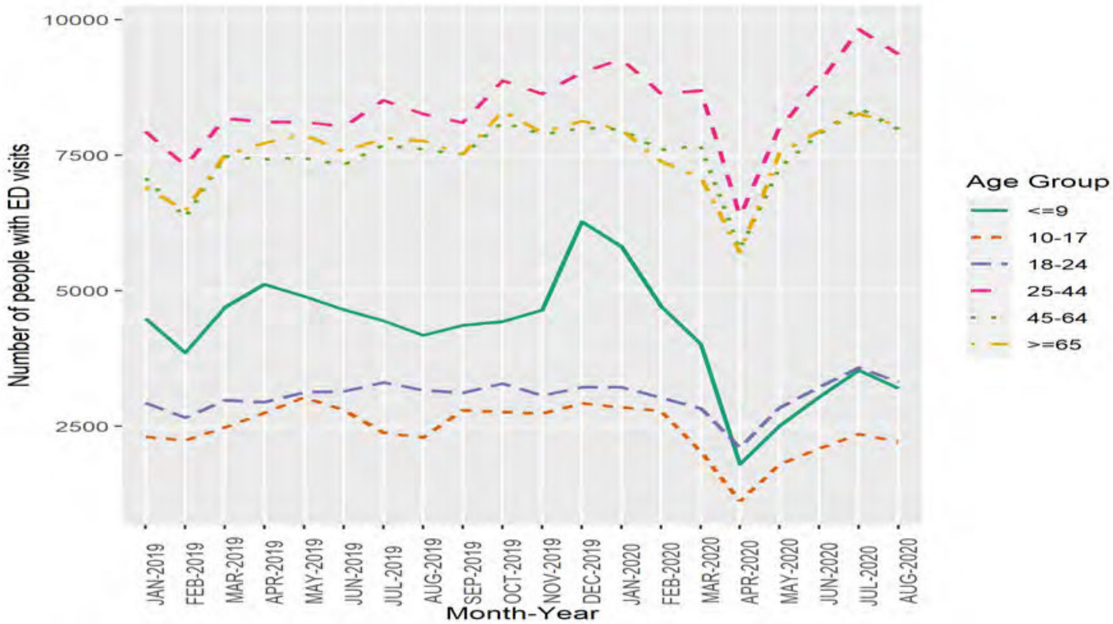
Figure 30: Monthly number of calls for service to Winnipeg Police by service type, January 01, 2017 – August 31, 2020

Conclusion

This report describes the impacts of COVID-19 public health measures on various health and crime indicators in Manitoba from the beginning of the pandemic (March 2020) to August 2020. Our analysis indicated that *overall*, in Manitoba, health services use due to any medical conditions, mental and behavioral disorders, substance use disorders, intentional injuries, accidental poisoning, or MMRV immunization increased from April to August 2020. A similar increasing trend during the same period was noted for ICU admissions and ED/UCC visits in those with a chronic condition, for diagnosis with chlamydia, gonorrhea, HBV, and/or HCV, and service calls to WPS. Conversely, a decreasing trend was noted for lab-confirmed diagnosis of syphilis.

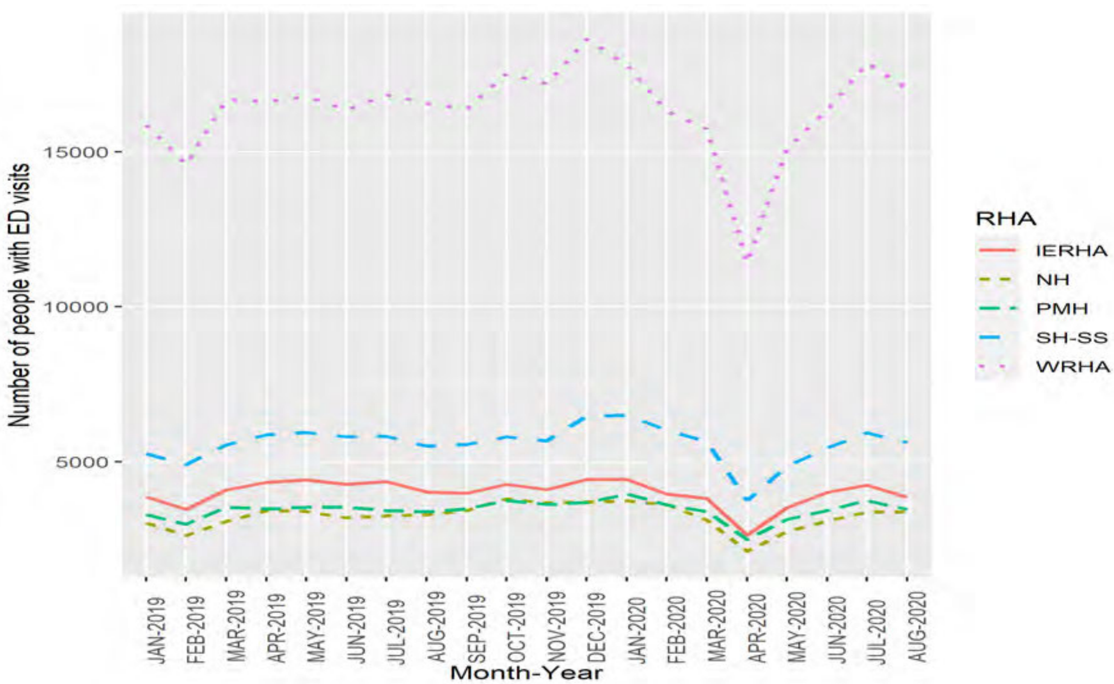
Ongoing monitoring of impacts of COVID-19 public health measure on various health indicators is important and, therefore, future analyses are suggested to determine if these trends hold over time.

Appendix



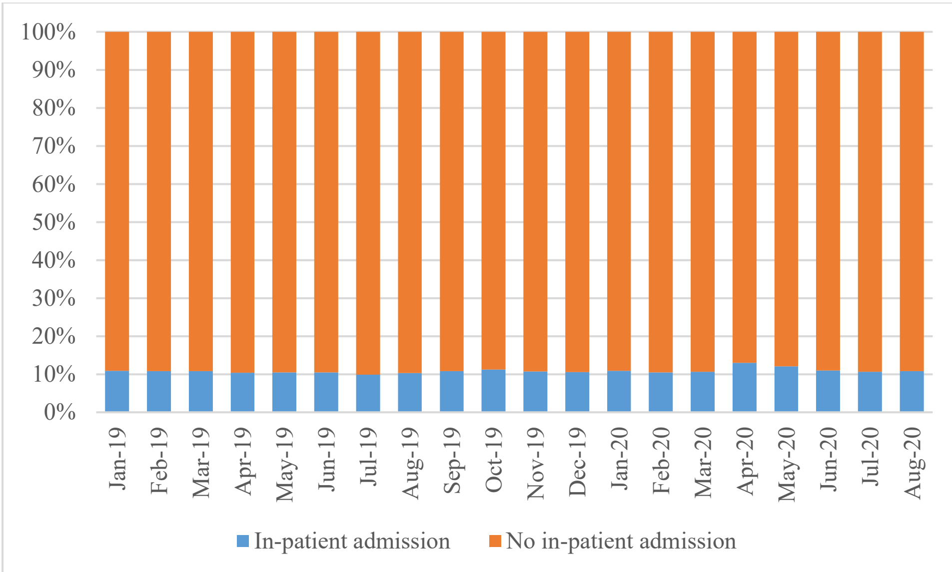
Data source: Emergency Department Information System (EDIS)

Figure 31: Monthly number of unique Manitobans with an ED/UCC visit due to any medical health conditions by age group, January 01, 2019 - August 31, 2020



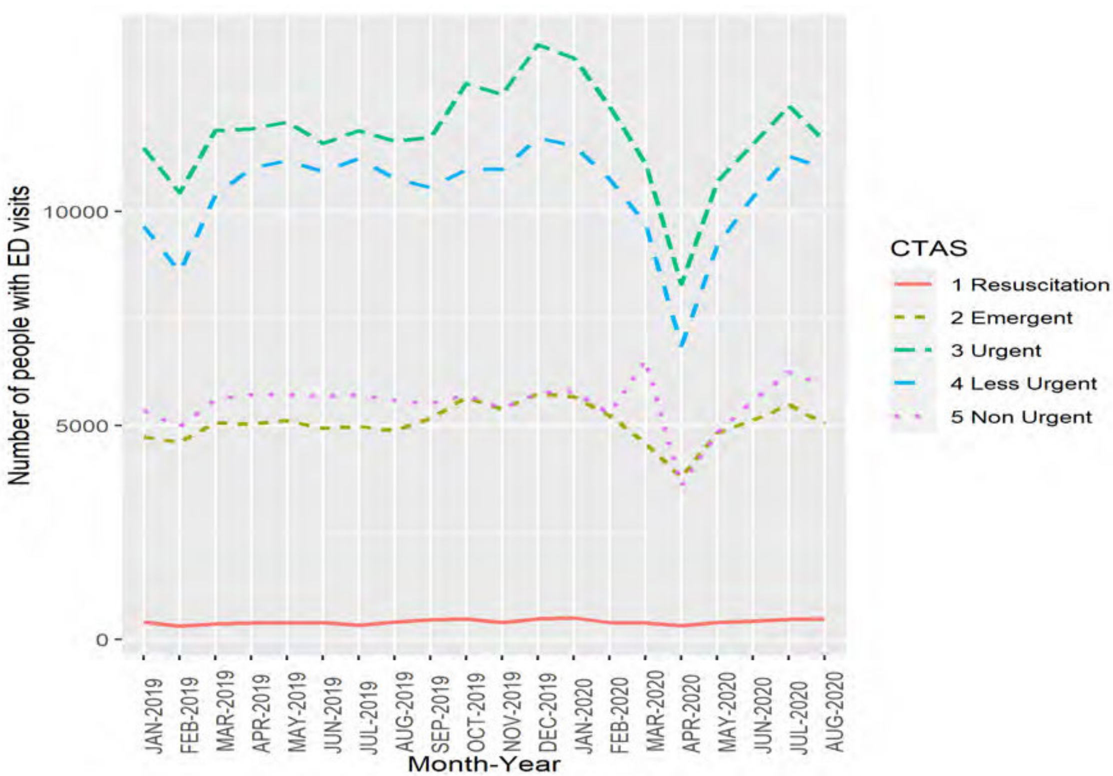
Data source: Emergency Department Information System (EDIS)

Figure 32: Monthly number of unique Manitobans with an ED/UCC visit due to any medical health conditions by health region of residence, January 01, 2019 - August 31, 2020



Data source: Emergency Department Information System (EDIS)

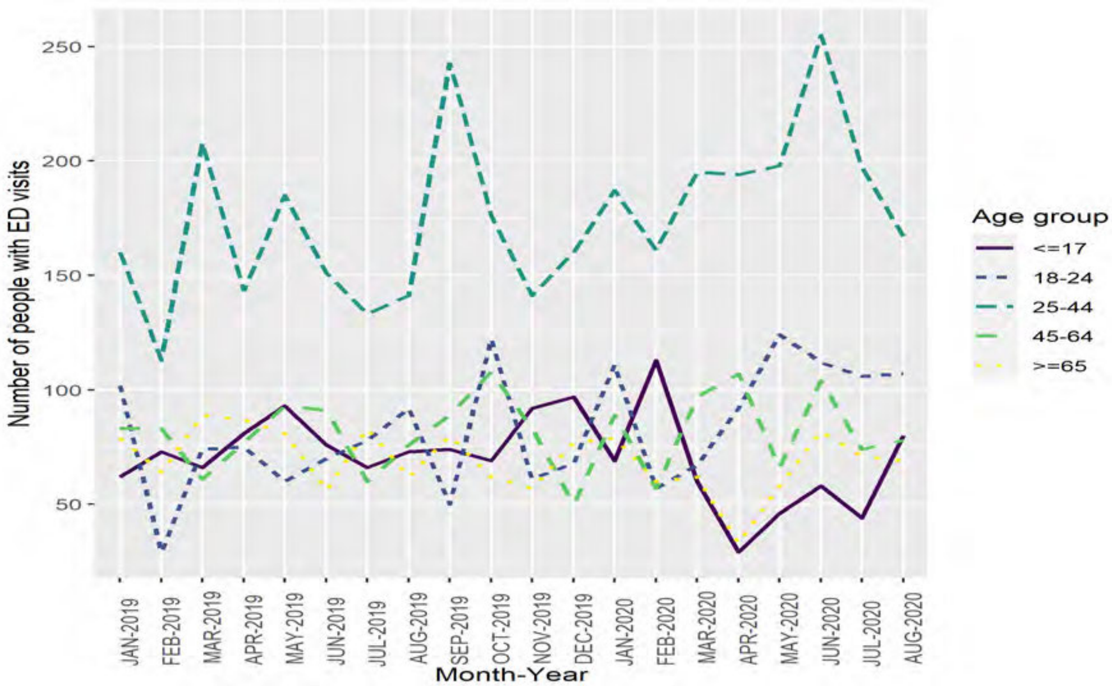
Figure 33: Proportion of unique Manitobans with an ED/UCC visit due to any medical health conditions by in-patient hospitalization status, January 01, 2019 - August 31, 2020



Data source: Emergency Department Information System (EDIS)

Figure 34: Monthly number of ED/UCC visits due to any medical conditions in Manitoba by Canadian Triage & Acuity Scale (CTAS), January 01, 2019 to August 31, 2020

AB1470

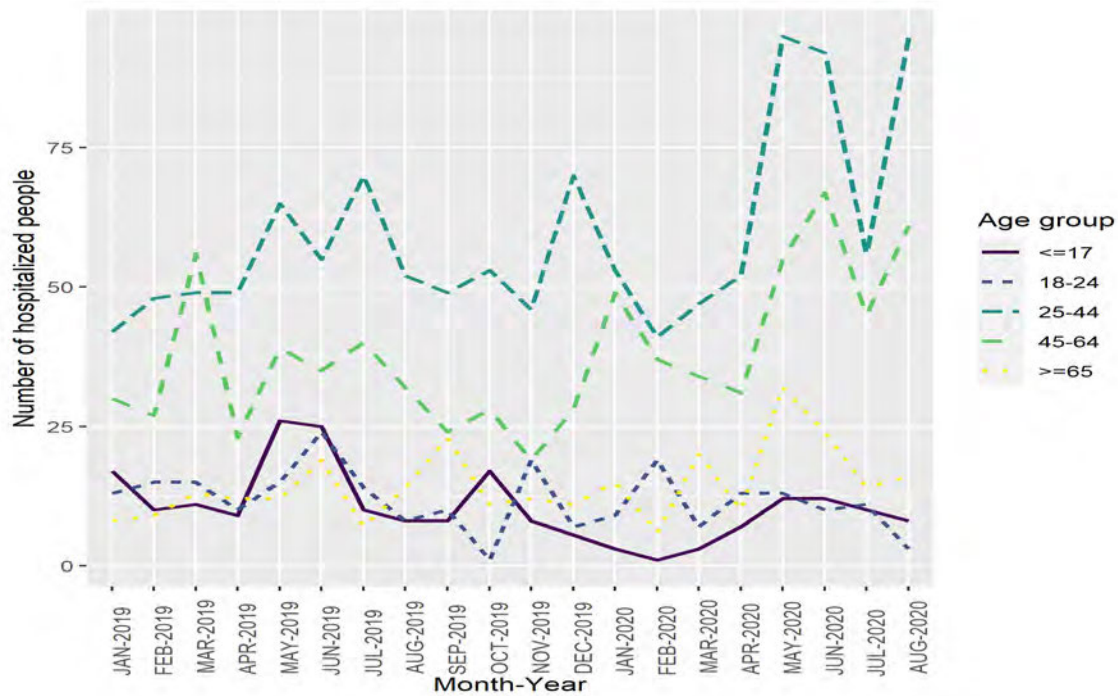


Data source: Admissions, Discharge & Transfer (ADT)

Figure 35: Monthly number of unique Manitobans hospitalized due to a reason related to mental and behavioural disorders by age groups, January 01, 2019 – August 31, 2020

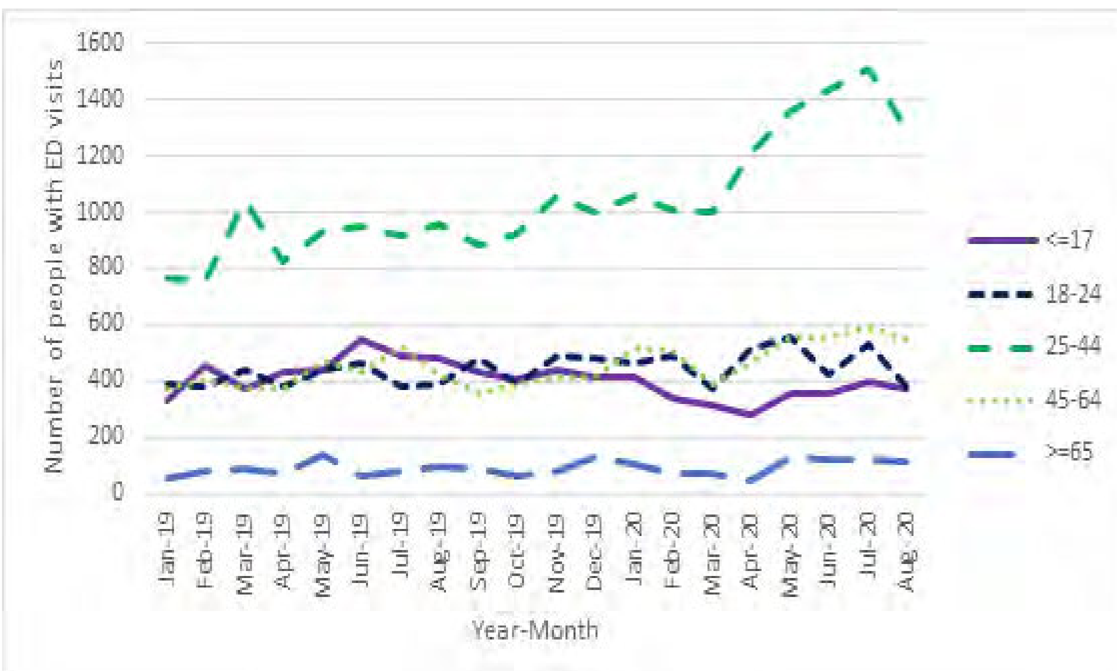
Data source: Emergency Department Information System (EDIS)

Figure 36: Monthly number of unique Manitobans who had an ED/UCC visit due to mental and behavioural disorders by age groups, January 01, 2019 – August 31, 2020



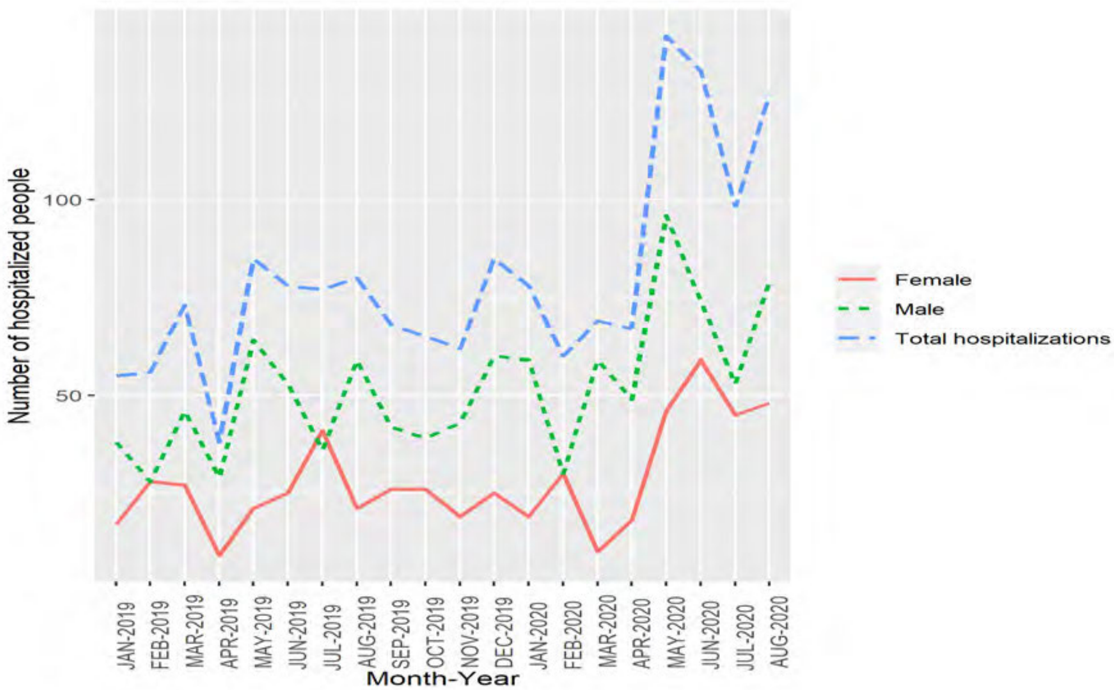
Data source: Admissions, Discharge & Transfer (ADT)

Figure 37: Monthly numbers of Manitobans hospitalized due to a reason related to substance use/misuse by age group, January 01, 2019 – August 31, 2020



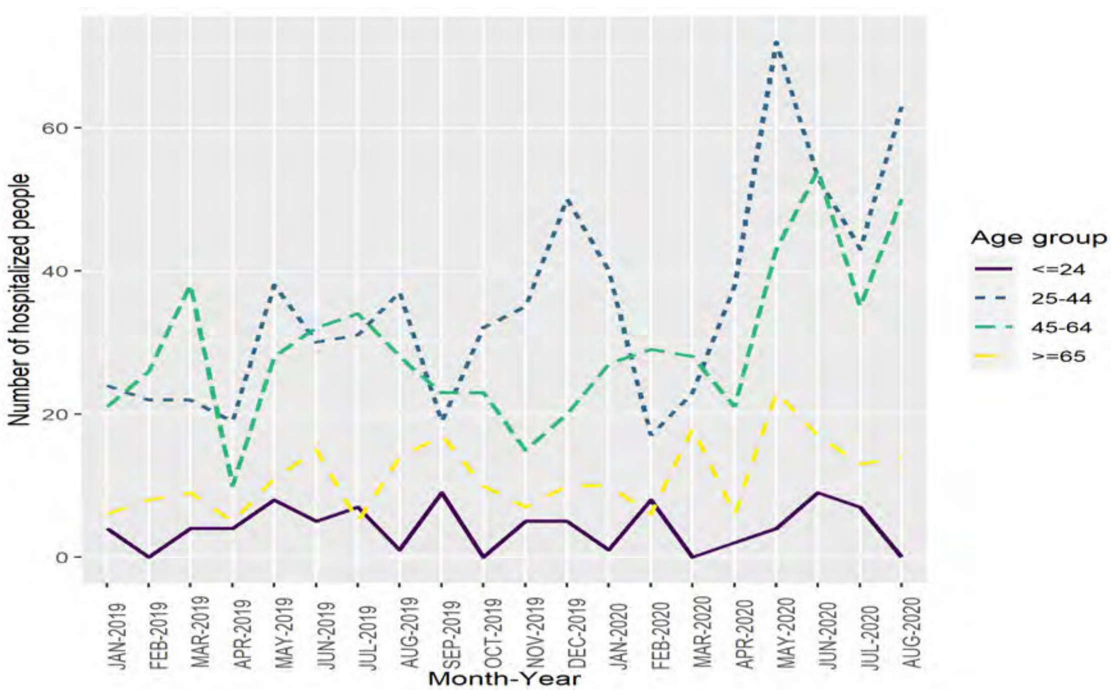
Data source: Emergency Department Information System (EDIS)

Figure 38: Monthly number of unique Manitobans who had an ED/UCC visit due to substance use disorders by age group, January 01, 2019 – August 31, 2020



Data source: Admissions, Discharge & Transfer (ADT)

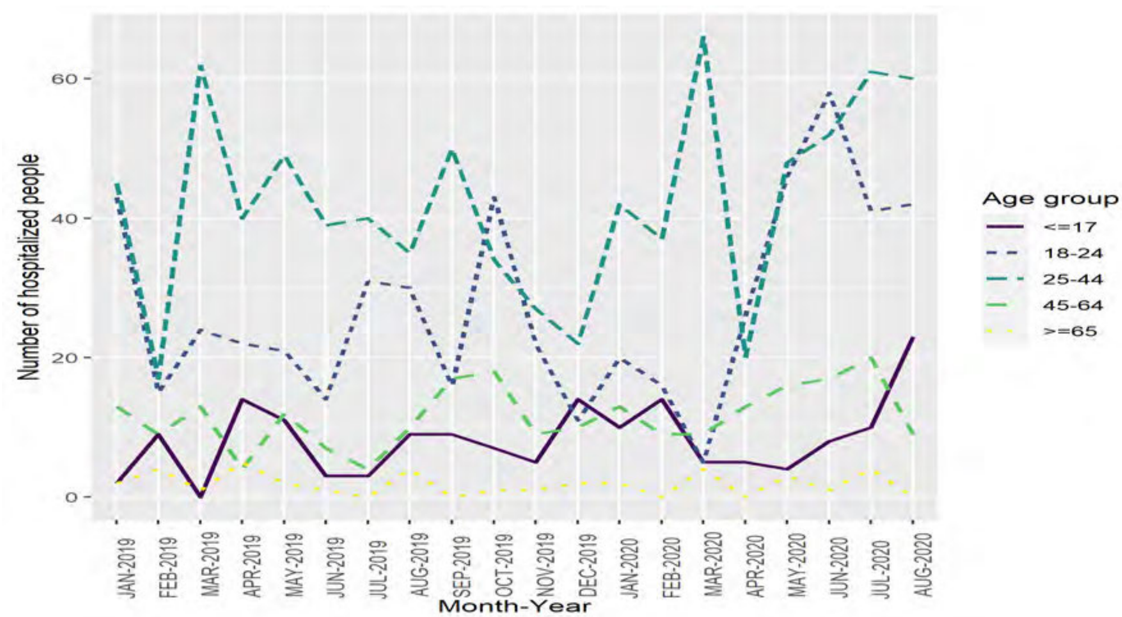
Figure 39: Monthly number of unique Manitobans hospitalized due to a reason related to alcohol use by sex, January 01, 2019 – August 31, 2020



Data source: Admissions, Discharge & Transfer (ADT)

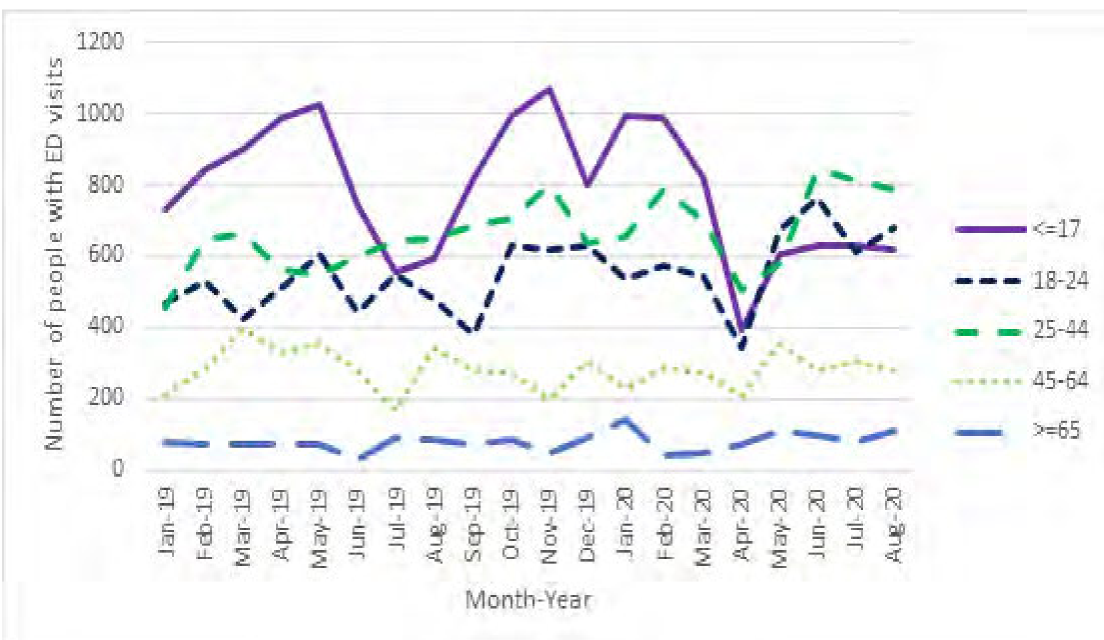
Figure 40: Monthly numbers of Manitobans hospitalized due to a reason related to alcohol use by age group, January 01, 2019 – August 31, 2020

AB1473



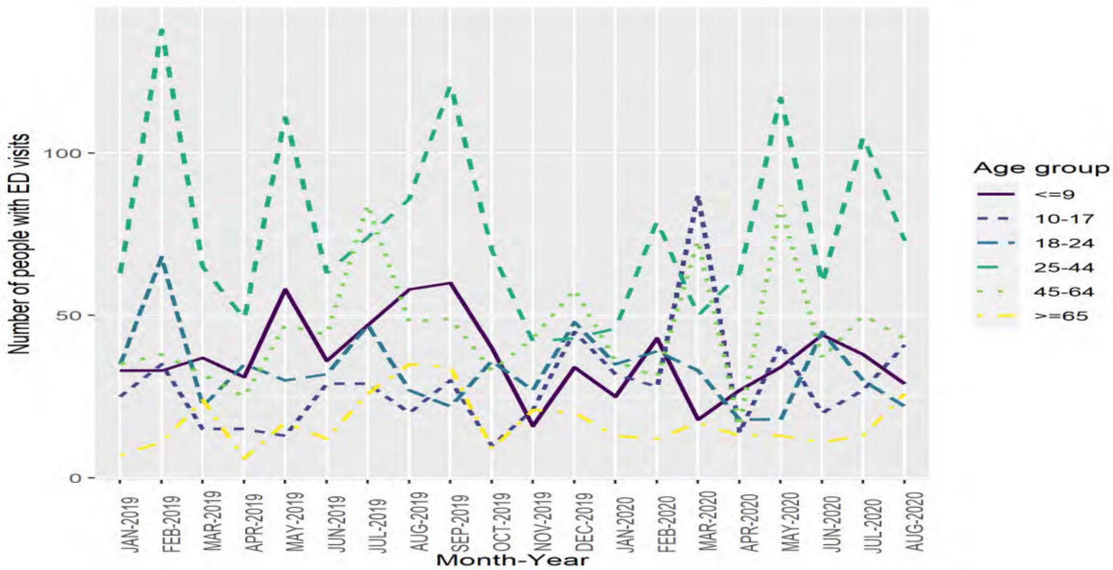
Data source: Admissions, Discharge & Transfer (ADT)

Figure 41: Monthly number of unique Manitobans hospitalized due to a reason related to intentional injury by age groups, January 01, 2019 – August 31, 2020



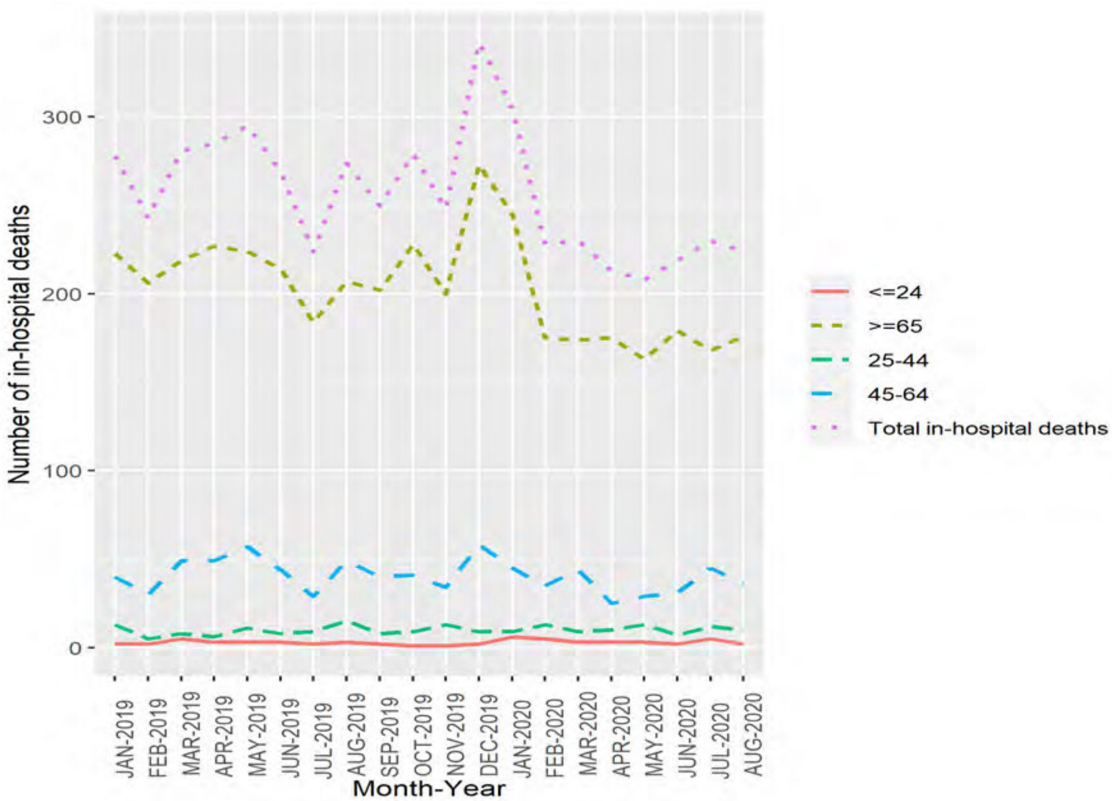
Data source: Emergency Department Information System (EDIS)

Figure 42: Monthly number of unique Manitobans with an ED/UCC visit due to intentional injury by age groups, January 01, 2019 - August 31, 2020



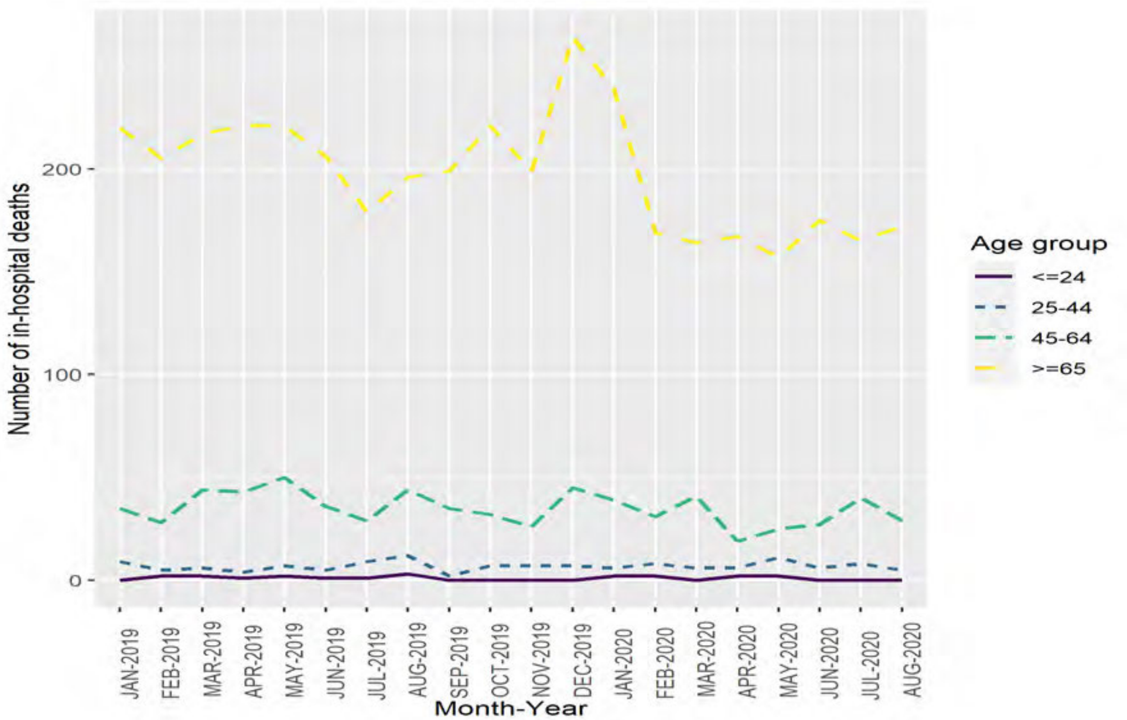
Data source: Emergency Department Information System (EDIS)

Figure 43: Monthly number of unique Manitobans who had an ED/UCC visit due to accidental poisoning by age group, January 01, 2019 – August 31, 2020



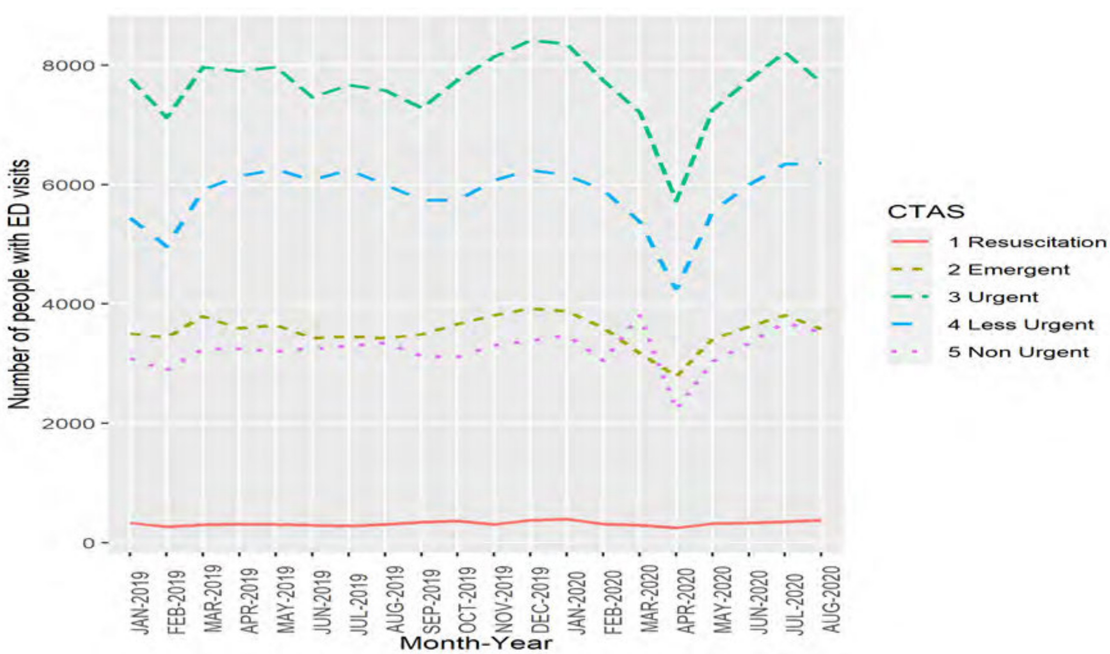
Data source: Admissions, Discharge & Transfer (ADT)

Figure 44: Monthly number of in-hospital deaths (due to any cause) in Manitoba by age group, January 01, 2019 - August 31, 2020



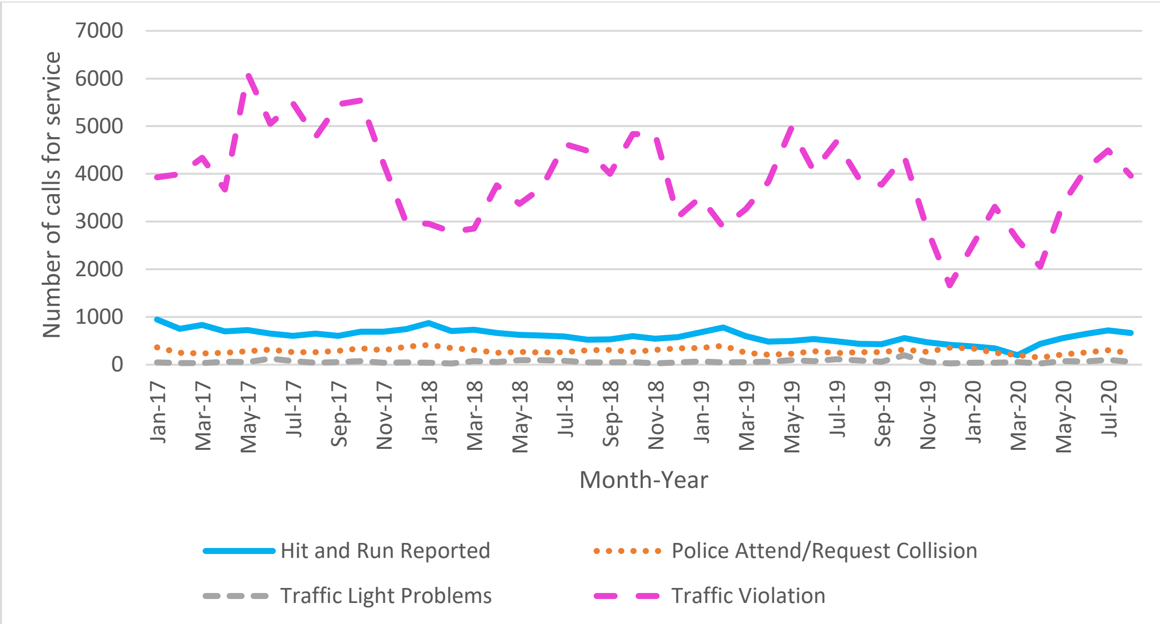
Data source: Admissions, Discharge & Transfer (ADT)

Figure 45: Monthly number of unique Manitobans with a chronic condition (as of 2018/19 FY) who died in hospital by age group, January 01, 2019 – August 31, 2020



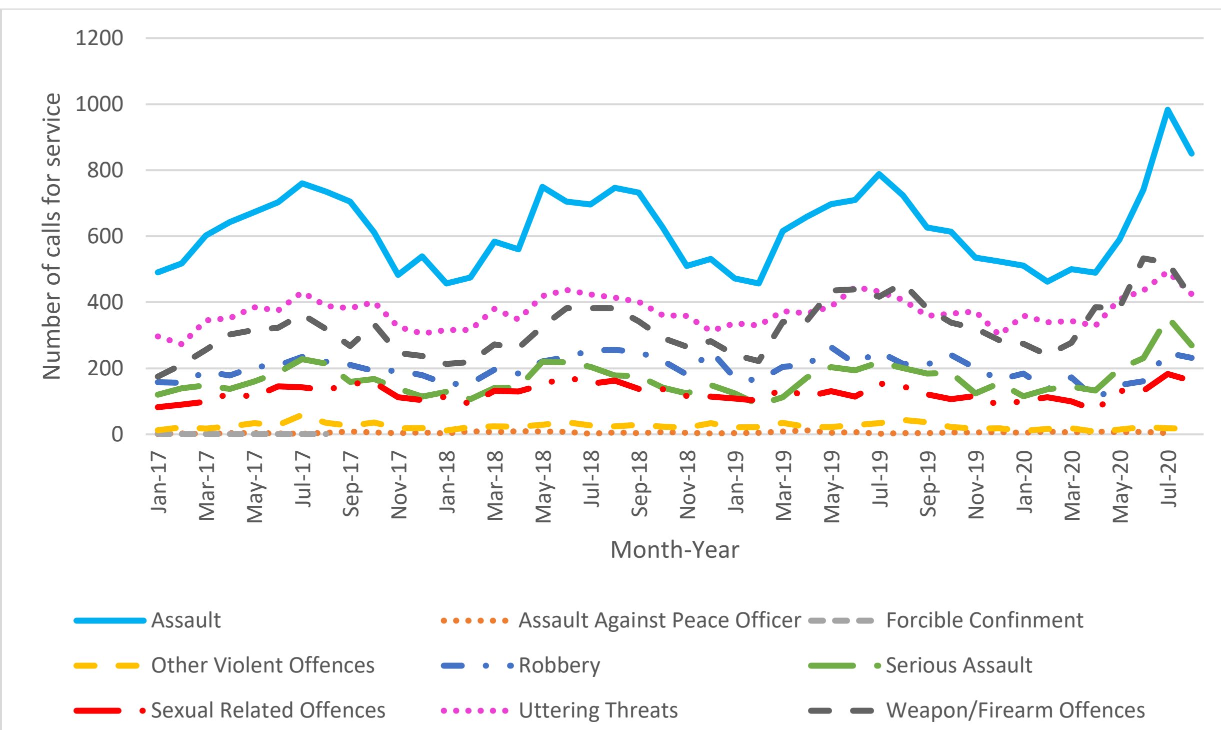
Data source: Emergency Department Information System (EDIS)

Figure 46: Monthly number of unique Manitobans with a chronic condition (as of 2018/19 FY) who had an ED/UCC visit by CTAS score, January 01, 2019 – August 31, 2020



Data source: Winnipeg Police calls for service data

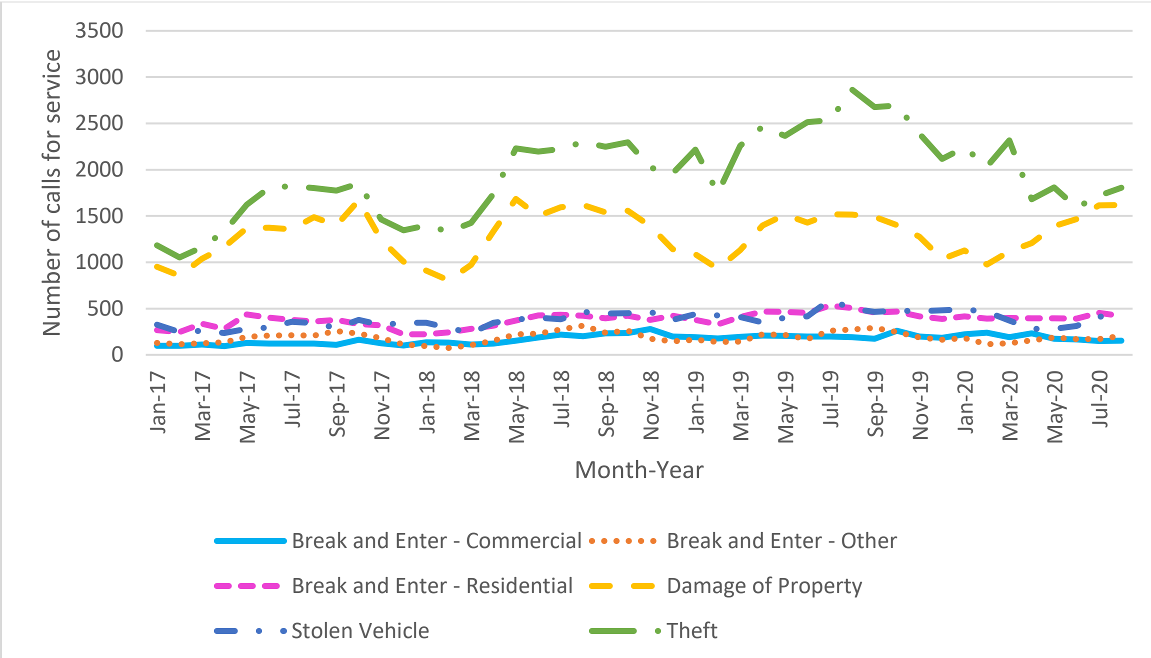
Figure 47: Monthly number of traffic related calls for service to Winnipeg Police by event type, January 01, 2017 – August 31, 2020



Data source: Winnipeg Police calls for service data

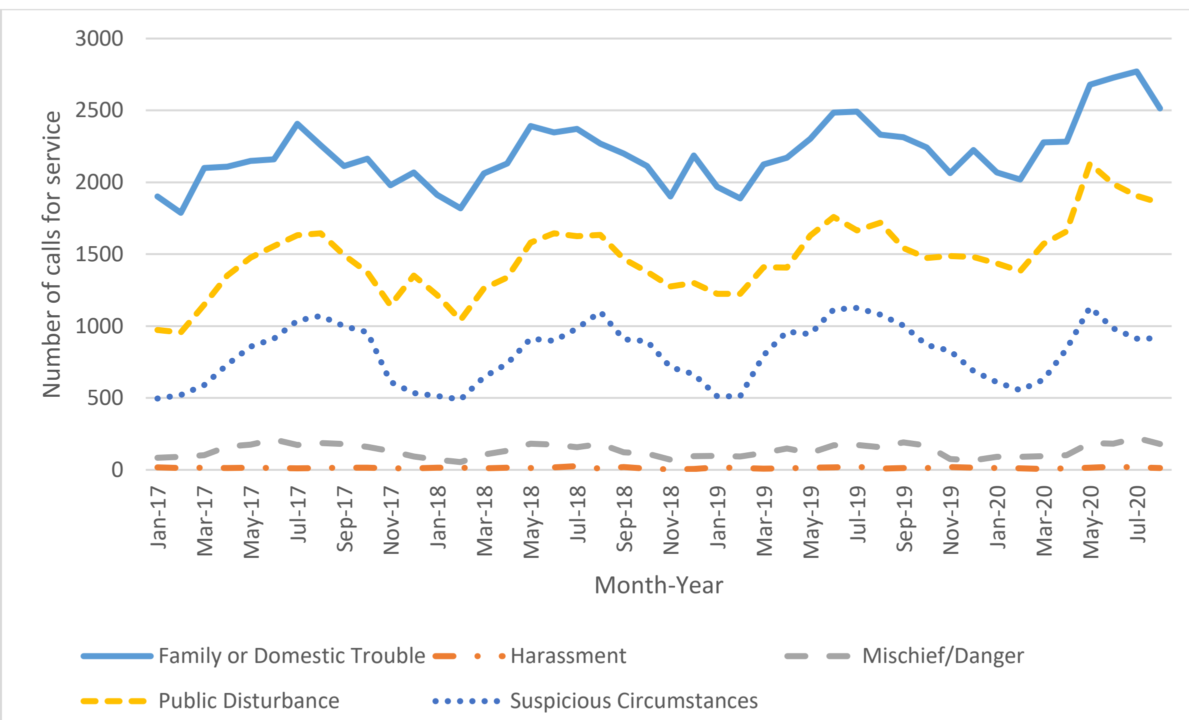
Figure 48: Monthly number of violence related calls for service to Winnipeg Police by event type, January 01, 2017 – August 31, 2020

AB1477



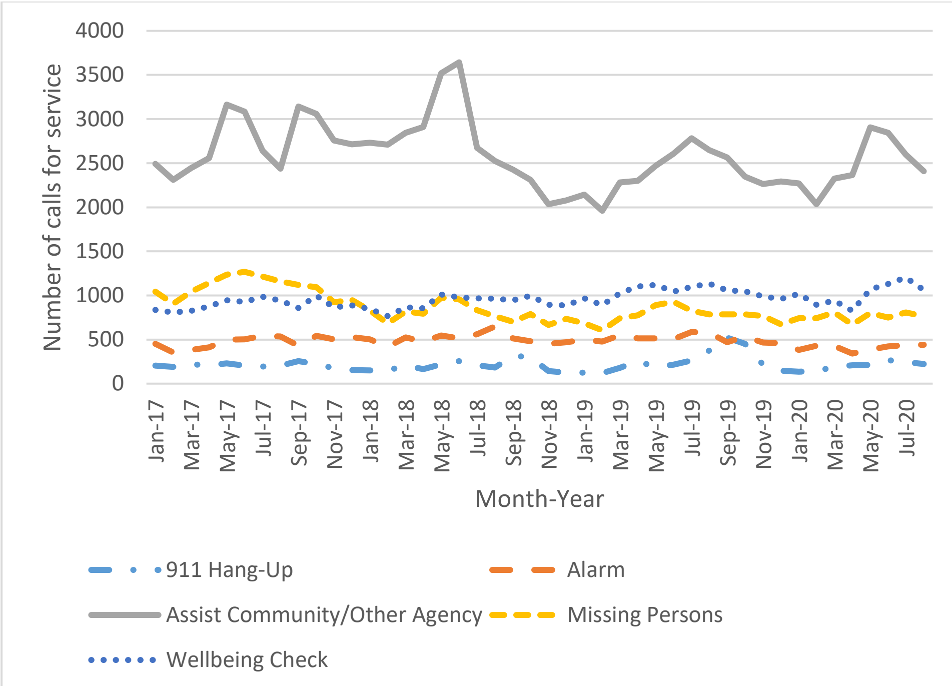
Data source: Winnipeg Police calls for service data

Figure 49: Monthly number of property related calls for service to Winnipeg Police by event type, January 01, 2017 – August 31, 2020



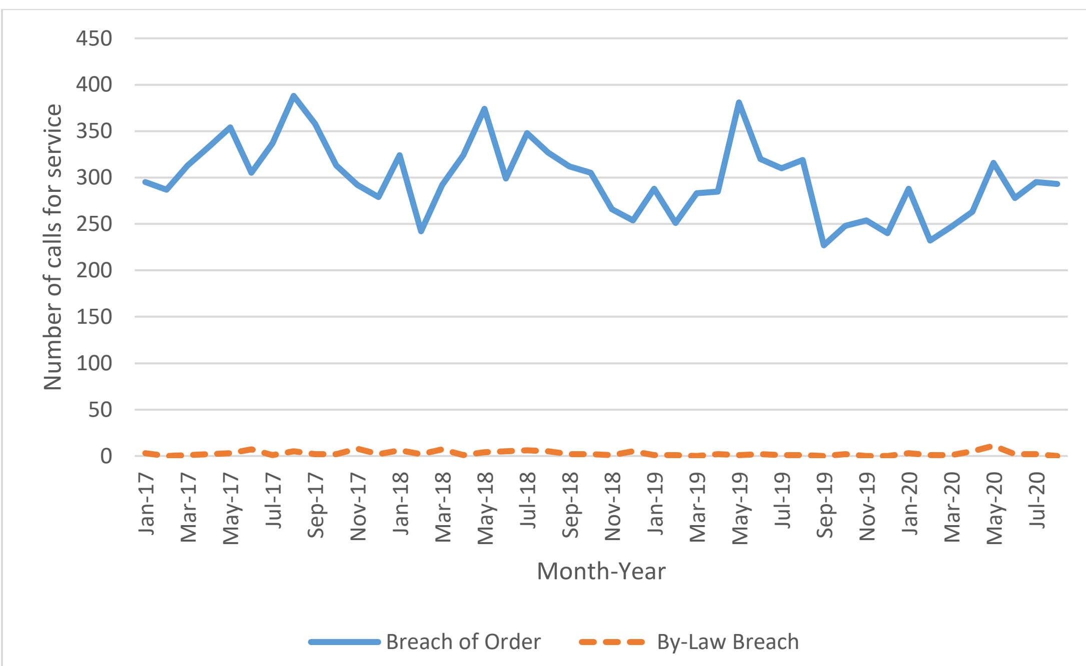
Data source: Winnipeg Police calls for service data.

Figure 50: Monthly number of disturbances / danger related calls for service to Winnipeg Police by event type, January 01, 2017 – August 31, 2020



Data source: Winnipeg Police calls for service data

Figure 51: Monthly number of wellbeing check related calls for service to Winnipeg Police by event type, January 01, 2017 - August 31, 2020



Data source: Winnipeg Police calls for service data

Figure 52: Monthly number of breaches and warrants related calls for service to Winnipeg Police by event type, January 01, 2017 – August 31, 2020

This is Exhibit " E " referred to
in the Affidavit of Carla Loeppky
Affirmed before me this 4
day of March A.D. 2021

A Barrister-at-Law entitled to practice
in and for the Province of Manitoba

COVID-19
NOVEL CORONAVIRUS

COVID Response Update

Manitoba

COVID-19 NOVEL CORONAVIRUS

Manitoba

CURRENT STATE

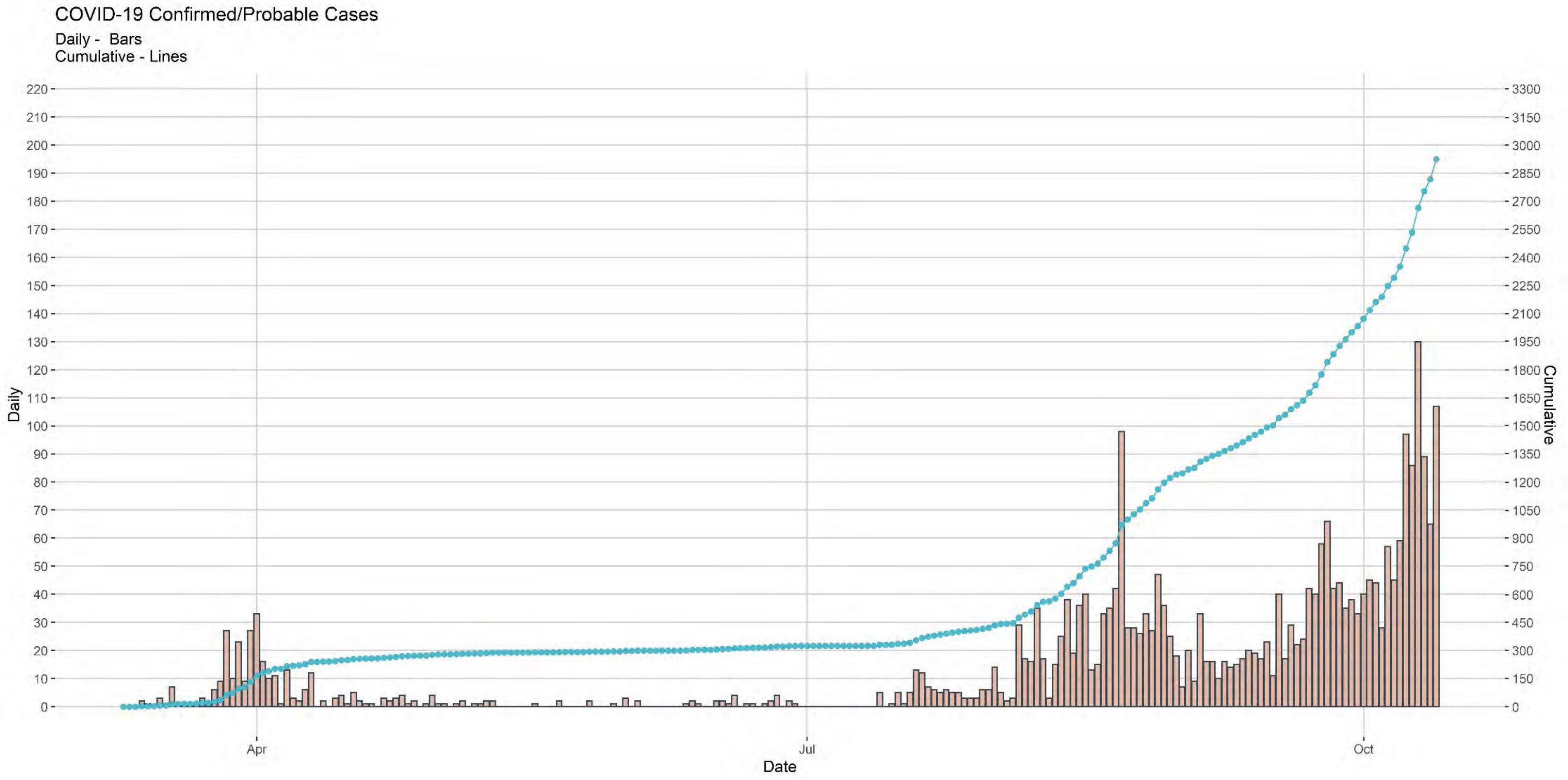
AB1481

AB1482

COVID-19 NOVEL CORONAVIRUS

Manitoba

Case Numbers in Manitoba



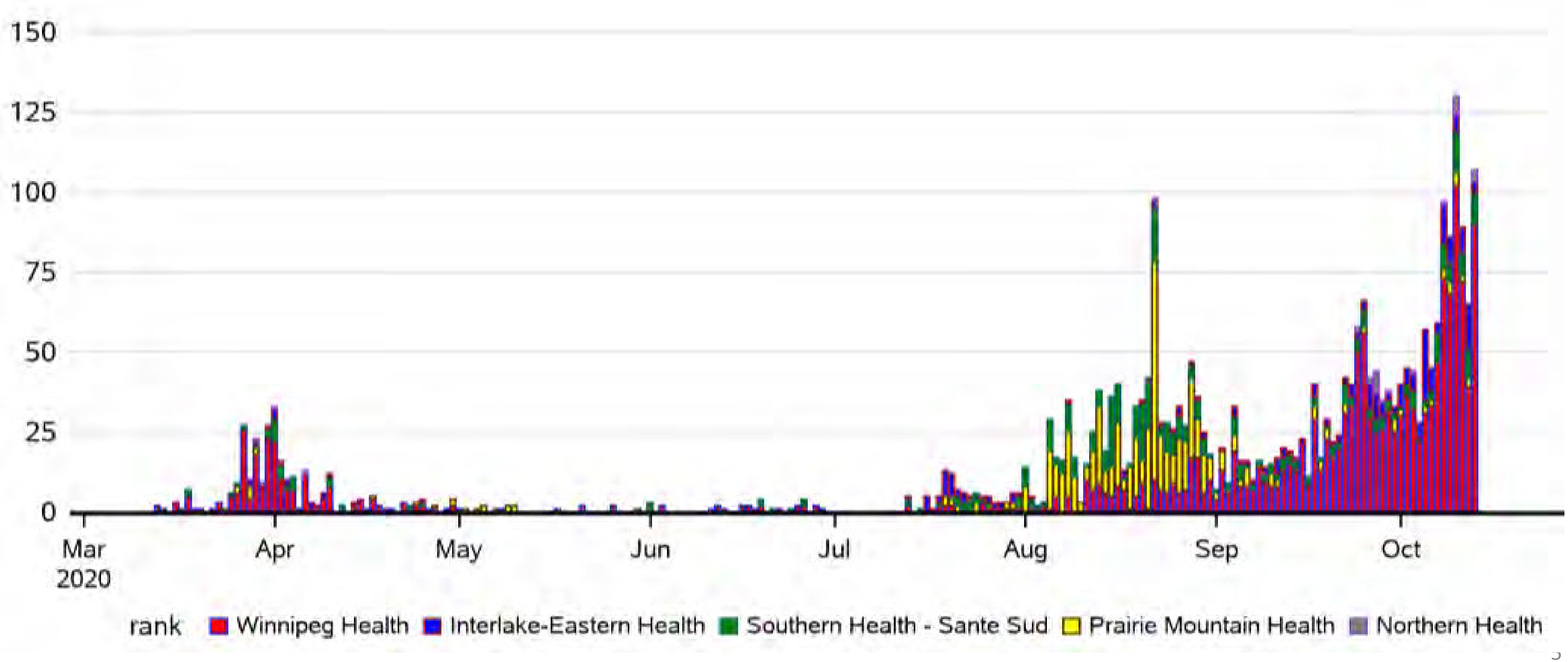
Highlights

- 67 colonies have reported cases (380 cases)
  - 49 cases have been hospitalized with 9 fatalities
- Hospitalization data shows that:
  - Over 50% of individuals currently hospitalized are First Nations.
  - On average (using median), hospitalized FN individuals have been younger compared to non FN; 50 vs 69 overall and 52 vs 67.5 currently.
- Three correctional institutions have reported cases in inmates and / or staff

AB1483

AB1484

Current Situation in Manitoba: Regional Variation



COVID-19 NOVEL CORONAVIRUS

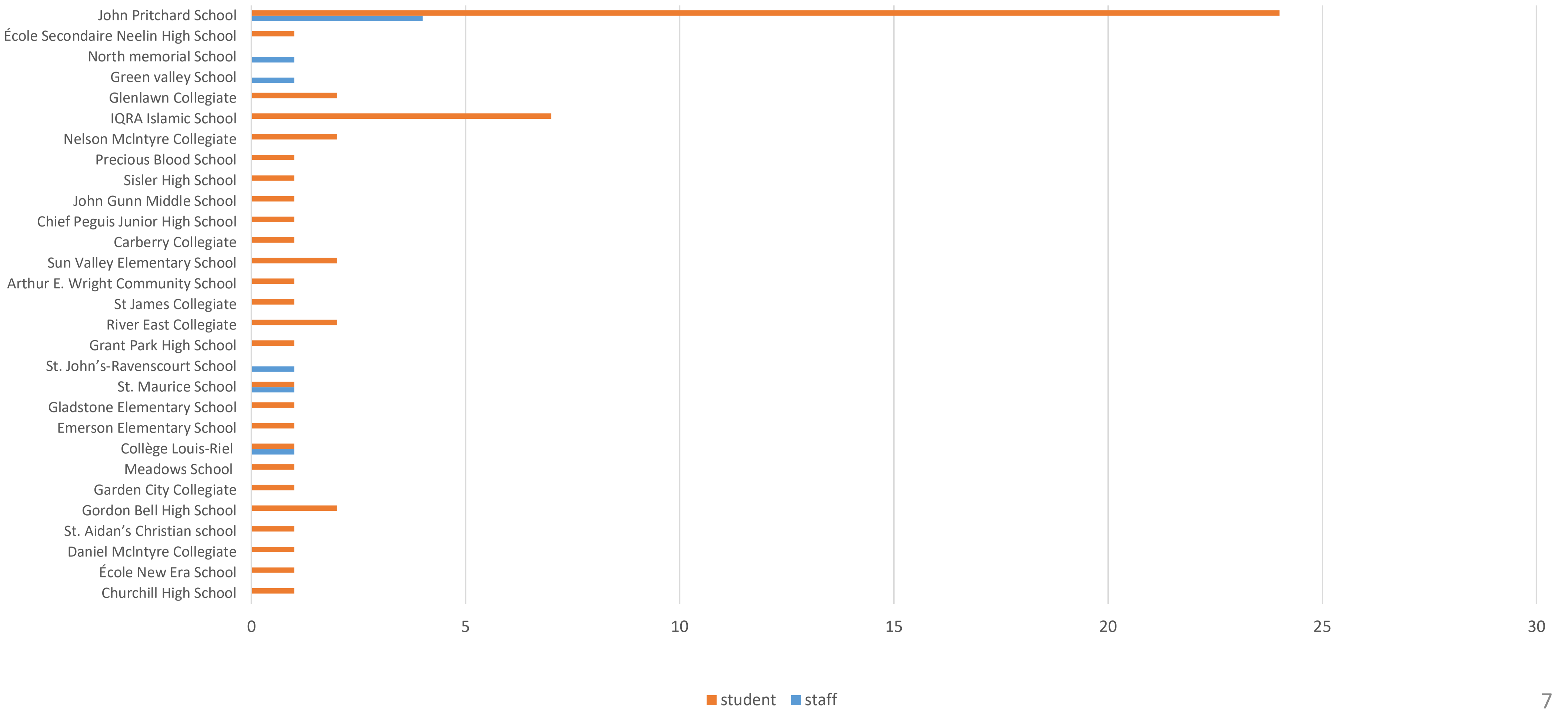
Manitoba

COVID Cases in PCH Staff or Residents
(N=133)

Cases in Residents: 90
Cases in Staff: 43
Fatalities: 15

AB1485

Cases in Schools (staff and students)



AB1486

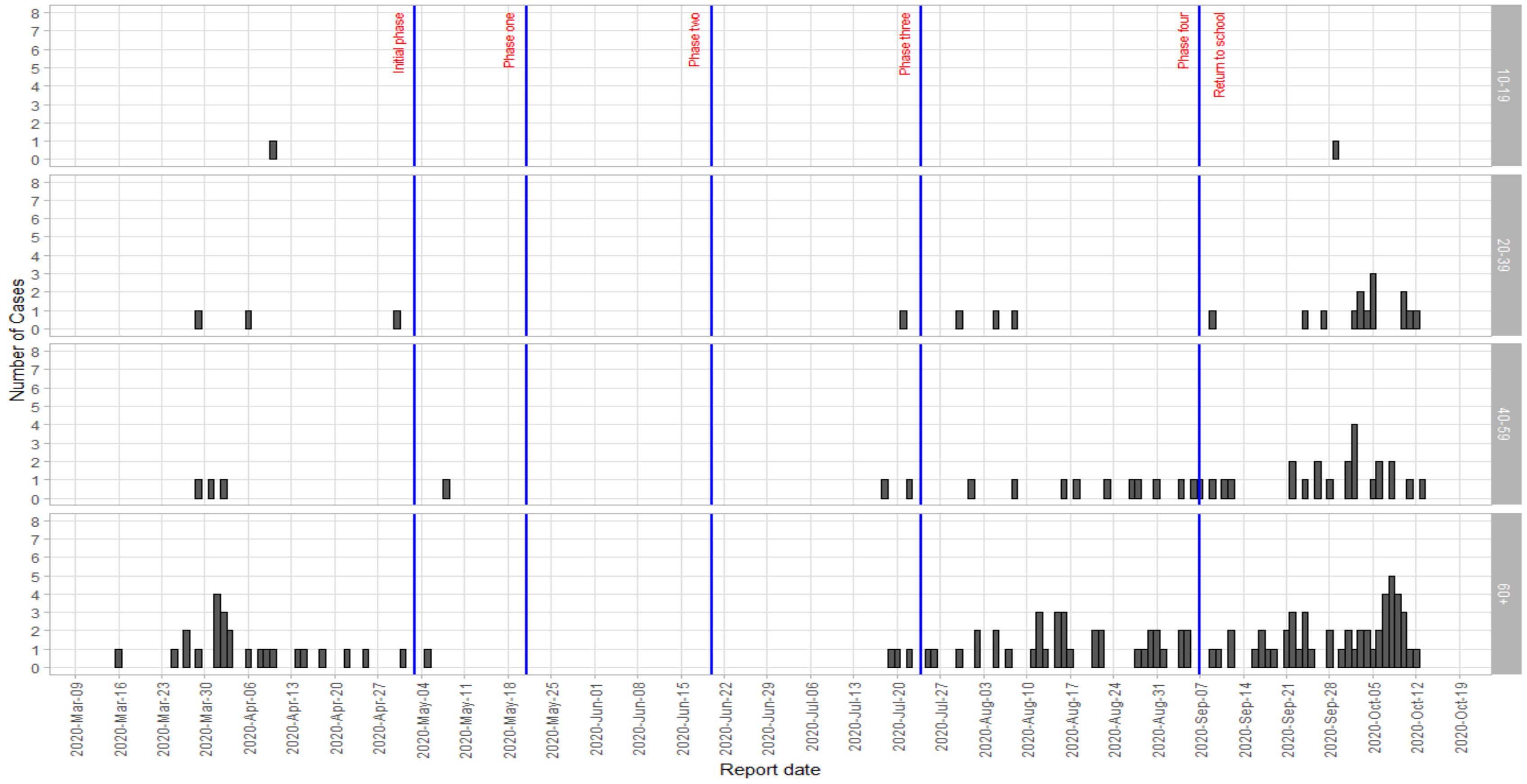
Characteristics	Deaths		ICU hospitalization ever		Non-ICU hospitalization only		No severe outcome		Total	
	n	%	n	%	n	%	n	%	N	%
Total	37		33		105		2750		2925	
Age group (years)										
18 or younger	0	0.0	0	0.0	2	1.9	447	16.3	449	15.4
19-59	3	8.1	15	45.5	42	40.0	1913	69.6	1973	67.5
60+	34	91.9	18	54.5	61	58.1	390	14.2	503	17.2
Median age (IQR)	80	(70-88)	61	(45-69)	64	(50-78)	34	(22-50)	35	(23-53)
Mean age (SD)	79	(14)	57	(17)	62	(20)	37	(19)	38	(21)
Sex										
Female	19	51.4	6	18.2	66	62.9	1404	51.1	1495	51.1
Male	18	48.6	27	81.8	39	37.1	1346	48.9	1430	48.9
Area level income quintiles										
Q1 (lowest)	7	18.9	8	24.2	21	20.0	653	23.7	689	23.6
Q2	9	24.3	6	18.2	28	26.7	475	17.3	518	17.7
Q3	3	8.1	4	12.1	15	14.3	394	14.3	416	14.2
Q4	5	13.5	11	33.3	26	24.8	578	21.0	620	21.2
Q5 (highest)	3	8.1	4	12.1	9	8.6	488	17.7	504	17.2
Unknown	10	27.0	0	0.0	6	5.7	162	5.9	178	6.1

AB1487

COVID-19 NOVEL CORONAVIRUS

Manitoba

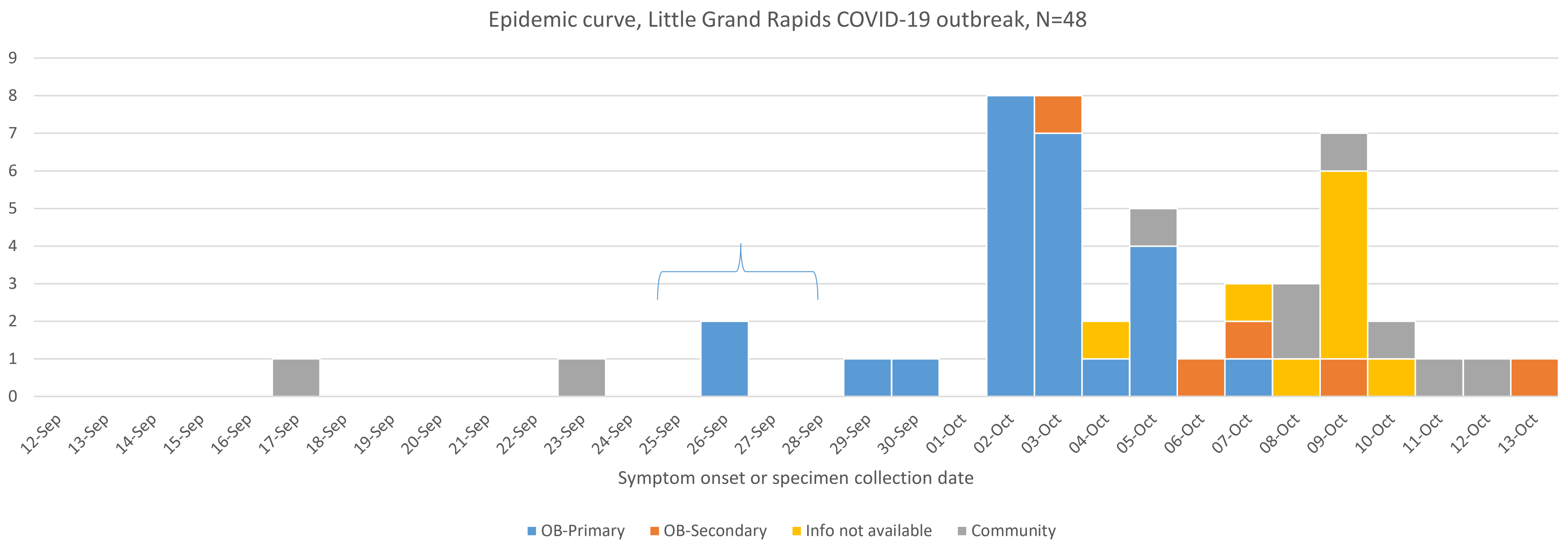
Severe Outcomes



AB1488

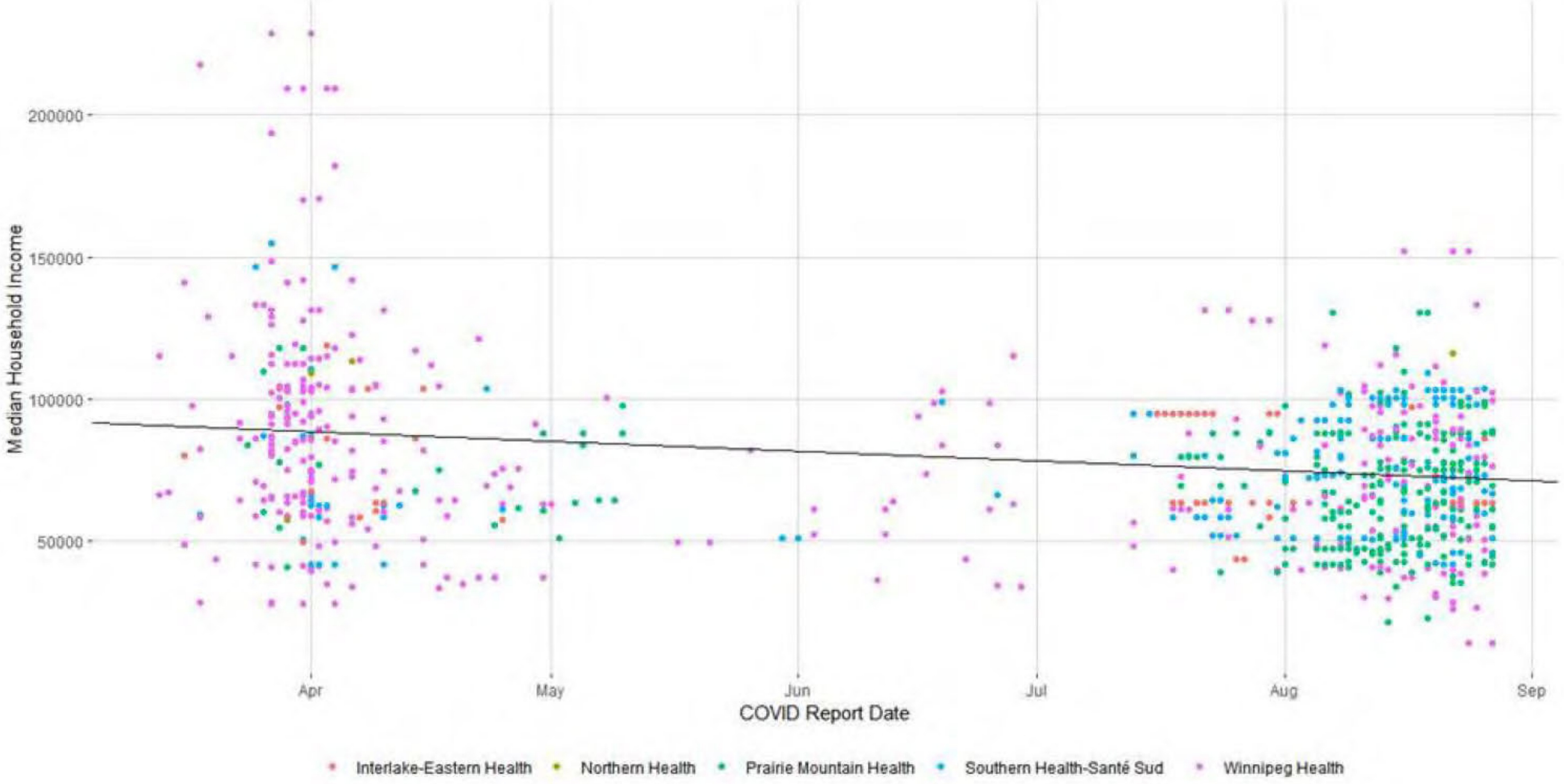
AB1489

An Example of an Outbreak: Little Grand Rapids



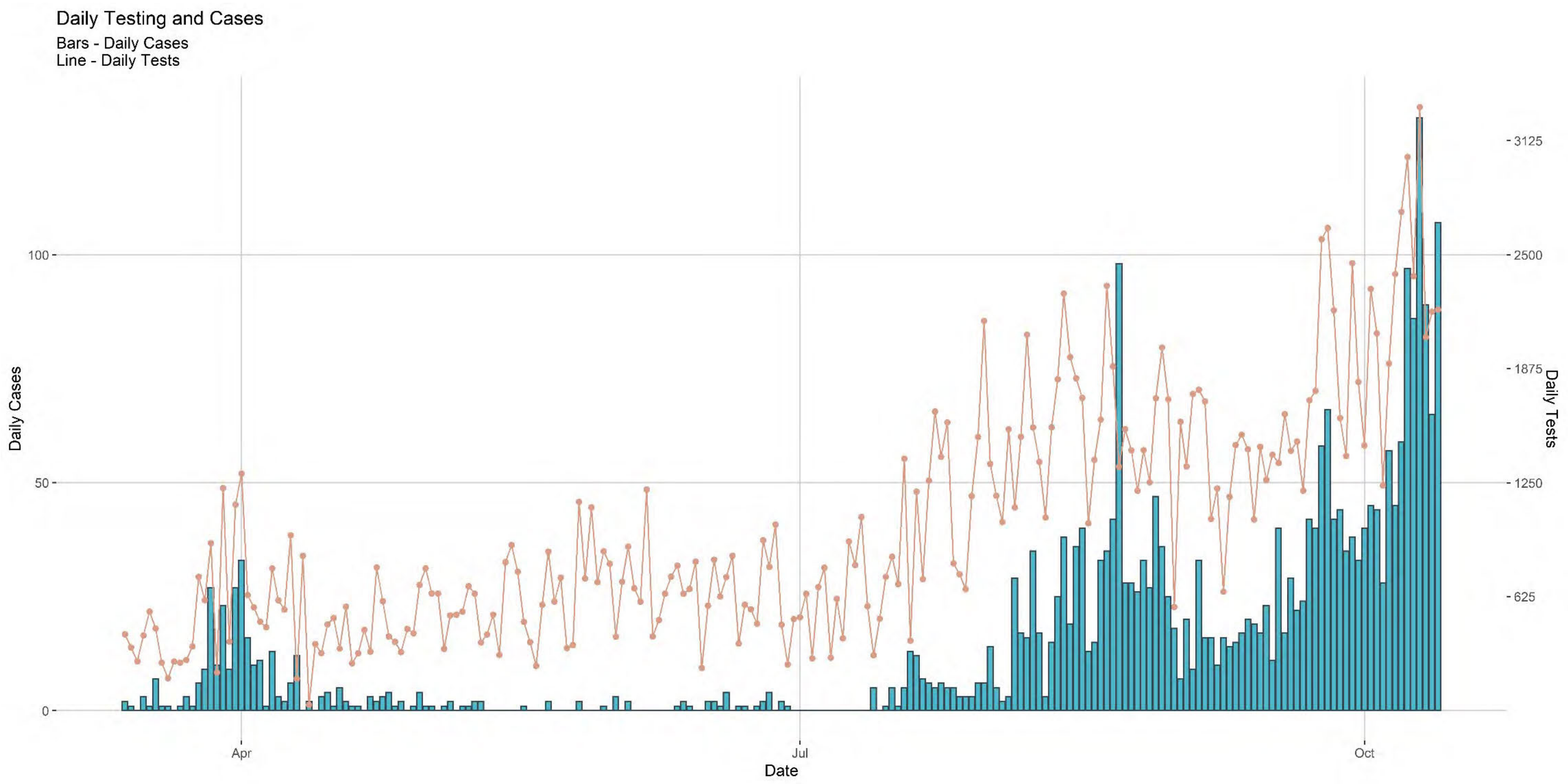
Median Household Income of COVID Cases Over Time

P-Value<0.001



AB1490

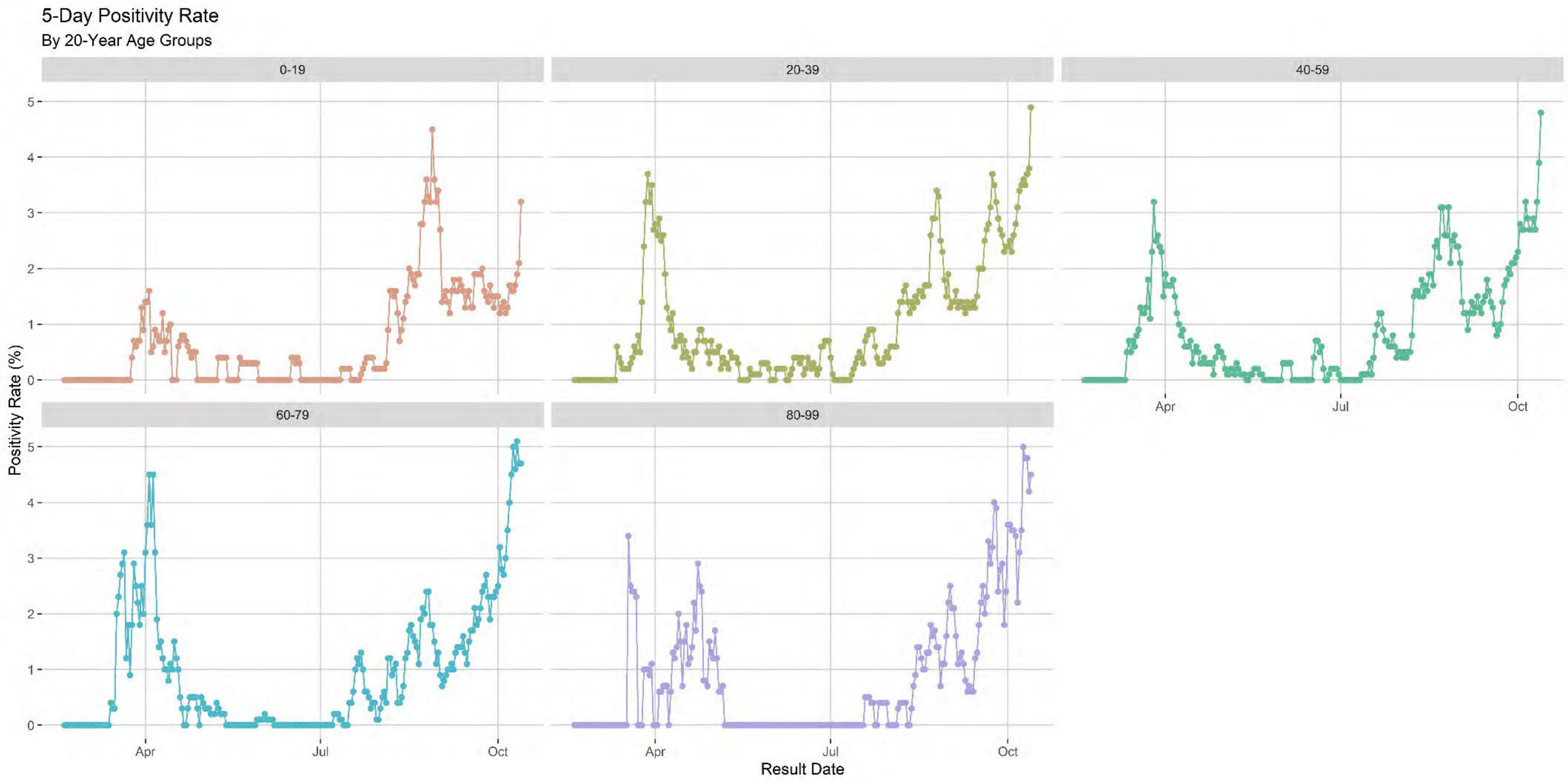
Testing



AB1491

AB1492

Test Positivity



COVID-19 NOVEL CORONAVIRUS

Manitoba

WINNIPEG UPDATE

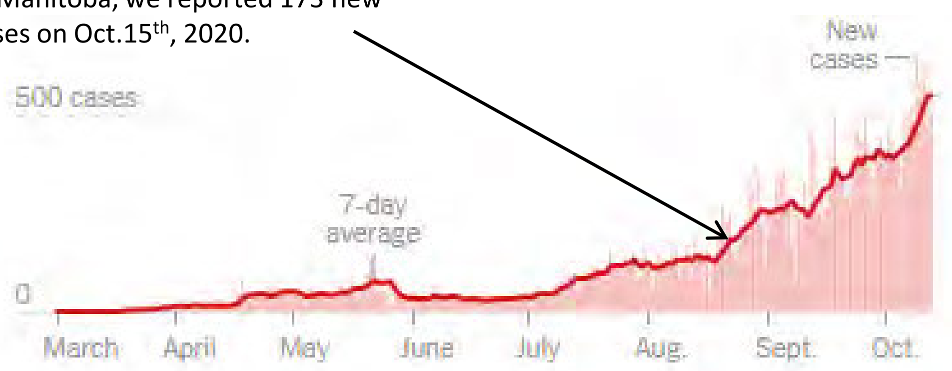
Cases are Doubling Every 2 Weeks

Case and contact tracing resources are now becoming overwhelmed, risking the ability to identify cases and quickly isolate their contacts

AB1494

Impact of Cases Doubling Evident South of the Border

In Manitoba, we reported 173 new cases on Oct.15th, 2020.

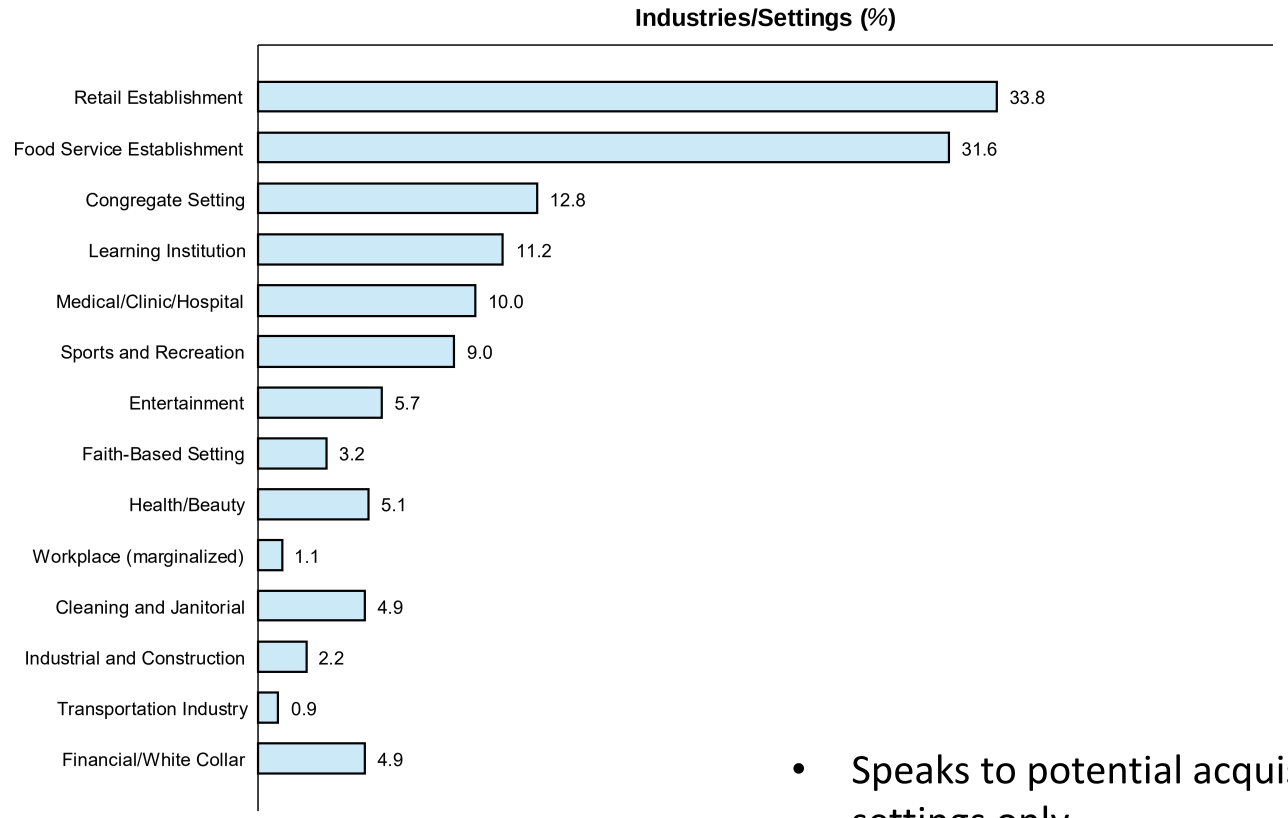


	TOTAL REPORTED	ON OCT. 13	14-DAY CHANGE
Cases	28,952	508	+34%
Deaths	370	12	+81%

AB1495

North Dakota (pop: 800,000 has reported 28,952 cases as of Oct. 13th, 2020.
As of Oct 13th, 2020, Manitoba (pop: 1.4 million) had 2,779 cases.

Potential Acquisition Settings are Diverse



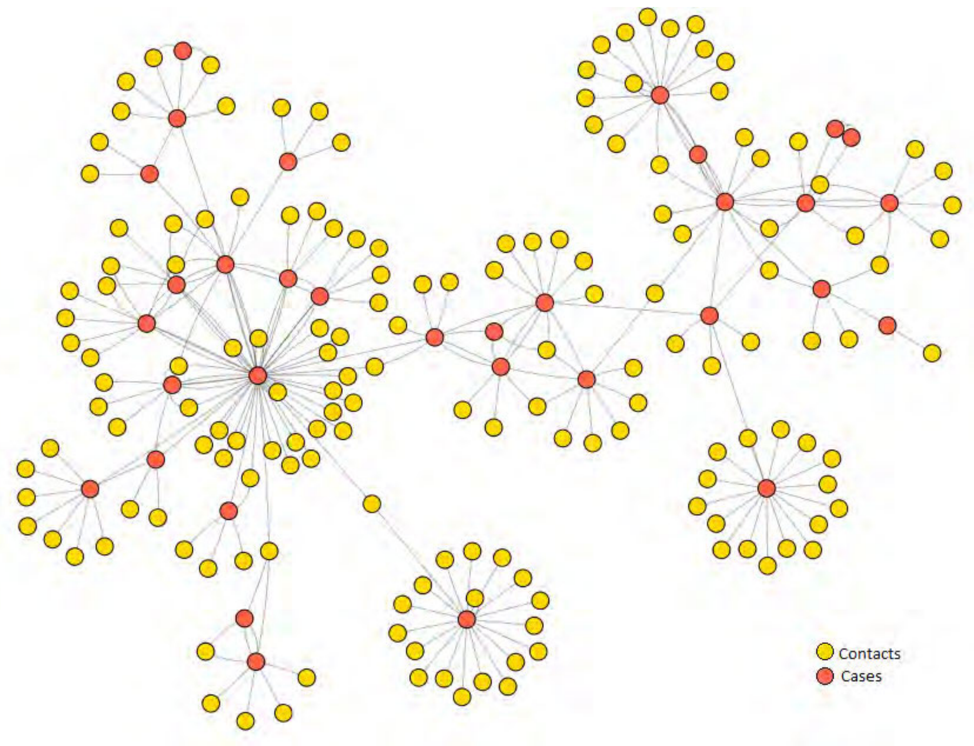
- Speaks to potential acquisition settings only.

- Confirmed outbreaks/clusters (with evidence of ongoing transmission by setting are listed below.

Confirmed Outbreaks/Clusters	
Food Service Establishment***	7
Congregate Setting**	12
Learning Institute*	2
Cleaning and Janitorial	1
Workplace/Industry	9
Sports and Recreation	1

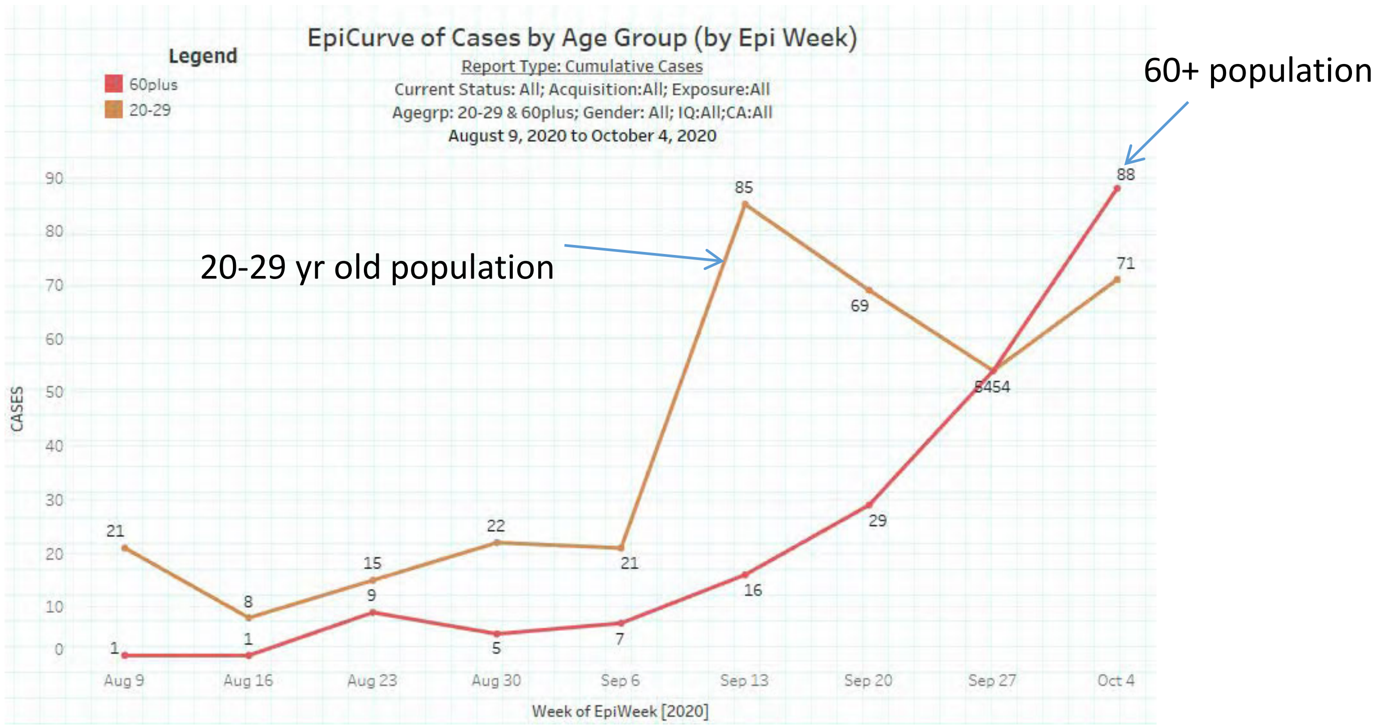
AB1496

New Infections Build Quickly from Small Number Cases



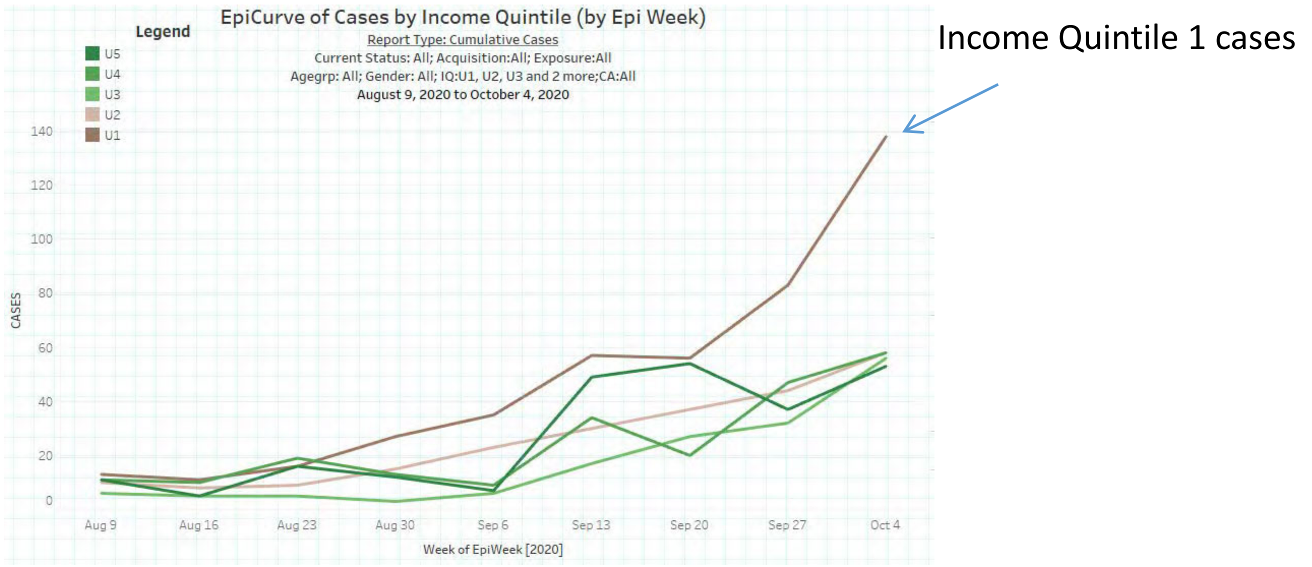
AB1497

Infections in Young Adults Preceded the Rapid Rise in 60+ Population



AB1499

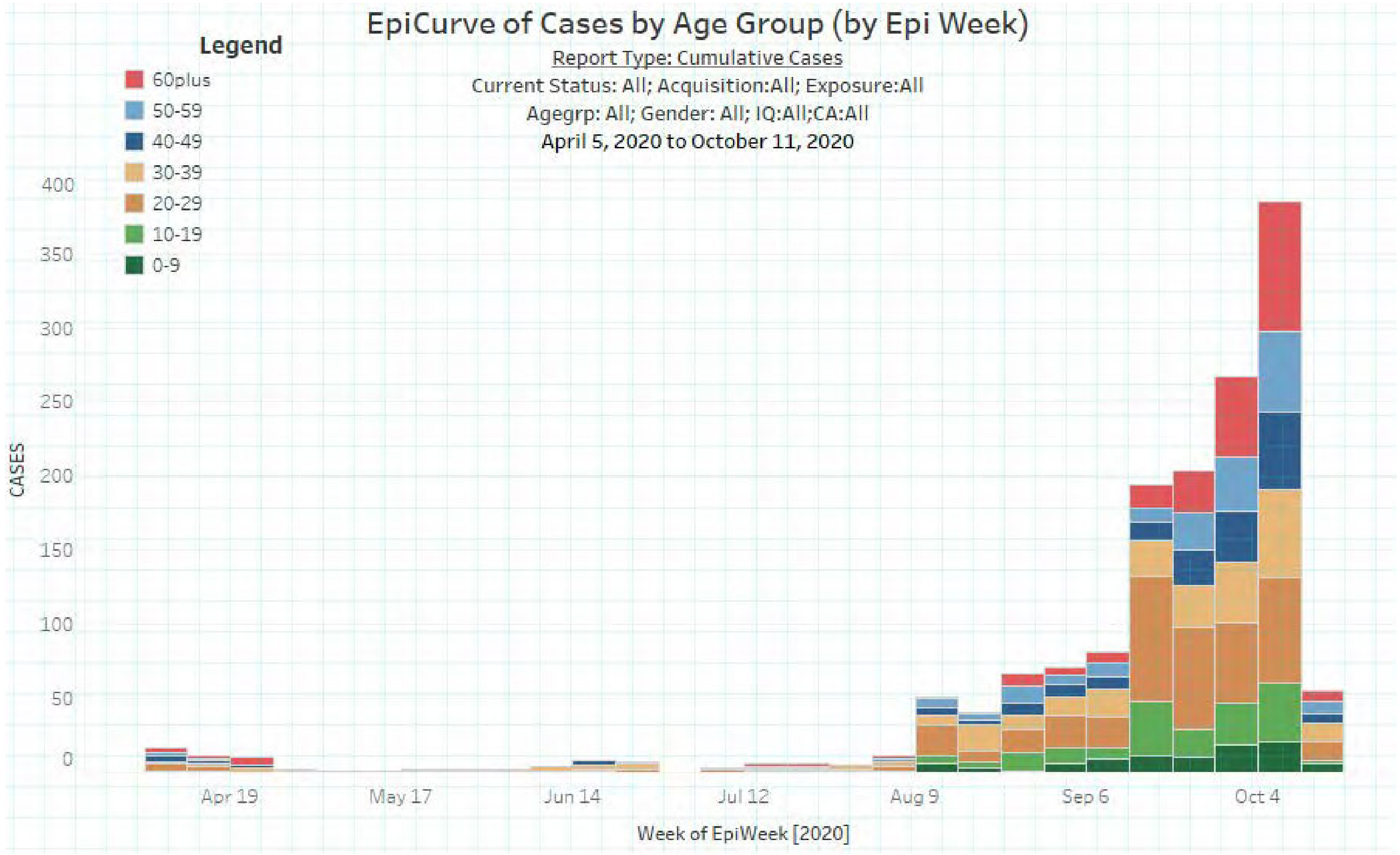
Infections in Structurally Disadvantaged Populations are Increasing the Fastest



Iq2016	8/9/20	8/16/20	8/23/20	8/30/20	9/6/20	9/13/20	9/20/20	9/27/20	10/4/20	Grand Total
U1	25.49%	28.21%	24.62%	38.57%	43.75%	30.48%	28.87%	34.16%	38.02%	33.75%

AB1500

Children are a Small Proportion of Cases



COVID-19 NOVEL CORONAVIRUS

Manitoba

COVID-19 MODELLING

AB1501

Notes on Modelling

AB1502

Notes on Modelling

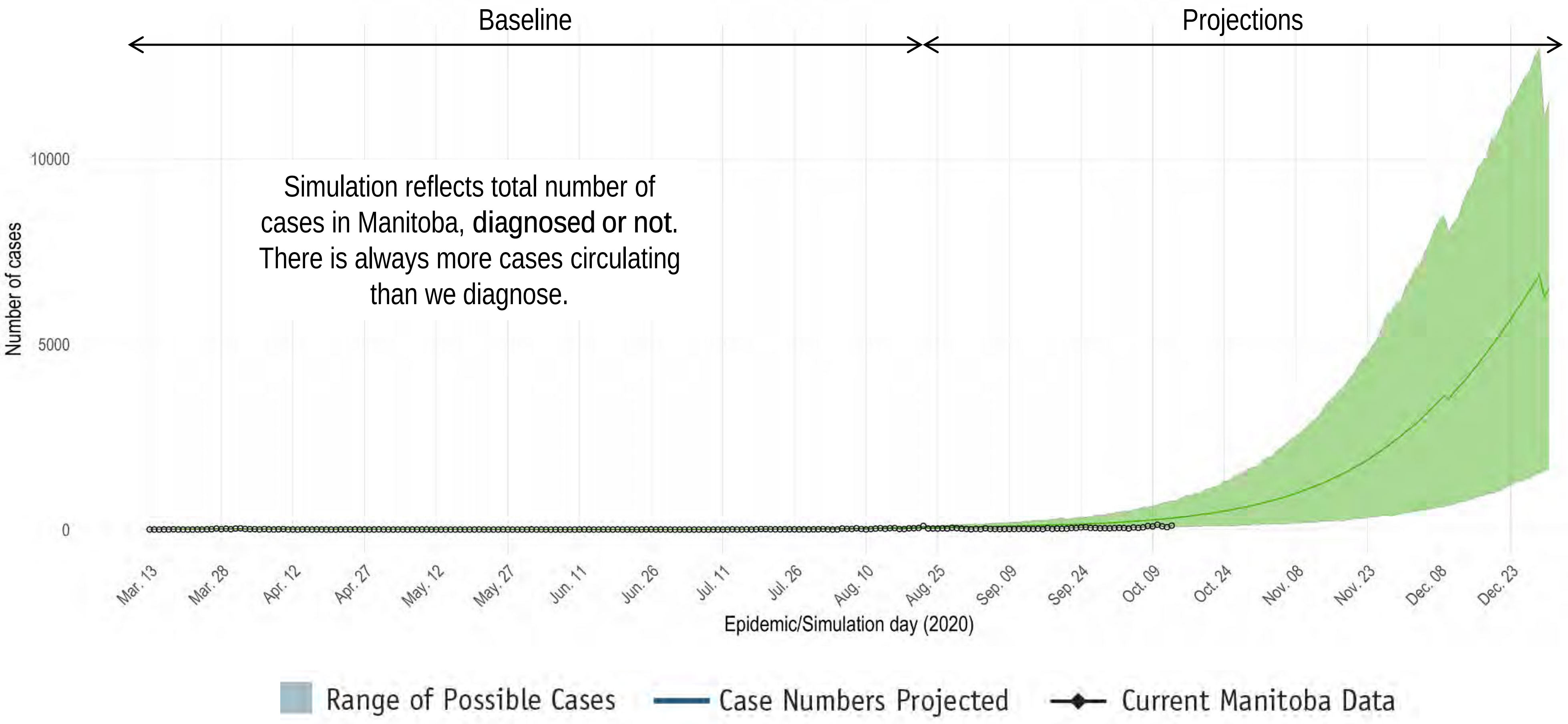
1. **Successful measures with compliant behaviour**.
   - Measures and the timing they are put in place are adequate and individuals behave accordingly.
2. **Successful measures with less compliant behaviour.**
   - Measures and the timing they are put in place are adequate but individuals behaviours are not well aligned with recommendations.
3. **Less successful measures with less compliant behaviour.**
   - Measures and the timing they are put in place are not ideal and individuals behave as if the situation is not as serious as it really is.
4. **Unsuccessful measures with poor compliant behaviour.**
   - Measures and the timing they are put in place are not ideal and individuals behave as if there was no problem.

AB1503

Notes on Modelling

AB1504

Projected Number of Infectious Cases (diagnosed or not)

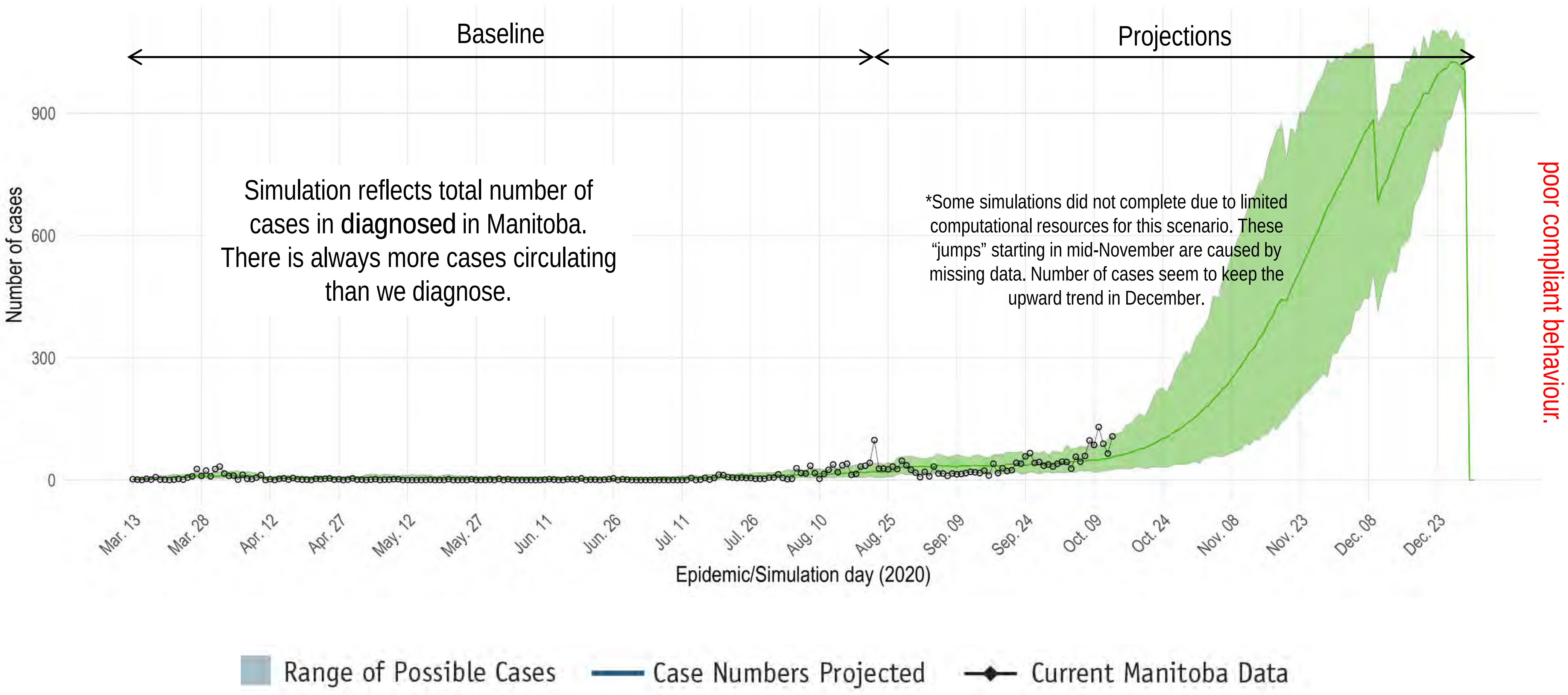


Less successful measures with less compliant behaviour

AB1505

Projected Number of Diagnosed

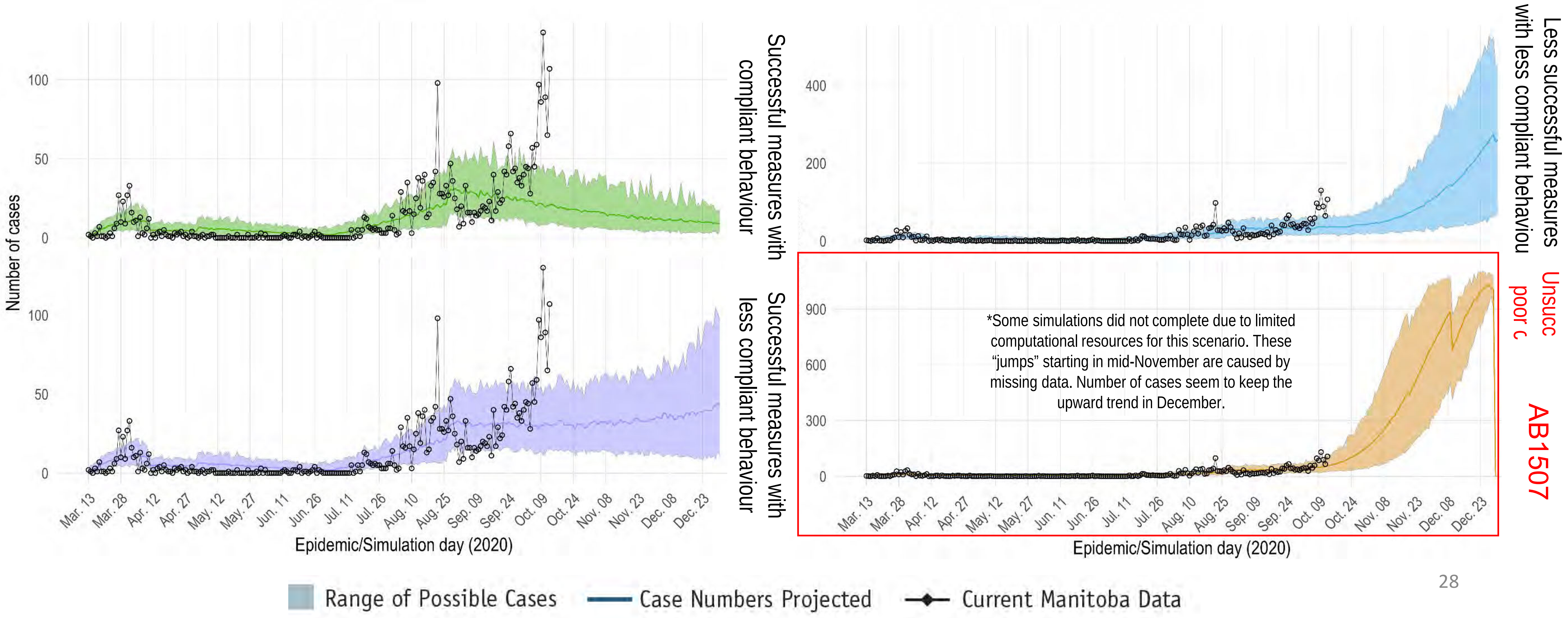
Observed number of cases in now aligned with the second worst case scenario projected. Worst case scenario has not been simulated.



Unsuccessful measures with poor compliant behaviour.

AB1506

Projected Number of Diagnosed Cases at Different Levels of Public Health Measures and Public Behaviour

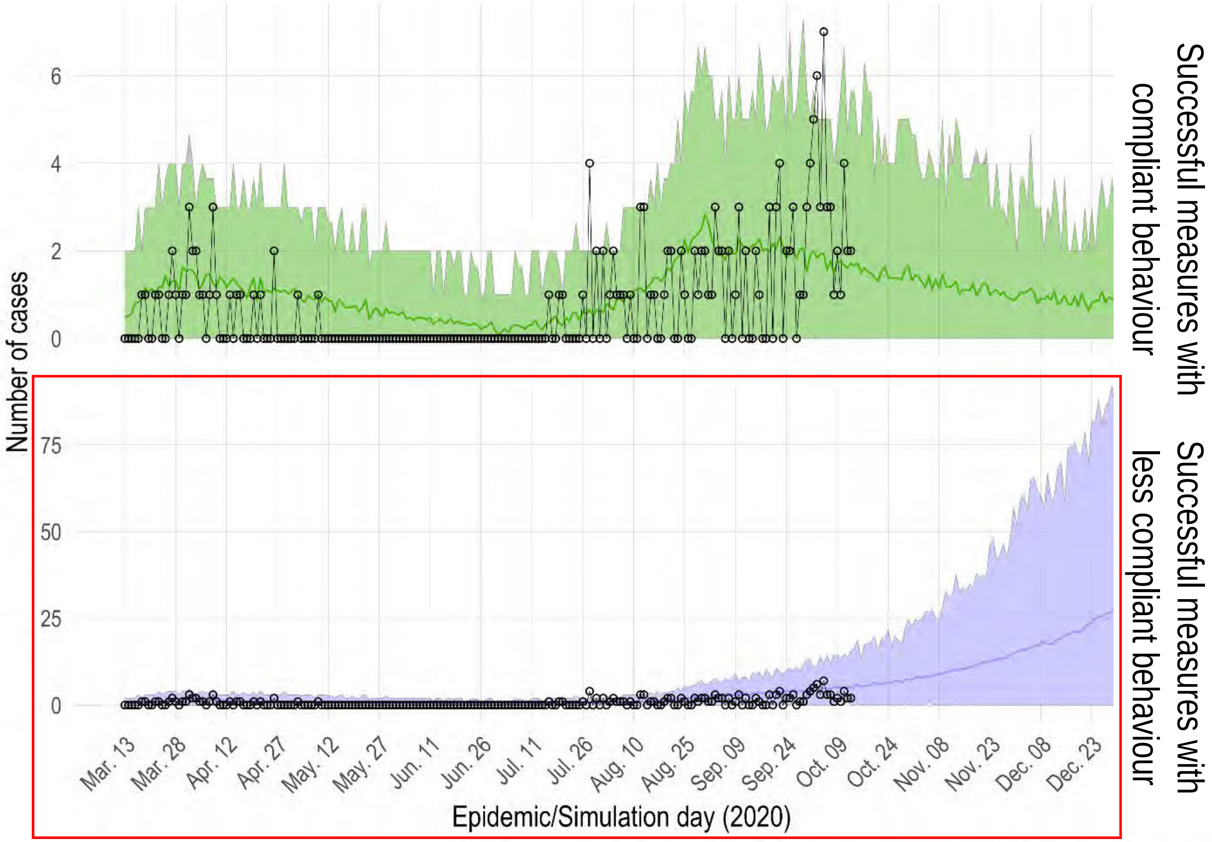


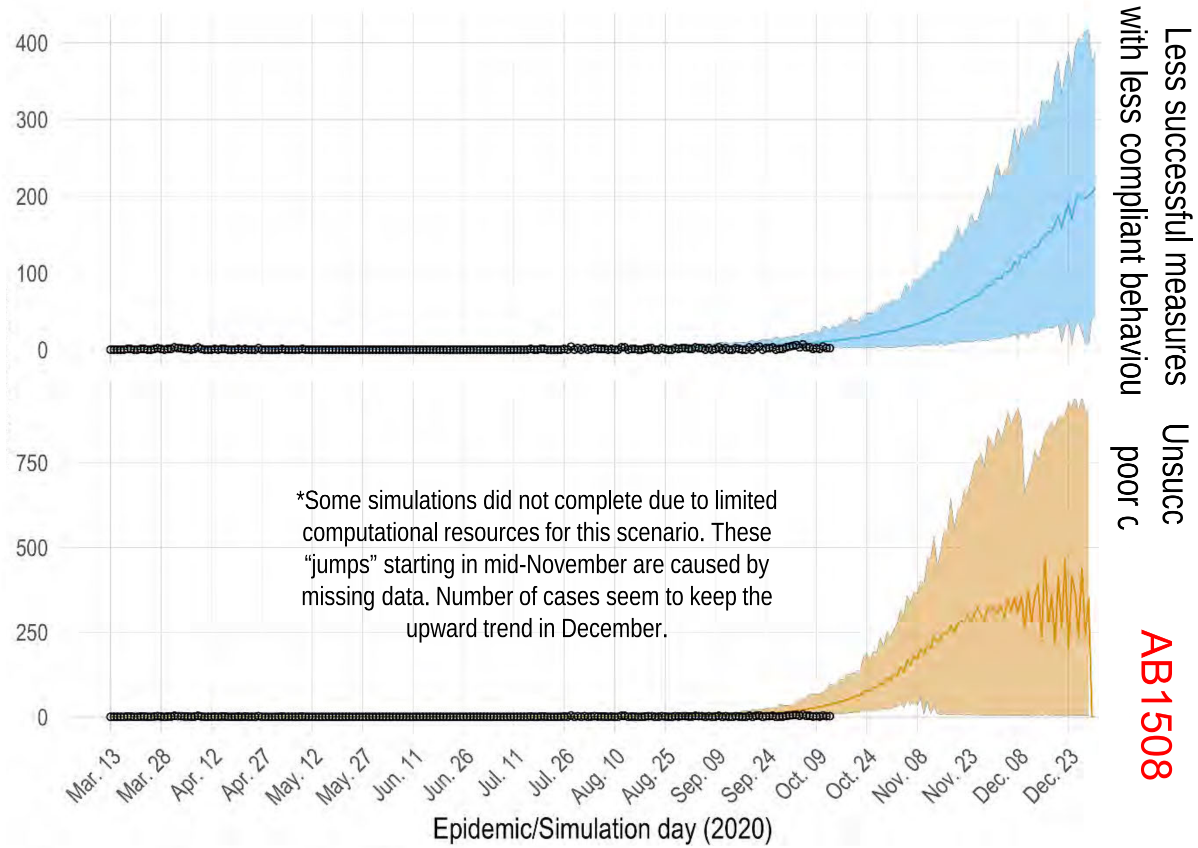
COVID-19 NOVEL CORONAVIRUS

Manitoba

Information from March 13 to December 31, 2020

Number of hospitalizations is better aligned with the scenario highlighted below in red (see next slide).





Range of Possible Cases — Case Numbers Projected — Current Manitoba Data

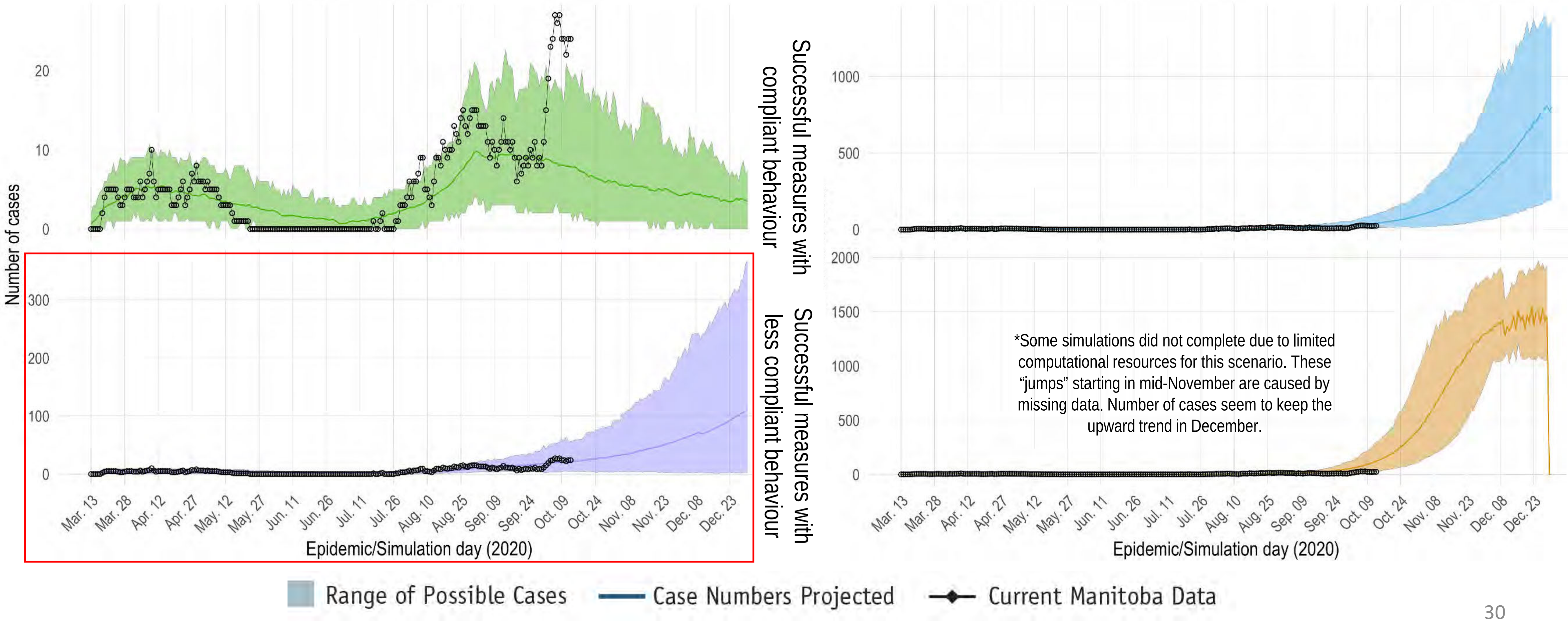
AB1508

COVID-19 NOVEL CORONAVIRUS

Manitoba

Number of hospitalizations is now aligned with the scenario highlighted below in red.

Information from March 13 to December 31, 2020

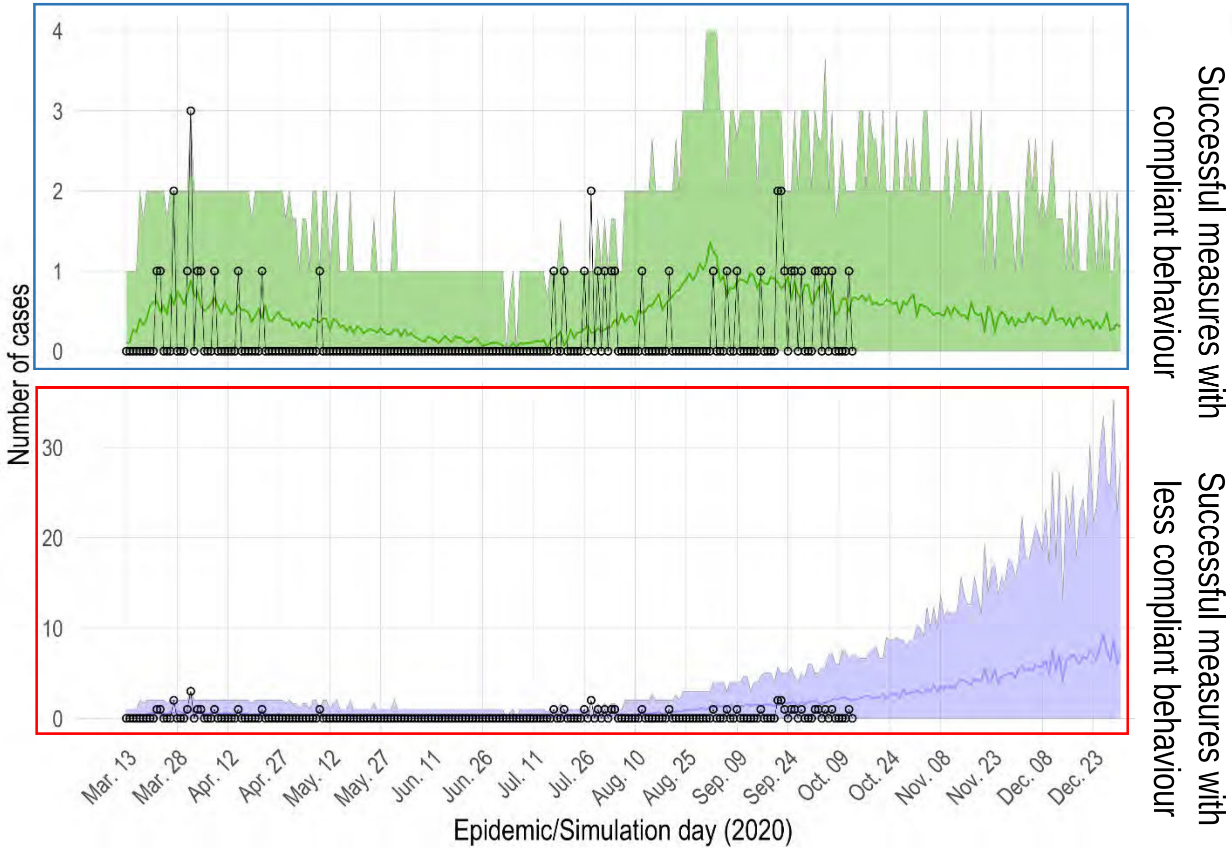


AB1509

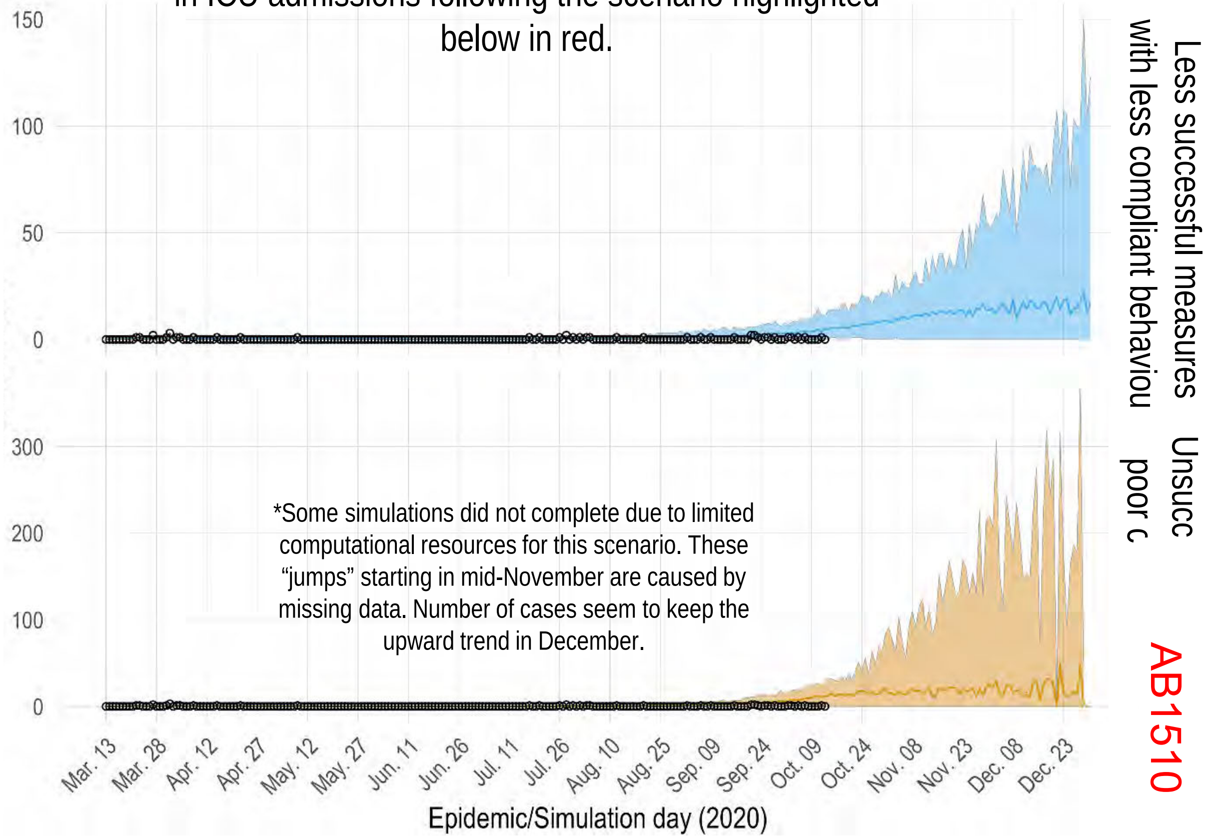
COVID-19 NOVEL CORONAVIRUS

Manitoba

Information from March 13 to December 31, 2020



ICU admissions seem to be aligned with the scenario highlighted below in blue. However, with the increase in number of cases, it is prudent to anticipate an increase in ICU admissions following the scenario highlighted below in red.



Range of Possible Cases — Case Numbers Projected — Current Manitoba Data

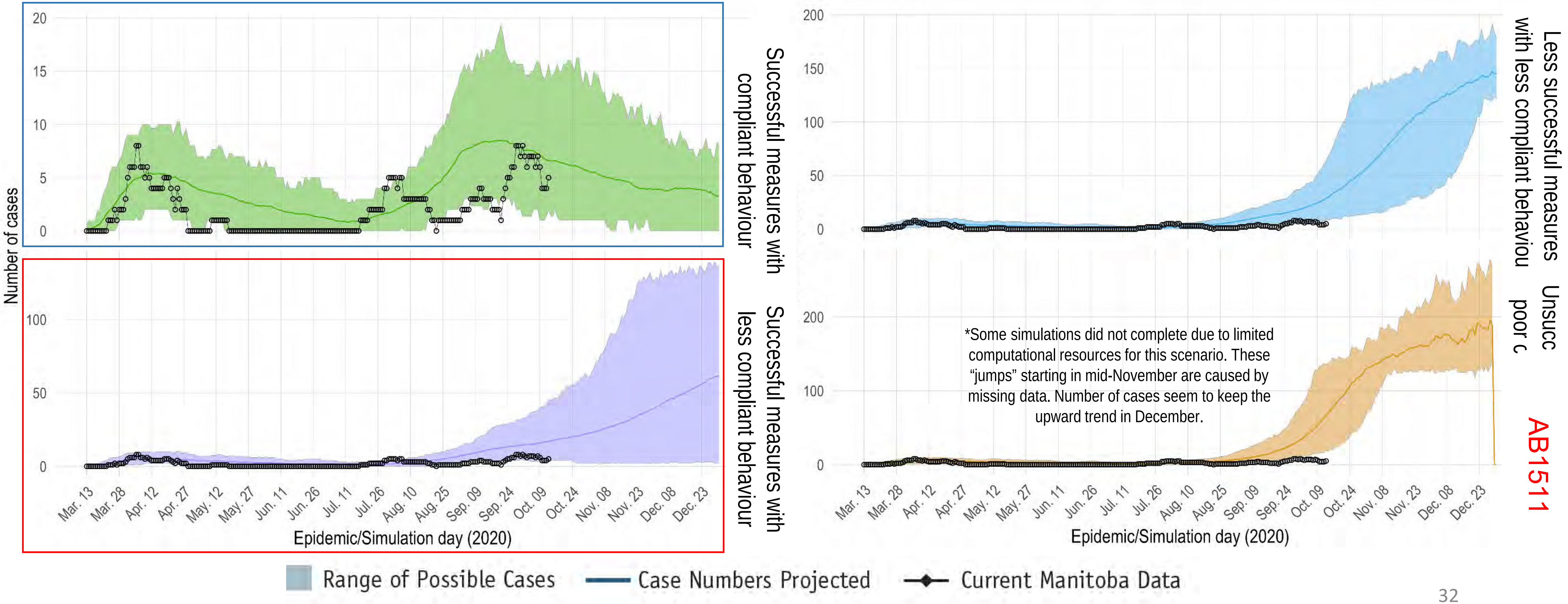
AB1510

COVID-19 NOVEL CORONAVIRUS

Manitoba

Information from March 13 to December 31, 2020

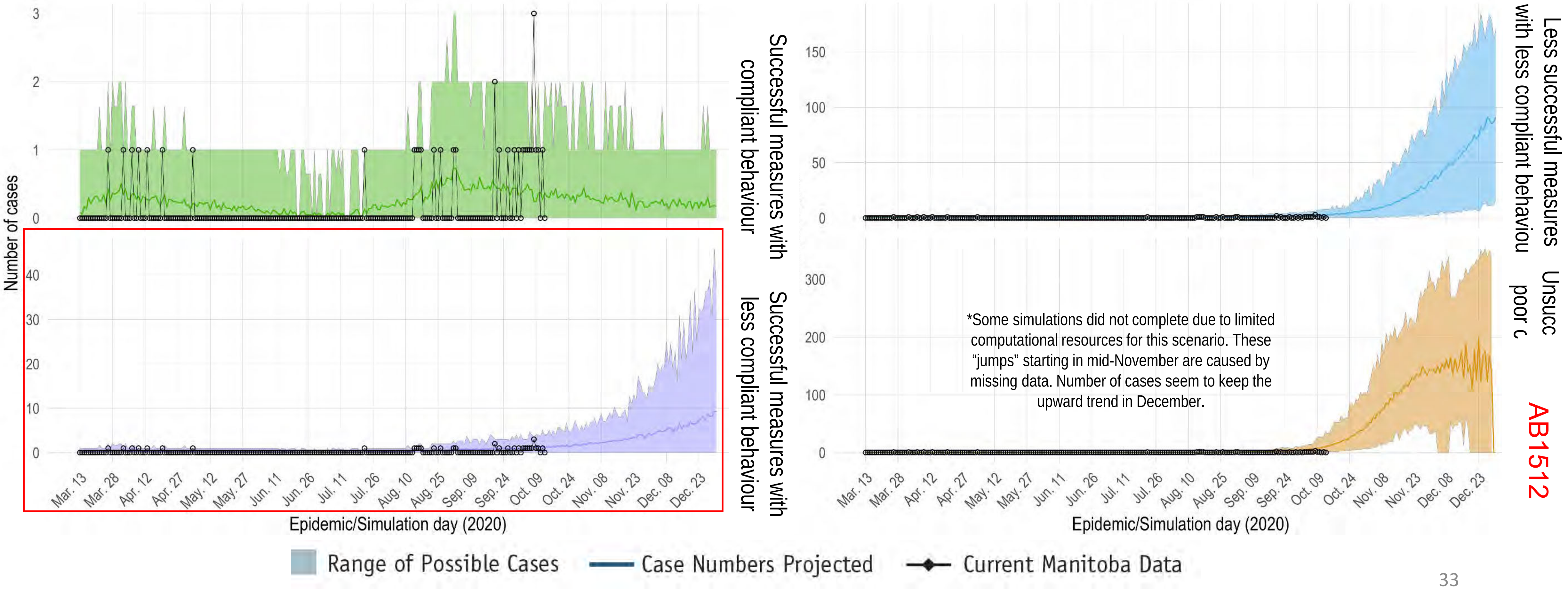
Prevalence in ICU admissions seem to be aligned with the scenario highlighted below in red, which accounts for an increase in number of cases.



AB1511

Information from March 13 to December 31, 2020

Number of deaths is now aligned with the scenario highlighted below in red.



COVID-19 NOVEL CORONAVIRUS

Manitoba

NEXT STEPS

- **Close non-essential businesses** for 2 weeks, and encourage minimal “out of home” activity (curfew?)
- **Engage young adults** through a comprehensive social media campaign about their behaviors and responsibilities relating to COVID19 spread
- Systematically identify and **address barriers faced by structurally disadvantaged populations** to adhere to public health recommendations and stay safe
- **Scale up PHN case and contact investigation resources**
- **Shore up acute care system** to prepare for increased COVID19 demands
- **Ramp up public education** around proper social distancing protocols, social bubbles, proper mask-use, and COVID19 app
- **Improve testing** options, convenience and speed for all populations
    - Use rapid tests in appropriate settings (e.g., high risk settings including processing plants; outbreak settings, and correctional facilities)

AB1514

- **Aggressive population based (non-targeted) interventions are required immediately since**:
  - COVID19 infection is now widespread in Winnipeg and is occurring through broad- based community spread in many diverse settings
  - Current upward trajectory of cases may lead to a surge in hospitalizations and deaths that may overwhelm the acute care system
  - Public health capacity for case and contact tracing is becoming overwhelmed and may no longer be an effective disease control intervention
- **Upstream targeted interventions (young adults, structurally disadvantaged populations) are required to ensure**:
  - all population groups are able and willing to comply with population based public health recommendations and can stay safe and not become a risk to others

AB1515

AB1516

This is Exhibit " F " referred to
in the Affidavit of Carla Loeppky
Affirmed before me this 4
day of March A.D. 2021

A Barrister-at-Law entitled to practice
in and for the Province of Manitoba

AB1517

COVID-19 NOVEL CORONAVIRUS

COVID Response Update

Manitoba

Key Messages

AB1518

COVID-19 NOVEL CORONAVIRUS

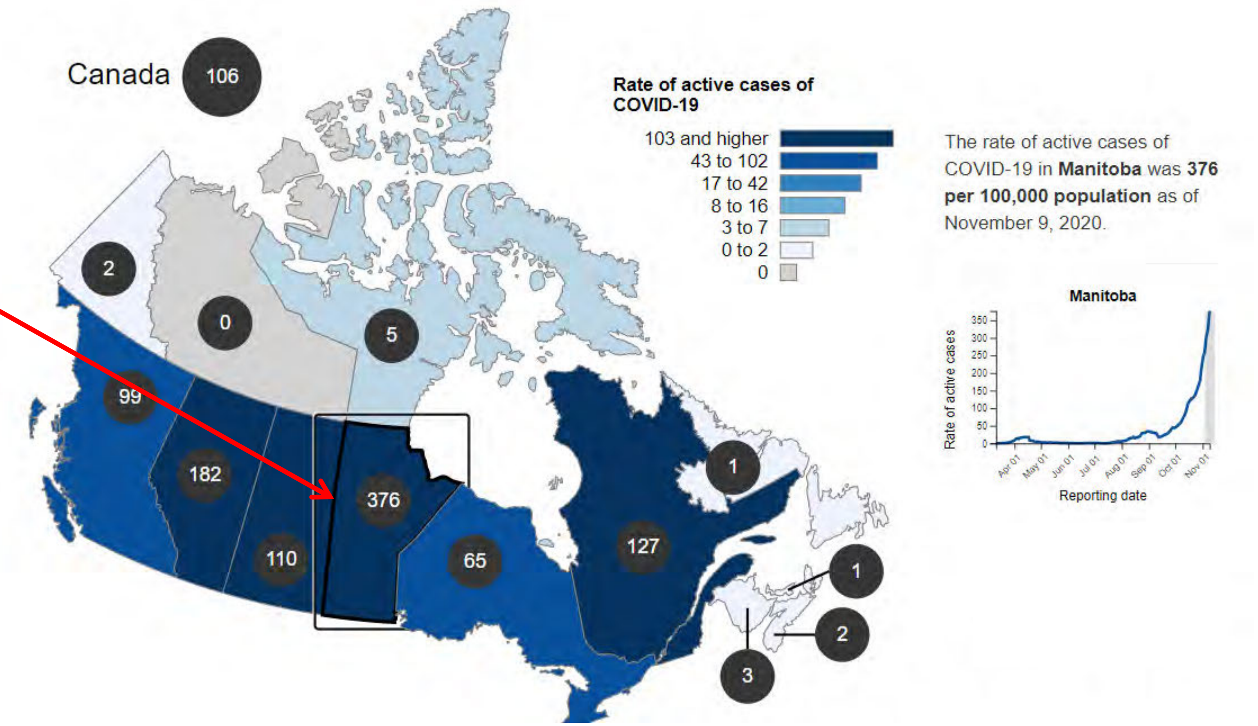
Manitoba

CURRENT STATE

AB1520

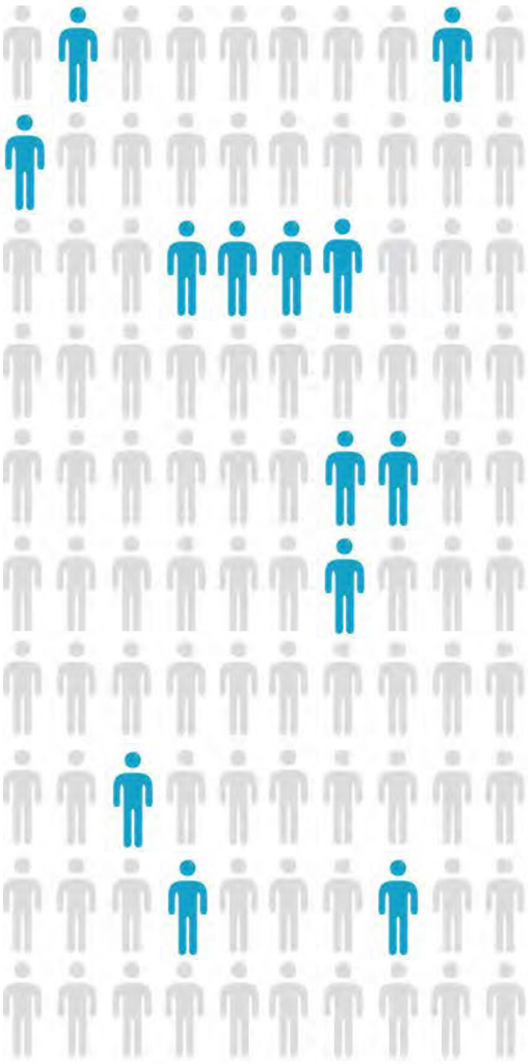
Manitoba Continues to be the Worst Performing Province in Canada for Active COVID Cases

Manitoba
376/100,000
(Nov. 9, 2020)



https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection.html

Case Numbers in Manitoba (to date)



8,878
Total Positive Cases

290,560
Total Tested

514
Total Hospitalized

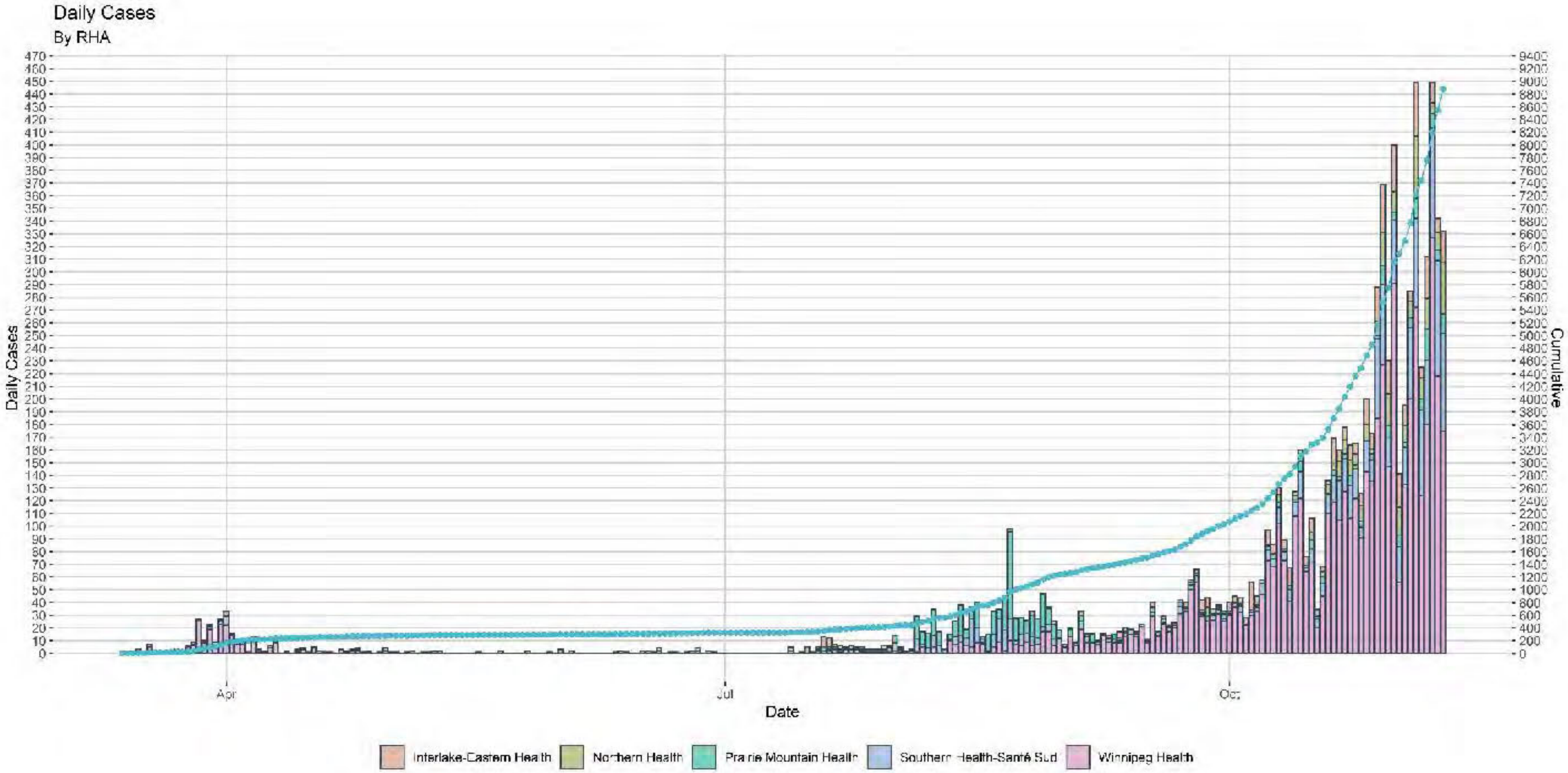
106
Total ICU Stays

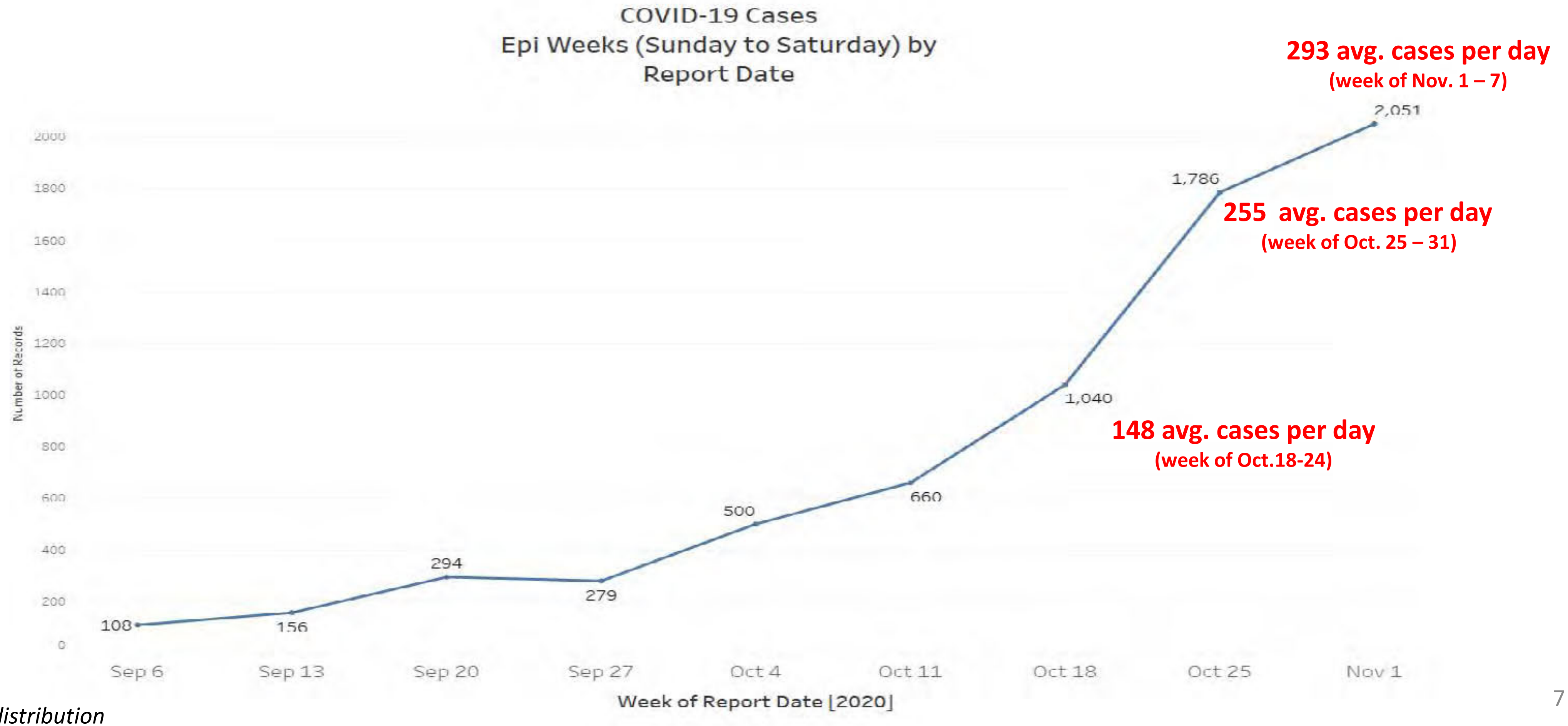
114
Total Deaths

AB1521

AB1522

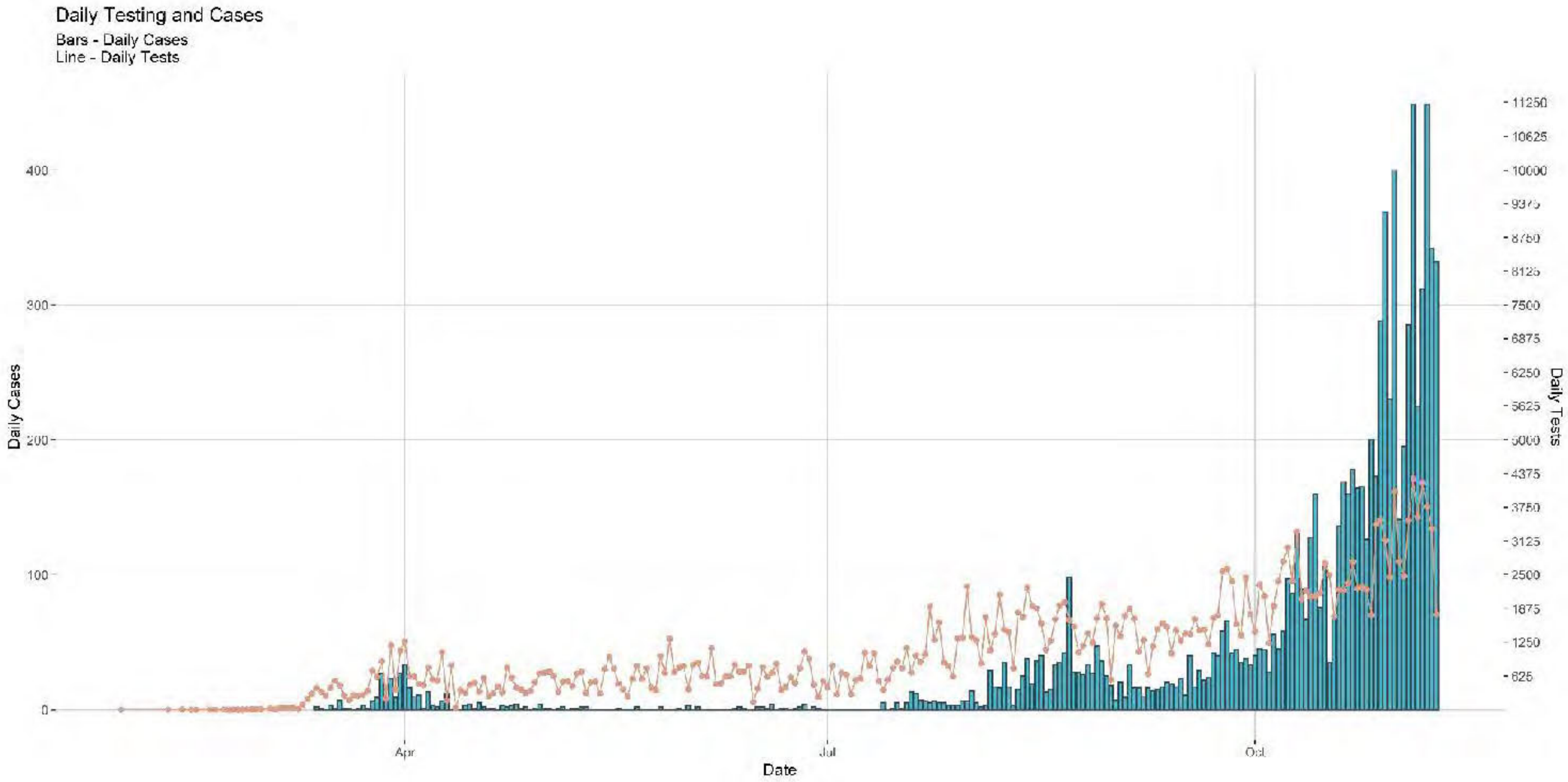
Daily COVID Cases by RHA




COVID-19 Cases
Epi Weeks (Sunday to Saturday) by
Report Date
293 avg. cases per day
(week of Nov. 1 – 7)
255 avg. cases per day
(week of Oct. 25 – 31)
148 avg. cases per day
(week of Oct.18-24)
Number of Records
2000
1800
1600
1400
1200
1000
800
600
400
200
0
108
156
294
279
500
660
1,040
1,786
2,051
Sep 6
Sep 13
Sep 20
Sep 27
Oct 4
Oct 11
Oct 18
Oct 25
Nov 1
Week of Report Date [2020]

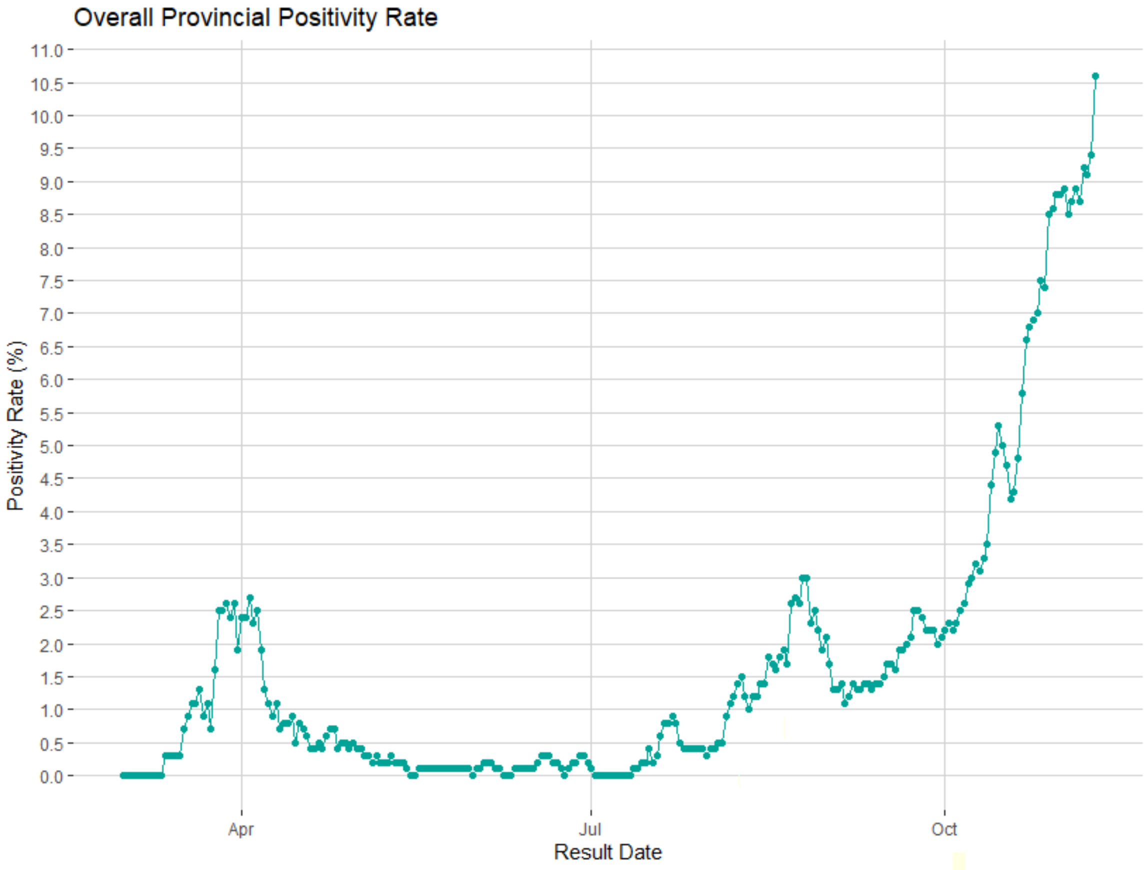
AB1523

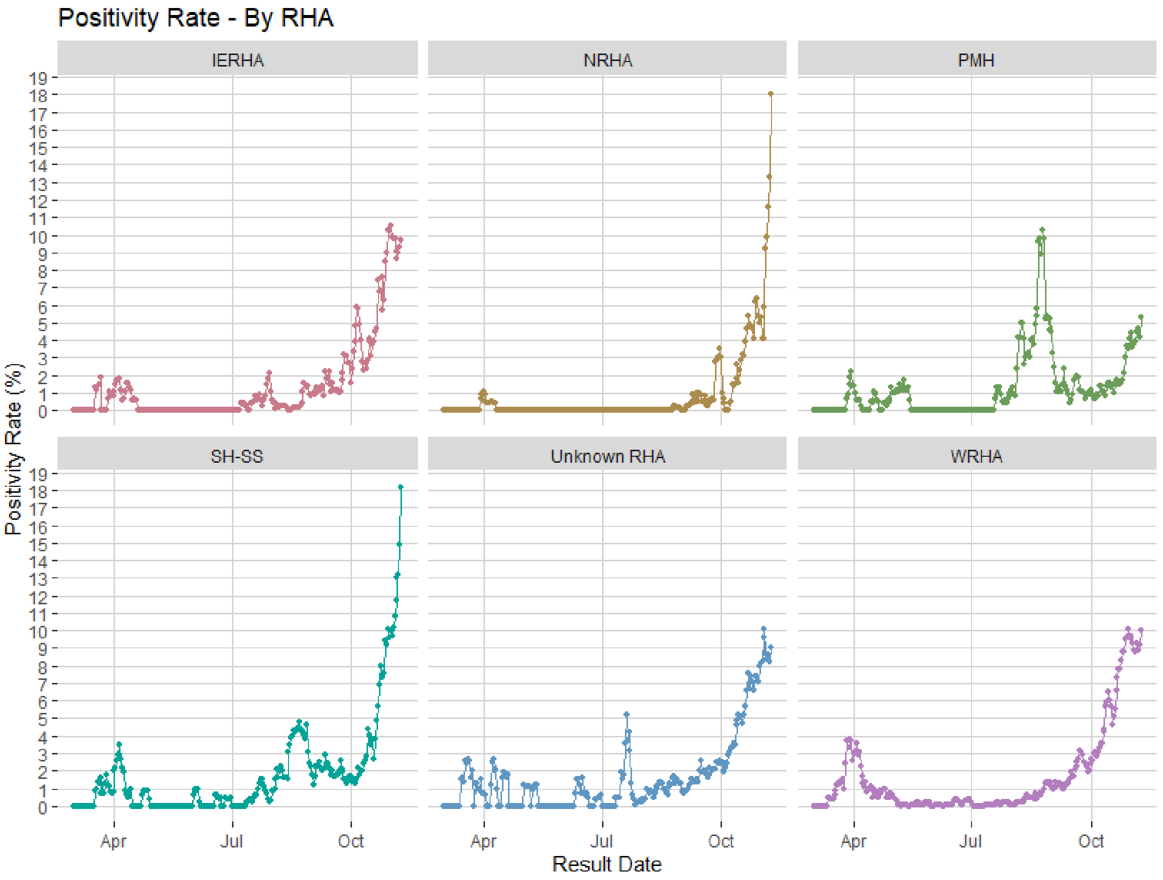
Testing Timeline



AB1524

Positivity Rates Provincially and by RHA





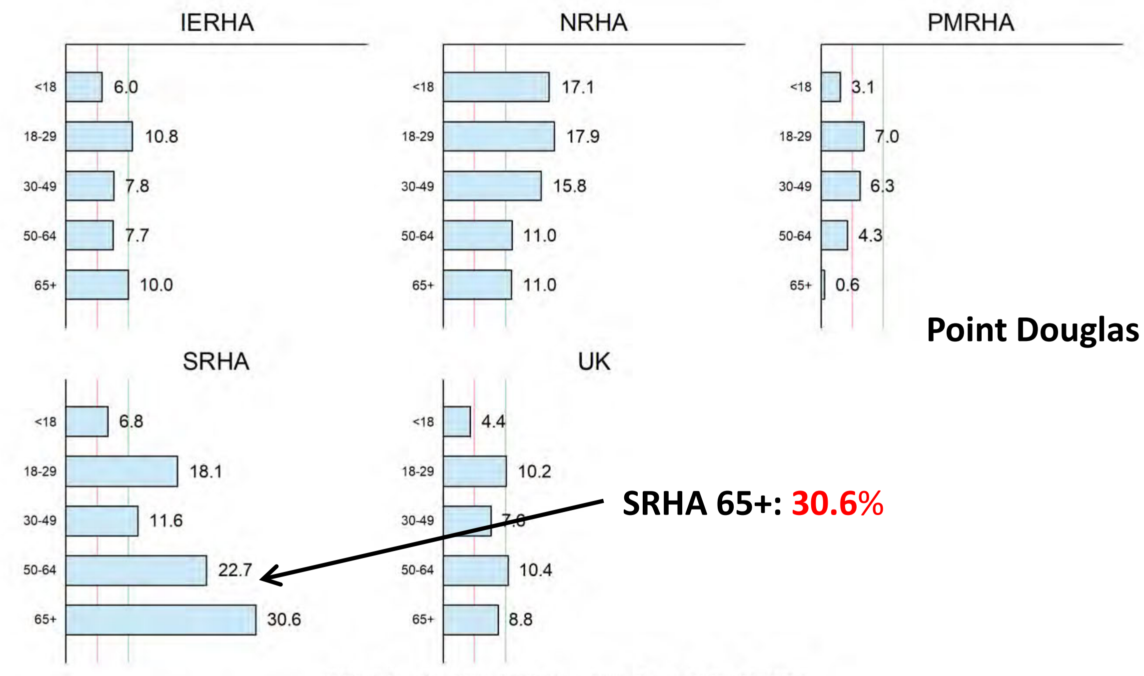
AB1525

AB1526

Test Positivity % by Rural RHA

Nov. 5 – Nov. 9, 2020

10%



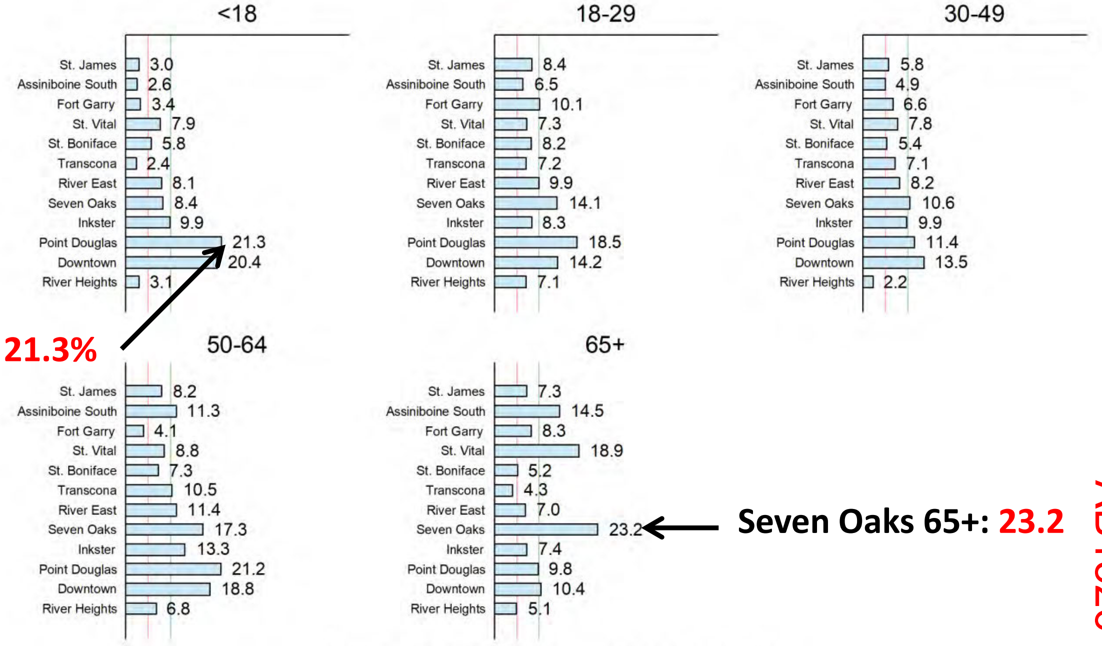
RHA 5-day (%): 05nov2020-09nov2020. Total: 10.0% (N: 6056)

Red line: 5%; Green line: 10% Does not include wards of the Public Trustee.

Test Positivity by Community Area (WHRA)

Nov. 5 – Nov. 9, 2020

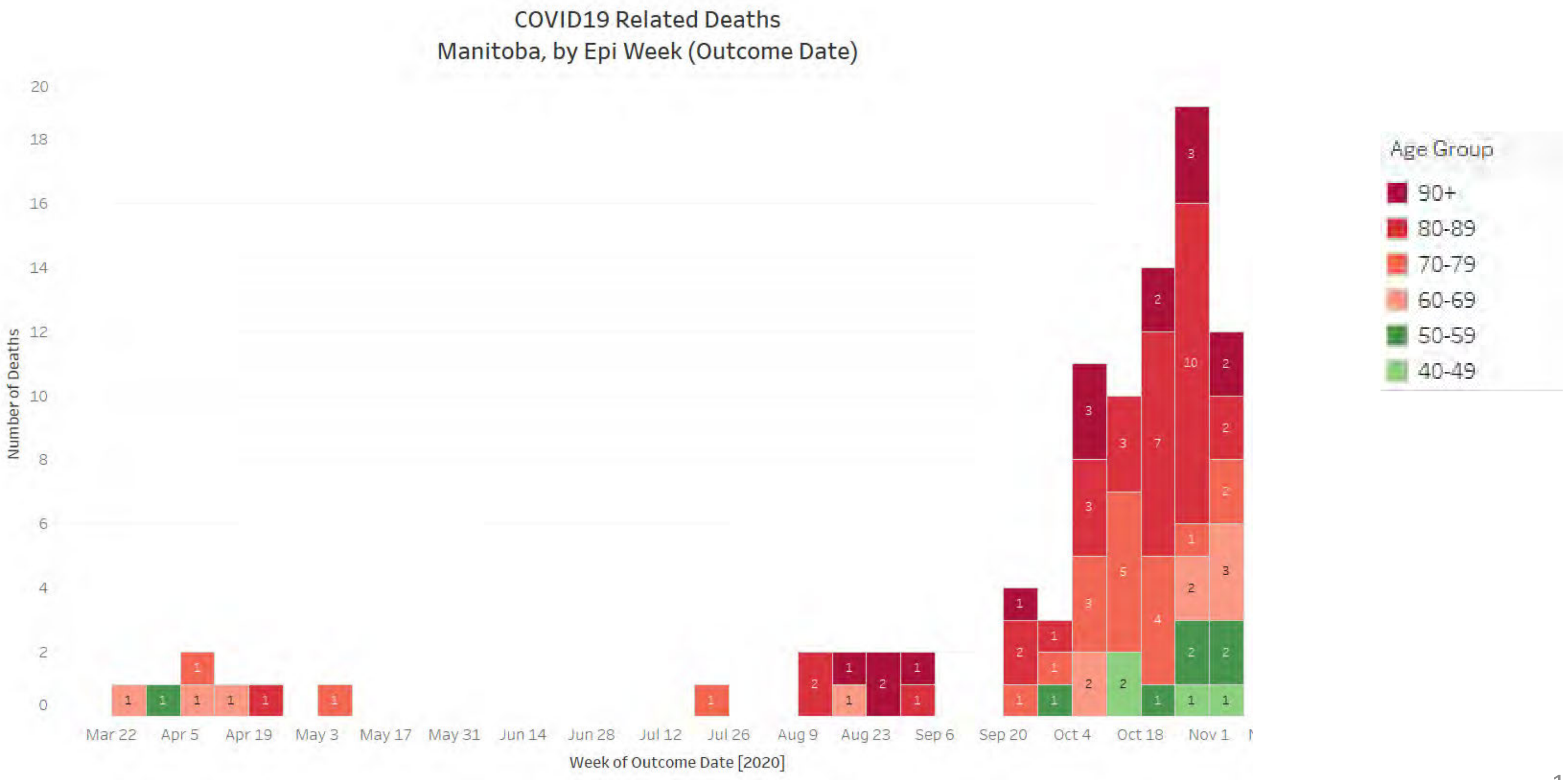
9.2%



CA 5-day (%): 05nov2020-09nov2020. Total: 9.2% (N: 8622)

Red line: 5%; Green line: 10%. Does not include wards of the Public Trustee (Total n: 23)

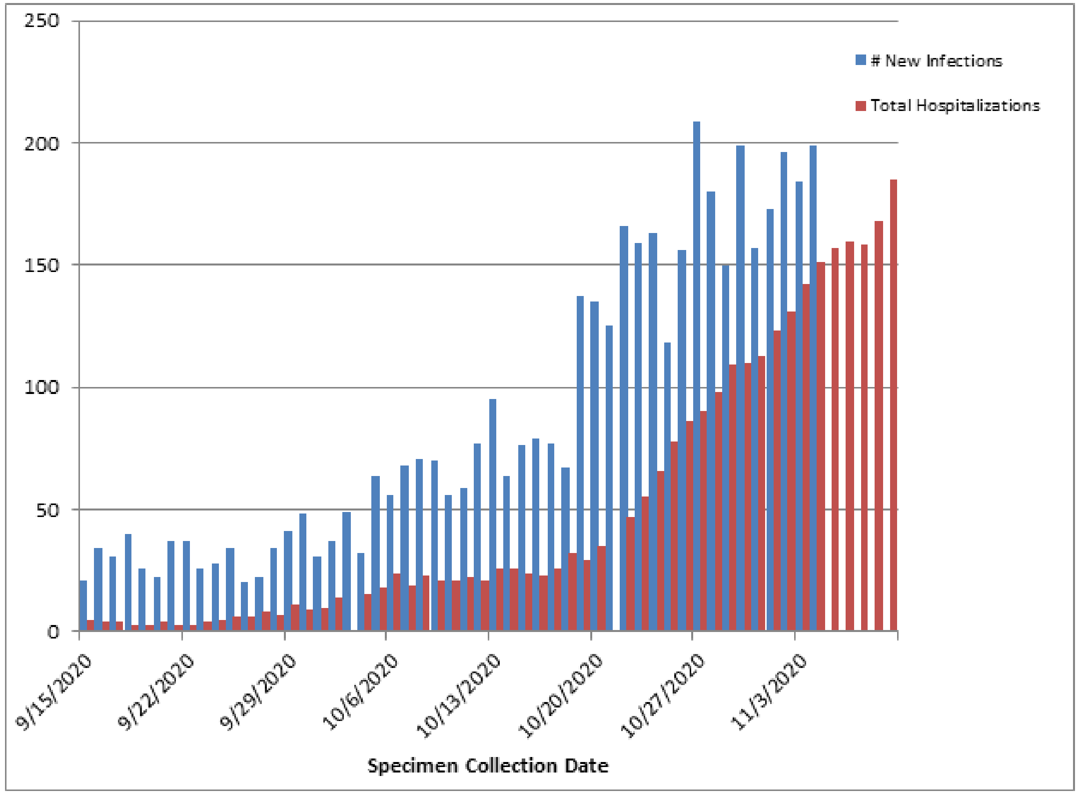
COVID-Related Deaths are now Rapidly Escalating



AB1527

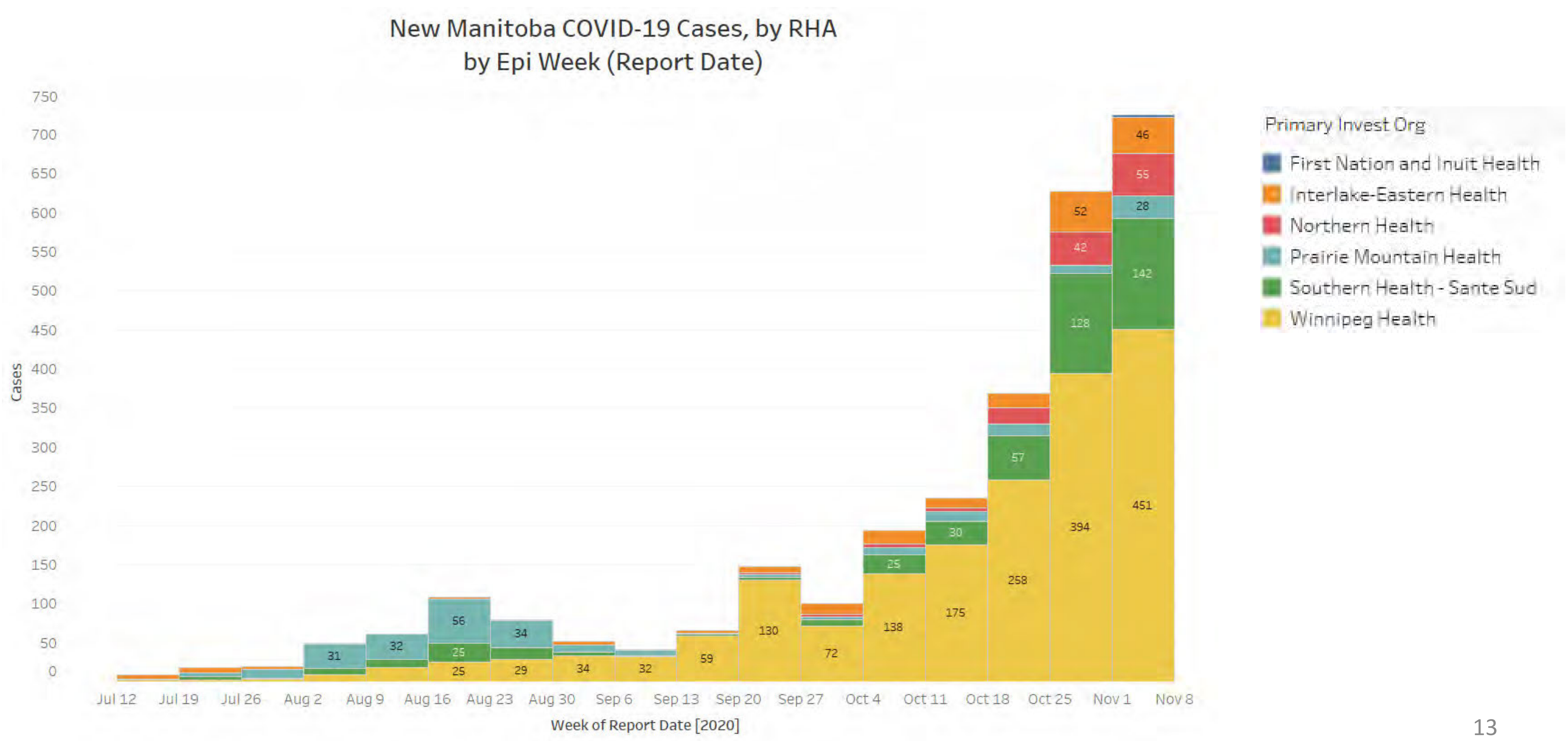
AB1528

COVID-Related Hospitalizations are Rising Quickly

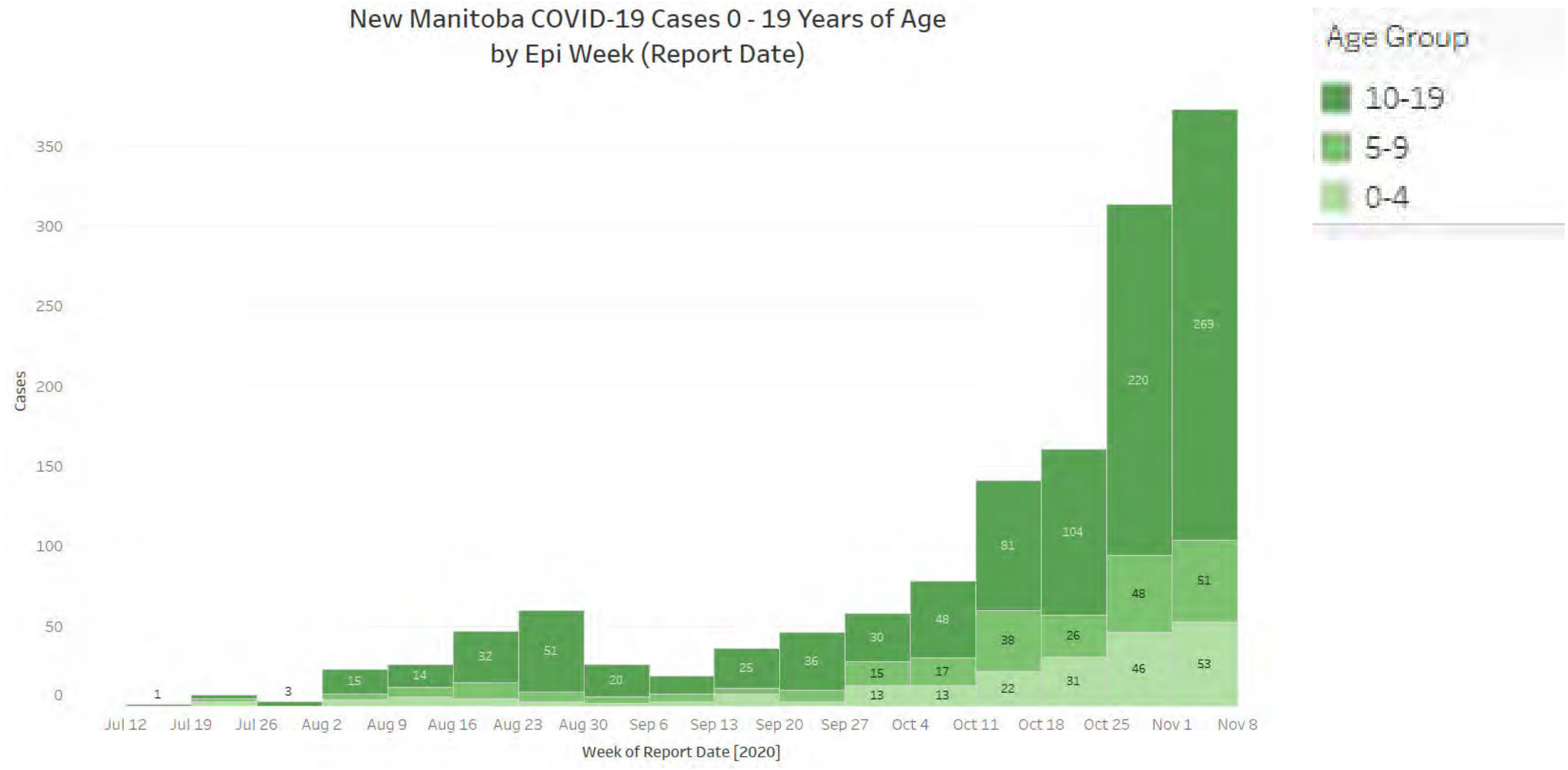


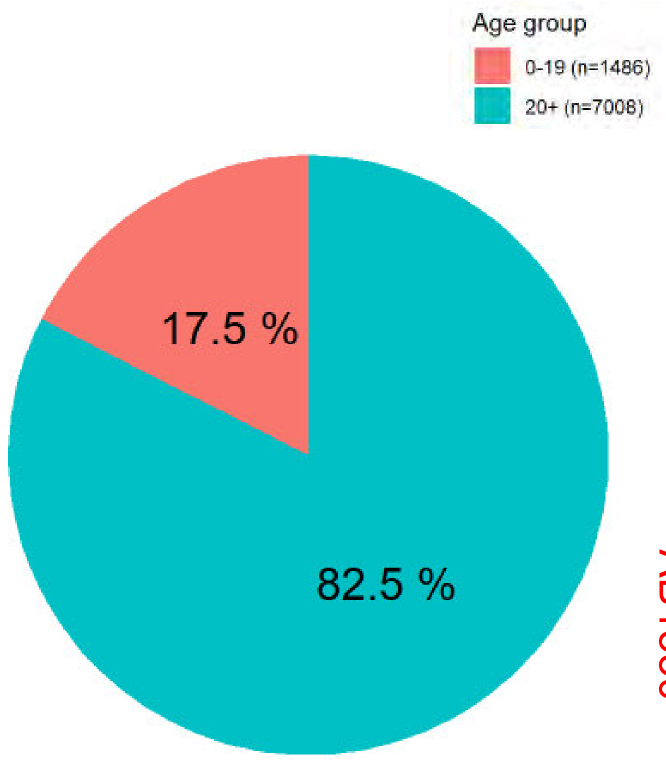
Note: Due to a lag in lab reporting from spec date to report date, all cases may not reflected above in more recent days.
Hospitalizations are total daily hospitalizations and not new admissions.

AB1529


New Manitoba COVID-19 Cases, by RHA
by Epi Week (Report Date)
Cases
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Jul 12
Jul 19
Jul 26
Aug 2
Aug 9
Aug 16
Aug 23
Aug 30
Sep 6
Sep 13
Sep 20
Sep 27
Oct 4
Oct 11
Oct 18
Oct 25
Nov 1
Nov 8
Week of Report Date [2020]
31
32
56
25
25
34
29
34
32
59
130
72
25
138
30
175
57
258
52
42
128
394
46
55
28
142
451
Primary Invest Org
First Nation and Inuit Health
Interlake-Eastern Health
Northern Health
Prairie Mountain Health
Southern Health - Sante Sud
Winnipeg Health

AB1530





Confidential – Not for distribution

AB1531

Information as of November 10 , 2020

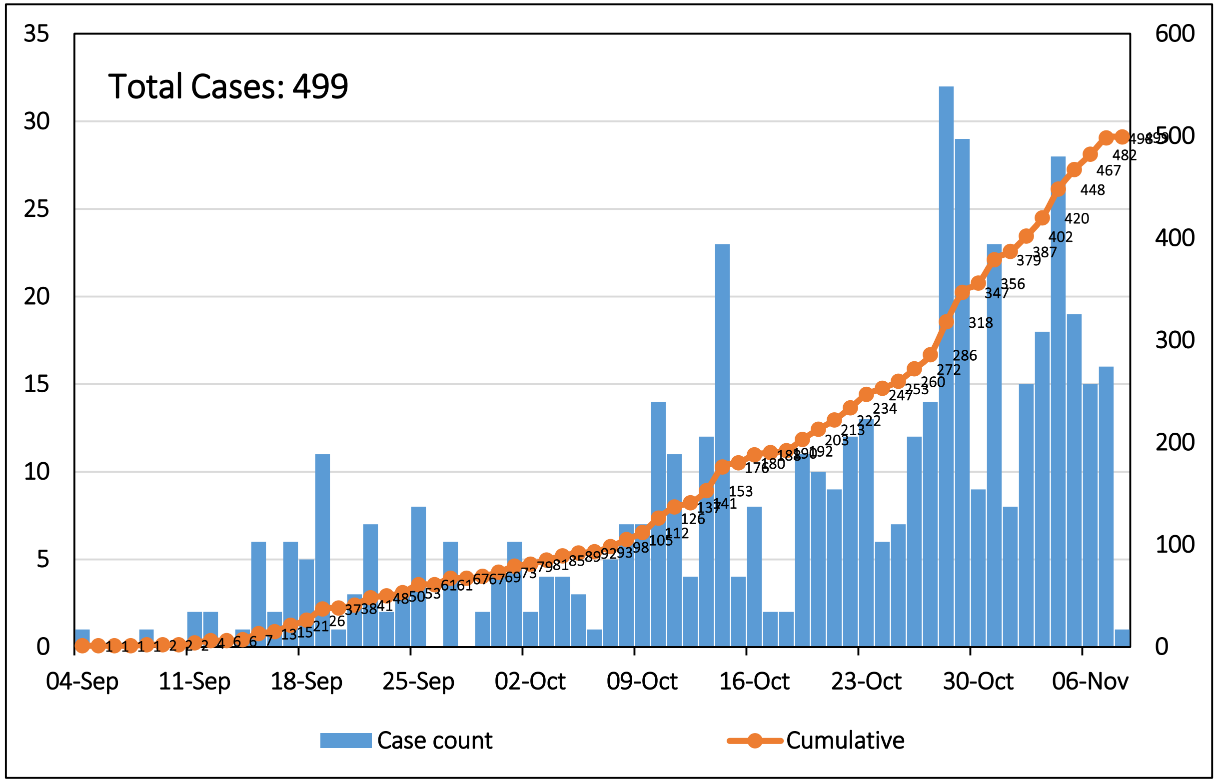


Figure 1: Epidemiological curve of COVID-19 school related cases in Manitoba since September 1, 2020

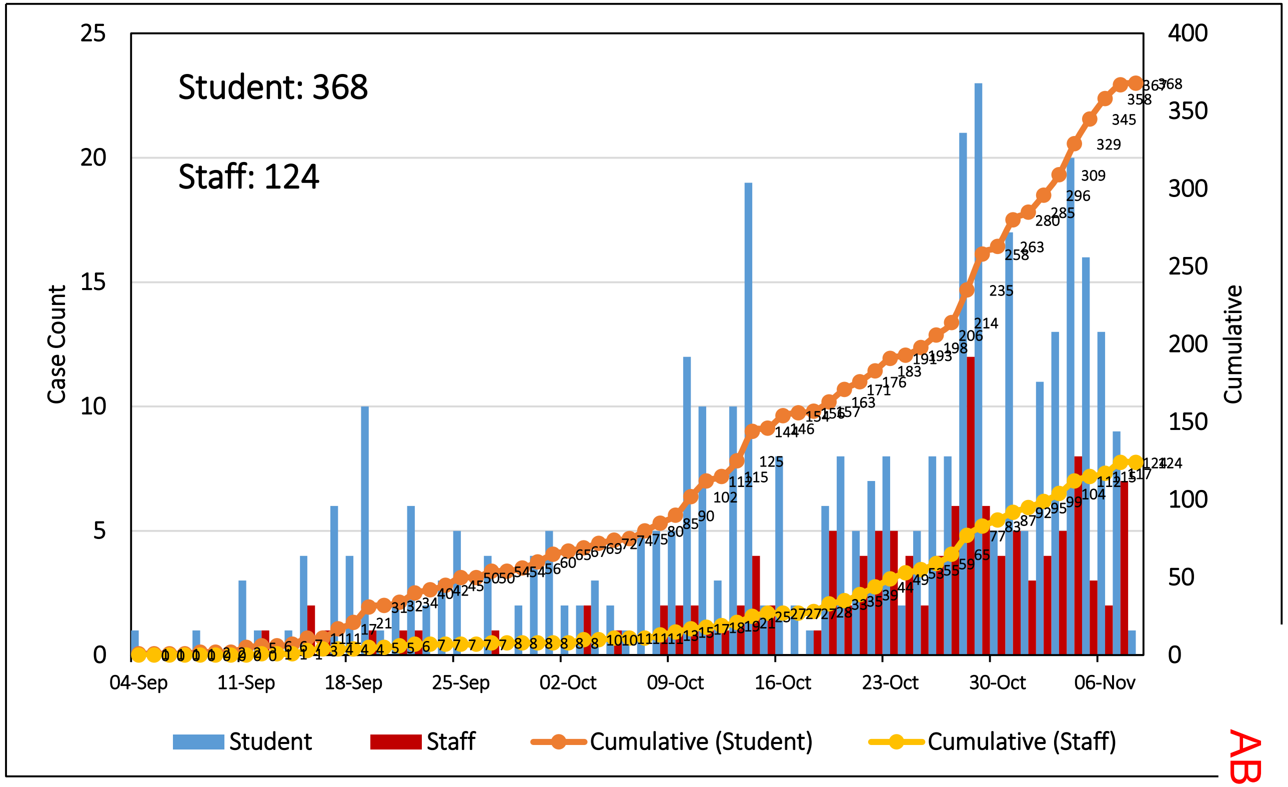
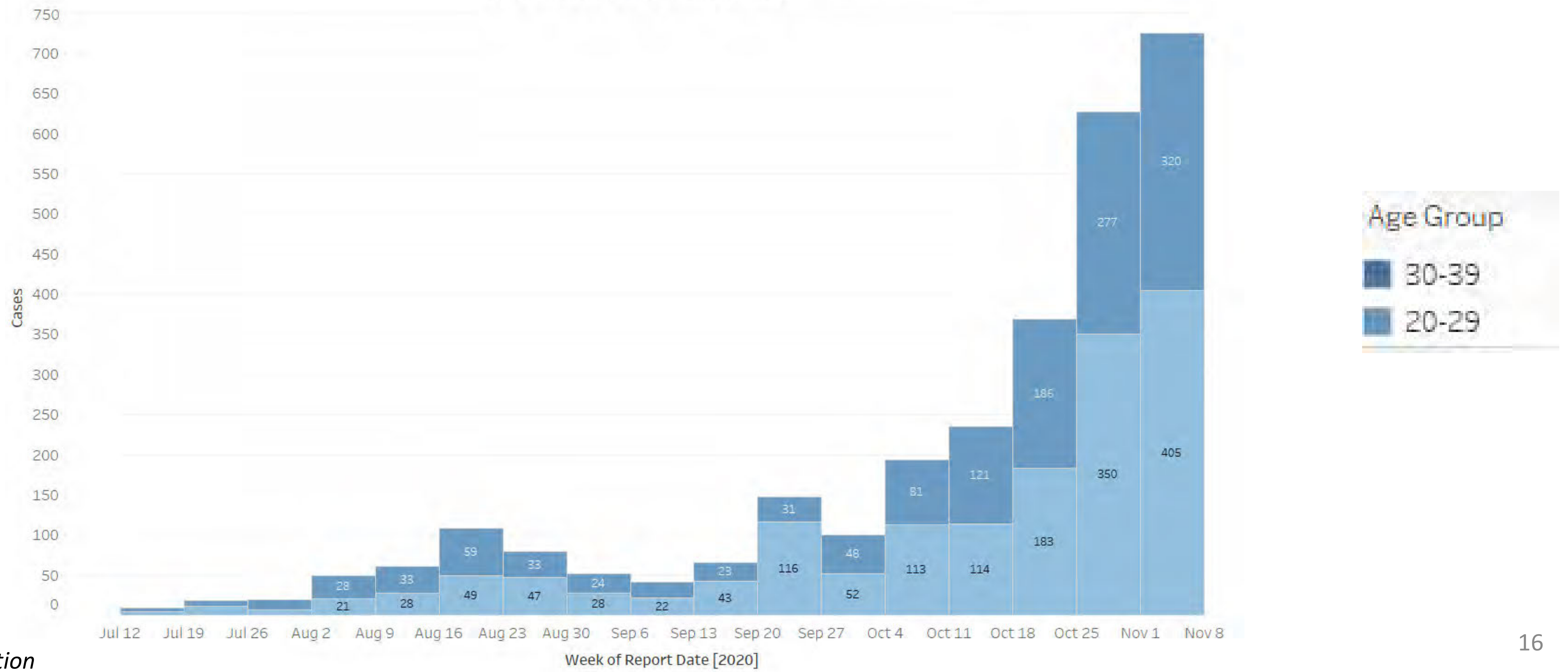


Figure 2: Epidemiological curve of COVID-19 school related cases(student an staff) in Manitoba since September 1, 2020

**Seven (7) cases are not in school environment (they are either parents or younger siblings of school related cases). As such, Figure 2 totals 492 cases relating to school environment (students and staff)*

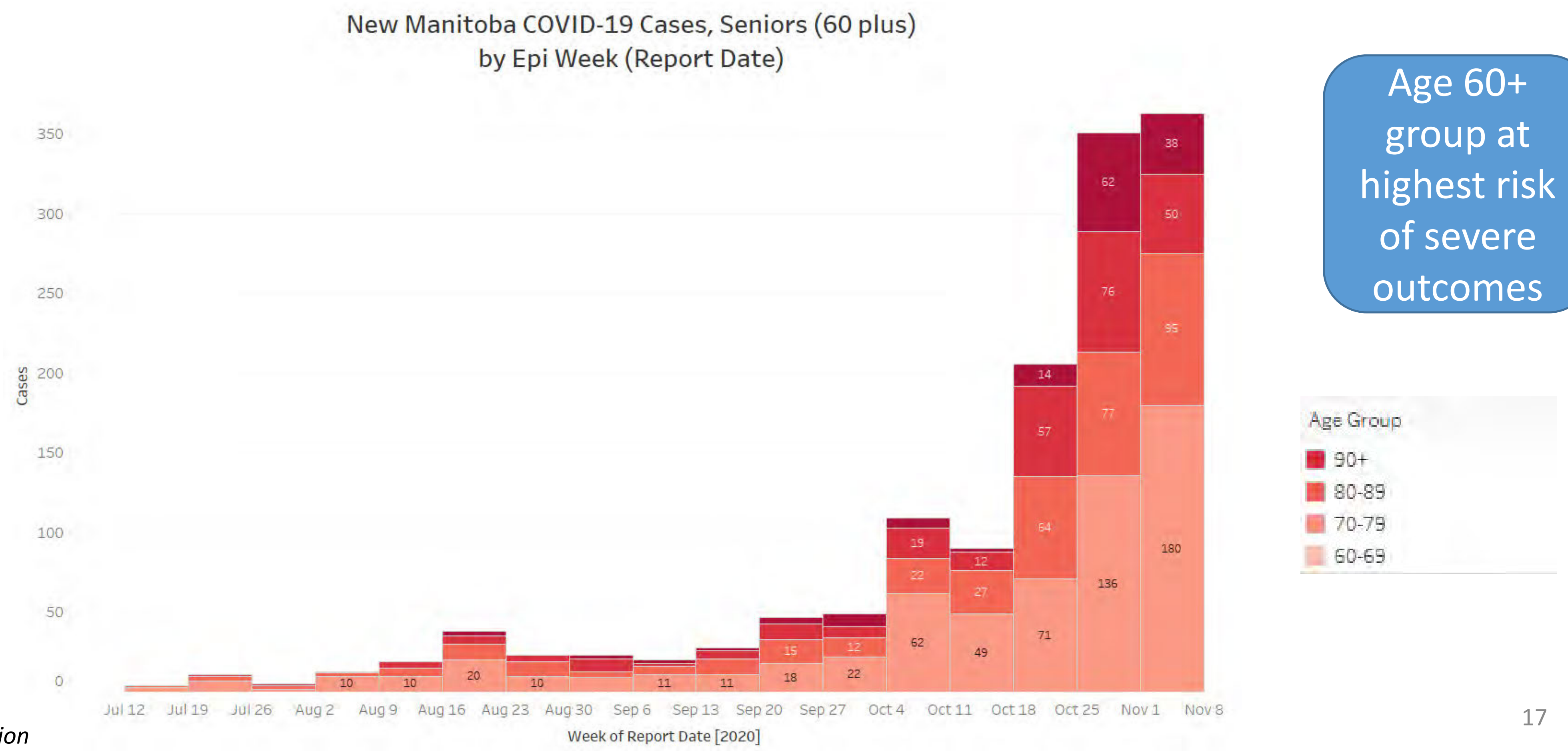
AB1532

New Manitoba COVID-19 Cases, Young Adults, 20- 39 Years of Age by Epi Week (Report Date)



COVID-19 NOVEL CORONAVIRUS

Manitoba



Age 60+ group at highest risk of severe outcomes

AB1533

Confidential – Not for distribution

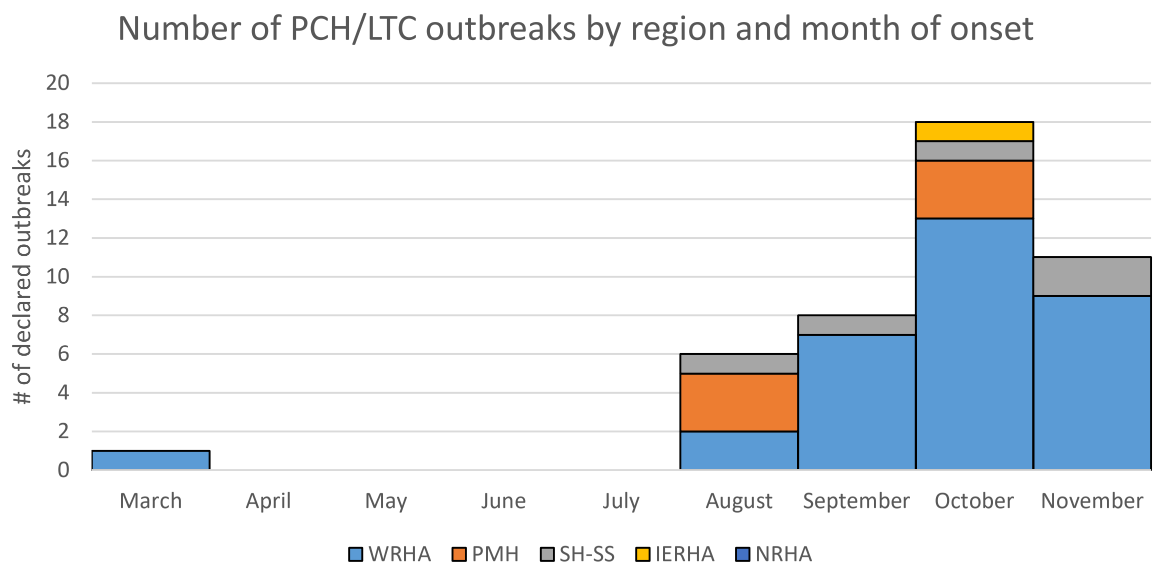
AB1534

PCH/LTC

- WRHA = 32 (73%)
- PMH = 6 (14%)
- SH-SS = 5 (11%)
- IERHA = 1 (2%)
- NRHA = 0

- 184 staff
- 336 residents

- Maples PCH = 66%
- Parkview Place PCH = 44%



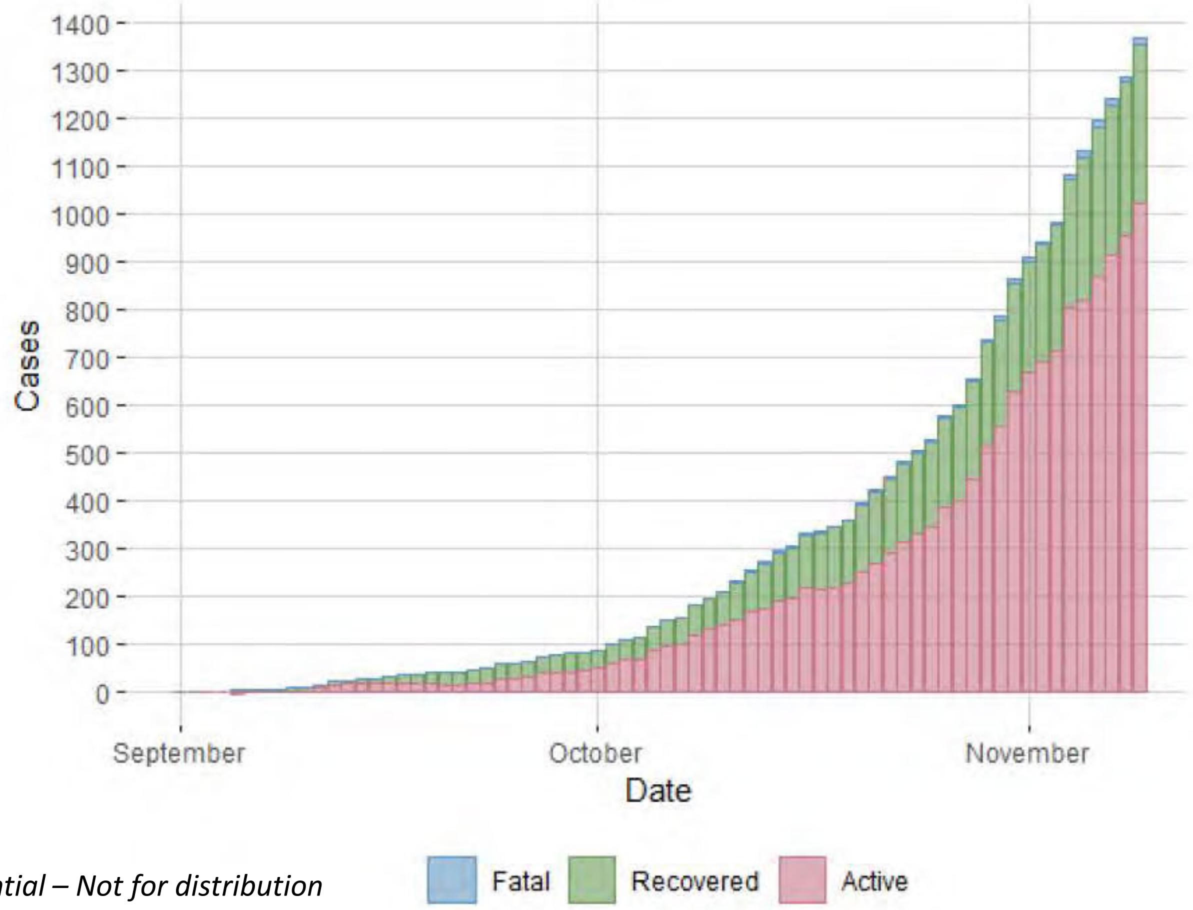
COVID-19 Impact on First Nations: Summary

- This allows First Nations living in Manitoba to determine how their data are shared both internally and publicly
- It supports quick PH action in the communities
- Permission was granted to share these data internally (data as of November 8, 2020)

- First Nations make up roughly 10-12% of the population but 16% of all cases in the province

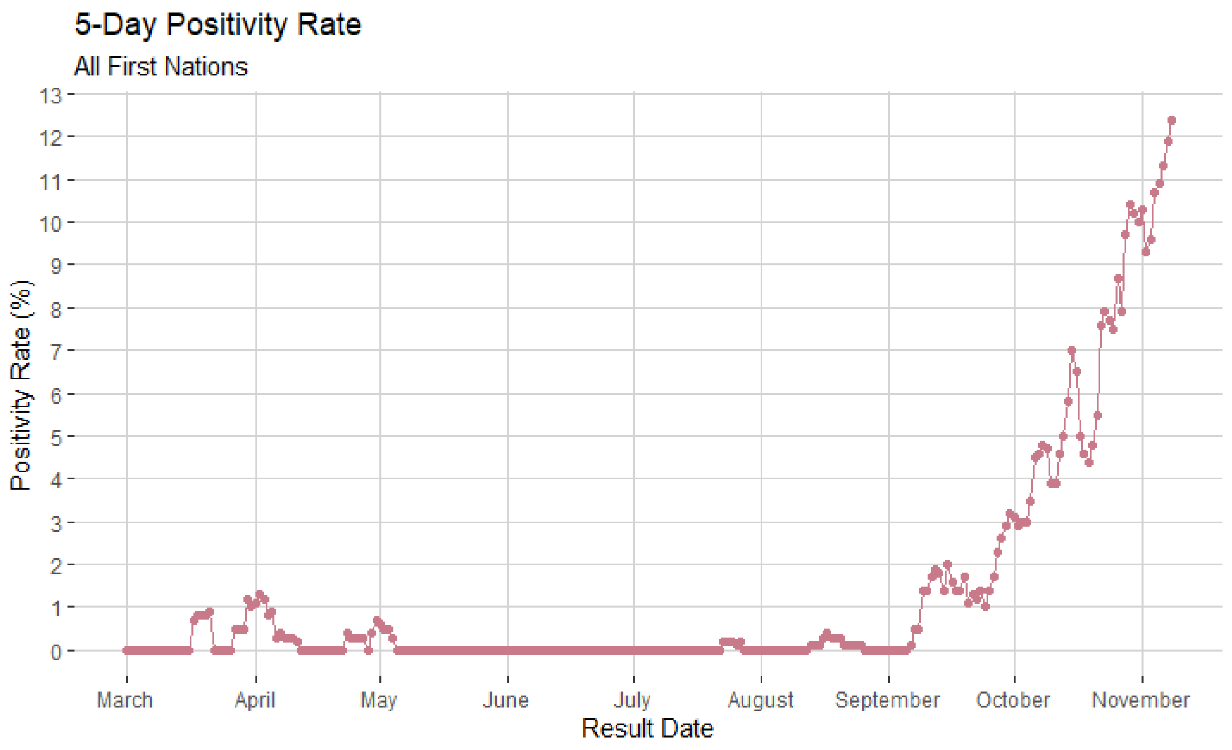
AB1535

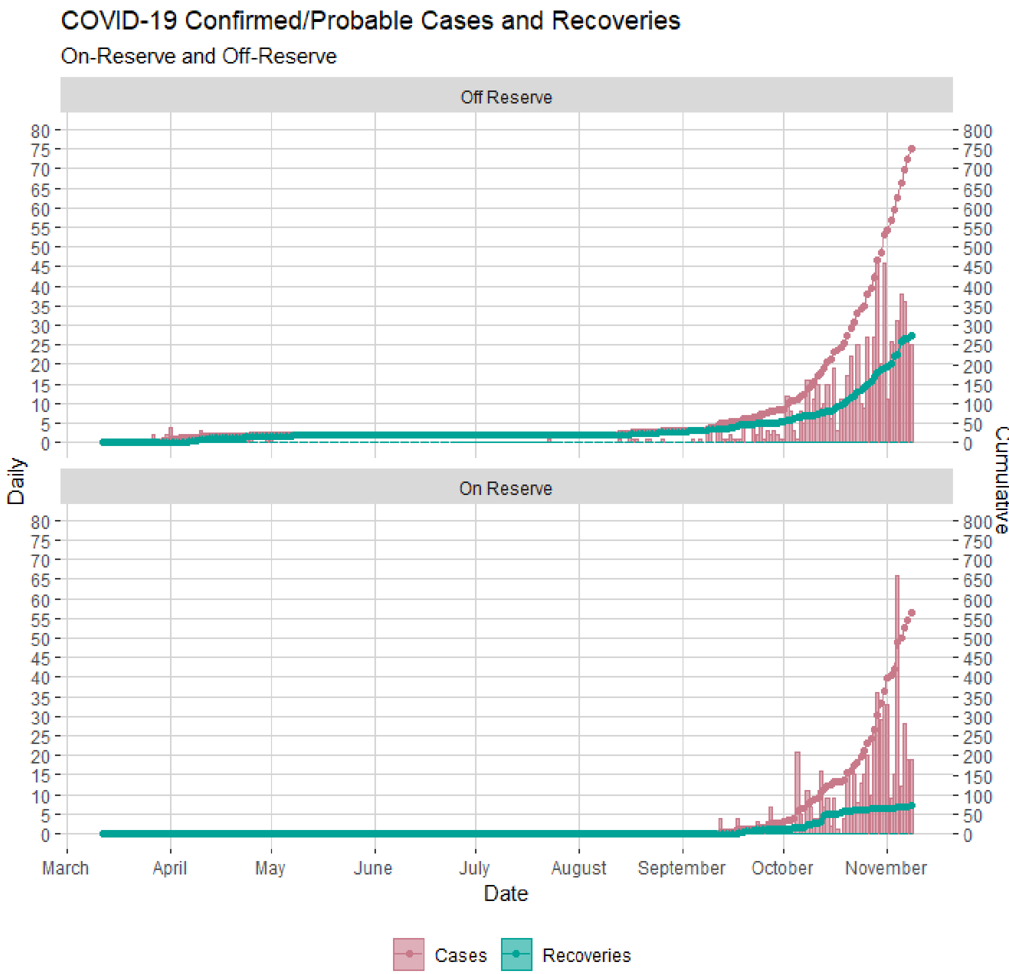
MB First Nations Experiencing Increased Cases with Severe Outcomes



Data derived from the Manitoba First Nations COVID-19 Pandemic Response Coordination Team PRCT Bulletin. Statistics as of November 8, 2020.

COVID-19 Impact on First Nations: Positivity Rate





AB1537

AB1538

In the WHR, COVID19 Cases are Occurring Everywhere, but are Concentrated in Downtown and Seven Oaks

Figure 6: Age-standardized rate (per 100,000) map of COVID-19 cases from the last 7 days in the Winnipeg Health Region

TABLE 2: Frequency, Crude and Age-Standardized Rates (per 100,000) of COVID-19 cases, from the past 7 days in the Winnipeg Health Region by Community Area

	Number	Crude Rate	Age-Standardized Rate	95% CI
Community area				
St. James	92	153.2	159.3	128.1 - 195.8
Assiniboine South	55	156.3	147.6	110.2 - 193.7
Fort Garry	126	145.4	139.8	116.2 - 166.9
St. Vital	133	190.0	192.3	160.8 - 228.2
St. Boniface	86	145.4	148.2	118.5 - 183.0
Transcona	54	138.3	138.1	103.7 - 180.2
River East	129	132.3	136.3	113.7 - 162.1
Seven Oaks	223	295.1	294.2	256.8 - 335.5
Inkster	72	209.5	209.5	163.6 - 264.2
Point Douglas	120	253.0	251.2	207.8 - 301.1
Downtown	187	229.3	230.7	198.6 - 266.5
River Heights	53	93.2	90.4	67.3 - 118.9
Total	1,330	178.9	178.7	169.2 - 188.6

COVID-19 NOVEL CORONAVIRUS

Manitoba

COVID-19 MODELLING

AB1539

Confidential – Not for distribution

Made-in-Manitoba Agent-Based Modelling Simulations

Made-in-Manitoba Agent-Based Modelling Simulations (cont.)

AB1541

Simulation Scenarios and Projections

- Measures and the timing they are put in place are adequate but individuals behaviours are not well aligned with recommendations.
- Measures and the timing they are put in place may not be ideal and individuals behave as if the situation is not as serious as it really is.
- Measures and the timing they are put in place are not ideal and individuals behave as if there was no problem.

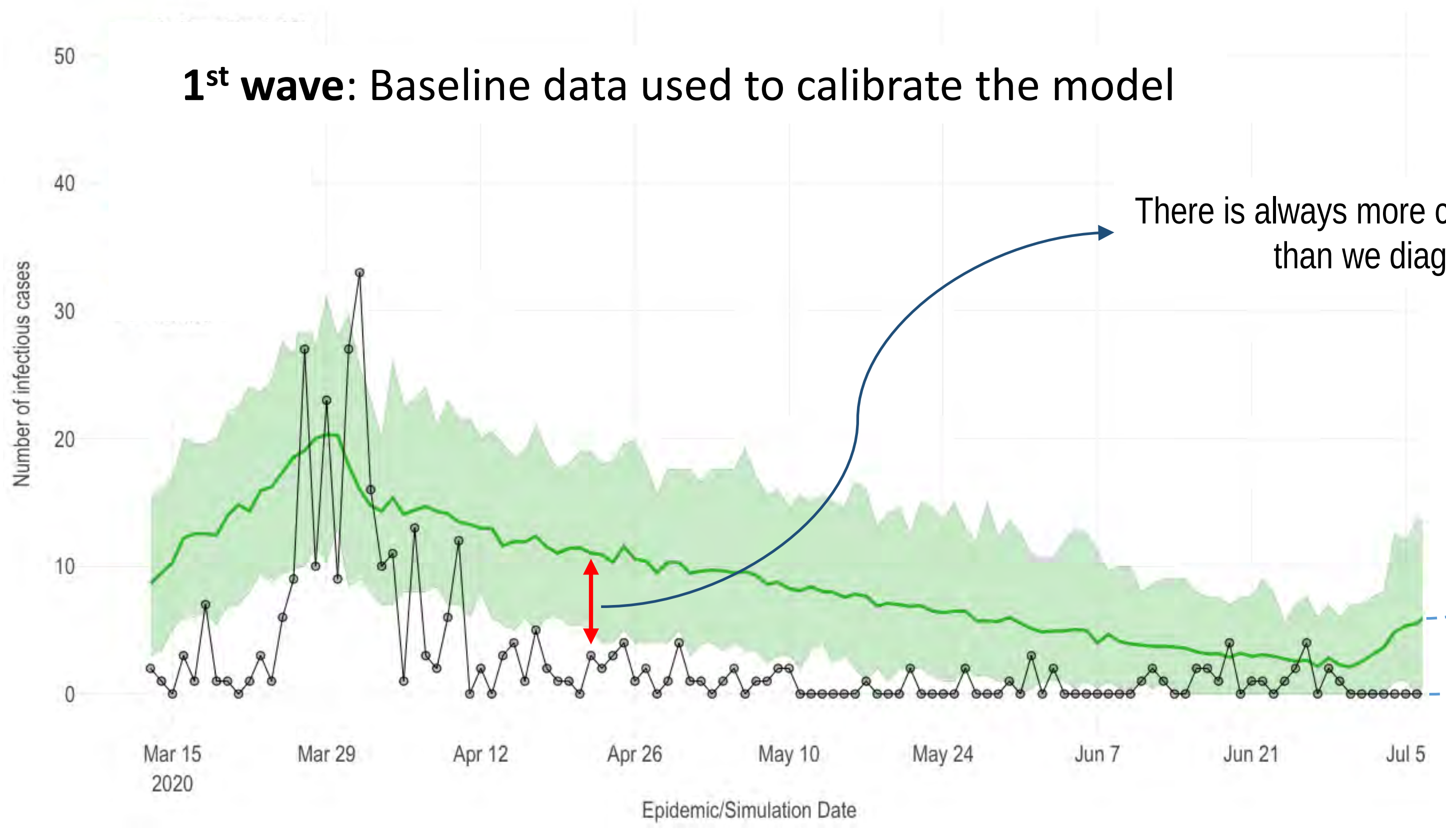
AB1542

Notes on Modelling

Health Care Capacity Thresholds

Health Care Capacity Thresholds (cont.)

Baseline: The First Wave. Total Number of Infectious Cases (diagnosed or not)



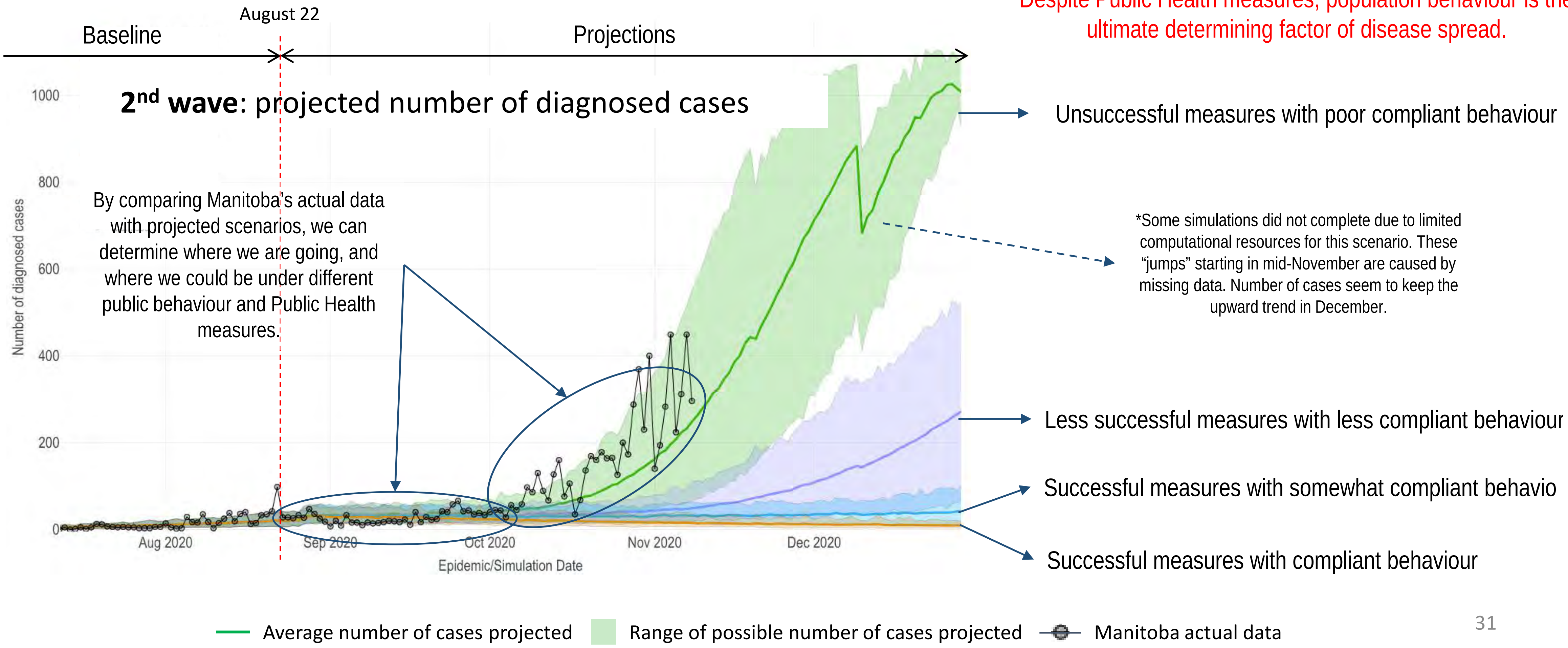
There is always more cases circulating than we diagnose.

This specific simulation includes all cases in Manitoba, **diagnosed or not**.

Manitoba data only includes diagnosed cases. Even if Manitoba data is showing zero cases, there may be cases circulating in the population that we are not aware of. This happens because there are asymptomatic cases or cases with mild symptoms that have not been tested.

Average number of cases projected | Range of possible number of cases projected | Manitoba actual data

Projected Number of Diagnosed Cases in Different Scenarios (daily number of new cases)



Despite Public Health measures, population behaviour is the ultimate determining factor of disease spread.

AB1547

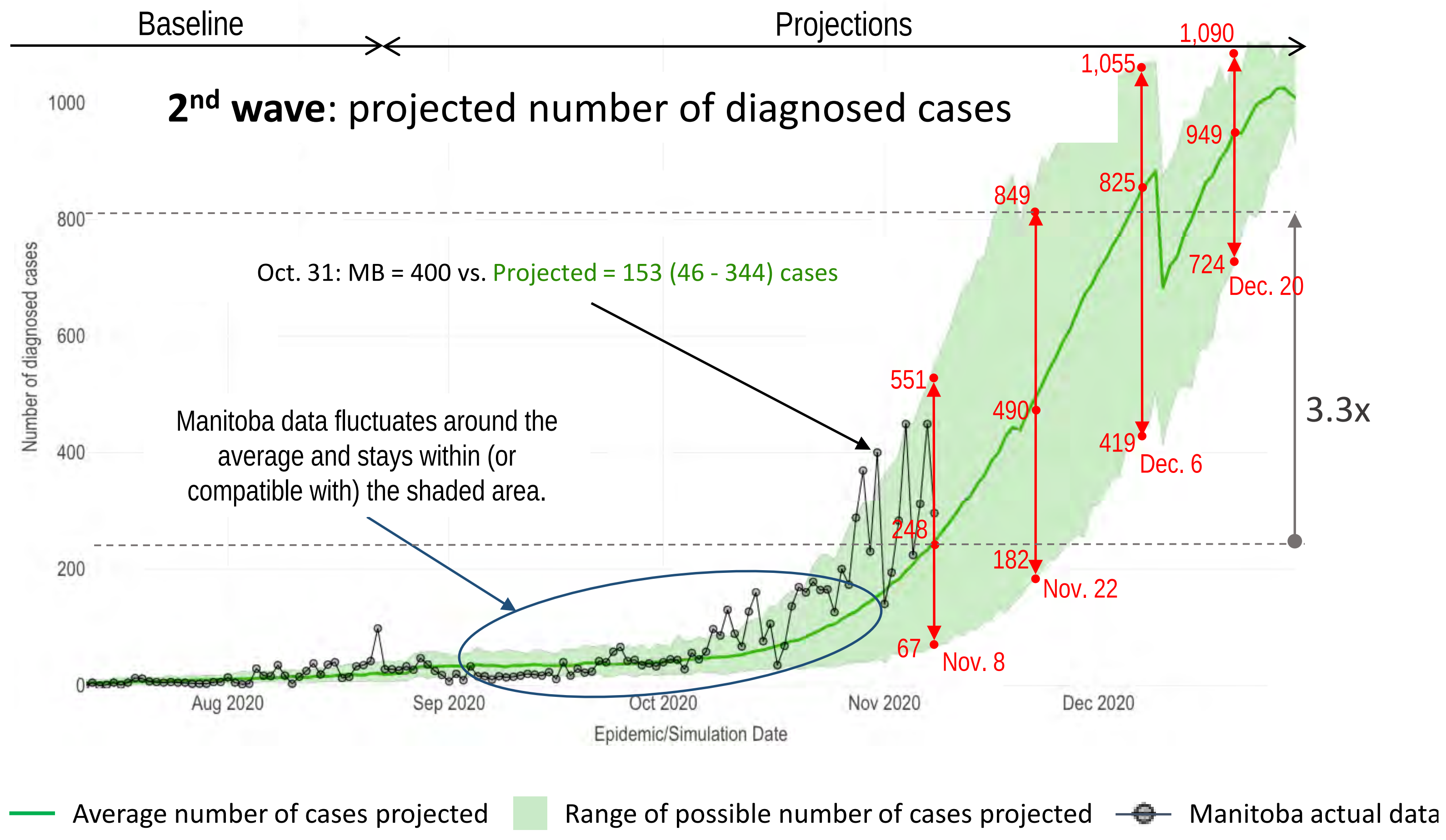
COVID-19 NOVEL CORONAVIRUS

Manitoba

Confidential – Not for distribution

Projected Number of Diagnosed Cases (daily number of new cases)

Information from July 12 to December 30, 2020. Manitoba data extracted: 2020-11-09.



Manitoba is following the the **worst-case scenario simulated** in terms of number of cases.

Simulations reflect total number of cases **diagnosed** in Manitoba. There is always more cases out there than the ones we diagnose.

Real number of infections (including non-diagnosed ones) is projected to **be 5 to 15 times larger**.

- **Public Health Capacity has been exceeded** (data entry backlogs and longer times to contact clients). We cannot handle 400-1,000 new cases a day.
- **Laboratory capacity may not be enough** to capture a more accurate picture.

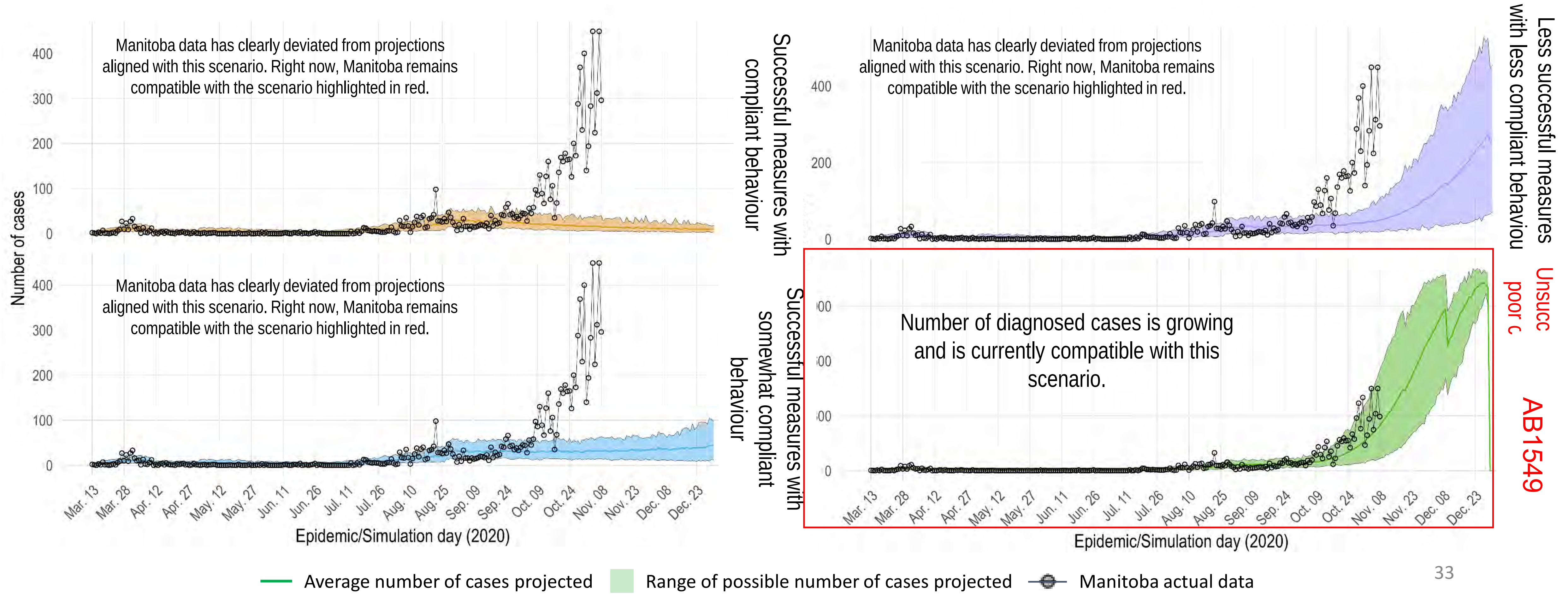
- Manitoba has seen **8,495 diagnosed cases to date** (Nov. 9).
- By Dec. 2, 2020 (**23 days from now**) the total number o diagnosed cases is expected to have **doubled**:

- **Projected - Dec. 2: 16,971 (7,956 – 28,569)** diagnosed cases.

AB1548

Confidential – Not for distribution

Projected Number of Diagnosed Cases at Different Levels of Public Health Measures and Public Behaviour (all scenarios)



COVID-19 NOVEL CORONAVIRUS

Manitoba

SYSTEM CAPACITY

AB1550

Confidential – Not for distribution

Manitoba Alignment With Projected Scenarios

- In terms of the number of cases and laboratory testing positivity rates, **Manitoba is aligned with the worst-case scenario simulated**, i.e. the one described as *Unsuccessful measures with poor compliant behaviour*.
- Although core public health measures (physical distancing and self-isolation when sick) haven't changed over time, **public behaviour has been driving the number of cases up**.
- In regards to interpreting projected health care capacity scenarios, we will not focus on the labels assigned to each scenario and that provide interpretation in terms of successful or unsuccessful public health measures or behavioural compliance.
- **Health care utilization relates to biological factors** such as the age and health profile of the population at a given time. Although volumes are driven by public behaviour and public health measures, these are not necessarily the main predictors for health care volumes.
- **Age and health profile can change over time**, which will make Manitoba data fit different curves (scenarios). For this reason, we will use the projections that best describe Manitoba data to highlight trends.

AB1551

Currently Available Hospital Capacity

1,956

Acute Hospital Beds

Current Vacancy

28%

AB1552

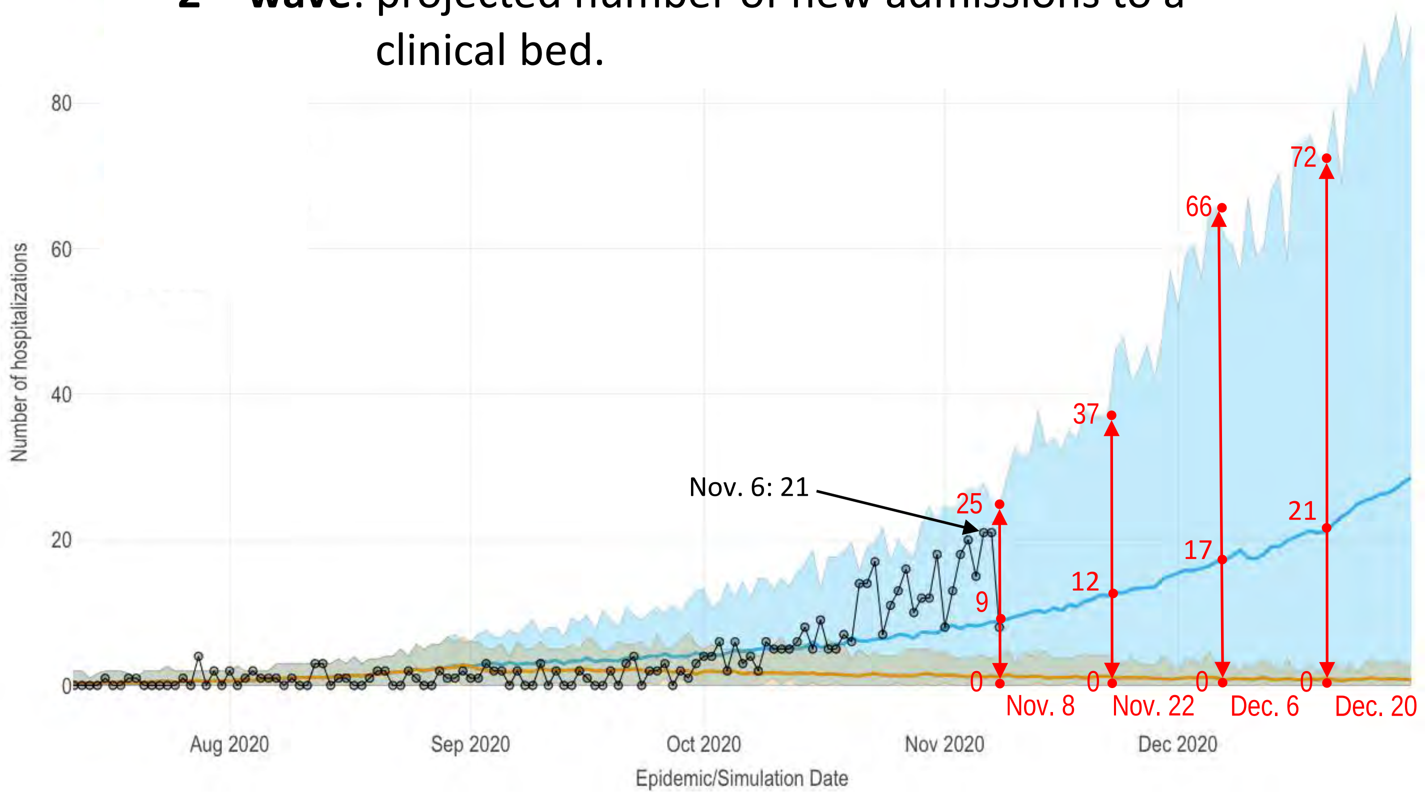
COVID-19 NOVEL CORONAVIRUS

Manitoba

Confidential –
Not for distribution

Information from July 12 to December 30, 2020. Manitoba data extracted: 2020-11-09.

2nd wave: projected number of new admissions to a clinical bed.



Average number of hospitalizations projected | Range of possible number of hospitalizations projected | Manitoba actual data

In the beginning of the 2nd wave, most cases were comprised of a younger and healthier population. That shift in population profile, when compared to the 1st wave, resulted in fewer hospitalizations.

With COVID-19 reaching Personal Care Homes and affecting the most vulnerable populations, we have been observing an increasing demand on the health system.

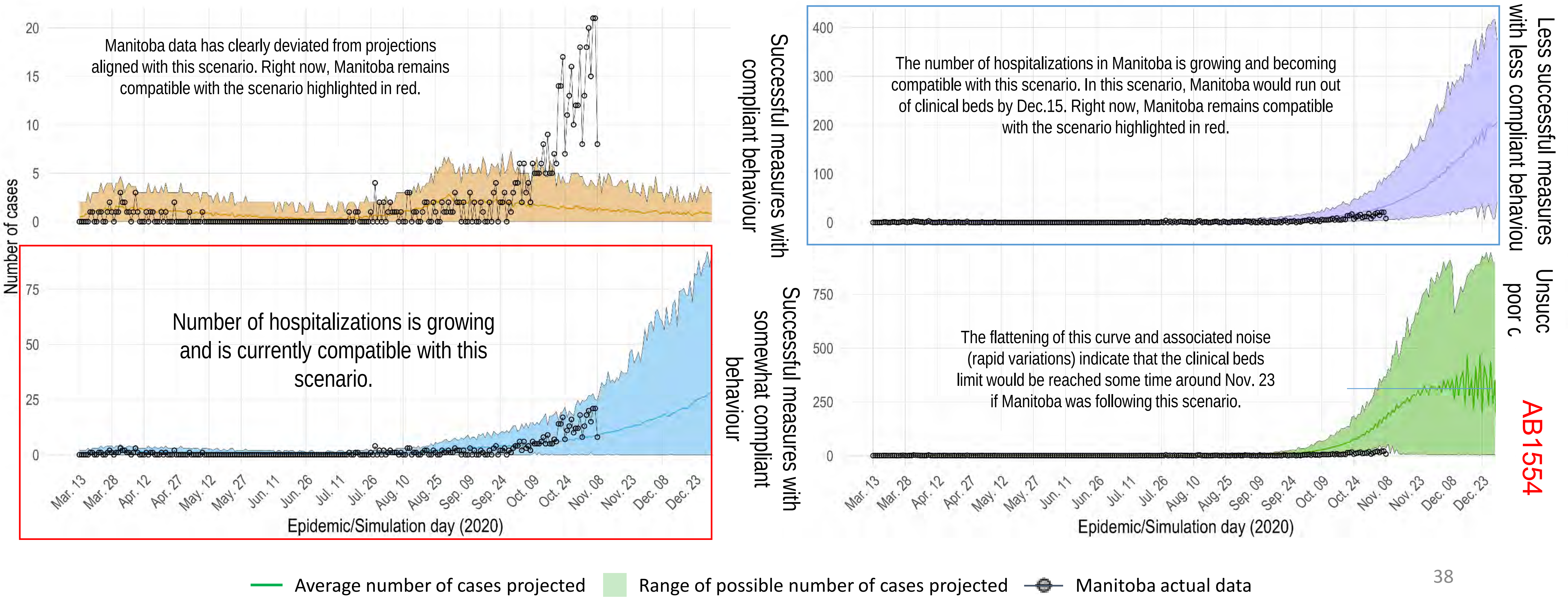
From this graph, if Manitoba data continues to follow this trend, we will be admitting to a clinical bed around:

- 9 (0 - 25) new patients on a single day by Nov. 8.
- 12 (0 - 37) new patients on a single day by Nov. 22.
- 17 (0 - 66) new patients on a single day by Dec. 6.
- 21(0 - 72) new patients on a single day by Dec. 20.

AB1553

Confidential –
Not for distribution

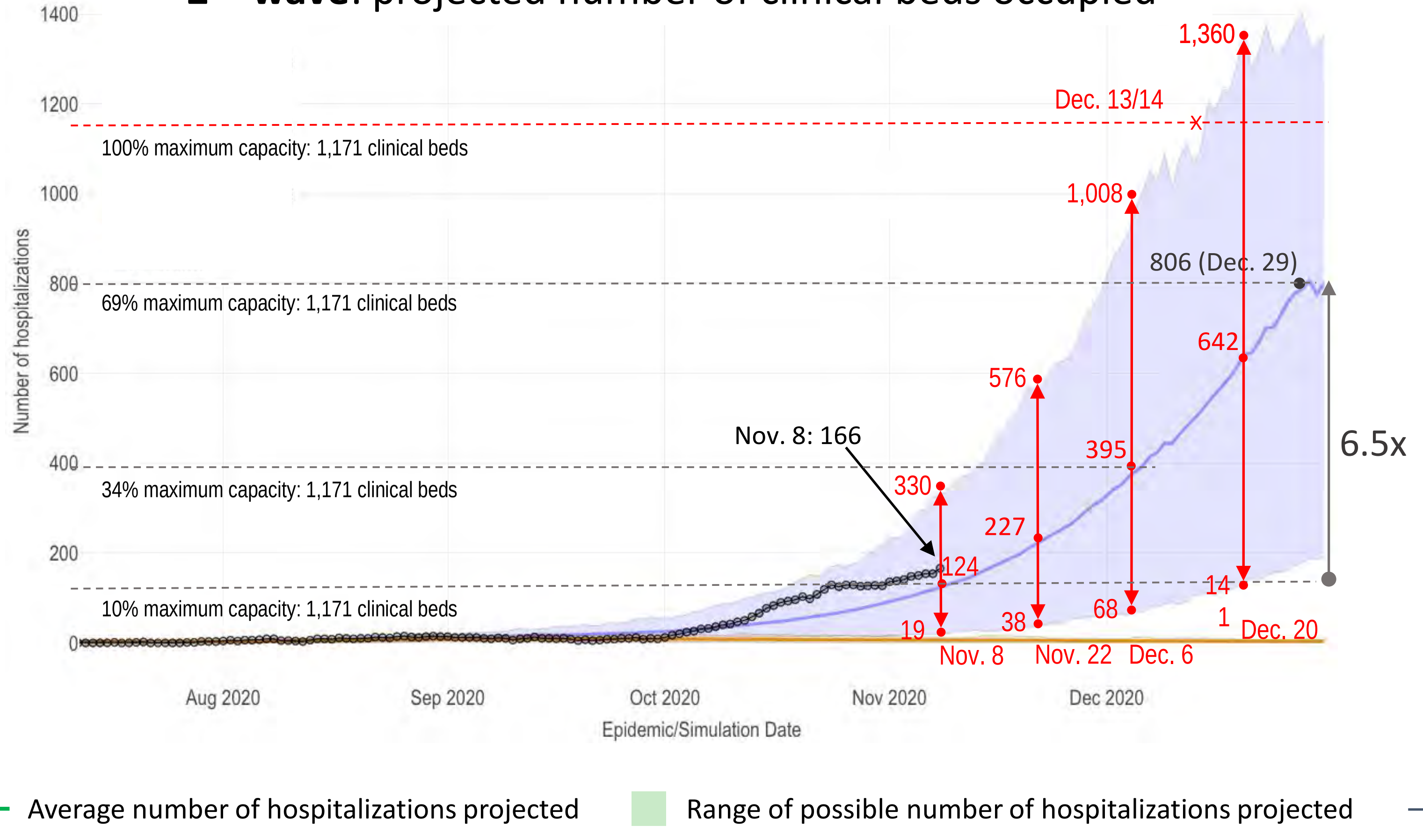
Information from March 13 to December 31, 2020. Manitoba data extracted: 2020-11-09.



AB1554

Information from July 12 to December 30, 2020. Manitoba data extracted: 2020-11-09.

2nd wave: projected number of clinical beds occupied



The model considers **1,171 clinical beds as the maximum number of clinical beds that can be made available for COVID-19 patients**. It is important to note that <u>most of these beds (~72%) are already occupied by COVID-19 and non-COVID-19 cases</u>.

- COVID-19 cases are currently occupying around 14% of the number of clinical beds available to COVID-19 patients.
- **COVID-19 patients may require 100% of clinical beds capacity by Dec. 13/14**

The length of stay in a clinical bed vary with age and health profile of the patient, and other biological factors.

- If age and health profiles change, maximum capacity can be reached even sooner.

A patient my require a clinical bed for either a few days or several weeks, and then recover. Some patients may require clinical bed for a few days and then require ICU care.

When maximum capacity is reached, the model (and medical experts) assumes that patients have 90% probability of dying.

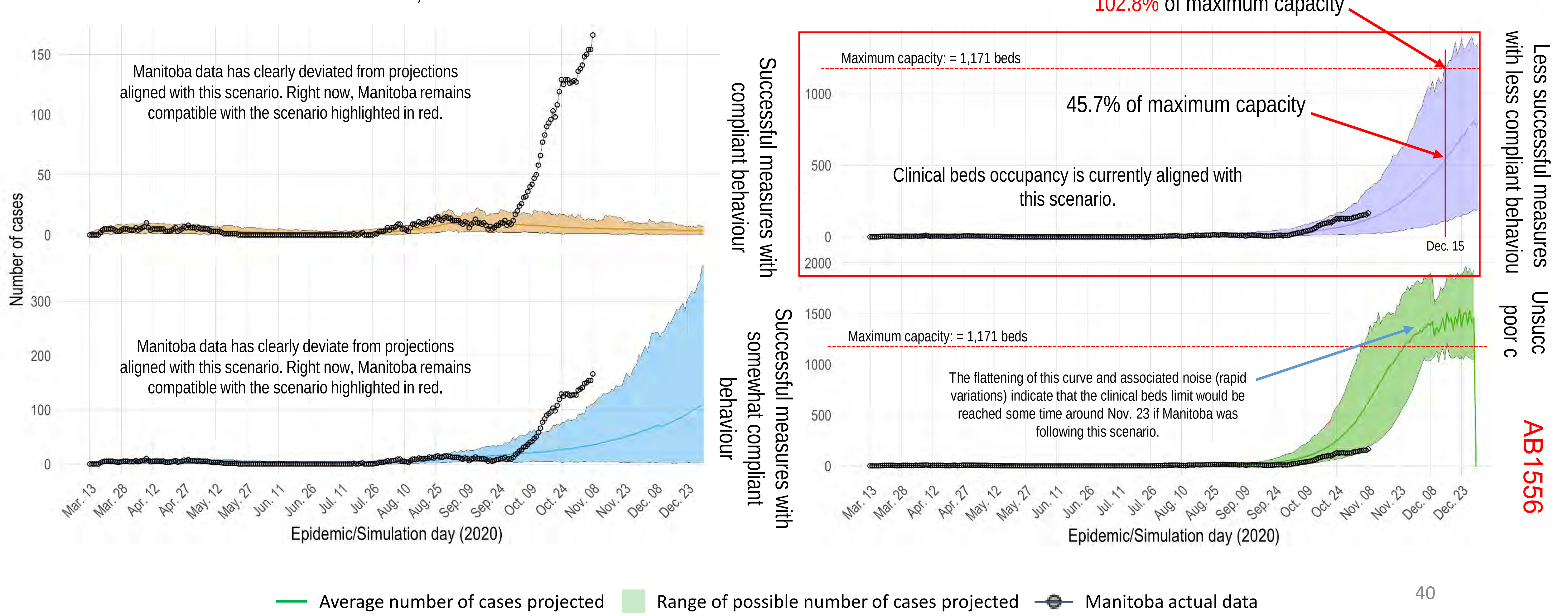
AB1555

COVID-19 NOVEL CORONAVIRUS

Manitoba

Confidential –
Not for distribution

Information from March 13 to December 31, 2020. Manitoba data extracted: 2020-11-09.



AB1556

*Confidential –
Not for distribution*

89 (67)*

Adult Intensive Care Hospital Beds

Current Vacancy

9% (45%)*

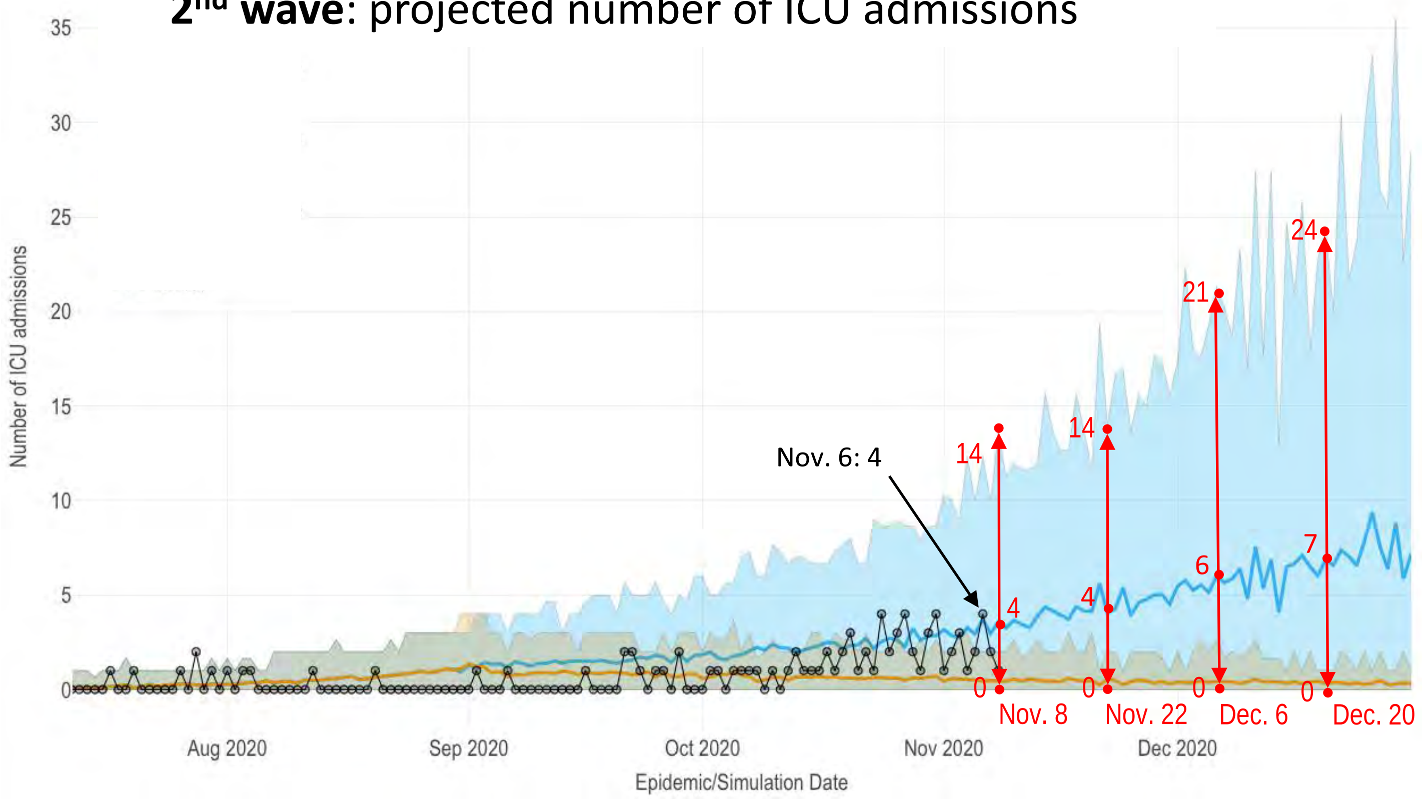
AB1557

* (Numbers in parenthesis reflect capacity related to COVID-19.)

Confidential – Not for distribution

Information from March 13 to December 31, 2020. Manitoba data extracted: 2020-11-09.

2nd **wave**: projected number of ICU admissions



Average number of cases projected — Range of possible number of cases projected — Manitoba actual data

Manitoba's trend for ICU admissions is currently not very clear. It seems to be best aligned with scenario described by blue curve

With a growing number of cases and hospitalizations, it is expected that the number of ICU admissions will grow and start following the blue curve more prominently, instead of decreasing as projected by the scenario represented by the orange curve.

From this graph, if Manitoba data is following the blue curve, it is expected that we will see around:

- 4 (0 - 14) new ICU admissions on a single day by Nov. 8.
- 4 (0 - 14) new ICU admissions on a single day by Nov. 22.
- 6 (0 - 21) new ICU admissions on a single day by Dec. 6.
- 7 (0 - 24) new ICU admissions on a single day by Dec. 20.

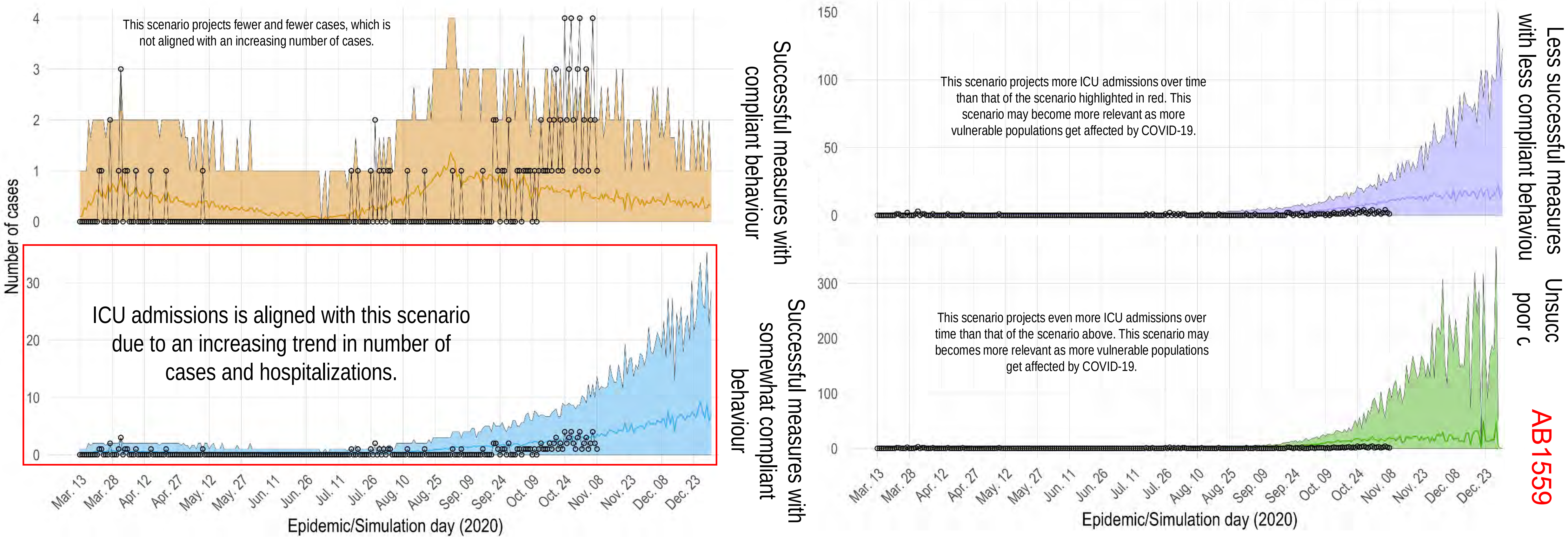
AB1558

COVID-19 NOVEL CORONAVIRUS

Manitoba

Confidential –
Not for distribution

Information from March 13 to December 31, 2020. Manitoba data extracted: 2020-11-09.



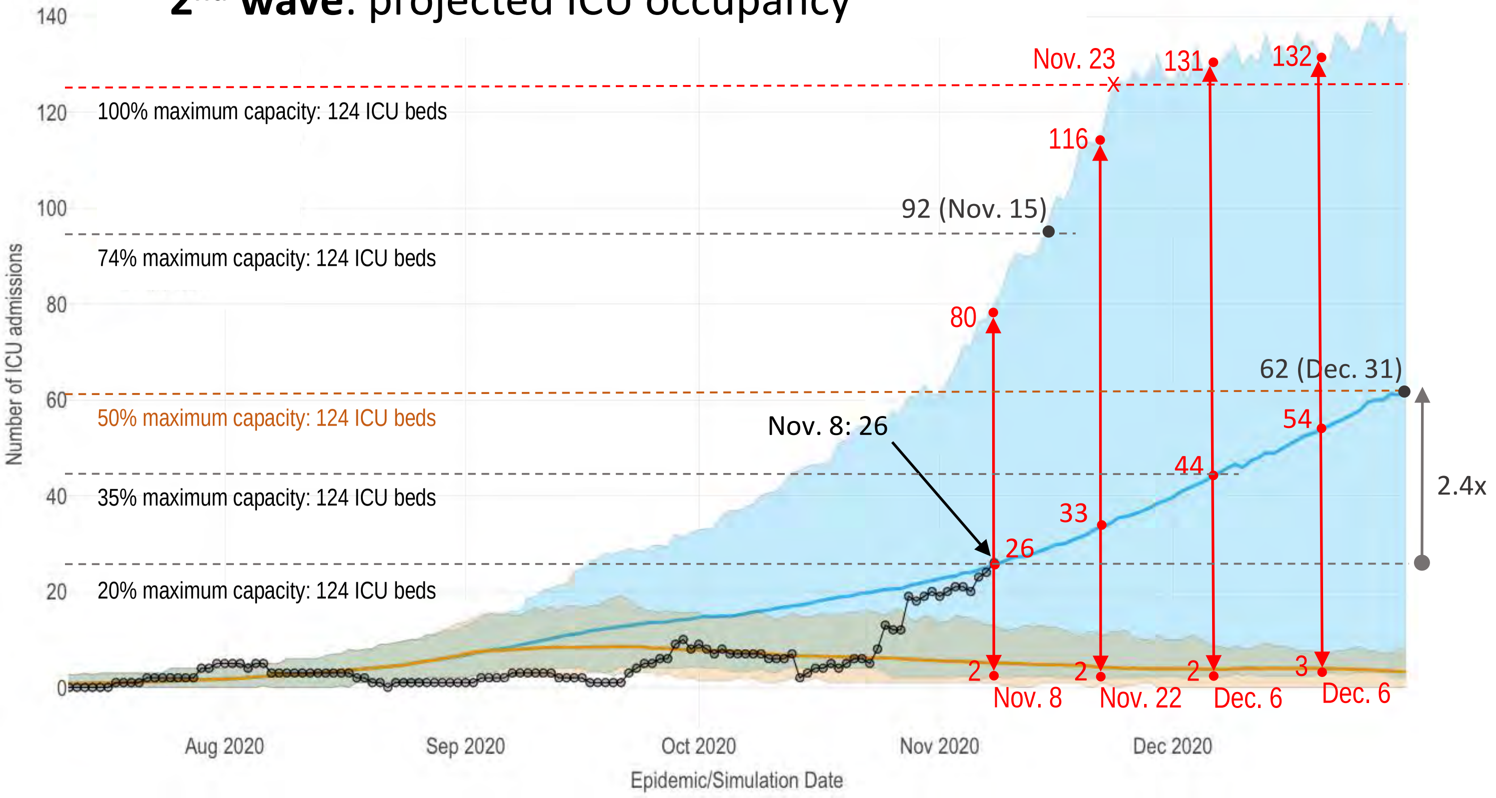
Average number of cases projected · Range of possible number of cases projected · Manitoba actual data

AB1559

Confidential –
Not for distribution

Information from March 13 to December 31, 2020. Manitoba data extracted: 2020-11-09.

2nd **wave**: projected ICU occupancy



Average number of cases projected | Range of possible number of cases projected | Manitoba actual data

The model considers **124 ICU beds as the maximum** number of ICU beds that can be made available for **COVID-19 patients**. It is important to note that <u>most of these beds are already occupied by non-COVID-19 cases</u>. Currently, there are only 8 ICU beds available in the Province.

- COVID-19 cases are currently occupying around **21%** of the maximum number of ICU beds that can be made available for COVID-19 patients.
- **It is possible that COVID-19 patients may require 100% of ICU beds capacity by Nov. 23.**

The length of stay in an ICU bed vary with age and health profile of the patient, and other biological factors.

- If age and health profiles changes, maximum capacity can be reached even sooner.

A patient my require an ICU bed for either a few days or several weeks, an then recover. Around 50% of patients in ICU will die within few days.

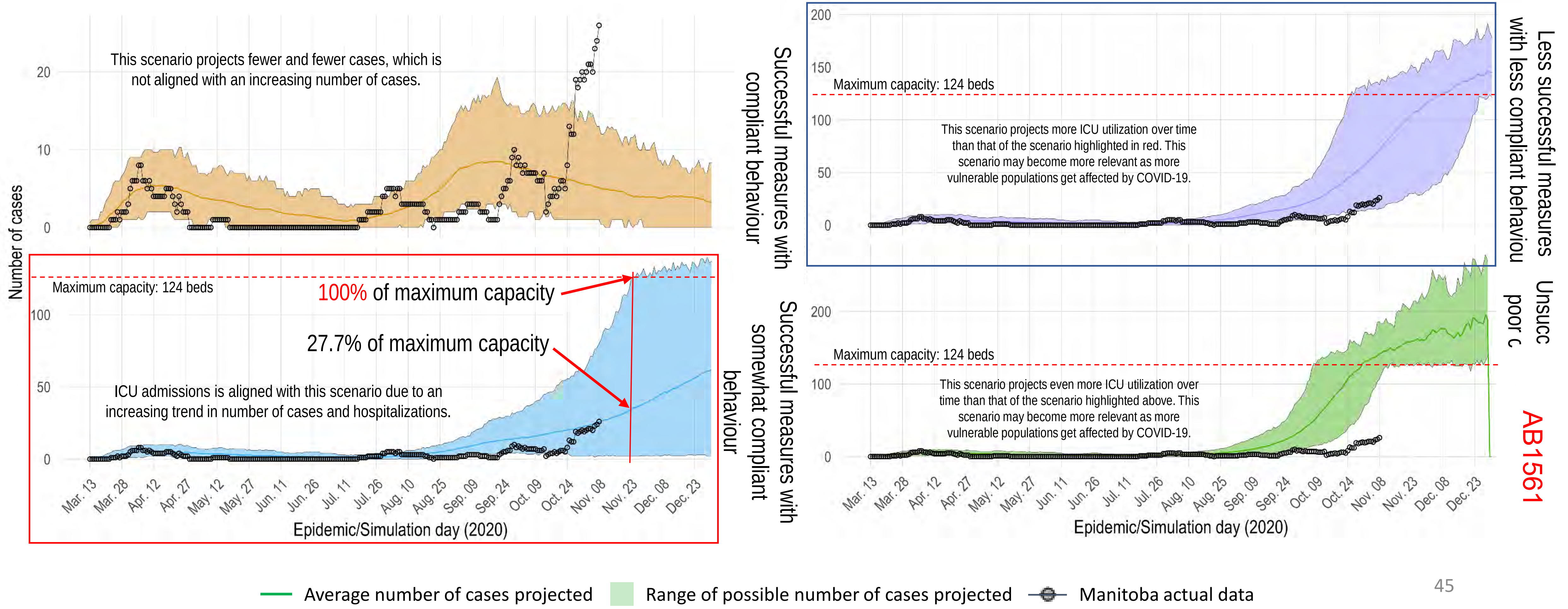
- ICU capacity is reached around one month prior clinical beds capac is reached.

When maximum capacity is reached, the model (and medical experts) assumes that patients have 100% probability of dying.

AB1560

Confidential –
Not for distribution

Information from March 13 to December 31, 2020. Manitoba data extracted: 2020-11-09.

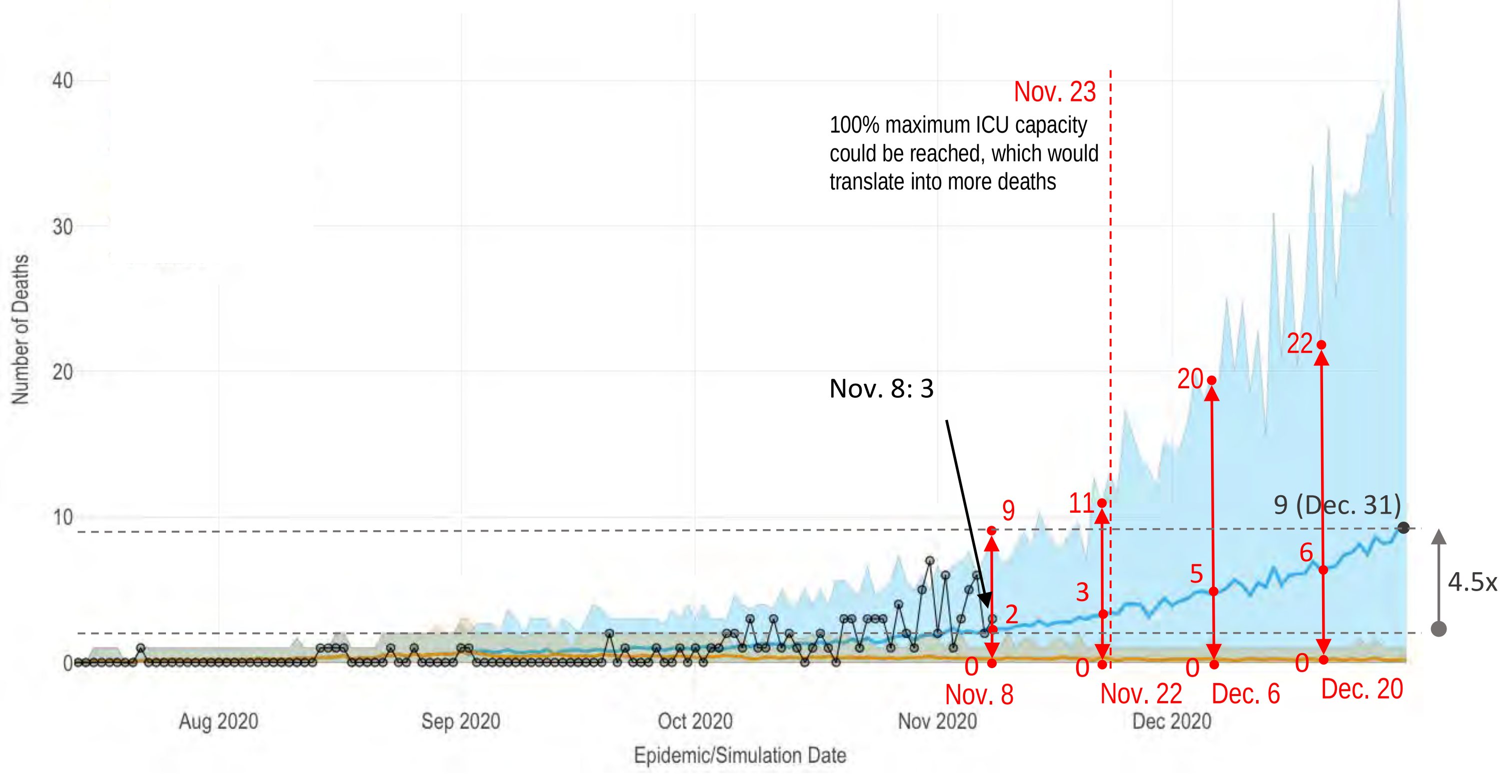


AB1561

*Confidential –
Not for distribution*

Information from March 13 to December 31, 2020. Manitoba data extracted: 2020-11-09.

2nd **wave**: projected daily number of deaths



Average number of cases projected | Range of possible number of cases projected | Manitoba actual data

When the ICU capacity has been reached, any excess patients requiring ICU will die for the lack of adequate care. At this point, the number of deaths will increase rapidly.

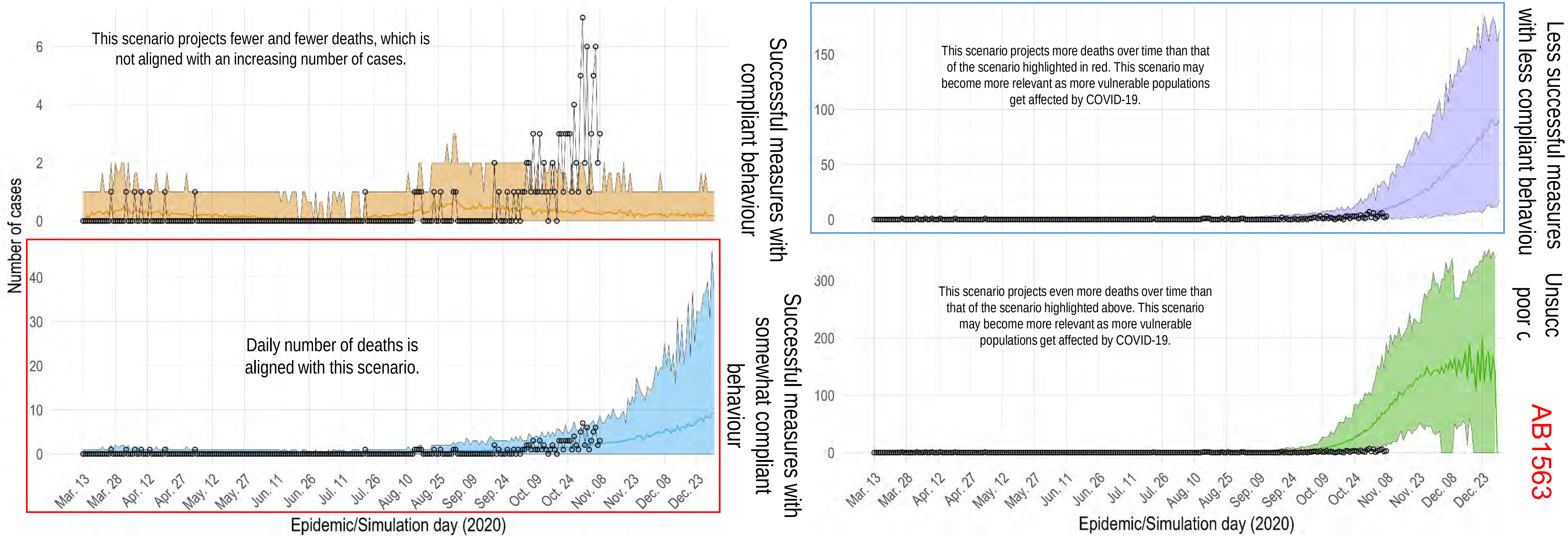
- Current total number of deaths: 109 (as of Nov. 9).
- By Dec. 10, 2020 (31 days from now) the total number of deaths is expected to have **doubled**:

- Projected: Dec. 10, 219 (46 – 597) deaths.

AB1562

Confidential – Not for distribution

Information from March 13 to December 31, 2020. Manitoba data extracted: 2020-11-09.



AB1563

Confidential – Not for distribution

If the rise in COVID-19 cases projected by the model continues to follow current trajectories:

- **The large volume of new cases will(?) render Case Identification and Contact Tracing ineffective** as a pandemic control measure. It will be impossible, for example, to follow up on 3500+ cases per week with existing resources (by the week around November 22, it is estimated that there will be 490 new cases of COVID-19 per day.)

- **The health care system may reach its limits in 14 days** as the demand for ICU and Medical beds overwhelm supply.
  - 100% ICU capacity can be reached with only COVID-19 cases as early as November 23.
  - Although it is currently not expected that the number of COVID-19 cases themselves will use the entire ICU capacity (124 beds) by November 23, a realistic scenario places ICU usage by COVID-19 cases at 50% by December 31.
  - **It is important to point out that ICU care is still needed for other health reasons** such as car accidents, violent crimes, other natural causes such as coronary diseases, strokes, and even Influenza.
  - As of Nov. 10, there are only 8 ICU beds available in the province.
  - **Properly staffing ICU units is really challenging** and a limiting factor to how far the system can be streached.

- **A shift in cases age and health profile towards more vulnerable populations has the potential to overwhelm the health care system sooner than the projections describing the current trajectory.**

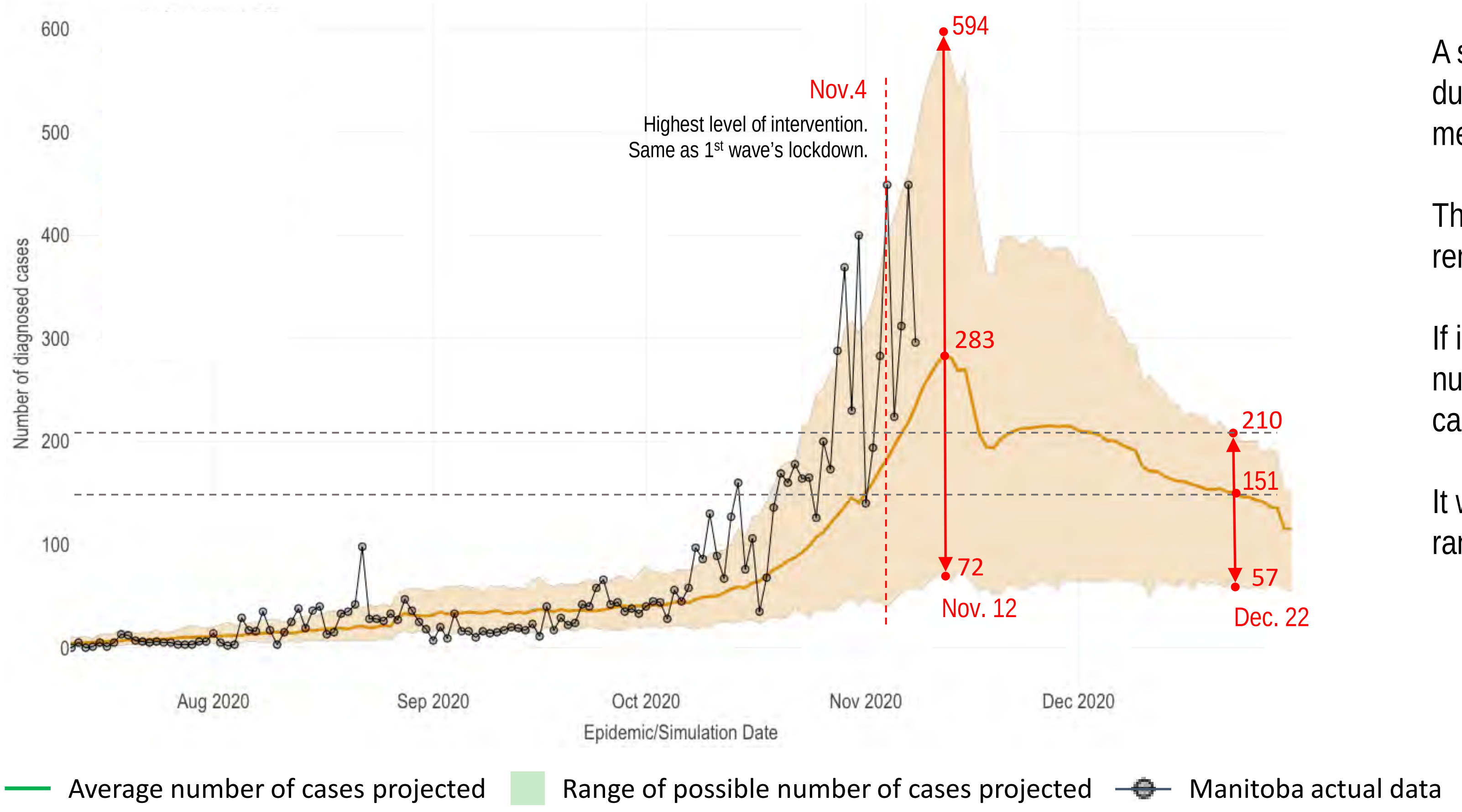
AB1564

INTERVENTIONS

Confidential –
Not for distribution

Information from March 13 to December 31, 2020. Manitoba data extracted: 2020-11-02.

2nd **wave**: projected daily number diagnosed cases



PRELIMINARY RESULTS

A scenario, same as the lockdown implemented in Manitoba during the 1st wave, has been simulated as a possible measure to change the trajectory of the diagnosed curve.

This measure is implemented starting November 4, and remains in effect until December 31.

If implemented on Nov. 4, we should still see an increase in number of diagnosed cases until Nov. 12 with 283 (72 – 594) cases diagnosed on that day.

It will take until Dec. 22 for the number of cases to be in the range 151 (57 – 210) cases on that day.

AB1566

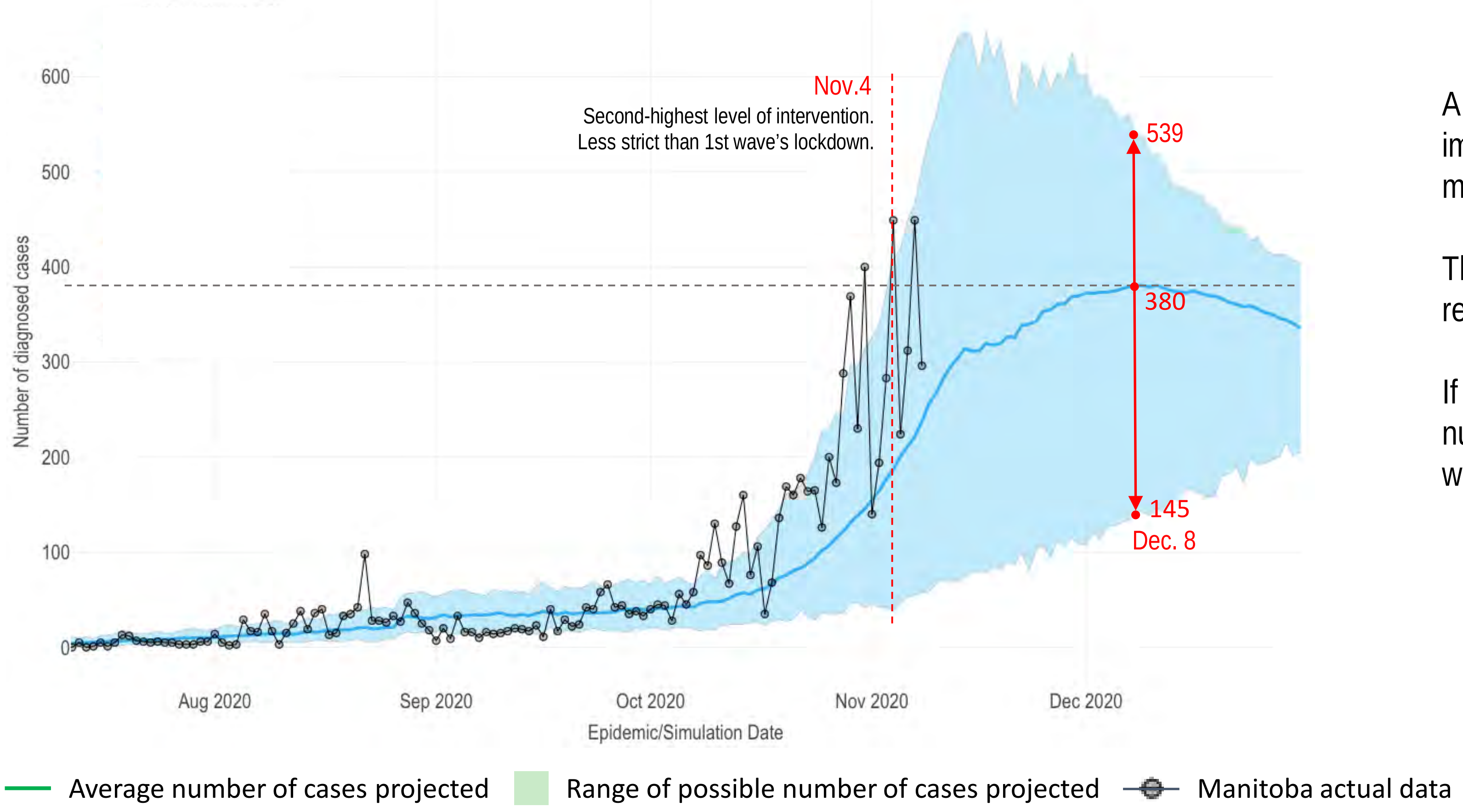
COVID-19 NOVEL CORONAVIRUS

Manitoba

Confidential – Not for distribution

Information from March 13 to December 31, 2020. Manitoba data extracted: 2020-11-02.

2nd **wave**: projected daily number diagnosed cases



PRELIMINARY RESULTS

A scenario, a bit less strict than the 1st wave's lockdown implemented in Manitoba, has been simulated as a possible measure to change the trajectory of the diagnosed curve.

This measure is implemented starting November 4, and remains in effect until December 31.

If implemented on Nov. 4, we should still see an increase in number of diagnosed cases until Dec. 8, 380 (145 – 539), but with a less steep growth rate than the current situation.

AB1567

- The intervention scenarios presented here assumes that:

  - **PCH visitations are not allowed**.
  - **High compliance with physical distancing**.
    - Large gatherings, professional sports events, amateur sports events, indoor congregations (religious and non-religious) are limited or not allowed. May require curfew for proper implementation and compliance. Making sure that house parties are not taking place.
  - **High compliance with self-isolation if showing symptoms**.
    - Requires explaining how people showing symptoms should behave at home. Making sure that sick individuals do not show up for work.
  - **The model assumes importation levels compatible with work-related travel only**.

- **Any set of interventions need to be supported by epidemiological evidence in order to determine what types of restrictions would be effective.**

- Although this scenario mimics the one implemented during the 1st wave's lockdown, it may be possible to achieve these levels with targeted interventions instead of a complete lockdown by **making sure that compliance levels are high**.

AB1568

COVID-19 NOVEL CORONAVIRUS

Manitoba

Confidential – Not for distribution

This is Exhibit " G " referred to
in the Affidavit of Carla Loeppky
Affirmed before me this 4
day of March A.D. 2021

[signature]

A Barrister-at-Law entitled to practice
in and for the Province of Manitoba

AB1571

COVID-19
NOVEL CORONAVIRUS

COVID Response Update

Manitoba

Key Messages

AB1572

COVID-19 NOVEL CORONAVIRUS

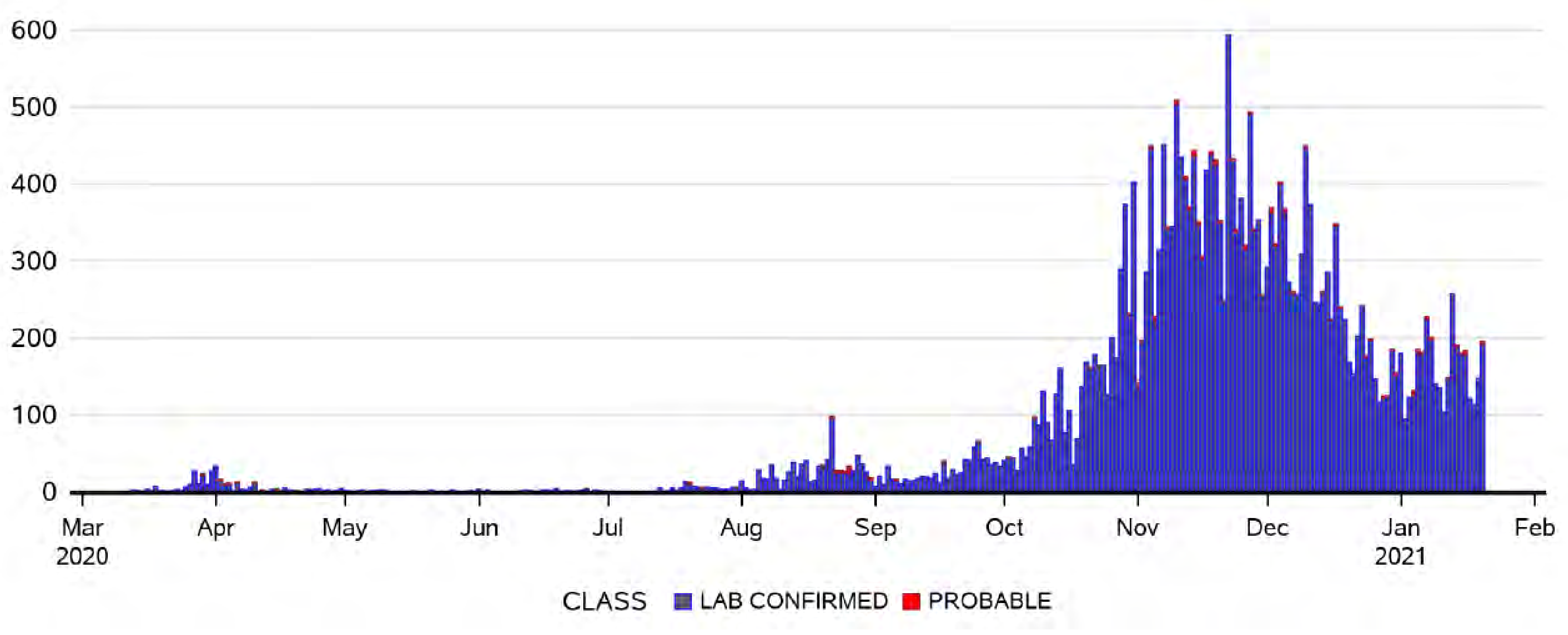
Manitoba

CURRENT STATE

AB1573

Confidential – Not for distribution

Epidemic Curve of COVID-19 in Manitoba

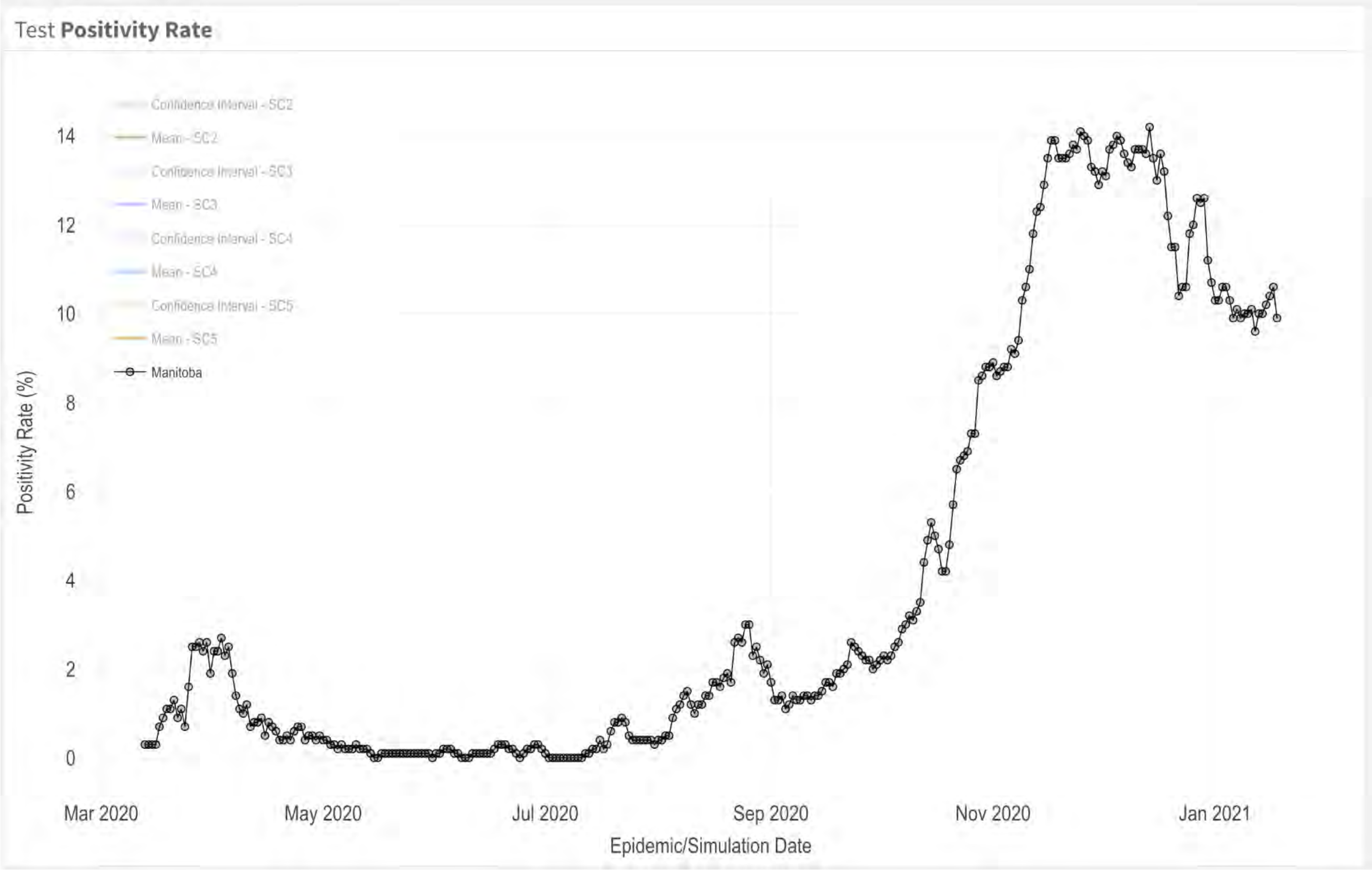


AB1574

COVID-19 NOVEL CORONAVIRUS

Manitoba

The Provincial Positivity Rate Has Decreased by Remains High



AB1575

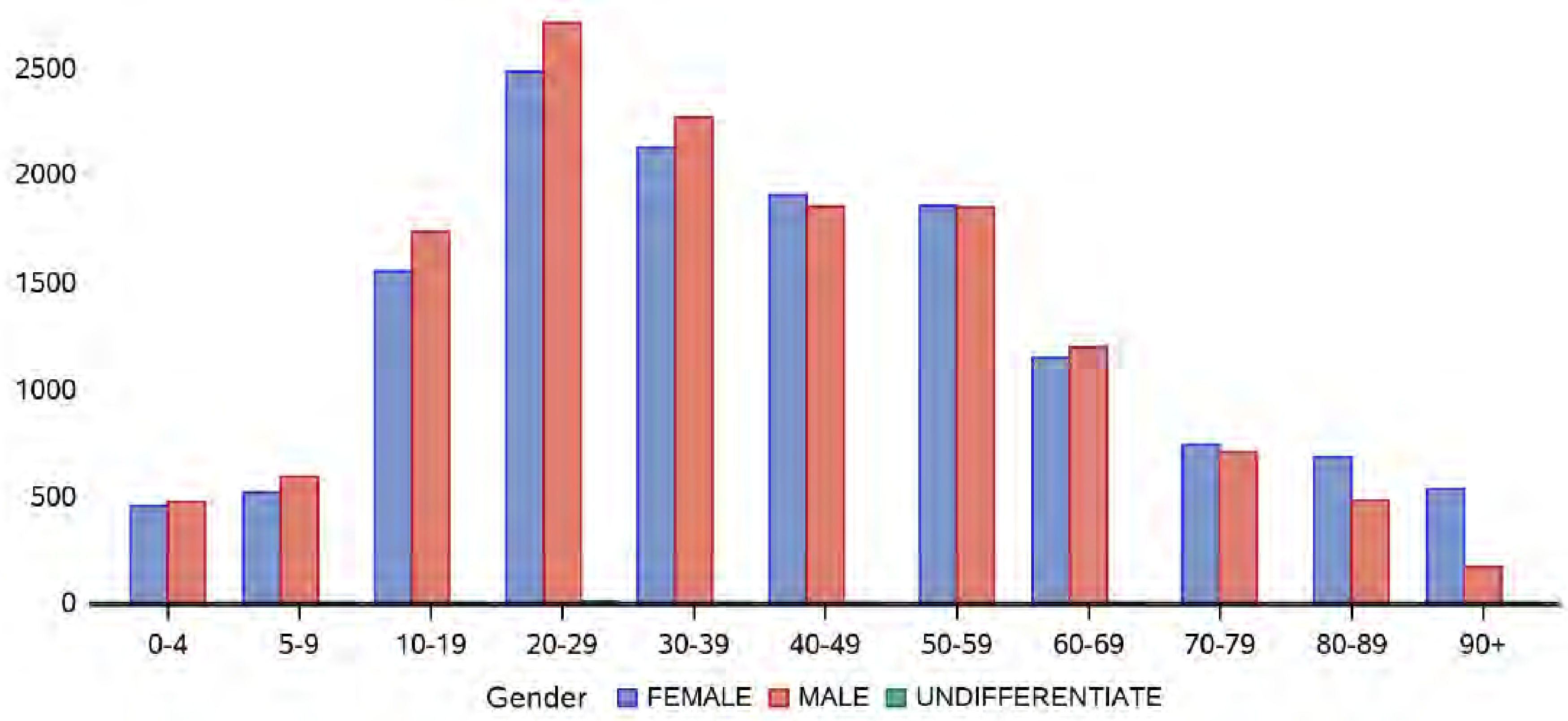
Map of Active COVID-19 Cases in Manitoba by RHA

Region	# of Positive Cases	# of Positive FNIHB Cases	# of Active Cases	# of Active FNIHB Cases	# of New Cases	# of New FNIHB Cases
Prairie Mountain Health	1845	141	195	79	17	4
Interlake-Eastern Health	2056	873	334	296	9	8
Northern Health	3183	1806	1559	1316	105	72
Southern Health - Sante Sud	4563	159	205	129	13	0
Winnipeg Health	16442	210	912	114	54	2

Confidential
Not for distribution

AB1576

COVID-19 Case Counts by Sex and Age-Group



COVID-19 NOVEL CORONAVIRUS

Manitoba

COVID-19 MODELLING

AB1578

Confidential – Not for distribution

Made-in-Manitoba Agent-Based Modelling Simulations

AB1579

Made-in-Manitoba Agent-Based Modelling Simulations (cont.)

Confidential – Not for distribution

Simulation Scenarios and Projections

Scenario 1 - Extreme
Minimal restrictions and poor compliance lead to a rapid rise in cases.

Scenario 2 - Severe
Some restrictions and poor compliance lead to increased cases.

Scenario 3 - Moderate
More restrictions and good compliance lead to manageable case numbers.

Scenario 4 - Controlled
Full restrictions and good compliance (lockdowns) lead to reduced cases.

AB1581

Notes on Modelling

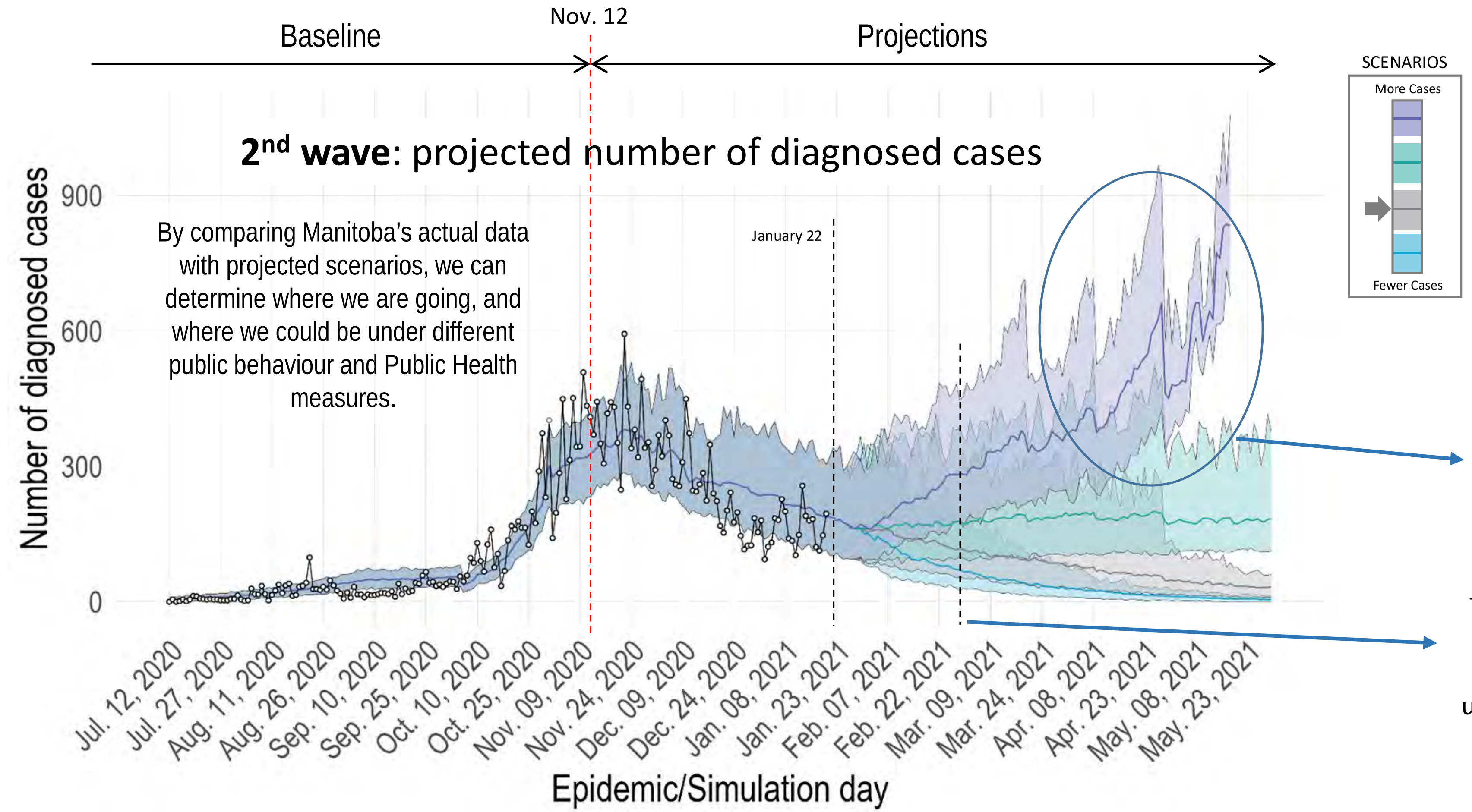
Health Care Capacity Thresholds

AB1583

Health Care Capacity Thresholds (cont.)

AB1584

Projected Number of Diagnosed Cases in Different Scenarios (daily number of new cases)



Manitoba: actual data **Projected:** average number of cases Range of possible number of cases

Simulations presented here project possible epidemic courses after January 22, 2021 at different intervention levels.

Simulations for scenarios Extreme and Severe are still running. For this reason, projections are still noisy and subject to change towards the end of the period simulated.

The effects of changing public health orders by January 22, 2021 will only be discernable by Late February/early March. Until then, it is unlikely that we will be able to tell for sure what trajectory Manitoba is following.

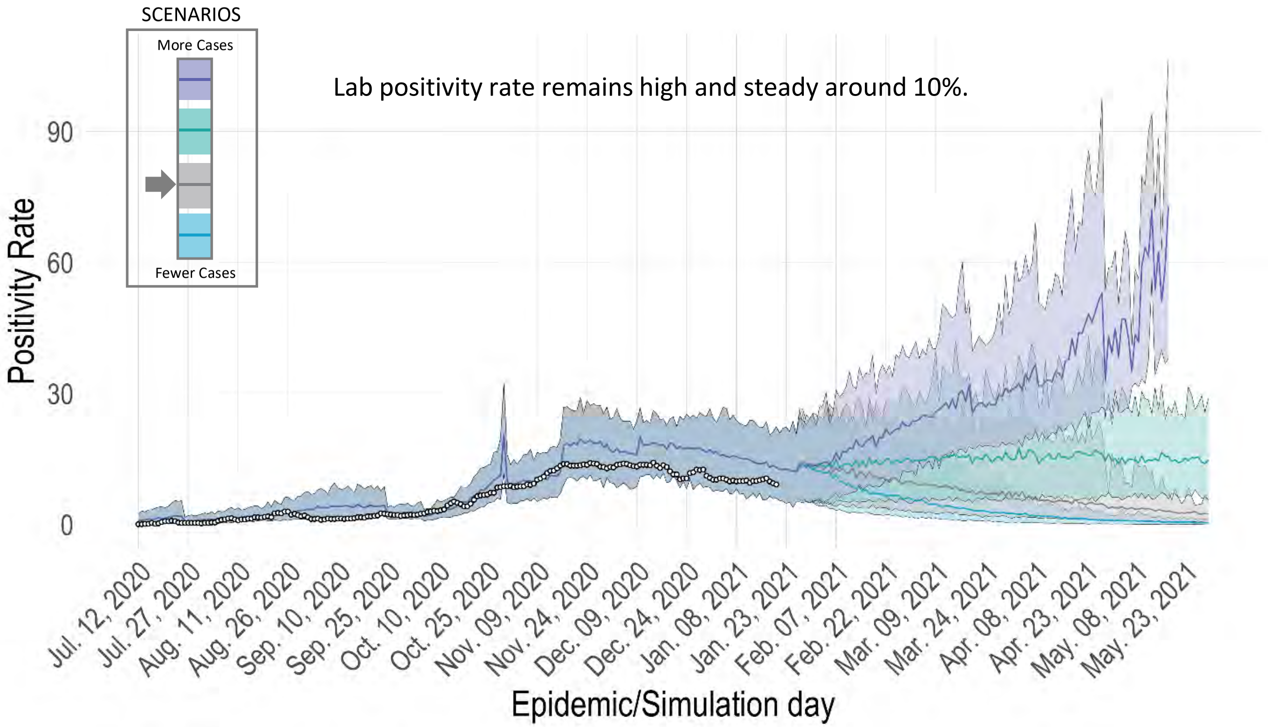
AB1585

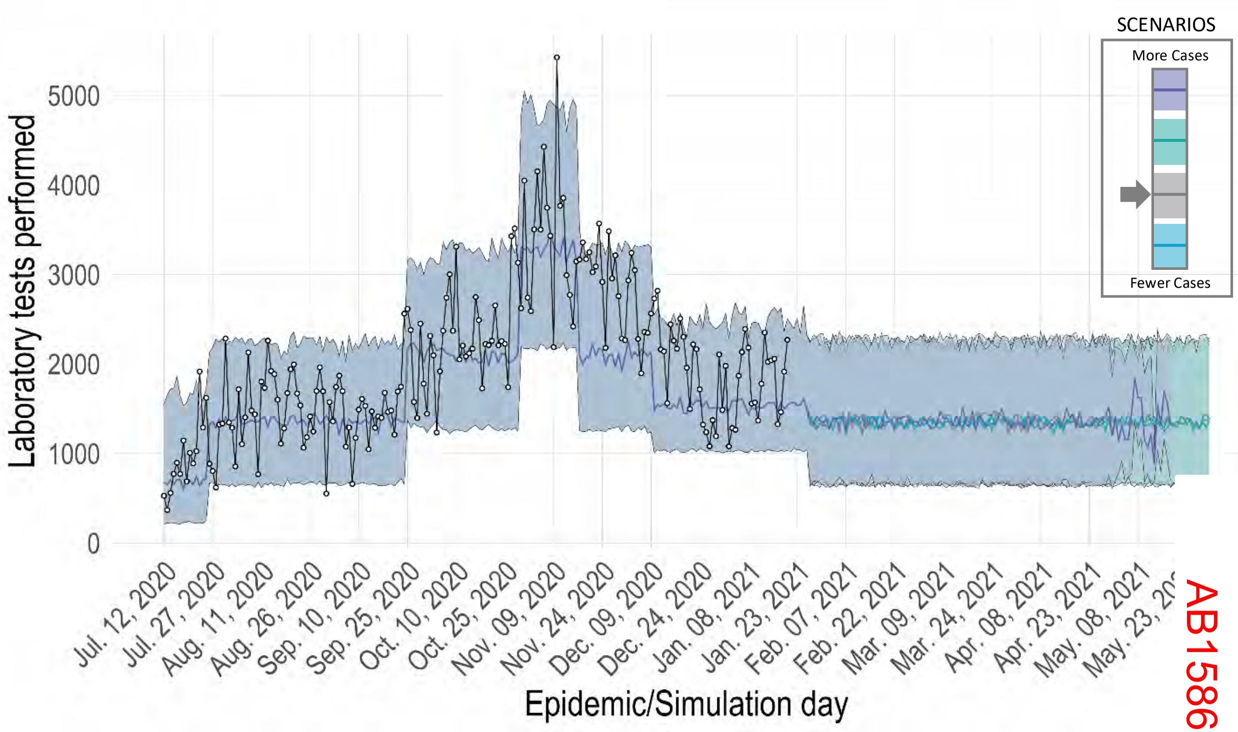
COVID-19 NOVEL CORONAVIRUS

Manitoba

Positivity Rate vs. Daily number of lab tests performed

Information from July 12, 2020 to May 30, 2021. Manitoba data extracted: 2021-01-21.





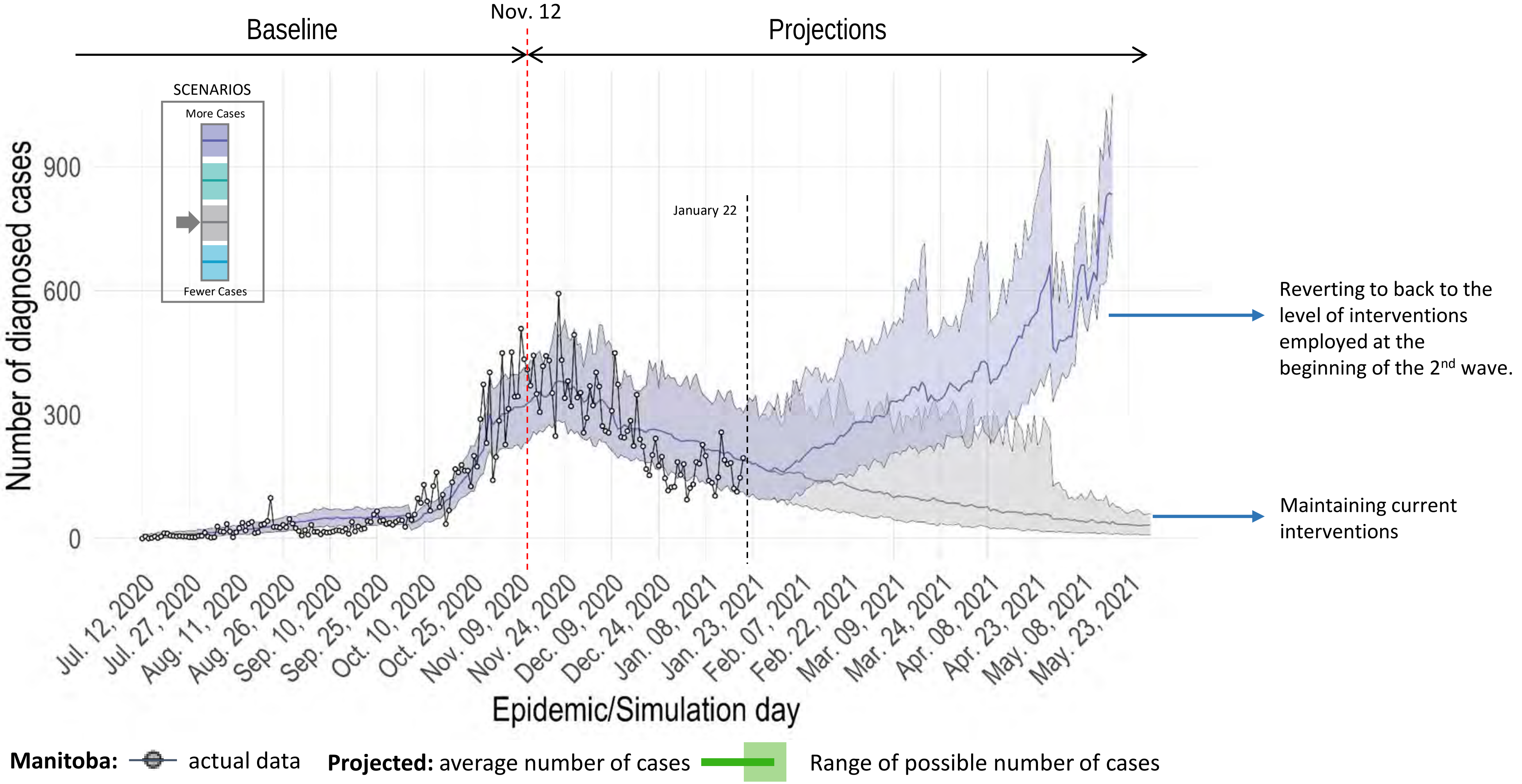
AB1586

Manitoba: actual data **Projected:** average number of cases Range of possible number of cases

AB1587

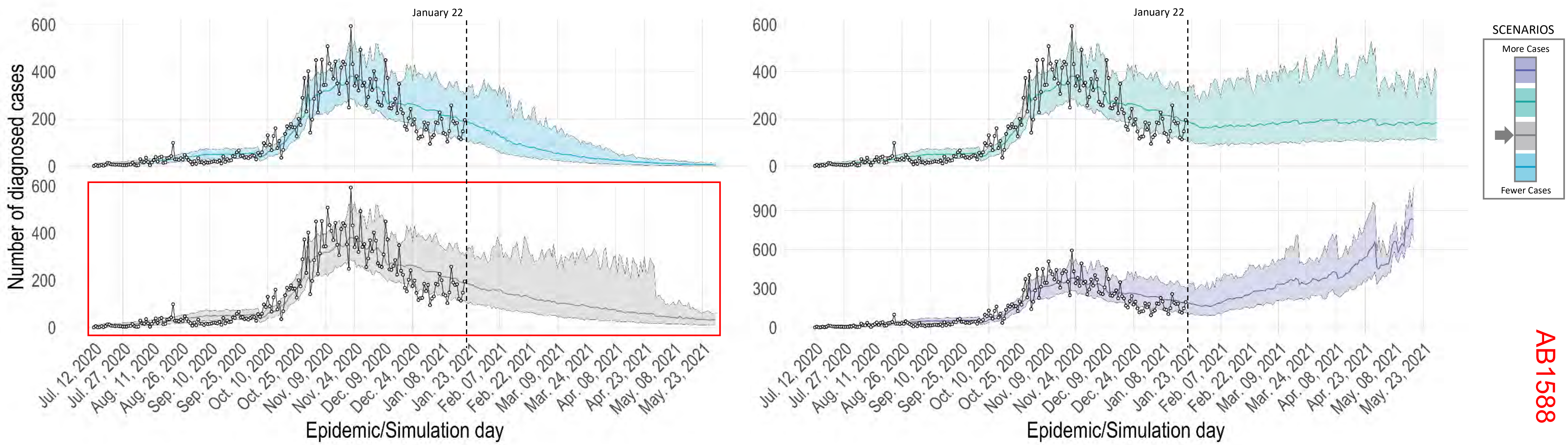
Projected Number of Diagnosed Cases (daily number of new cases)

Information from July 12, 2020 to May 30, 2021. Manitoba data extracted: 2021-01-21.



Projected Number of Diagnosed Cases at Different Levels of Public Health Measures and Public Behaviour (all scenarios)

Information from July 12, 2020 to May 30, 2021. Manitoba data extracted: 2021-01-21.



AB1588

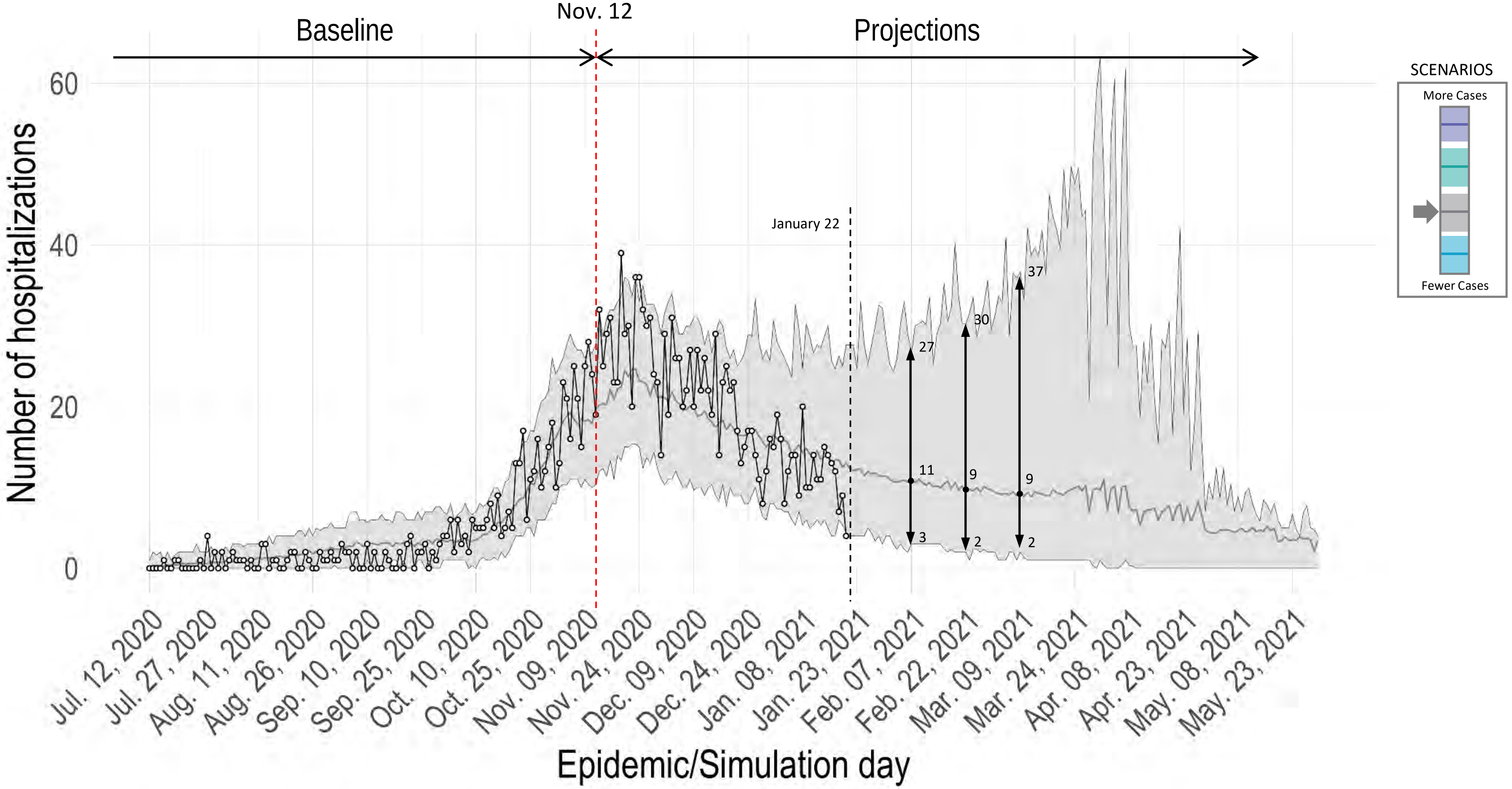
Manitoba: actual data **Projected:** average number of cases Range of possible number of cases

COVID-19 NOVEL CORONAVIRUS

Manitoba

Confidential –
Not for distribution

Information from July 12, 2020 to May 30, 2021. Manitoba data extracted: 2021-01-21.



Manitoba: actual data **Projected:** average number of cases Range of possible number of cases

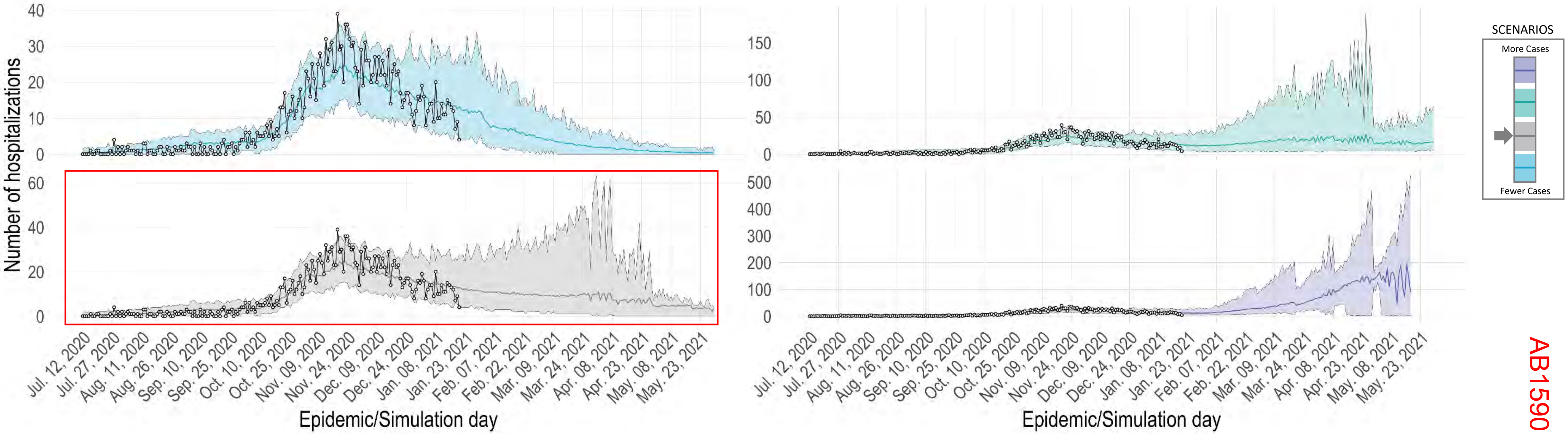
AB1589

COVID-19 NOVEL CORONAVIRUS

Manitoba

Confidential –
Not for distribution

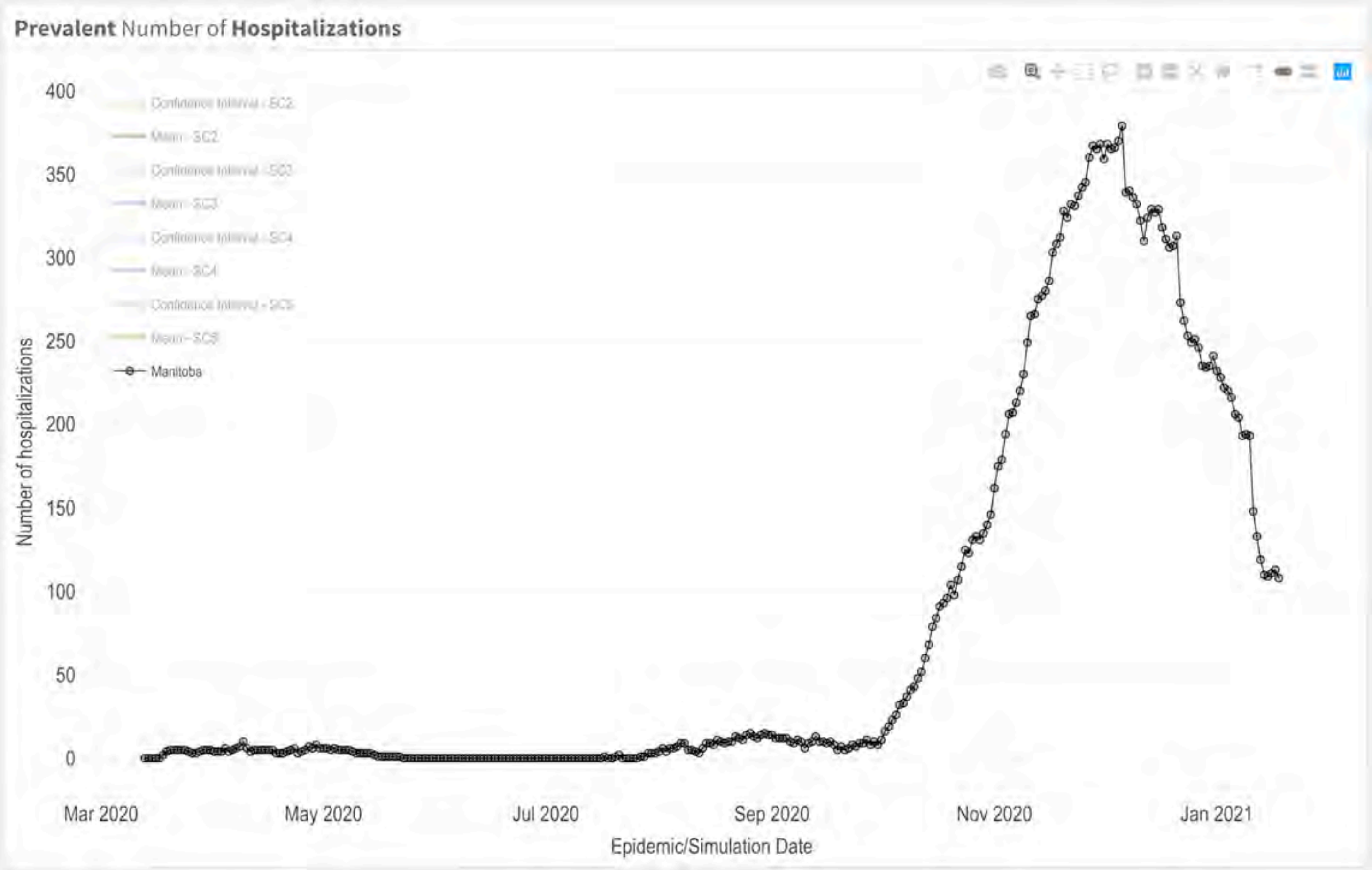
Information from July 12, 2020 to May 30, 2021. Manitoba data extracted: 2021-01-21.



AB1590

Manitoba: actual data **Projected:** average number of cases Range of possible number of cases

Prevalent Number of Hospitalizations (clinical bed utilization)



Simulations regarding prevalent number of hospitalizations are being revised and recalibrated.

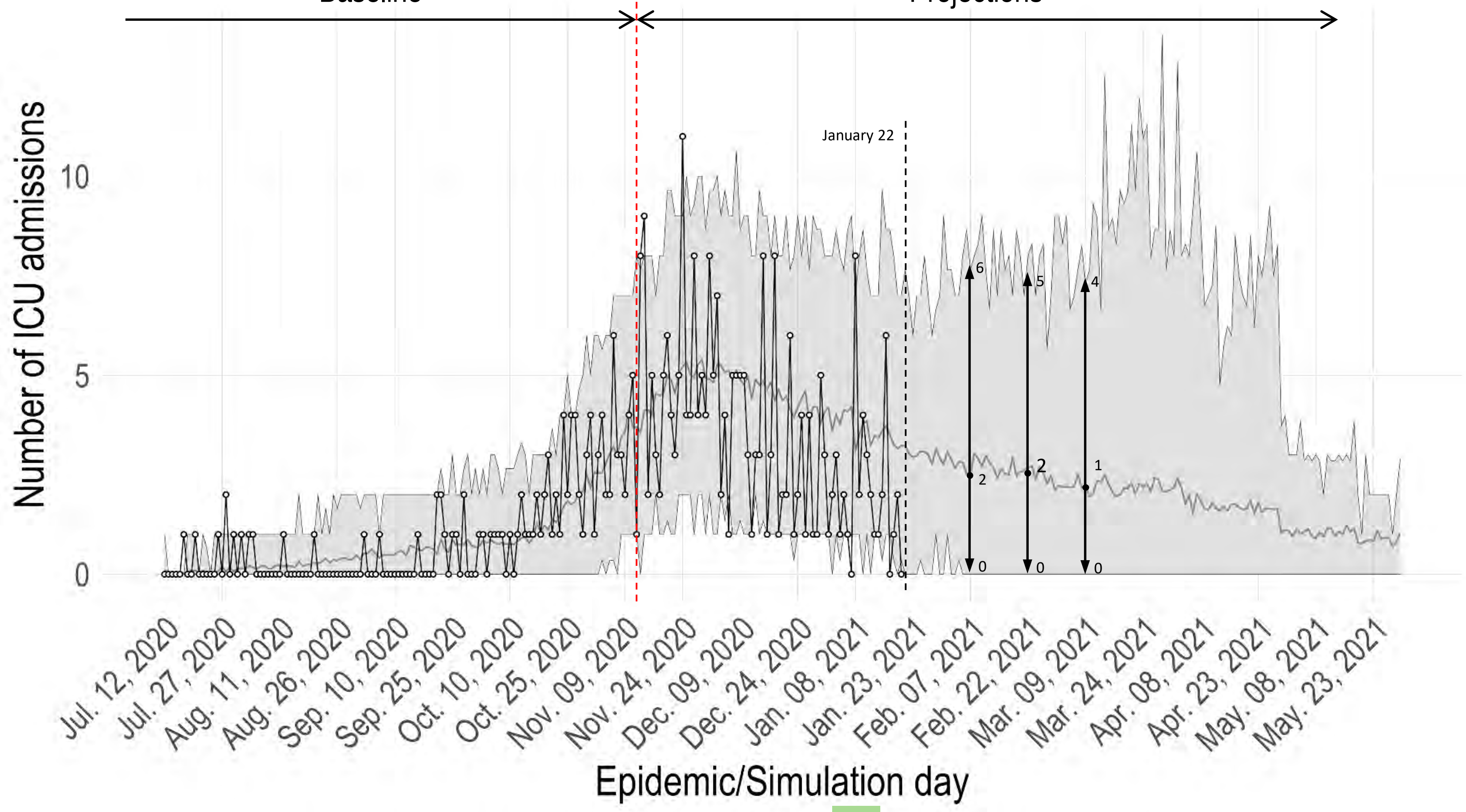
AB1591

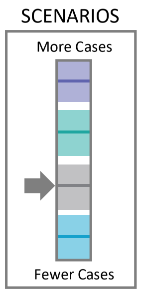
COVID-19 NOVEL CORONAVIRUS

Manitoba

Confidential – Not for distribution

Information from July 12, 2020 to May 30, 2021. Manitoba data extracted: 2021-01-21.





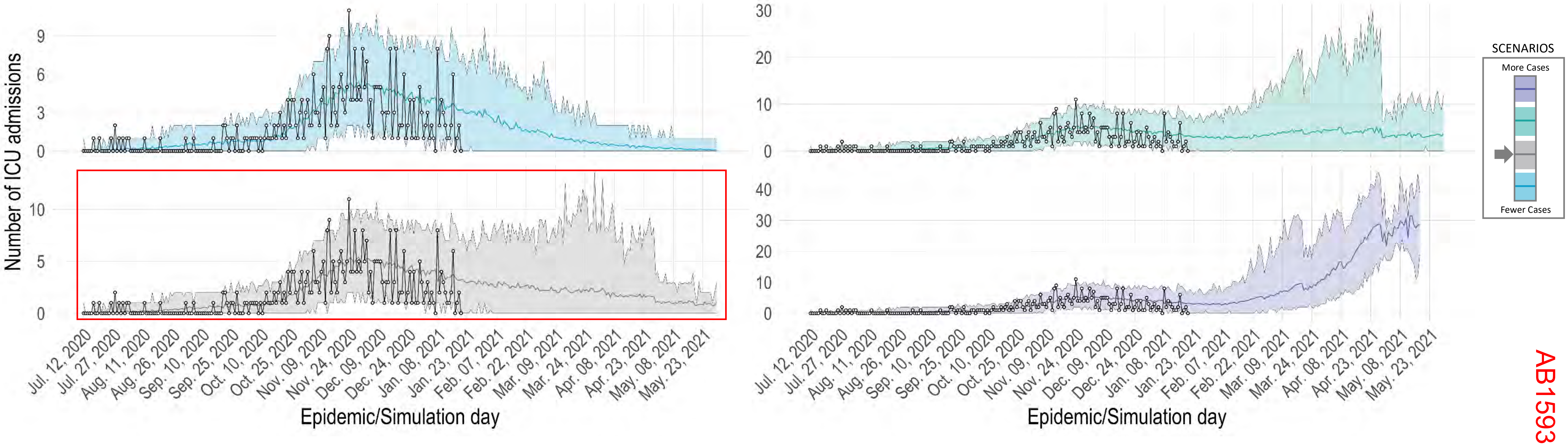
Manitoba: actual data **Projected:** average number of cases Range of possible number of cases

AB1592

COVID-19 NOVEL CORONAVIRUS

Manitoba

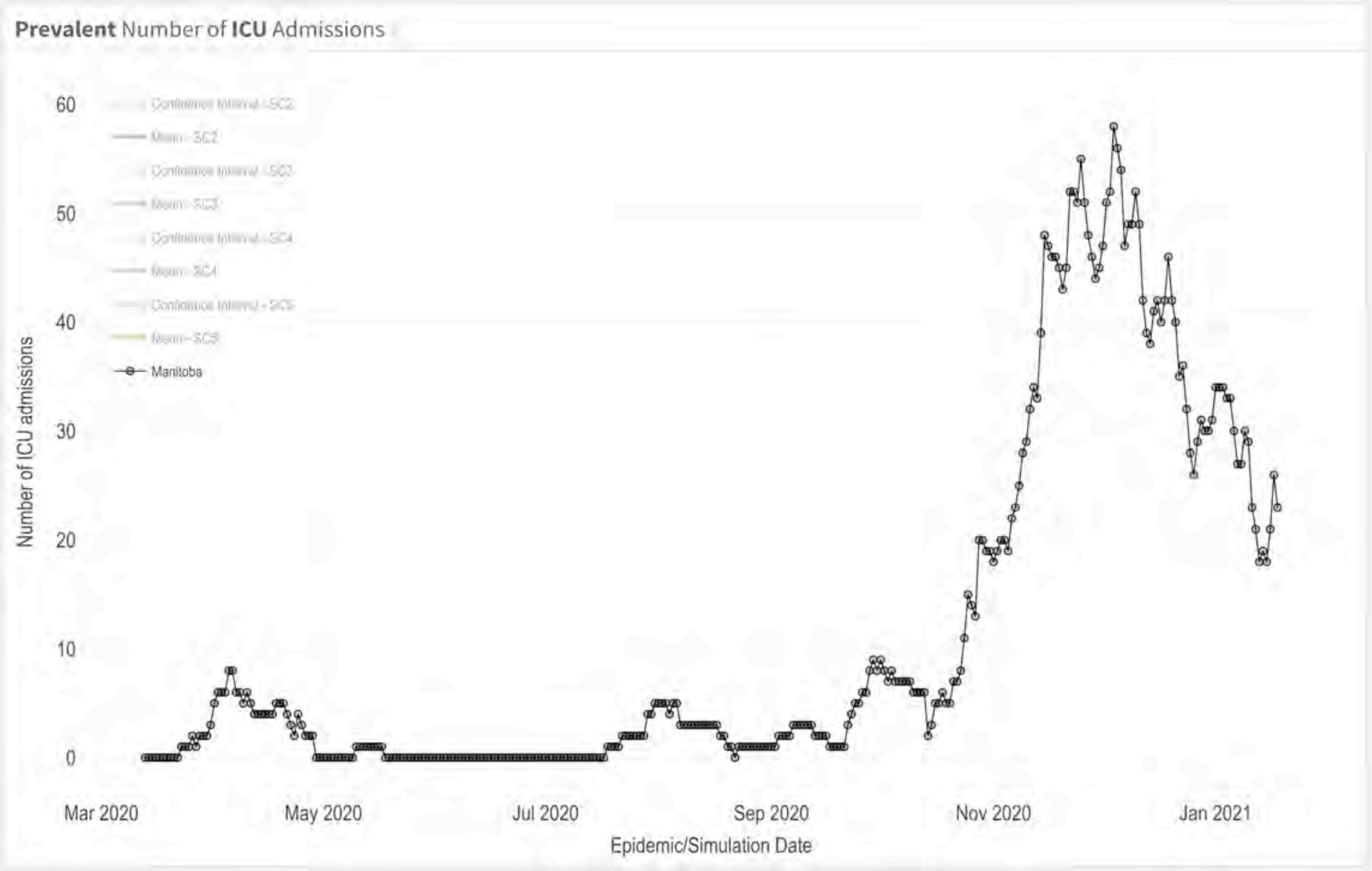
Confidential – Not for distribution



Manitoba: actual data **Projected:** average number of cases Range of possible number of cases

AB1593

Prevalent Number of ICU Admissions (ICU occupancy)

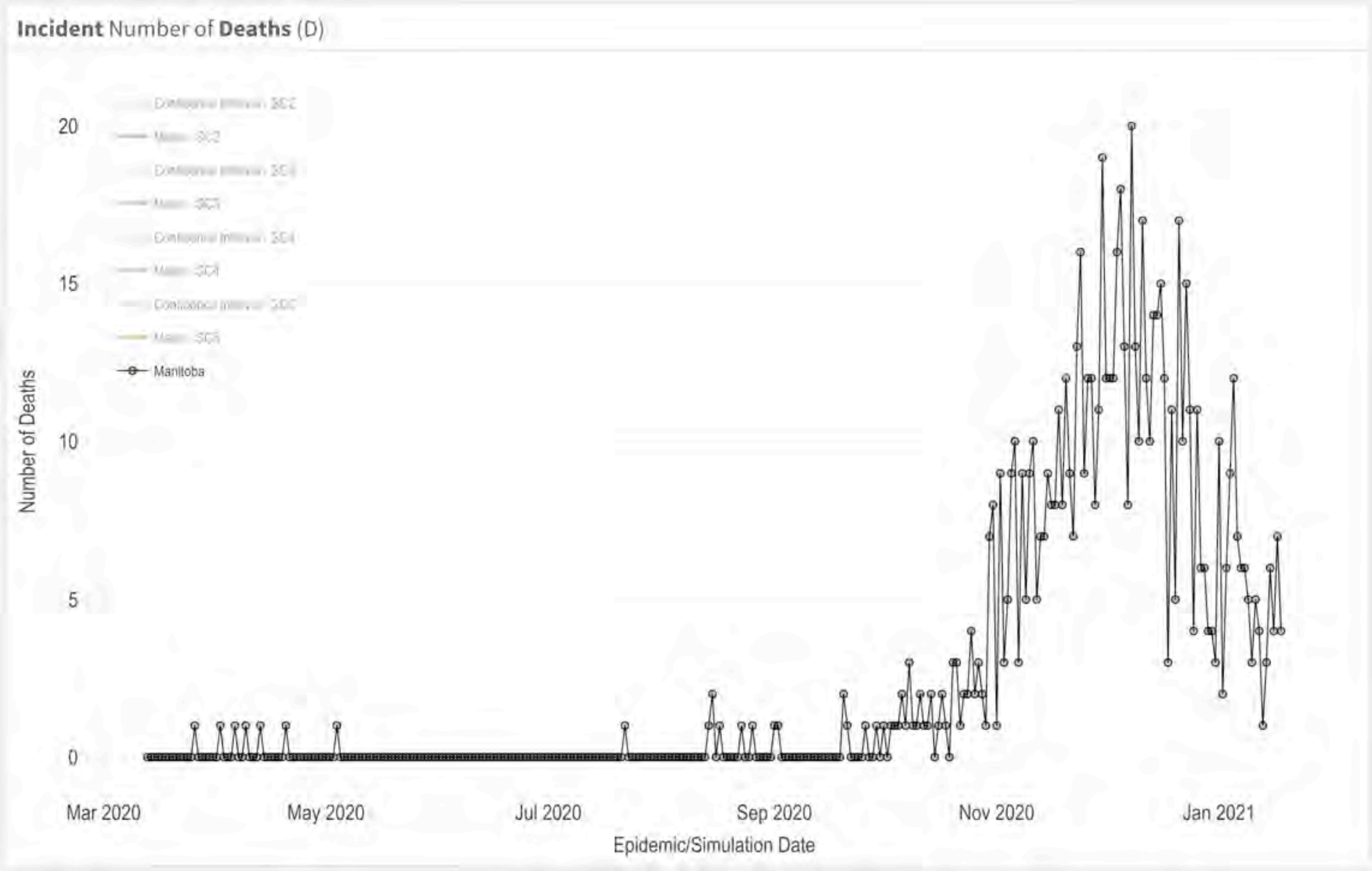


Simulations regarding prevalent number of ICU admissions are being revised and recalibrated.

AB1594

Confidential –
Not for distribution

Incident Number of Deaths (daily number of deaths)



Simulations regarding incident number of deaths are being revised and recalibrated.

AB1595

This is Exhibit " H " referred to
in the Affidavit of Carla Loeppky
Affirmed before me this 4
day of March A.D. 2021

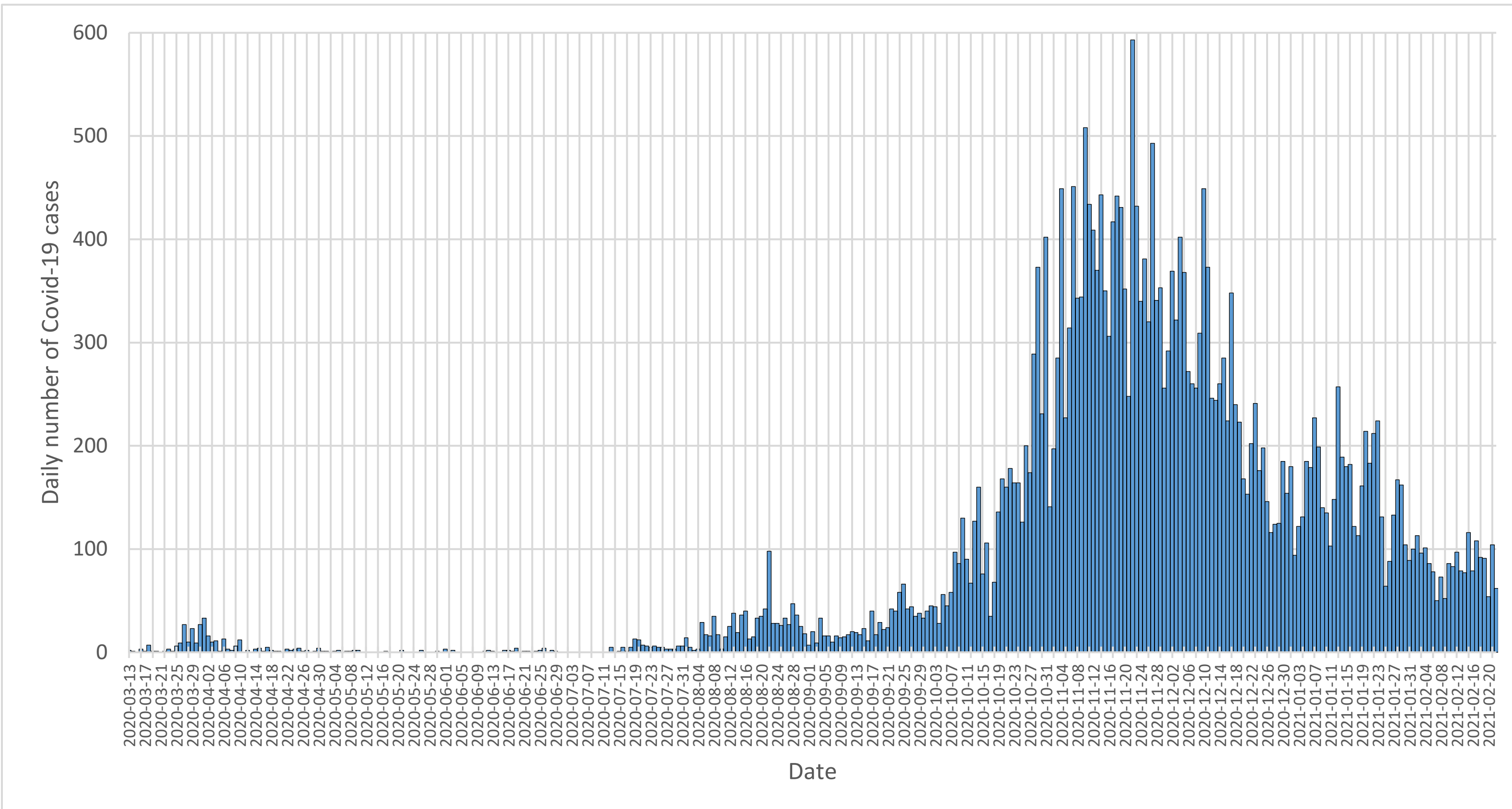
Michael Conner

A Barrister-at-Law entitled to practice
in and for the Province of Manitoba

AB1597

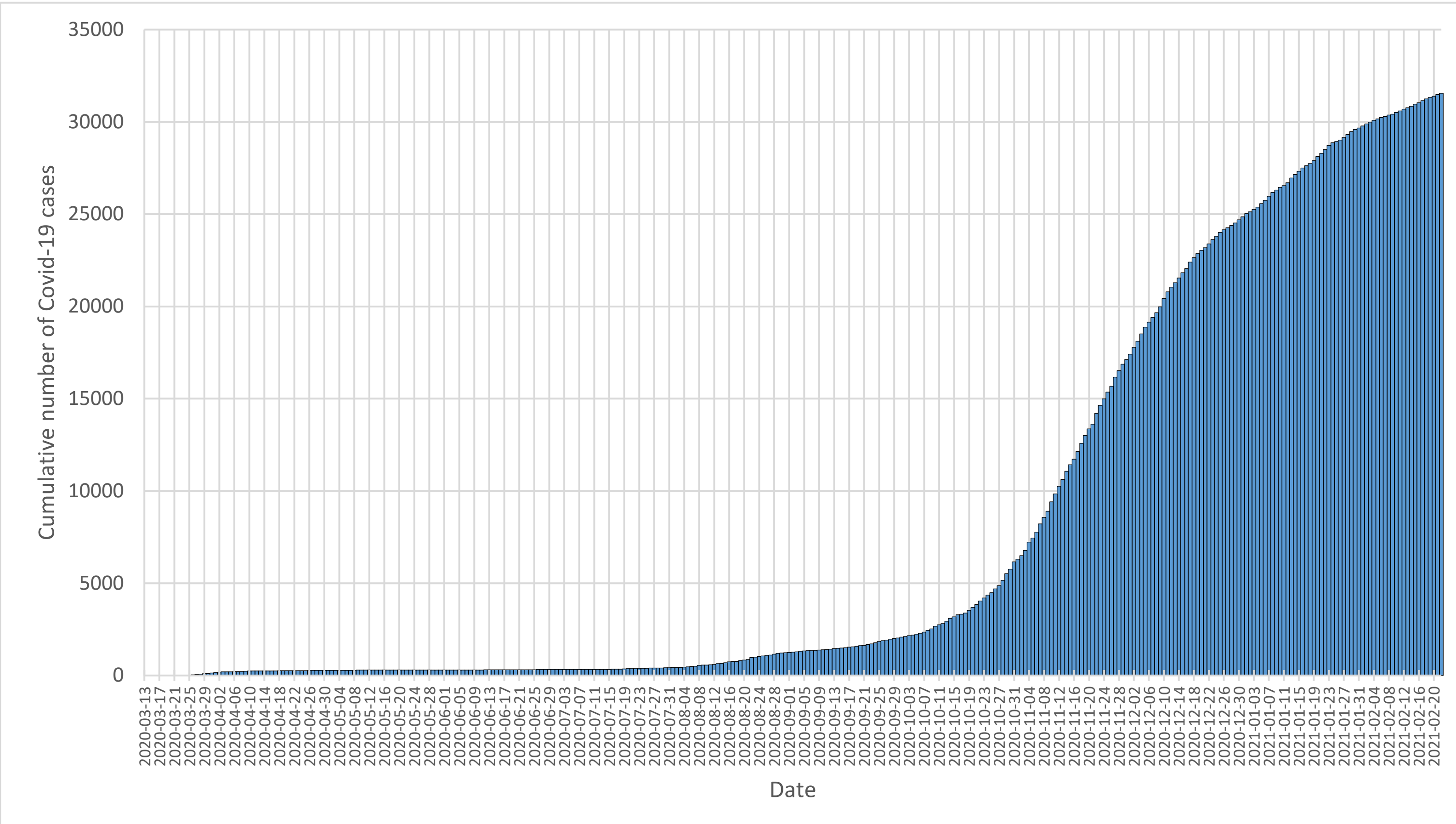
COVID-19 Epidemiological Information

Total Daily Covid-19 cases (March 13, 2020 to February 22, 2021)



AB1598

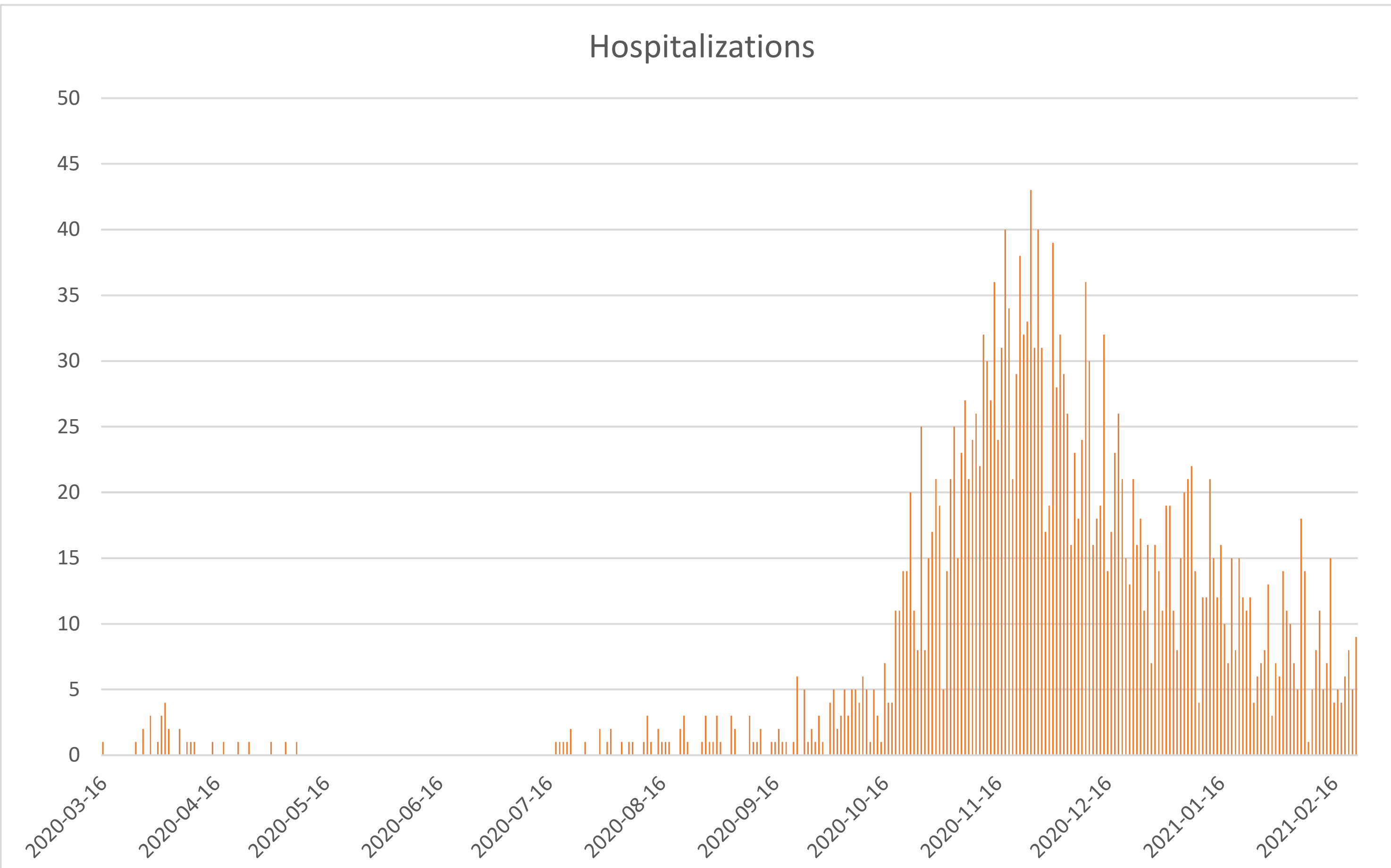
Cumulative Number of Covid-19 Cases (March 13, 2020 to February 22, 2021)



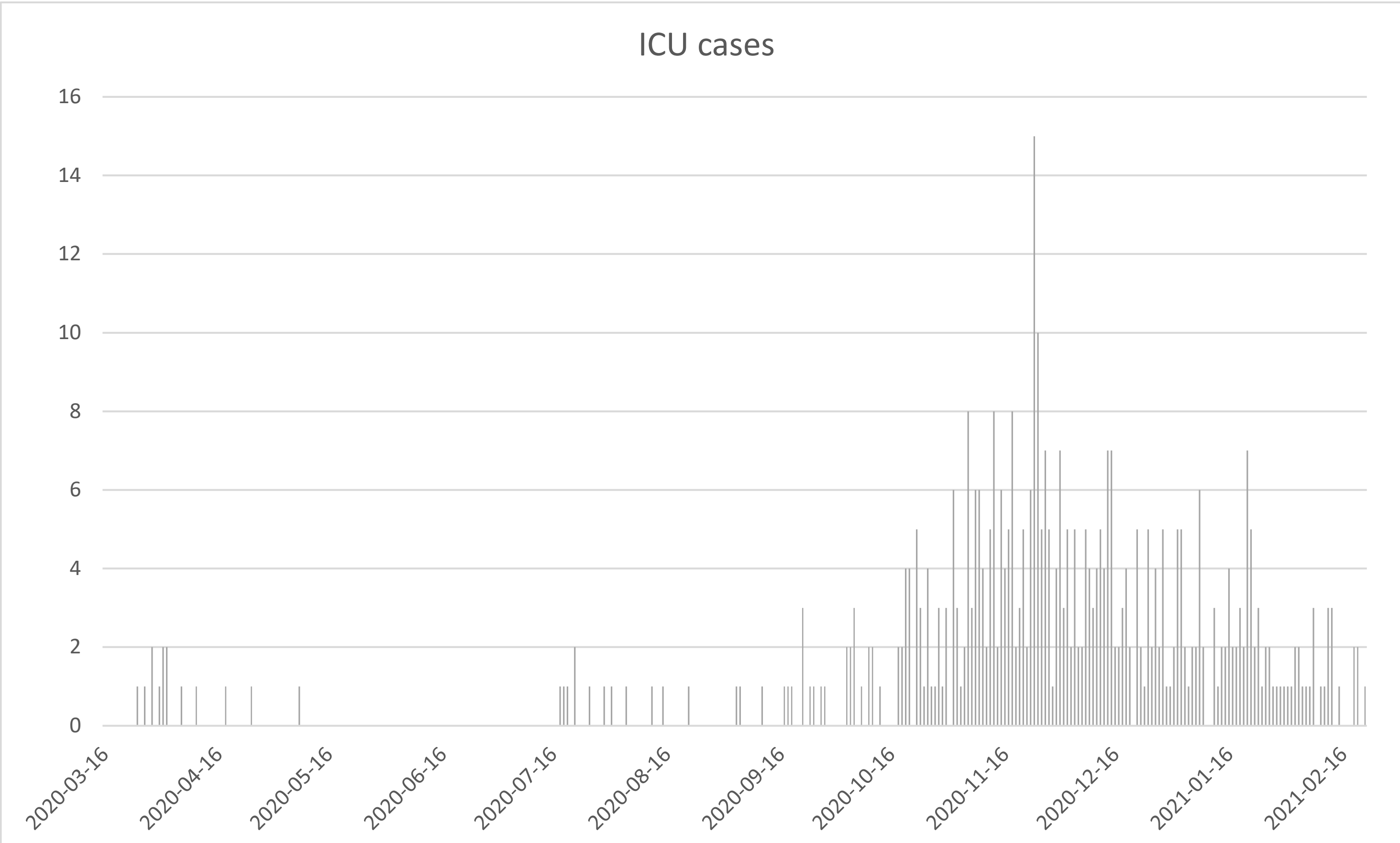
AB1599

Serious Outcomes: hospitalizations, ICU cases and deaths (March 16, 2020 to February 22, 2020)

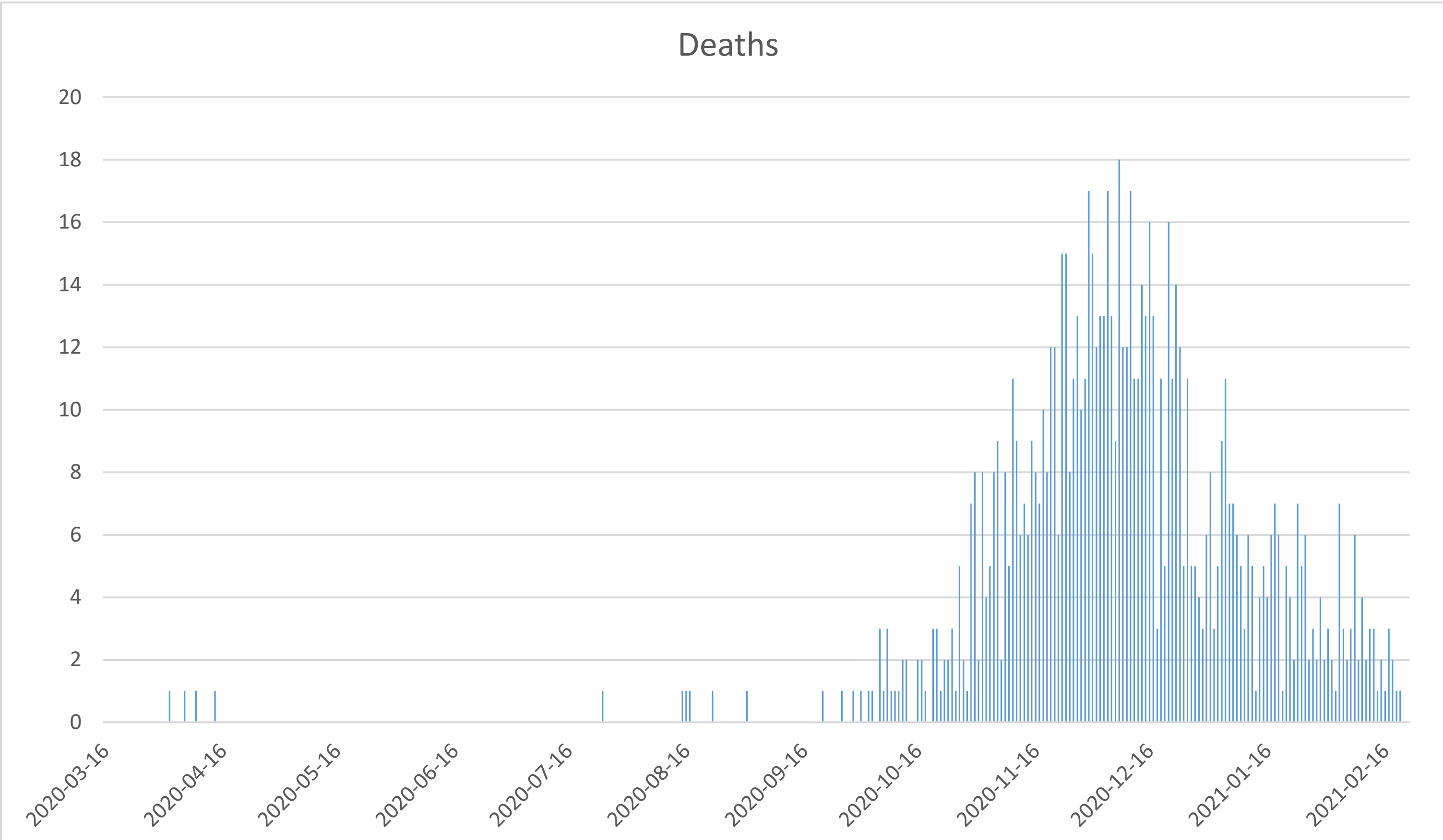
Daily number of hospital admissions, ICU admissions and deaths related to Covid-19



AB1600


ICU cases
16
14
12
10
8
6
4
2
0
2020-03-16
2020-04-16
2020-05-16
2020-06-16
2020-07-16
2020-08-16
2020-09-16
2020-10-16
2020-11-16
2020-12-16
2021-01-16
2021-02-16

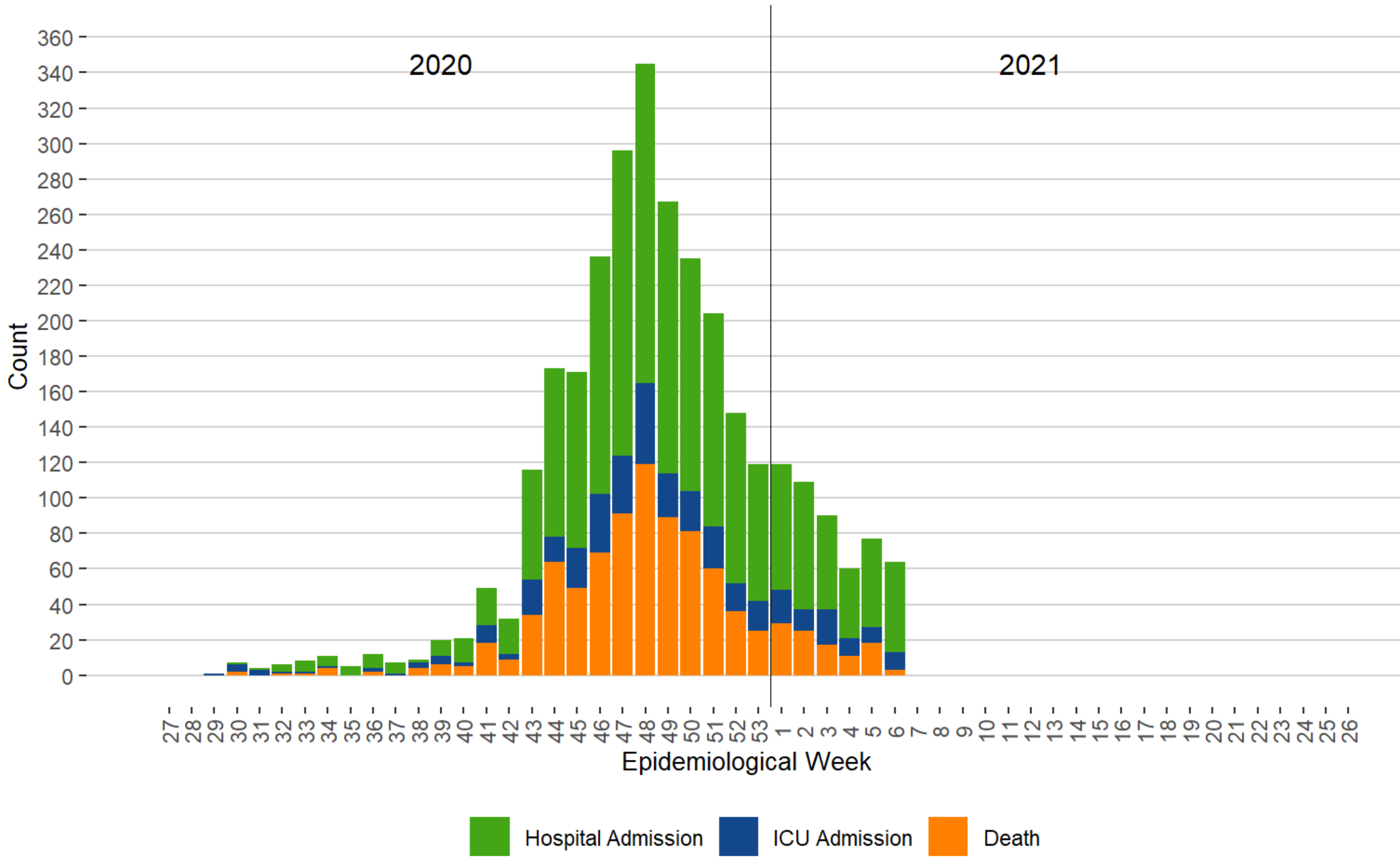
AB1601



Deaths
20
18
16
14
12
10
8
6
4
2
0
2020-03-16
2020-04-16
2020-05-16
2020-06-16
2020-07-16
2020-08-16
2020-09-16
2020-10-16
2020-11-16
2020-12-16
2021-01-16
2021-02-16

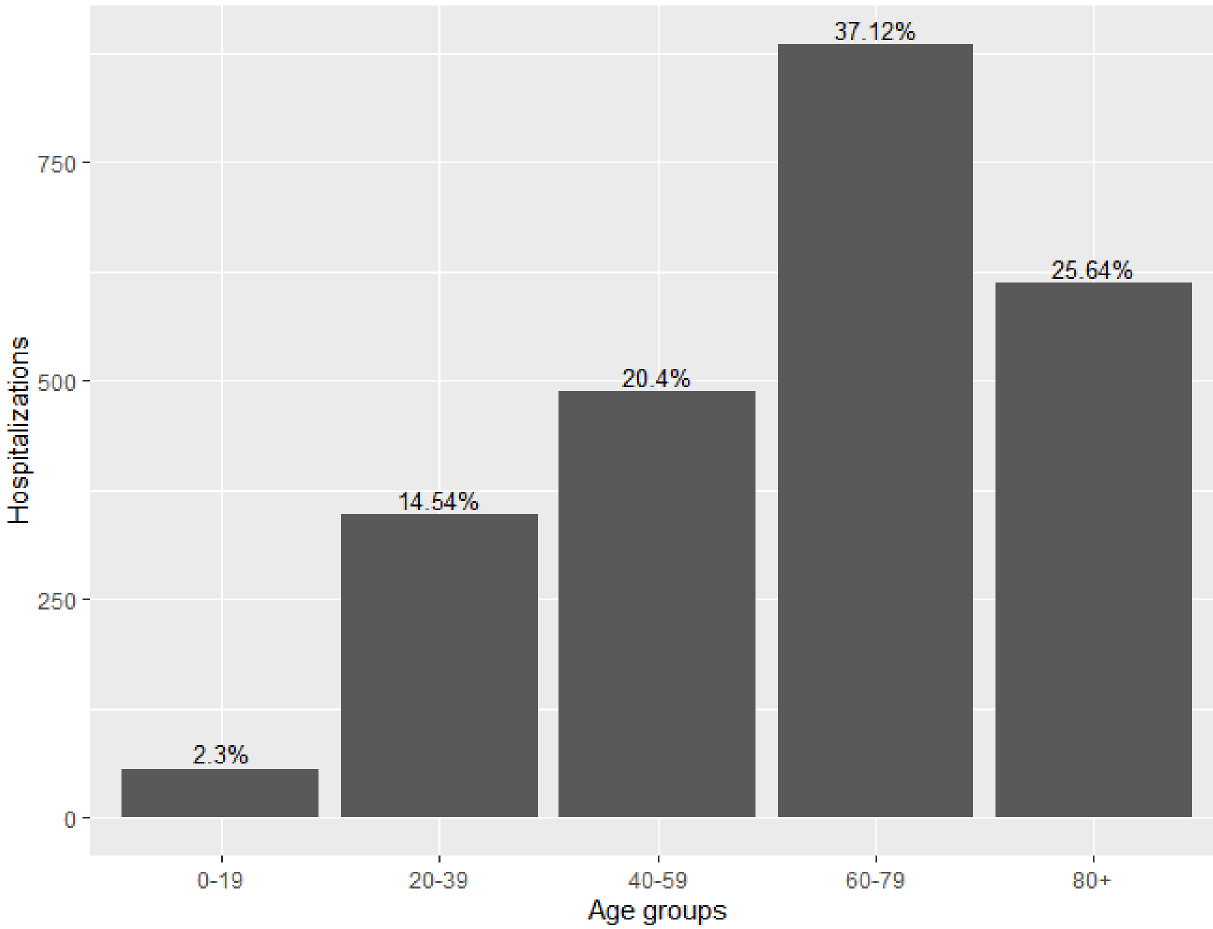
AB1602

Severe Outcomes of COVID-19 by Week of Public Health Report Date (as of February 19, 2021)

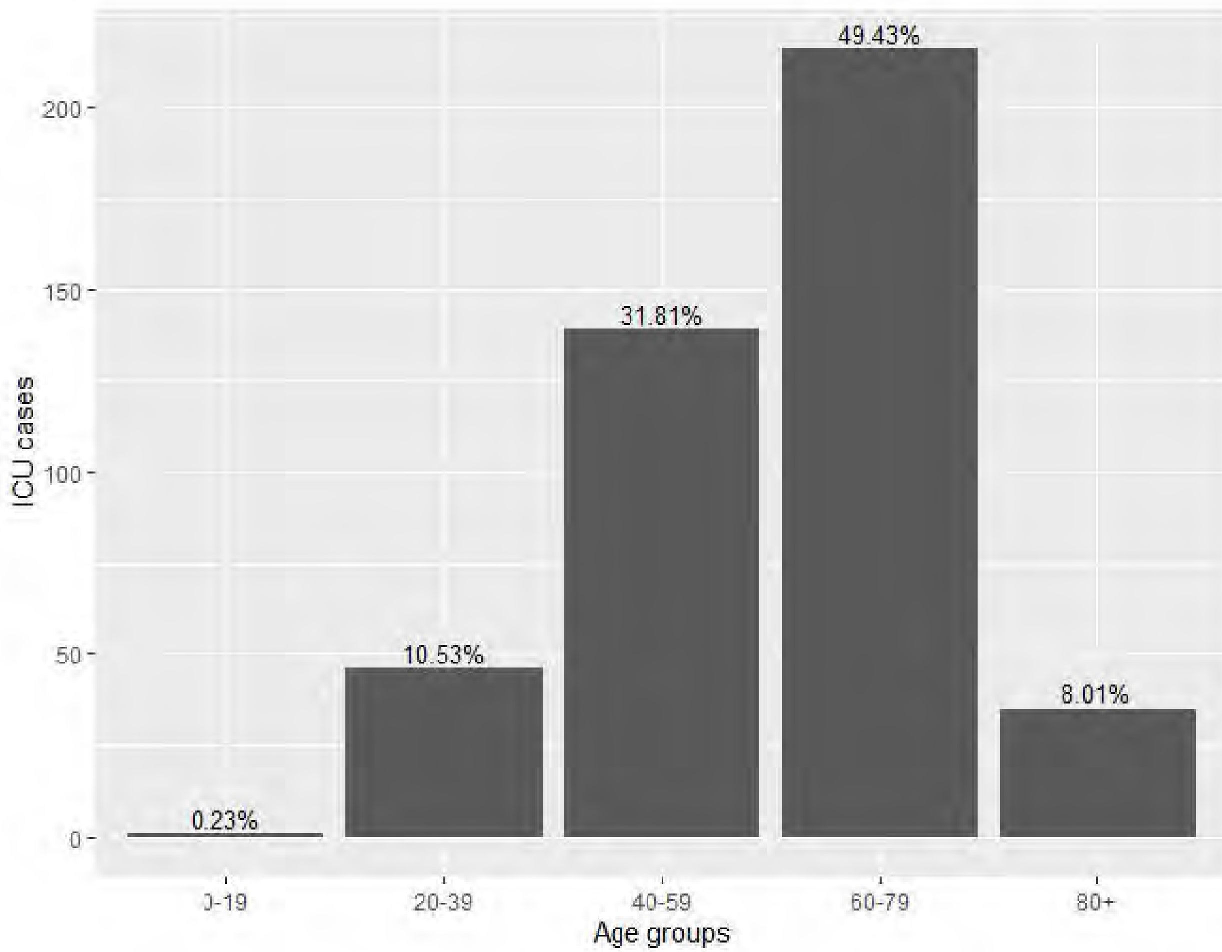


AB1603

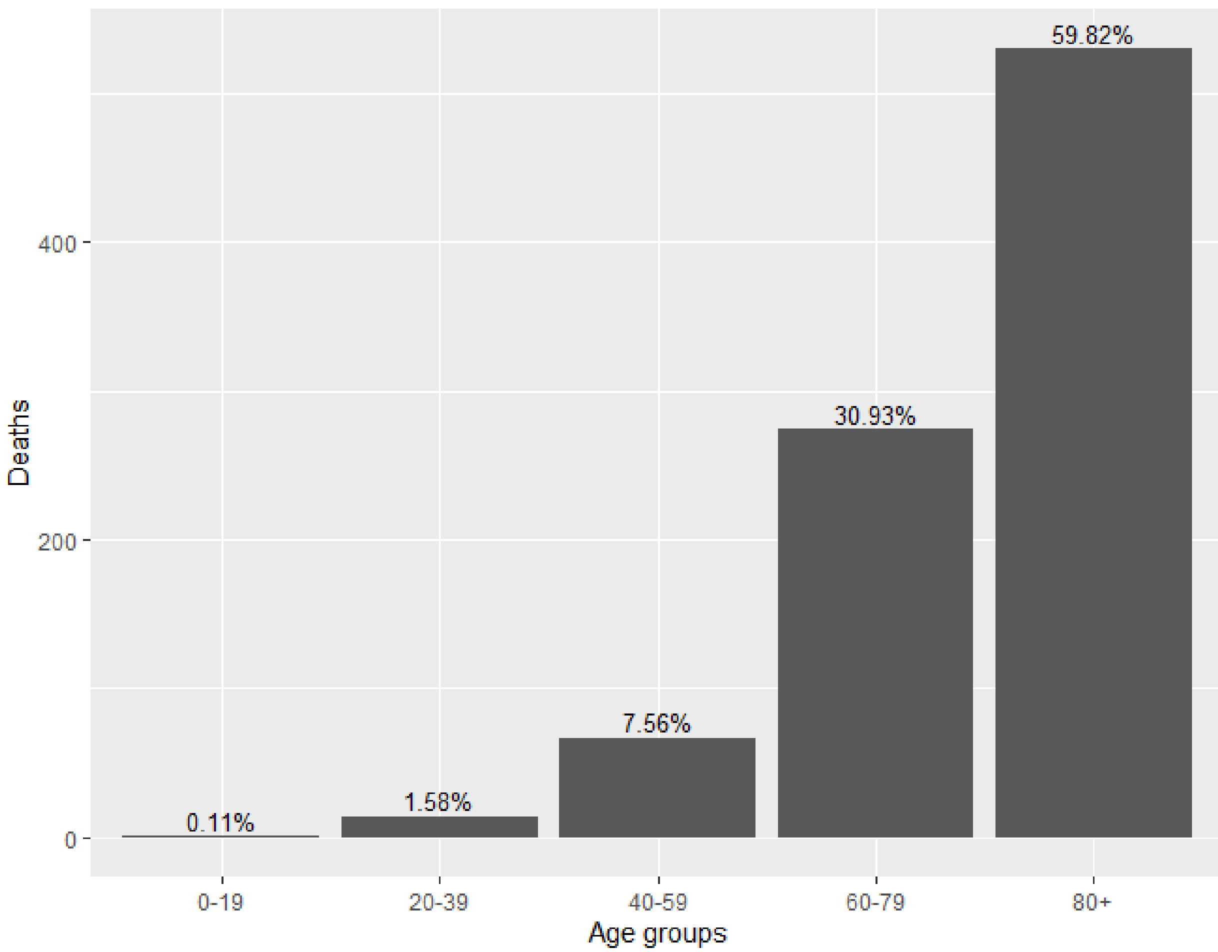
Age distribution of hospitalizations, ICU cases and deaths (as of February 22, 2021)



AB1604


49.43%
31.81%
10.53%
8.01%
0.23%
200
150
100
50
0
ICU cases
0-19
20-39
40-59
60-79
80+
Age groups

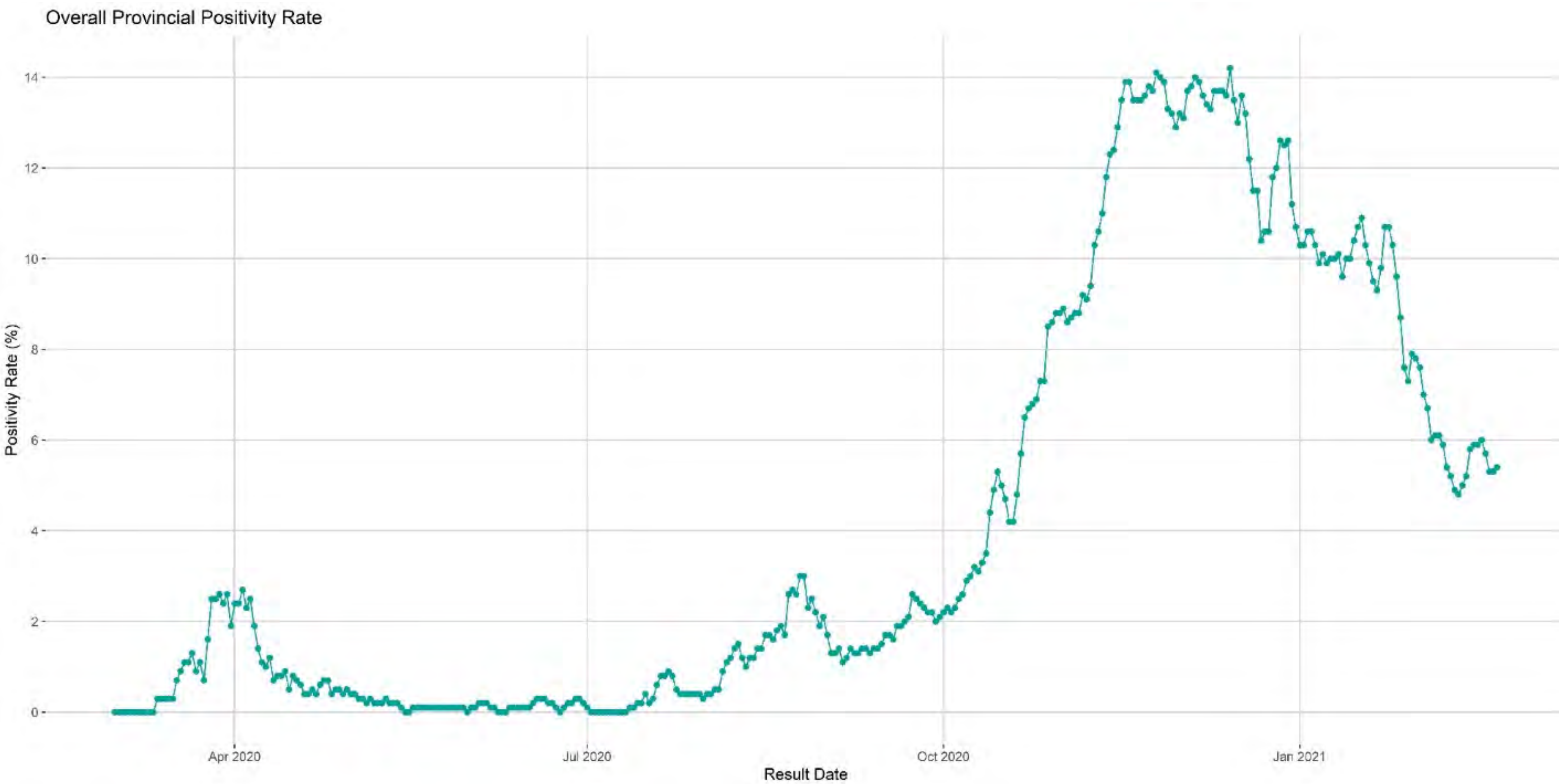
AB1605



59.82%
30.93%
7.56%
1.58%
0.11%
400
200
0
Deaths
0-19
20-39
40-59
60-79
80+
Age groups

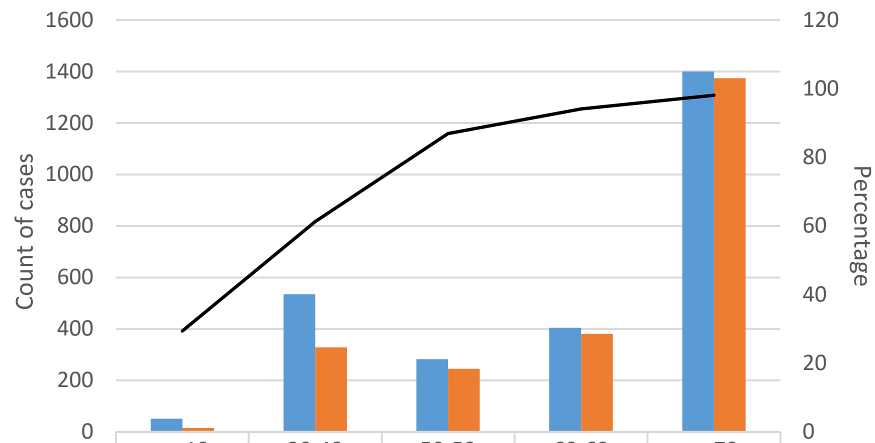
AB1606

Five-day test positivity rate (March, 2020 to February 25, 2021)



AB1607

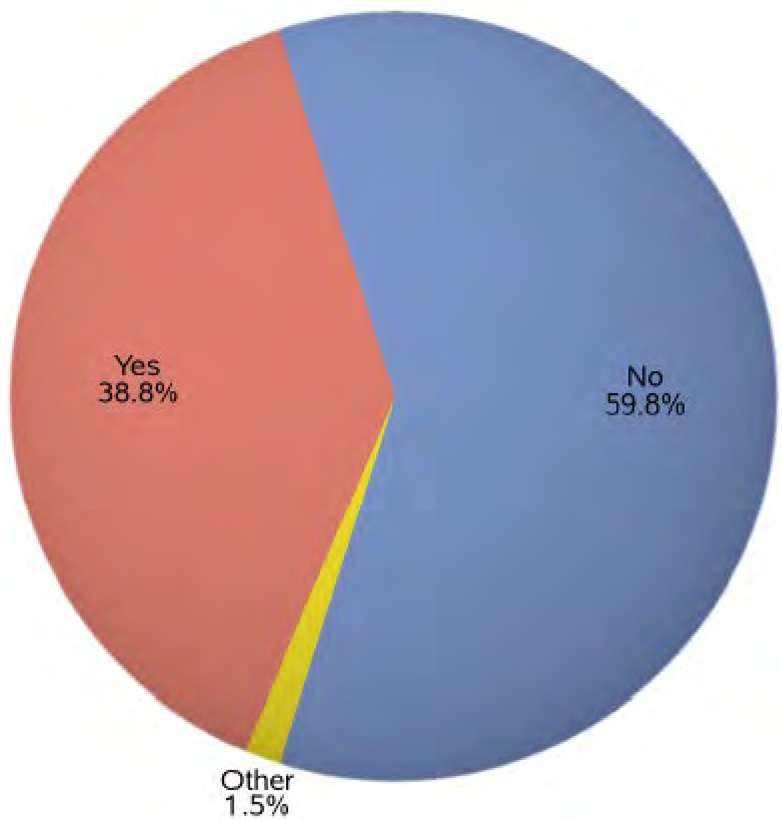
Number of severe outcome cases (hospitalizations, ICU and deaths) and number of severe outcome cases where patients had underlying conditions— as of February 23rd, 2021



	<= 19	20-49	50-59	60-69	>=70
Severe Outcomes	51	535	282	405	1400
Having a severe outcome and an underlying illness	15	328	245	381	1374
Percentage of having a severe outcome and an underlying illness	29.4	61.3	86.9	94.1	98.1

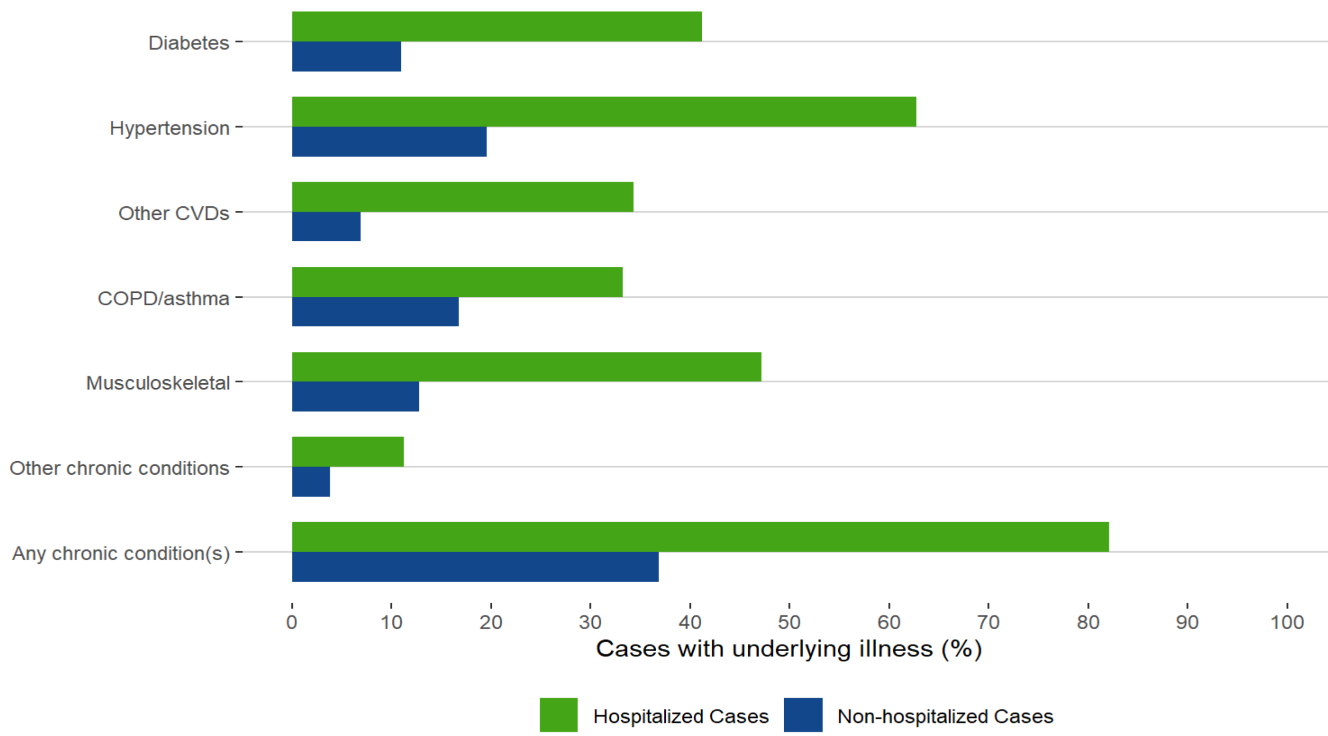
Presence of an underlying Illness in COVID-19 Cases in Manitoba

As of February 25th, 2020 of 22,650 reports, there are 8,777 cases of COVID-19 indicating an underlying illness. These include co-morbidities such as cardiac, pulmonary, kidney, liver disease, diabetes, hypertension, asthma, and any immunocompromised status.



AB1609

Percentage of COVID-19 Cases With Underlying Illnesses, Manitoba 2020 – 2021 (as of February 19, 2021)



Note. Musculoskeletal illnesses include: osteoporosis, osteoarthritis, juvenile idiopathic arthritis, gout and crystal Arthropathies; COPD-chronic obstructive pulmonary disease; CVD-cardiovascular disease; Other CVDs include: ischemic heart disease, heart failure, acute myocardial infarction, and stroke; Other chronic conditions include: parkinson's disease, multiple sclerosis, alzheimer's disease and epilepsy. About definitions of chronic conditions

AB1610

Severe Outcomes in Manitoba

Counts, age-specific and age-adjusted case rates of death, hospitalization, ICU admission, and severity (death/hospitalization) outcomes among COVID-19 cases in Manitoba by socio-demographic characteristics, March 12, 2020 – February 08, 2021 (N=30,289)

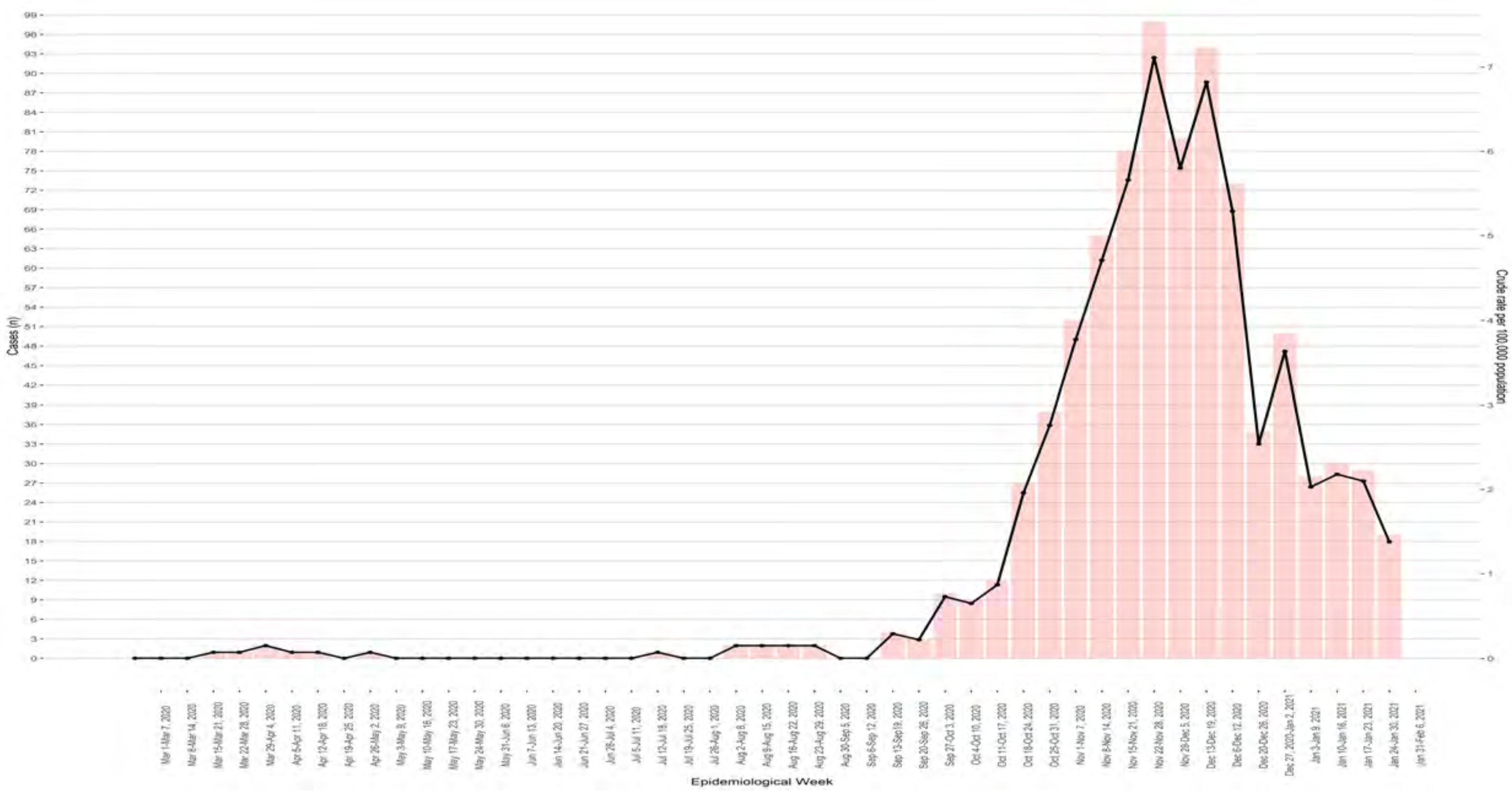
Characteristics	Deaths		Hospitalizations		ICU admissions		Severe outcomes*		Total
	Count	Case rate (%)	Count	Case rate (%)	Count	Case rate (%)	Count	Case rate (%)	Count
Total	***850***	2.4	***2,131***	7.1	***409***	1.5	***2,553***	8.1	***30,289***
Age group (years)**									
19 and younger	1	0.0	51	0.9	1	0.0	51	0.9	5933
20-49	38	0.3	503	3.5	93	0.6	515	3.6	14355
50-59	44	1.1	261	6.6	87	2.2	270	6.9	3940
60-69	87	3.4	365	14.3	109	4.3	380	14.9	2547
70+	680	19.4	951	27.1	119	3.4	1337	38.0	3514
Median age (IQR)	83	(73-90)	67	(49-79)	62	(51-71)	71	(52-84)	37 (22-56)
Mean age (SD)	80	(14)	63	(21)	60	(15)	66	(21)	40 (23)
Sex									
Female	445	2.1	1086	6.7	167	1.2	1329	7.7	15130
Male	405	2.9	1045	7.5	242	1.8	1224	8.7	15138
Unknown	0	0.0	0	0.0	0	0.0	0	0.0	21
Health region									
IERHA	35	2	133	6.6	41	1.9	148	7.5	2332
NRHA	32	1.6	256	9.2	41	1.4	262	9.5	4149
PMH	51	2	103	5.4	20	1.3	140	6.7	2028
SH-SS	138	2.2	373	6.8	55	1.1	421	7.4	4677
WRHA	594	2.7	1266	7	252	1.6	1582	8.3	17103
Area level income quintiles									
Q1 (lowest)	150	2.5	680	10.1	152	2.2	712	10.7	8012
Q2	110	2	369	7	68	1.3	408	7.7	5547
Q3	90	1.9	282	6.4	53	1.3	318	7.1	4324
Q4	123	2.2	320	6.3	63	1.4	375	7.1	5036
Q5 (highest)	67	2	201	5.9	34	1	228	6.7	3791
Unknown	310	3.7	279	7.1	39	1.3	512	9.2	3579

*Severe outcomes include death or hospitalizations

**Data presented is for age-specific case rates

AB1611

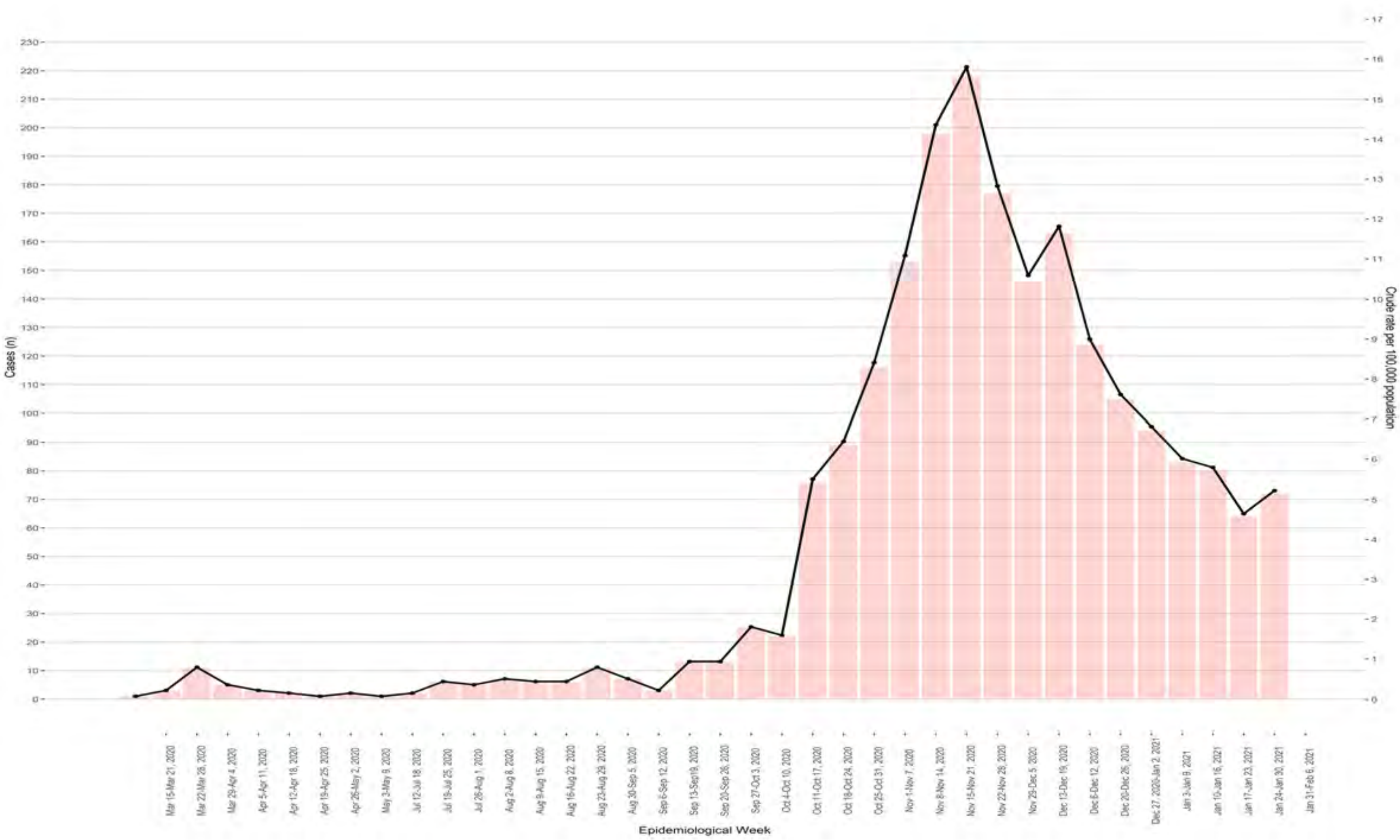
Weekly count and crude mortality rate (per 100,000 population) related to COVID-19 in MB, March 12, 2020 – February 06, 2021



- The highest weekly count occurred on November 29-December 5, 2020 with a count of 98. The highest crude mortality rate occurred November 29-December 5, 2020 with a rate of 7.11 per 100,000 people.
- From March 1- October 3, 2020 the weekly count ranged from 0-4. From March 1- October 3, 2020 crude mortality rates ranged from 0-0.29 per 100,000. There was 0 new deaths from May 10- August 8, 2020, with the exception of 1 occurring July 19-July 25, 2020.

AB1612

Weekly count and crude hospitalization rate (per 100,000 population) among COVID-19 cases in MB, March 12, 2020 – February 06, 2021



- The highest weekly count occurred on November 22-November 28, 2020, 2020 with a count of 218. The highest crude hospitalization rate occurred November 22-November 28, 2020, 2020 with a rate of 15.81 per 100,000 people.

- From March 15- September 19, 2020 the weekly count ranged from 1-11. From March 15- September 19, 2020 crude hospitalization rates ranged from 0.07-0.8 per 100,000. The average was 0.7 per 100,000 in this interval.