Court File No. T-539-20

FEDERAL COURT

BETWEEN:

CANADIAN CIVIL LIBERTIES ASSOCIATION,
CANADIAN PRISON LAW ASSOCIATION,
HIV & AIDS LEGAL CLINIC ONTARIO,
HIV LEGAL NETWORK,
& SEAN JOHNSTON

Applicants

– and –

THE ATTORNEY GENERAL OF CANADA

Respondent

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VOLUME 2 OF 5

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AFFIDAVIT OF Dr. ADELINA IFTENE

I, **ADELINA IFTENE**, of the City of Halifax, in the Province of Nova Scotia, DO AFFIRM THAT:

A. Introduction

1. I am an Assistant Professor of Law at the Schulich School of Law at Dalhousie University and the incoming Associate Director of the Health Law Institute at Dalhousie. I teach criminal law, evidence, and prison law and policies. My doctorate in law, completed at Queen's University, grounded the vast majority of my current work which investigates issues surrounding health needs and health rights of vulnerable populations in federal prisons, as well as access to justice and rights protection of incarcerated people. Much of

my work draws upon an empirical investigation that I conducted with 197 incarcerated older men in seven federal prisons and the extensive qualitative and quantitative analysis I developed based on those interviews. I have published peer-reviewed articles on prison health and rights, compassionate release, and end-of-life issues in federal prisons. I have also provided invited testimony before the Senate's Human Rights Committee on vulnerable prisoners. My work has been relied on by the Office of the Correctional Investigator and the Canadian Human Rights Commission in their 2019 joint report, "Aging and Dying in Prison." My book, "Punished for Aging: Vulnerability, Rights and Access to Justice in Canadian Penitentiaries" was published by University of Toronto Press in August 2019. My CV is attached as **EXHIBIT "A".**

2. I am providing independent expert evidence in this affidavit, as a socio-legal scholar, based on information that I have gathered in the course of my research. The opinions and facts deposed hereafter are based on my own research with federal prisoners, as well as on other scholars' and governmental reports for which I will indicate the source. The methodology for my research is detailed in the peer-reviewed article attached as **EXHIBIT "B".** When I refer to medical issues related to COVID-19 I will cite the sources; I have not conducted direct research on the viral infection, and I am not a medical doctor.

3. Based on the underlying characteristics of the demographic, as well as what we know of the disease thus far, it is my opinion that federally incarcerated people are, as a group, at higher risk of contracting COVID-19, as well as of developing complications, including death, due to infection. It is also my opinion that federal prisons are ill-equipped to contain the spread

of COVID-19 and that the prison health care system cannot properly provide health care to a large number of infected people, due to pre-existing challenges and gaps in prison health care.

B. The underlying demographic and health characteristics of federally incarcerated prisoners

4. The social determinants for health are also determinants for criminalization and incarceration. This means that socially marginalized people in poor health are overrepresented in prisons. For instance, adverse childhood events such as physical and sexual abuse, institutionalization (including residential schools), witnessing family violence, absent parents, and racial discrimination are significant determinants of criminalization and incarceration. Indigenous people are significantly overrepresented in prisons (27% for men and 36% for women, while in the community they comprise about 4% of the population).[1] Most individuals experiencing incarceration have a low socio-economic status, low levels of education, and low income. Finally, most people enter prisons with a high burden of disease and often engage in high-risk behaviour before and after admission to correctional facilities (e.g. smoking, injecting drugs, overuse of alcohol, etc.).[2]

[1] Public Safety Canada, *Corrections and Conditional Release Statistical Overview*, 2018 Annual Report (Ottawa: Public Safety Canada Portfolio Corrections Statistics Committee, 2019) at 53 [Public Safety Canada, 2018 Annual Report], online: <https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ccrso-2018/index-en.aspx>

[2] See Fiona Kouyoumdjian et al, "Health Status of Prisoners" (2016) 62 Can Fam Physician 215 at 217; Ontario, Ministry of the Solicitor General, *Independent Review of Ontario Corrections, Corrections in Ontario: Directions for Reform* (Toronto: Queen's Printer for Ontario, September 2017)

5. Quite apart from the burdens individuals enter prisons with, imprisonment in and of itself presents numerous risks to health: prison violence, isolation, poor nutrition, little opportunity for exercise, lack of stimulating programming, conditions that may lead to family breakdowns, challenging infrastructure, overcrowding, and poor access to and quality of health services and related supports. In such environments, the risk of contracting communicable diseases, overdose, death due to preventable and treatable diseases, worsening of mental health and other health conditions, and self-harm and suicide is significantly higher than in the community.

6. Currently, 25% of federally incarcerated people are over the age of 50.[3] In prison research, 50 years is often used as the lower limit of seniority, recognizing that every incarcerated individual tends to present the health problems of someone 10–15 years older than their equivalent in the community. This means that the number of non-communicable diseases, including chronic diseases and diseases associated with aging, are also increasing. There is a higher prevalence of cardiovascular disease, diabetes, asthma, and other respiratory diseases in incarcerated populations than in community populations. These issues are further illustrated in **EXHIBITS "B"** and **"C"**.

[3] The source for this information is: Public Safety Canada, 2018 Annual Report, *supra* note 1 at 47.

7. The life expectancy for incarcerated people is significantly lower than in the community (60[4] versus 82[5]) and the vast majority of annual deaths in prisons are accounted to natural causes or expected death (71%).[6] The leading causes of death are: cancer (36% of all natural deaths), cardiovascular-related (29%), and respiratory-related (11%).[7]

8. In my own research with aging prisoners, I found that among this age group, over 90% of individuals suffered from at least one diagnosed illness, with the average person being diagnosed with 6 to 7 illnesses. Over 10% of this group reported over 12 diagnosed conditions, 4% had been diagnosed with dementia or significant cognitive impairment, and 5% were terminally ill (i.e. were given a prognosis of a few months left to live). Nearly half of the sample reported a psychiatric condition (including chronic depression, anxiety, and psychosis), and over 50% reported a physical disability that impaired their movement. These impairments ranged from difficulties working or standing to being bedridden. Symptoms of the illnesses affecting this population include self-harm, chronic and/or debilitating pain (over 50%), and incontinence (14%). **EXHIBIT "B"** (in Table 5) includes the percentages of the most common illnesses among this population.

9. Rates of communicable diseases in Canadian federal prisons are generally higher than those in the community. Some examples include a Tuberculosis rate of 22%, compared to 4.6%

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[4] The source for this information is: Canada, Office of the Correctional Investigator, *Annual Report of the Office of the Correctional Investigator 2017-2018*, (Ottawa: OCI, 2018) at 28 [Office of the Correctional Investigator, *Annual Report 2017-2018*].

[5] The source for this information is: Statistics Canada, *2018 Archived – Life Expectancy and Other Elements of the Life Table, Canada and Provinces*, Table 39-10-0007-01 (Ottawa: Statistics Canada, 2018), online: <www150.statcan.gc.ca>.

[6] Office of the Correctional Investigator, *Annual Report 2018*, *supra* note 4 at 27.

[7] The source for this information is: Correctional Service Canada, *Annual Report on Deaths in Custody 2015*/2016, (Ottawa: CSC, 2017), Table 6 [Correctional Service Canada, *Annual Report 2017*].

in the community, and a Hepatitis C (HCV) rate of 31%, compared to 1%, or 39 times lower in the community. The HIV/AIDS rate was 4.6%, or 15 times more frequent than in the community.[8]

10. Substance use and addiction rates are also higher in prisons than in the community. Data on natural death in Canadian federal custody indicates that 76% of deaths were related to substance use and smoking.[9] In 2015–2016, there were seven deaths due to overdose in federal institutions, compared to 23 deaths caused by overdose in the seven years prior. This increase in 2015–2016 was due in part to the Fentanyl crisis: six out of seven deaths were attributed to Fentanyl.[10] This crisis is ongoing.

C. Potential vulnerability of incarcerated people to COVID-19

11. Due to life challenges and underlying health conditions, incarcerated individuals have higher rates of morbidity (incidence) and mortality (death) for nearly every illness. In the

[8] The source for this information is: Canadian HIV/AIDS Legal Network, "Brief to the Standing Senate Committee on Human Rights regarding its study on human rights of prisoners in the correctional system: The public health and human rights rationale for prison-based needle and syringe programs", prepared by Sandra Ka Hon Chu (Toronto: AIDSLAW, 23 June 2017) at 1, online: https://sencanada.ca/content/sen/committee/421/RIDR/Briefs/LegalNetworkandPASAN_e.pdf; Correctional Service Canada, "Health Services Quick Facts: Hepatitis C Virus (HCV) Age, Gender and Indigenous Ancestry" (Ottawa: CSC, September 2016), online: https://www.csc-scc.gc.ca/publications/005007-3037-eng.shtml

[9] The source for this information is: Office of the Correctional Investigator, *Annual Report: 2017-2018*, *supra* note 4 at 34.

[10] The source for this information is: Correctional Service Canada, *Annual Report on Deaths in Custody 2015/2016* (No SR-1702) (Ottawa: CSC, November 2017) at 44, online: https://www.csc-scc.gc.ca/research/005008-3010-en.shtml.

short span of time since the pandemic started, we have already seen this to prove true for COVID-19, as well.

12. As of April 26, 2020, there have been 444 confirmed COVID-19 cases related to federal prisons, 309 of these cases being incarcerated people. This number indicates that, at the moment, the rate of infection is over 9 times higher than in the community, even though the first reported case was much later than in the community. A table detailing the number of cases per federal institution is included as **EXHIBIT "D"**.

13. The first reported cases in federal penitentiaries were on March 30, 2020,[11] and there has already been one death in custody due to COVID-19. Given the high number of already infected people, the quick spread, the period of time it takes COVID-19 to kill (from a few days to a few weeks), and the high level of vulnerability among prisoners, there will likely be many more deaths, if the current rate of infection continues

14. Based on what is known thus far about COVID-19, a number of underlying conditions are risk factors for contracting the disease and experiencing complications: chronic lung disease (inclusive of asthma, chronic obstructive pulmonary disease (COPD), and emphysema); diabetes mellitus; cardiovascular disease; chronic renal disease; chronic liver disease; immunocompromised condition; neurologic disorder, neurodevelopmental, or intellectual disability; pregnancy; current smoking status; former smoking status; or other chronic

[11] The source for this information is: Julia Page, "Correctional officers, inmates at Port-Carter prison test positive for COVID-19" *CBC News* (30 March 2020), online: https://www.cbc.ca/news/canada/montreal/covid-19-correctional-officers-port-cartier-1.5514962

diseases. The medical study providing preliminary data on COVID-19 and underlying health conditions is attached as **EXHIBIT "E"**.

15. A comparison between the table in **EXHIBIT "E"D** and the tables in **EXHIBITS "B"** and **"C"**, as well as the other data highlighted above, show that there is an overlap between the conditions that appear to increase the vulnerability to COVID-19 and those that are disproportionately experienced by federally incarcerated people.

16. In terms of severe outcomes as a result of COVID-19, American data shows that 45% of hospitalizations, 53% of intensive care unit admissions, and 80% of deaths were reported in adults over the age of 65 (**EXHIBIT "F"**). As highlighted above, the age of 65 roughly corresponds to the age of 50 in incarcerated people in terms of their health status. Individuals in this group comprise 25% of those federally incarcerated.

17. Based on research concerned with vulnerable prison populations and health, as well as based on the preliminary studies regarding COVID-19, it is my opinion that federally incarcerated individuals are at a higher risk of contracting the disease once it enters an institution, of developing serious complications from it, and of dying. I believe this elevated risk is present in a disproportionate number of incarcerated people, given that a higher percentage of them are elderly, are immuno-compromised, and are suffering from underlying acute and chronic health conditions.

D. Challenges and gaps in penitentiary health care systems that would impede the ability of institutions to respond to a COVID-19 outbreak

18. As illustrated both by **EXHIBITS "E"** and **"F"**, prevention of disease in individuals deemed high risk is essential. Prevention measures include social distancing, washing hands, avoiding any contact with infected people, and cleaning and disinfecting all surfaces. When vulnerable individuals contract the disease, they are more likely to require hospitalization and intensive care. Even mild cases require symptom control, which includes proper nutrition, liquid intake, painkillers, and fever medication.

19. It is my opinion that the prevention, control of spread, as well as symptom management is very difficult, if not impossible, in many penitentiaries, due to logistical challenges, infrastructure, limited resources, and inadequate health care services. I will provide some examples of these challenges and I am attaching my book chapter detailing the shortcomings of prison health care and its impacts on public health as **EXHIBIT "G"**.

20. Social distancing and maintaining a clean and disinfected environment are almost impossible in many institutions. In many institutions double-bunking is still a reality. Some institutions do not have proper ventilation in the summer and adequate heating in the winter. Disinfectants and hand-sanitizers cannot be made available to prisoners to clean their cells. Water is sometimes shut off for drug searches, which results in prisoners not having access to running water for hours.

21. Lining up for food and medication involves proximity to others for an extended period of time. Even in the institutions where food and medication are brought to cells, direct handling of food by the numerous prisoners and staff needed to cater to large groups cannot be avoided.

22. Harm reduction measures remain largely unavailable in prisons. The high level of addiction that individuals have, and the lack of adequate harm reduction mechanisms mean that individuals continue using drugs and sharing syringes. It is unrealistic to expect them to cease doing so without adequate support. This support is limited and there is no indication that it has been increased since the pandemic was declared. Syringe sharing exposes prisoners to very high risks of contracting illnesses, including COVID-19.

23. Some institutions have responded to the pandemic with longer lockdowns in an attempt to contain the spread. This is ill-advised and it is not a sustainable long-term measure. Individuals already have high levels of mental health problems, and segregation significantly increases those issues. This in turn leads to acute psychiatric problems, suicide and self harm, as well as withdrawals that may result in death. In addition, prolonged lockdowns prevent individuals from accessing basic hygiene measures such as showers.

24. Barriers to satisfactory treatment in federal custody include, even in non-crisis times, a lack of adequate training, overcrowding, and a lack of escorting officers, resulting in difficulties transporting people to community specialists. There is a chronic shortage of health personnel in many institutions, and oftentimes the nurses, general practitioners, and psychiatric health staff are overwhelmed and cannot provide adequate health care to each

individual in need. Issues with untimely or inaccurate diagnoses that have sometimes led to death have been reported with some regularity.[12]

25. Medication is an issue both in terms of availability and distribution in federal institutions. The CSC National Drug Formulary is restrictive and the autonomy of physicians to prescribe a course of treatment also appears to be restricted. For instance, the Formulary provides only a limited set of options for the management of chronic pain, and the options that are available are not always the most efficient form of treatment. Requests from physicians for drugs that are not on the Formulary are denied so often that physicians usually stop prescribing anything other than what the Formulary permits. Tylenol 3 is often the only prescription medication available. Morphine is only available in some institutions and, even then, only sometimes. Furthermore, medication distribution only takes place once or twice daily and under direct supervision, so dosages must be adjusted to accommodate for this restricted schedule. Therefore, certain classes or dosages of medication simply cannot be used, regardless of how sick the individual is and how inefficient the alternative treatment is.

E. Conclusion

26. CSC has taken some measures, listed on their website, to prevent the transmission of COVID-19. It is clear that these measures are falling short, considering the incredible high rate at which the number of infections is increasing among people in custody. The health

[12] The source for this information is Office of the Correctional Investigator of Canada, *An Investigation of the Correctional Service's Mortality Review Process* (Ottawa: OCI, 28 December 2013) at 9, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/oth-aut/oth-aut20131218-eng.pdf

care received by those who are becoming infected should be of significant concern, given the strained functioning of prison health services at the best of times.

27. It is my opinion that given the high numbers of people incarcerated and logistical barriers, it is not possible to implement essential preventative measures, such as social distancing and cleanliness, without systemic depopulation measures within prisons. CSC has taken no steps in that direction, nor has it indicated any intentions to do so.

28. It is my opinion that, because of the characteristics of the population and the challenges in preventing infection spread and providing health care, prisoners are at a higher risk of contracting the disease in prison than they would be in the community. Also, given their underlying conditions, for many prisoners, the consequences of contracting COVID-19 may be more severe than for most people in the community.

29. I made this affidavit in good faith and for no improper use.

AFFIRMED BEFORE ME at the City of Toronto, in the province of Ontario, affiant appearing by video while located in the City of Halifax, in the Province of Nova Scotia, this 13th day of April, 2020.

A Commissioner for taking Affidavits *(or as may be)*

Jody Brown LSUC#: 58844D

Dr. Adelina Iftene

This is Exhibit **"A"** to the
Affidavit of Adelina Iftene sworn
before me this 13th day of May, 2020.

A Commissioner, etc.

CURRICULUM VITAE – ADELINA IFTENE

Schulich School of Law, Dalhousie University, 6061 University Street, Halifax, B3H4R2, NS

CURRENT POSITION

Assistant Professor (July 2017- present)
Schulich School of Law, Dalhousie University
Courses Taught: Criminal Justice, Evidence, Imprisonment and Prison Policy, International Criminal Law
Research Areas: Prison Law, Criminal Justice, Evidence, Sentencing, Canadian Charter of Rights and Freedoms

EDUCATION

Doctor of Philosophy (PhD) in Law (2015)
Queen's University, Kingston, Ontario, Canada
Supervisor: Professor Allan Manson
Committee: Allan Manson, Sharry Aiken, David Freedman, Fiona Kay
Dissertation: "Elderly Inmates in Canadian Prisons: Specific Needs and Institutional and Legal Responses"

LL.B Accreditation with the Canadian Federation of Law Societies, National Committee for Accreditation (NCA) (April 2016)
Requirments completed in part at Queen's, through JD courses and in part as NCA exams

Master of Law (LL.M) (2011)
Queen's University, Kingston, Ontario, Canada
Supervisor: Professor Stan Corbett
Thesis: "Convicts and Human Rights: A Comparative Study on Prison Treatment in Europe and Canada."

Bachelor of Law (LL.B) (2010)
Babes-Bolyai University, Cluj-Napoca, Romania.

PUBLICATIONS (*R = Peer-Reviewed)

Book

Punished for Aging: Vulnerability, Rights, and Access to Justice in Canadian Penitentiaries (Toronto: University of Toronto Press, 2019). (R)

Book Chapters

"Aging Prisoners," in Carla Cesaroni (ed.), *Canadian Prisons: Understanding the Canadian Correctional Landscape* (Toronto: Oxford University Press, 2021, forthcoming) (R)

"Incarceration in Canada: Risks to and Opportunities for Public Health," in Tracey Bailey, Tess Sheldon, and Jacob Shelley, *Public Health Law and Policy in Canada*, 4ed (Toronto: LexisNexis, 2019)

"Mr. Big: The Undercover Breach of the Right against Self-Incrimination," in C. Hunt (ed), *Perspectives on the Law of Privilege* (Toronto, Thomson Reuters, 2019).

Articles

"Mr. Big and the New Common Law Confessions Rule: A Five-Year Review," Manitoba Law Journal, Criminal Justice Special Issue (forthcoming 2020) (with Vanessa Kinnear) (R)

"Mother-Child Programs for Incarcerated Mothers and Children and Associated Health Outcomes: A Scoping Review" Canadian Journal of Nursing Leadership (forthcoming 2020) (with Martha Paynter, Shelley McKibbon, Keisha Jefferies, Ruth Martin-Misener, and Gail Tomblin Murphy) (R)

"End-of Life Care for Federally Incarcerated Individuals in Canada," (2020) 14:1 McGill Law and Health Journal 1 (with Jocelyn Downie) (R)

"Assisted Dying for Prison Populations: Lessons from and for Abroad," (2019) 19:2-3 Medical Law International 207 (with Jocelyn Downie and Megan Steeves) (R)

"Employing Older Prisoner Empirical Data to Test a Novel s. 7 Charter Claim," (2018) 40:2 Dal LJ 1 (R)

"The Case for a New Compassionate Release Statutory Provision," (2017) 54:4 Alberta Law Review 929 (R)

"The Pains of Incarceration: Aging, Rights, and Policy in Federal Penitentiaries," (2017) 59:1 Canadian Journal of Criminology and Criminal Justice 63. (R)

"Unlocking the Doors to Canadian Older Inmate Mental Health Data: Rates and Potential Legal Responses," (2016) 47 International Journal of Law and Psychiatry 36. (R)

"The *Hart* of the (Mr.) *Big* Problem," (2016) 63 Criminal Law Quarterly 151.

"Tort Based Actions in Canadian Prison Litigation," (2014) 39:2 Queen's Law Journal 655 (with Lynne Hansen and Allan Manson). (R)

"Recent Crime Legislation: The Challenge for Prison Health Care," (2012) 185:10 Canadian Medical Association Journal, doi: 10.1503/cmaj.120222 (with Allan Manson). (R)

"The Religious Foundations of the Protection of the Right to Life," (2011) 8:6 US-China Law Review 511 (with Nicolae Pasca). (R)

Academic Essays and Commentary

"Red Zones: Criminal Law and the Terrial Governance of Marginalized People," [Book Review] (2020) 53:3 Canadian Journal of Law and Society (forthcoming).

"The Bad, the Ugly and The Horrible: What I Learned about Humanity by Doing Prison Research [Book Launch Speech]" (2020) 43:1 Dalhousie Law Journal.

AWARDS

Hanna and Harold Barnett Award for Excellence in Teaching First Year (2018-2019)
Schulich School of Law, Dalhousie University

GRANTS:

Nova Scotia COVID-19 Health Research Coalition Research Grant (2020 - $50,000, co-investigator)

Post-doctoral Fellowship (2015 – 2017, $80,500)
Social Science and Humanities Research Council (SSHRC), Canada
Completed at Osgoode Hall Law School, Yprk University

Armand Bombardier Canadian Scholarship (2012-2015, $105,000)
Social Science and Humanities Research Council (SSHRC), Canada

Ontario Graduate Scholarship (2011, $15,000)
Ontario Graduate Scholarship (OGS)

SELECTED CONFERENCE/ORAL PRESENTATIONS

INVITED ORAL PRESENTATIONS

"Health Care and Incarceration: A Brief Overview" (March 2020)

Hot Topics in Health Care, organized by Dalhousie Health Sciences Students' Association, Dalhousie University,

"Mr. Big and the New Common Law Evidentary Rule: A Five Year Review" (October 2019) (with Vanessa Kinnear)
Criminal Justice and Evidentiary Thresholds: Ten Years in Review Conference, Winnipeg, University of Manitoba

"Of Life and Death: Rights and Access to Health Care in Canadian Federal Penitentiaries" (March 2019)
Law Hour for Students, Schulich School of Law, Dalhosuie University
"End-of Life in Prisons" (September 2019)
East Coast Prison Justice Society Association Meeting

"Civil Legal Needs for Aging Prisoners" (November 2018)
NS CBA, Patterson Law Truro

"Preserving the Rights of Older Prisoners," (April 2018)
Mini Law Community Lecture, NSSC Cumberland Campus, Springhill, Nova Scotia

"Incarceration: Human Rights Violations and Access to Justice," (March 2018)
IDEALaw 2018 Conference: Law's Human Impact, Dalhousie Univeristy, Halifax

"Addressing Chronic Illnesses in Prison: Law, Policy, and Reality" (January, 2018)
Seminar Series, Health Law Institute, Dalhousie University, Halifax

"Wrongful Convictions and Legal Rights behind Bars" (October, 2017)
Wrongful Conviction Day Panel, Schulich School of Law, Dalhiusie University

"Women Aging behind Bars" (March 2017)
International Women's Day Seminar, Osgoode Hall Law School, York University

"Prisoner Civil Litigation Needs" (January 30, 2017)
Rural Justice Forum, Gananoque, Ontario

"Prison medical services for older prisoners" (December 6, 2016)
Test Case Strategy Meeting, Legal Aid Ontario, Toronto

"Adjudicating Human Rights Claims in International Courts" (October 20, 2016)
Faculty of Law, Queen's University

"Humanity Meets Pragmatism: The Case for a New Compassionate Release Statutory Provision" (September 28, 2016)
Faculty Research Seminar, Osgoode Hall Law School, York University

"Disability Behind Bars and Constitutional Considerations" (November 9, 2015)

Panel on Disbailities, Centre for Human Rights, Faculty of Law, McGill University

“Introduction to International Criminal Law” (October 29, 2015)
Faculty of Law, Queen’s University

“Vulnerable Prison Groups” (2015)
Faculty of Law, Queen’s University

“Pain in Older Offenders and Institutional Responses” (2015)
Faculty of Law, Queen’s University

“Data Management in Legal Research” (2014)
Data Day Conference at Queen’s University.

“Vulnerable Prison Populations,” (2014, roundtable)
The 51st Meeting of the Academy of Criminal Justice Sciences, Philadelphia.

“International and European Standards for the Protection Against Prison Overcrowding” (2012)
Symposium on Prison Crowding and Its Implications for Human Rights, organized by John Howard Society, Ottawa

PAPER PRESENTATIONS

"Palliative Care and Self-Directed Death for Incarcerated Individuals: Mapping the Law, Policies, and Practices in Canadian Federal Prisons" (September 2018)
Canadian Prison Law Conference, Halifax, Nova Scotia

“Dementia and Aging Prisoners” (June 2018)
Law and Society Association Meeting, Toronto, Ontario

“Contextual Concerns regarding the Introduction of MAiD in Canadian Federal Prisons” (September 2017)
Internanational Conference on End of Life, Halifax, Nova Scotia

“The Case for a New Canadian Statutory Compassionate Release System” (June 2017)
Law and Society Association Meeting, Mexico City, Mexico

“Challanging the Treatment of Senior Prisoners in Canadian Penitentiaries,” (June 2016)
Law and Society Association Meeting, New Orleans, Louisiana.

“Double-Vulnerability: Mentally Ill Older Prisoners in Canadian Penitetiaries,” (May 2016)
Canadian Law and Society Association Meeting, Calgary, Alberta.

"Older Incarcerated Women: Are Canadian Prisones Prepared for Them?," (February 2016)
Imagination of Law and Wellbeing, Feminist Legal Studies Annual Conference, Faculty of Law, Queen's University

"Unlocking the Doors to Canadian Older Inmate Mental Health Data: Rates and Potential Legal Responses" (July 2015)
XXXIVth International Congress of Law and Mental Health, Vienna, Austria

"Tug-of-War Behind Bars: Needs and Legal Protection of Older Offenders" (2015)
McGill Annual Graduate Conference in Law, Montreal, Quebec.

"Older Canadian Offenders: Needs and Protection of Rights" (2015)
The 9th Annual International Graduate Legal Research Conference (ILGRC), King's College, London, UK.

"Exclusion of Evidence from Criminal Trials in Canada, the USA, and Continental Europe" (2014)
Younger Comparativists Conference (American Association of Comparative Law), Portland, Oregon.

"Needs of Elderly Inmates in Canadian Federal Corrections" (2014)
51st Meeting of the Academy of Criminal Justice Sciences, Philadelphia.

"International Legislation on Elderly Inmates" (2013)
50th Meeting of the Academy of Criminal Justice Sciences, Dallas, Texas.

"Needs of Elderly Inmates in North American Literature" (2013)
50th Meeting of the Academy of Criminal Justice Sciences, Dallas, Texas.

"Specific Needs of Elderly Inmates in Canadian and American Literature" (2012)
International Interdisciplinary Aging and Society Conference, 2nd Ed, Common Grounds Publishing, Vancouver.

"Comparative Study on Prison Treatment in Europe and Canada" (2012)
The 49th Annual Meeting of the Academy of Criminal Justice Sciences, New York.

"Comparative Study on the Protection of Convicts' Rights under the European Court of Human Rights and the Canadian Courts" (2012)
The 49th Annual Meeting of the Academy of Criminal Justice Sciences, New York.

"Religious Foundations of the Protection of the Rights to Life" (2011)
The IX Annual Graduate Conference "Creative Law," University of British Columbia, Vancouver.

OTHER SELECTED ACADEMIC/POLICY INVOLVEMENT

Organized the Canadian Prison Law Conference (with attendance from over 200 participants from across the country and beyond) (21-23 September, 2018)

Appeared before Standing Senate Committee on Human Rights (tetsified on the human rights of incarcerated indivdiuals) (March 2018)

Organized the End-of-Life in Prison Metting (featuring 30 prison professionals, and representatives of NGOs and govermental institutions from across the country to disscus the implementation of the End of Life Legislation in prisons and other policy considerations around the issue) (September 16, 2017)

Member on the Dementia Justice Advisory Committee (2017-2018)

Consultant on Ontario's Correctional Legislation (for John Howard Society Ontario and for the Intedependant Reviewer of Ontario Corrections) (summer 2017)

Member of the Executive Committee of the Canadian Association of Prison Lawyers (2017 – present)

Member on the Prison Law Advisory Committee of Legal Aid Ontario (2016 – present)

Member of the Canadian Law and Society Association (2016 - present)

Chairperson and Disscusant at the Law and Society Association Meeting (2016)
New Orleans, Louisiana, USA.

Member of the American Academy of Criminal Justice Sciences (2010 – 2014)

Chairperson at the International Interdisciplinary Aging and Society Conference (2013)
Common Ground Publishing, Vancouver.

MEDIA OUTREACH

"We must decarcerate across the country, then fix the prison system," Op-Ed, Policy Options, IRPP, April 20, 2020.

"La situation dans les penitenciers pourrait prolonger la crise de la COVID-19," (feat. in), Radio-Canada, April 22, 2020.

"Inmate with cancer wins prison release during pandemic. This is his story," (feat. in), , Samantha Beatty, Huffington Post, April 24, 2020.

"Old people in prisons are facing a COVID-19 'death sentence'"(feat. in)
Moira Donovan, The Halifax Examiner, April 5, 2020.

"Advocates push to have scores of inmates released amid corona virus pandemic," (feat. in)
Sean Finn, Patrick White, The Globe and Mail, March 19, 2020.

"Punished for Aging: Vulnerability, Rights and Access to Justice in Canadian Penitentiaries," Dalhousie Law Journal Blog, March 5, 2020.

"Supreme Court to hear appeal on constitutionality of solitary-confinement law," (feat. in)
Patrick White, The Globe and Mail, February 12, 2020.

"Compassionate Release in Canada," (Podcast episode)
Dalhousie Law Journal Podcasts, September 2019.

"Outrage over Stephenville murderer's parole shows flaws in justice system: lawyer" (feat in)
Lindsay Bird, CBC Nfld & Labrador, October 2, 2019

"Trans woman 'shocked' by treatment in Halifax police custody" (feat in)
Erin MacInnis, CBC Nova Scotia, August 20, 2019

"Suicide watch: What we know about the Epstein case and how it works in Canada" (feat in)
Rachel D'Amore, Global News, August 13, 2019

Interview on Aging Prisoners
Information Morning, CBC News, July 31, 2019.

Interview on Bill C-83
Information Morning, CBC News, June 21, 2019.

"Amended solitary confiment bill must pass the House"
IPRR Policy Options, June 19, 2019.

"Lawyers tell Ottawa solitary confinement bill is unconstitutional" (feat in)
Patrick White, The Globe and Mail, June 9, 2019.

Interview on Prisoners Rights
Information Morning, CBC News, January 4, 2019 (also news article based on the interview "Dal prof calls for indepedant watchdog for Nova Scotia Prisons")

"Sick inmates in N.S. jail say emergency intercoms should be in cells" (feat in.)
Michael Tutton, The Canadian Press (syndicated), November 7, 2018

"Judges, legal experts talking all things prison law at Dal conference" (feat. in)
Stuart Peddle, The Chronicle, September 19, 2018**.**

"Watchdog calls for 'compassionate' parole as prison system adopts new assisted death policy," (feat. in)
Kathleen Harris, CBC News, February 25, 2018.

"Even behind bars, aging prisoners deserve proper health care,"
Sandra Martin, article on prisoners health issues featuring my work presented at the International End of Life Conference, Globe and Mail, October 2, 2017.

"Prisoners' access to medical assistance in dying focus of discussion at meeting,"
Amanda Jerome, article on my work presented at the International End of Life Conference, September 11, 2017.

"Solitary Confinemnt Needs to Go – It Doesn't Even Work,"
Opinion Piece, Globe and Mail, June 10, 2016.

Interview on Older Prisoners
News Talk 770, June 3, 2016.

Syndicated Interviews on Mentally Ill Prisoners
CBC Radio, May 31, 2016, on the follwing shows: Halifax Mainstreet Show, Winnipeg Up to Speed, Sudbury Up North, Yellowknife's Trail's End, Vancouver On the Coast, Ottawa All in a Day, Kelowna Radio West, Quebec City Breakaway, Saskatchewan Afternoon Edition, Edmonton Radio Active, Calgary Homestretch, Whitehorse Airplay,

"Women Aging Behind Bars: Villains or Victims?"
Blog entry on the Blog page of the Instittute for Feminisits Legal Studies, Osgoode Hall Law School, http://ifls.osgoode.yorku.ca; December 3, 2015

"Overcrowding in prisons negatively affects health"
MedicalXpress, article on my "Recent crime legilsation" article by MedicalXpress.ca, November 5, 2012

"Canada's crime bill could increase mental, physical problems among prisoners, researchers say"
Sharon Kirkey, article on my "Recent crime legilsation" article by canada.ca, November 5, 2012

"Population spike could harm prisoner health"
Kathleen Harris, article on my "Recent crime legilsation" article, CBC News, cbc.ca, November 6, 2012

VOLUNTEER ACTIVITY

Book Club Facilitator (2016 – present)
Book Club for Inmates, Nova Medium Security, Nova Scotia and Milhaven Correctional Institution, Ontario

Institutional Volunteer (2010)
John Howard Society, Kingston, Ontario

European Law Students' Association Volunteer (member 2006 – 2008, vicepresident 2008-2009, president 2009-2010)
Cluj-Napoca, Romania

Prison Fellowship Volunteer (2006 – 2008)
Cluj-Napoca, Romania

LANGUAGES

Romanian (mother tongue)

English (proficient/fluent - oral and writing)

French (advanced – comprehension, intermediate – speaking and writing)

CITIZENSHIP

Canadian and Romanian

This is Exhibit **"B"** to the
Affidavit of Adelina Iftene sworn
before me this 13th day of May, 2020.

A Commissioner, etc.

January, 2017

The Pains of Incarceration: Aging, Rights, and Policy in Federal Penitentiaries

Adelina Iftene, *Dalhousie University Schulich School of Law*

The Pains of Incarceration: Aging, Rights, and Policy in Federal Penitentiaries

Adelina Iftene*
Osgoode Hall Law School, York University

Le nombre de détenus vieillissants a augmenté au cours des dernières décennies. Leurs besoins croissants sont un fardeau sur les établissements correctionnels, un fardeau sans précédent. Cet article présente les résultats d'une étude effectuée auprès de 197 détenus âgés. Ces résultats identifient les problématiques causées par les douleurs chroniques chez les détenus âgés et la gestion de cette douleur en prison. Le Service correctionnel du Canada (SCC) ne voit pas les détenus âgés comme un groupe vulnérable, et les politiques pénitentiaires n'ont pas tendance à inclure l'âge (et ses implications) comme variable digne de considération. Les données obtenues de cette étude soulèvent des problèmes peu explorés au sujet du vieillissement derrière les barreaux, problèmes qui doivent être étudiés plus profondément. Si les résultats sont confirmés dans le futur, le SCC pourrait voir ses politiques contestées devant les tribunaux. Pour prévenir ces contestations, une réforme systématique des politiques du SCC — notamment, les politiques médicales — devra être entreprise afin de les rendre appropriées à l'âge des détenus.

Mots clés : détenus âgés, gestion de la douleur, droits des détenus, politiques

The number of aging people in prison has been on the rise in the last few decades. Their heightened needs place burdens on correctional institutions that have not been encountered before. This article presents the results of a study conducted with 197 older prisoners. This study's findings identify issues raised by chronic pain in older prisoners and the management of this pain in a prison setting. Correctional Service Canada (CSC) does not acknowledge older prisoners as a vulnerable prison group, and correctional policies thus tend not to include age (and its implications) as a variable worthy of consideration. Data from this study raise some under-explored issues about the matter of aging behind bars that are in need of future research. If the findings are confirmed in the future, the CSC might find its policies challenged in court. To prevent that from happening, a systematic reform of the CSC's policies – in particular, the medical ones – will need to be undertaken, with the goal of making them age-sensitive.

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 doi:10.3138/cjccj.2016.E03

Keywords: older prisoners, pain management, prisoners' rights, policy

In the last few years, problems associated with aging have emerged in correctional environments. Extensive studies have been conducted in the U.S. since the 1990s (Colsher et al. 1992; Ornduff 1996; Arndt, Turvey, and Flaum 2002; Aday 2003; Delgado and Humm-Delgado 2009), but Canada has been slow in dealing with problems associated with the aging of the prison population. There has been only one independent study conducted in Canada with older male prisoners (Gallagher 2001).

A change of direction was evident four years ago, when the Office of the Correctional Investigator, the federal prison ombudsman, published in its annual report serious concerns regarding the needs and the treatment of older prisoners in Canadian federal institutions (Sapers 2011). The correctional investigator continued to highlight these concerns in the years that followed (Sapers 2012; 2015: 10–11), even though the response from Correctional Service Canada (CSC), the agency that administers the federal correctional system, has not been positive (Correctional Service Canada 2013b). Other authors, while not working with older prisoners, have recently highlighted health issues, which are common in old age, pertaining to the management of chronic diseases and dying in prison (Kouyoumdjian et al. 2016). Finally, the CSC itself has conducted a couple of studies with older male prisoners (Uzoaba 1998; Correctional Service Canada 2014) and three with older female prisoners (Greiner and Allenby 2010; Michel, Gobeil, and McConnell 2012; Gobeil 2014). However, they are brief, most pertain to criminogenic factors in an older age group, and all but one (Gobeil 2014) are based solely on data from the CSC's administrative databases.

Although federal imprisonment rates have been fairly stable for more than 50 years (Webster and Doob 2014: 328, fig. 1), the proportion of older people admitted to federal penitentiaries in Canada has increased dramatically in recent years. (Age-at-admission data are available; unfortunately, data on the average age of those in custody on an average or census day are not consistently available.) In 1993–94, 12.2% of those admitted to federal facilities were 45 years of age or older. Twenty years later, in 2013–14, 24.1% of those admitted to federal custody were 45 years of age or older. Indeed, in 1993–94, there were 96 people aged 60 or older admitted to federal penitentiaries (2.1% of those admitted). By 2013–14, this number had increased to 250 people aged 60 or older (4.9% of those admitted) (Public Safety Canada 1998,

2014). In 2014, the correctional investigator noted that one in five prisoners was over the age of 50 (Sapers 2014: 21), and in his latest report (Sapers 2015: 10–11), he stated that the older prison population has increased by 50% in the past 10 years, so that it now represents 25% of the incarcerated population. It has been predicted that the number of older incarcerated people will continue to grow, especially considering the number of people serving life sentences (Sapers 2011: 21).

The study had two main goals. First, it intended to describe the needs of older male penitentiary prisoners. Second, the data were interpreted in a legal rights context. The study was a broad, interview-based investigation into the quality of life of male prisoners over the age of 50. This age is generally accepted as an appropriate measure of seniority, as shown by both CSC documents and the American literature. According to these reports, most prisoners have the physical and psychiatric problems of people living in the community who are typically 10 to 15 years older because of the rigours of incarceration and the consequences of previous lifestyles (Aday 1994: 48; Uzoaba 1998; Lemieux, Dyeson, and Castiglione 2002; Canadian Public Health Association 2004; Sapers 2011: 20).

In this article, only two of the research questions that generated the study are addressed. The purpose of this article is to understand how physical pain is treated in prison from the perspective of prisoners over 50. In addition, quantitative and qualitative data are used to make a set of recommendations that could improve some of the CSC's policies and make them more age-friendly. The findings and discussion are also placed in the context of the Canadian statutory and constitutional framework, especially the *Corrections and Conditional Release Act* (CCRA) as well as the *Canadian Charter of Rights and Freedoms* (Charter).

1. Description of the study and methodology

The study was focused on determining the general quality of life of incarcerated older prisoners to be able to better understand the extent to which their rights were being upheld. For the purpose of this study, quality of life included the satisfaction of prisoners with their own health, the perceived quality of the treatment received in prison, the programming available, adjustment to the prison environment, the maintenance of family relations, and the presence or absence of abuse.

After receiving ethics approval from the General Research and Ethics Board of Queen's University, 197 interviews were carried out in seven federal correctional institutions in Ontario, at all levels of security. In 2012, when the study commenced, the population of male prisoners over 50 in federal institutions was roughly 2,000, according to data provided by the CSC (out of a total number of prisoners averaging 15,313 during the 2011–12 fiscal year) (Public Safety Canada 2014: 36).

Recruitment was carried out in each institution separately, either through posters and recruitment letters or group presentations. Participation was purely voluntary, and no one who asked to be interviewed was turned down. On average, one third to one half of the eligible prisoners (prisoners over 50) were interviewed in each of the institutions visited. The smallest number of participants in one institution was 7 and the largest 36. The youngest interviewee was 50 and the oldest 82. Interviews took between 30 and 60 minutes, and they were based on a structured protocol of 71 questions.

The prisoners' answers were quantified by creating variable names and labels based on their similarities. The unusual answers were labelled "other." The codified answers were entered into an SPSS data table. The data were analysed in SPSS v. 12.0 by calculating frequency, distributions, and running cross-tabulations among answers in different sections of the protocol. Their statistical relevance was determined by using chi-square tests.

The study has several limitations. For administrative reasons, a comparison group was not available for this project (e.g., younger prisoners, people under supervision in the community, or another patient population in the community). The medical files of the prisoners were also not available for review; this means that the study is entirely self-reported, and it cannot objectively establish whether the general medical care practices of the CSC are below regular standards.

To minimize the limitations posed by the lack of a younger population control group, medical literature on older people in the community was reviewed to identify the problems recognized as associated with aging. The inability to corroborate the information received is obviously a limitation, so it needs to be kept in mind that the data come from the prisoners themselves. As a result, to attempt to compensate for this limitation, the number of questions in the protocol was increased to see whether there was internal consistency across responses within individuals'

answers. However, it is clear that this study cannot offer a comprehensive overview of the CSC's general medical practices.

This study is thus simply a first attempt to shed light on the challenges that aging presents in a system that has been used to dealing with a younger population. It is also an attempt to highlight the fact that if the policies do create the issues identified, they may give rise to serious legal issues in the future.

2. Pain management and health care in federal institutions

2.1 Overall health status

For this study, 197 male prisoners over the age of 50 from seven penitentiaries were interviewed (Tables 1 and 2). Slightly more than half of the participants (55.4%) had been to prison (either federal or provincial) before their current sentences. The rest were being incarcerated for the first time. As shown in Table 3, their sentences varied considerably.

Over 63% of the prisoners in the study stated that they believed their health had deteriorated since they entered prison on their current incarceration, because of both the natural aging process and the rigours

Table 1: Distribution of sample by age

Age	Number of Incarcerations (%)
50–59	109 (55.3)
60–69	65 (33.0)
70 and over	23 (11.7)

Table 2: Distribution of sample by security level

Level of Security	Number of Incarcerations (%)
Minimum	66 (33.5)
Medium	99 (50.3)
Maximum	18 (9.1)
Assessment unit	14 (7.1)

Table 3: Distribution of sample by sentence

Length of Sentence	Number of Incarcerations (%)
Short (2–5 years)	59 (29.9)
Medium (6–10 years)	27 (27.0)
Long determined (< 10 years)	10.7 (21.0)
Life	66 (33.5)
Indeterminate	24 (12.2)

Table 4: Overall perceived health by number of physical problems mentioned

Overall Perceived Health	Number of Physical Conditions Mentioned (%)			
	0–4	5–7	8–16	Total
Relatively poor	3 (5.7)	19 (35.8)	31 (58.5)	53 (100.0)
Average	21 (29.2)	32 (44.4)	19 (26.4)	72 (100.0)
Relatively good	45 (63.4)	20 (28.2)	6 (8.5)	71 (100.0)

Chi-square = 59.300, $df = 4$, $p < .001$

of incarceration. Over 19% said their health had improved while incarcerated, with the main explanation being the lack of access to alcohol and illicit drugs. About 17% believed that their health had remained the same.

Regarding their perceived overall health, 27% graded it as relatively poor, 36.7% as average, and 36.2% reported being in relatively good shape (Table 4). Not surprisingly, there is a statistically relevant connection between perceived health and the reported number of physical conditions.

The most commonly mentioned diseases were arthritis, digestive problems, skin problems – especially psoriasis – severe heart problems, diabetes, hypertension, severe oral health problems, severe hearing problems, severe vision problems, back problems, and high cholesterol (Table 5).

Table 5: Distribution of physical illnesses

Illness/Problem	Number (%)
Asthma	24 (12.2)
Arthritis	100 (50.8)
Digestive problems	48 (24.4)
Skin problems	53 (26.9)
Severe heart problems	54 (27.4)
Cancer	14 (7.1)
Physical disability	37 (18.8)
Wounds	24 (12.2)
Diabetes	53 (26.9)
Hypertension	83 (42.1)
Severe oral health problems	48 (24.4)
Cerebral – vascular problems/epilepsy	19 (9.6)
Hepatitis	28 (14.2)
Circulation	39 (19.8)
Sleep apnea	16 (8.1)
Severe hearing problems	52 (26.4)
Severe vision problems	162 (82.2)
Pinched nerve	6 (3.0)
Back problems	63 (32.0)
Hernia	13 (6.6)
Thyroid	10 (5.1)
Sciatic nerve	11 (5.6)
High cholesterol	48 (24.4)
Foot problems	33 (16.8)
Bladder	11 (5.6)
Constipation	9 (4.6)
Severe prostate problems	15 (7.6)
Other	94 (47.7)

2.2 Chronic pain – Consequences and management: Qualitative and quantitative findings

Pain and effects

Pain was identified by numerous participants as the most debilitating aspect of their life in prison. Pain and the manner in which it was

Table 6: Distribution of pain by number of physical problems mentioned

Pain on Regular Basis	Number of Physical Problems Mentioned (%)			
	1–4	5–7	8–16	Total
No	48 (64.9)	19 (25.7)	7 (9.5)	74 (100.0)
Yes	21 (17.1)	53 (43.1)	49 (39.8)	123 (100.0)
Total	69 (35.0)	72 (36.5)	56 (28.4)	197 (100.0)

Chi-square = 48.962, $df = 2$, $p < .001$

handled in prison was a recurring theme during the interviews, especially when participants were allowed to make unstructured comments about their experiences. Most of the participants – 62.4% – reported suffering from severe pain on a regular basis. When asked about the source of their pain, at the top of the list was arthritis or other joint pain (49.2% of the total sample) as well as headaches or migraines (8.6%). Other sources were cancer, foot pain, muscular pain, and nerve pain. The pain that individuals reported appeared to be directly proportional to the number of physical ailments they suffered (Table 6).

In addition, the physical conditions that appeared to have a statistically relevant connection to pain were arthritis (64.2% of those in pain reported arthritis, as opposed to 28.4% of those who were not in pain), physical disabilities (26% versus 6.8%), long-term, severe back problems (43.9% versus 12.2%), digestive issues (34.1% versus 8.1%), outstanding wounds (18.7% versus 1.4%), diabetes (31.7% versus 18.9%), hypertension (49.6% versus 29.7%), severe oral health problems (32.5% versus 10.8%), hernia (9.8% versus 1.4%), sciatic nerve pain (8.9% versus 0%), high cholesterol (30.1% versus 14.9%), and foot problems (22.0% versus 8.1%). While not statistically relevant, there was a tendency for people reporting pain to also report conditions such as pulmonary disease (15.4% versus 6.8%), severe hearing problems (30.9% versus 18.9%), and severe vision problems (86.2% versus 75.7%). Many of these health problems – most notably arthritis, severe back problems, physical disabilities, diabetes, severe oral health problems, hypertension, physical injuries, pulmonary diseases, and severe hearing and vision problems – are commonly associated with aging (Cassel, Cohen, and Larson 2003: 361–65, 509, 921; McKenna et al. 2005; Blackburn and Dulmus 2007; Jagger et al. 2007; Andrade 2010; Halter and Hazzard 2009).

It also appears that those who were in pain were more predisposed than the others to fall and injure themselves. Of those reporting pain,

Table 7: Distribution of drug abuse by effectiveness of pain treatment

Treatment of Pain Effective	Number of Drugs Consumed Daily (%)		
	No	Yes	Total
No	20 (46.5)	23 (53.5)	43 (100.0)
Yes	29 (58.0)	21 (42.0)	50 (100.0)
N/A (not in pain or not treated)	74 (71.2)	30 (28.8)	104 (100.0)
Total	123 (62.4)	74 (37.6)	197 (100.0)

Chi-square = 8.439, $df = 2$, $p = .015$

Table 8: Distribution of perceived health by reported pain, number (%)

Pain on Regular Basis	Overall Health			
	Relatively Poor	Average	Relatively Good	Total
No	9 (12.2)	23 (31.1)	42 (56.8)	74 (100.0)
Yes	44 (36.1)	49 (40.2)	29 (23.8)	122 (100.0)
Total	53 (27.0)	72 (36.7)	71 (36.2)	196 (100.0)

Chi-square = 24.603, $df = 2$, $p < .001$

42.3% also reported falling at least once within the previous 12 months, as opposed to 23% of those who were pain-free. Sleep was also affected by pain. Of those reporting regular pain, 52.8% also reported serious sleep problems, as opposed to 36.5% of those not in pain. This was of particular concern, especially since a different set of the study's findings also identified sleep deprivation as having statistically relevant connections to other aspects of an inmate's well-being, especially mental health.

Perhaps not surprisingly, it appeared that those in pain were more likely to self-identify as drug abusers (46.3% as opposed to 23.0%). However, those who were treated effectively for pain were less likely to report drug abuse than the ones who received inefficient painkillers (Table 7). Finally, the pain that individuals were in was related to the way they perceived their overall health status (Table 8).

Pain management

Most people in pain reported receiving some treatment (Table 9). However, only a little over half of the people receiving regular treatment of

Table 9: Individuals in pain who received treatment

Pain Treated	Number (%)
No	31 (15.7)
Yes/sometimes	93 (47.2)

Table 10: Distribution of treatment reported to be effective

Treatment Effective	Number (%)
No	43 (21.8)
Yes	50 (25.4)
N/A (not in pain)	104 (52.8)

their pain reported getting relief from it. A little less than half identified the medication they received as not being strong enough for their type of pain (Table 10). The questions and answers regarding pain treatment referred to medication prescribed by the prison physician. The medication that generally seemed to be prescribed in cases of chronic or acute pain was Tylenol 3 (acetaminophen and codeine).

The majority of people not treated for pain identified as a reason for this that they were not prescribed any treatment by the prison doctor (7.1% of the total sample) or that they did not want to take it, generally because that would mean going to pick it up every day. This activity placed added stress on their bodies and made the pain worse (6.6%). Several of the 47.2% who received pain treatment also reported the treatment as being ineffective in alleviating their suffering, and some of them mentioned having been on stronger medication in the community. From the 25.4% who were responsive to treatment, a small number were not on Tylenol 3. In particular, some reported receiving methadone for their drug addiction, which also functioned as a painkiller, and a few were receiving morphine. It did appear, however, that, aside from Tylenol 3 and morphine, nothing else was generally available.[1] The lack of pain medication options was best illustrated by two individuals in advanced stages of cancer, who complained that morphine was available only for those diagnosed with terminal cancer (i.e., who had only a maximum of six months to live). Nonetheless, they complained that their excruciating pain was too strong for Tylenol 3.

In addition to the lack of effective medication for their pain, prisoners complained about having to pick up painkillers every day from the

infirmary. Such requirements were governed by safety concerns as there have been instances in which people abused their medication, sold it, or were robbed by other inmates. However, asking a disabled person who is in pain to stand for an hour outside at −15 degrees Celsius (as is the case in some institutions in winter) to pick up their medication for that single day appears to defeat the purpose of medical care. As mentioned, this was one of the most important reasons that some individuals refused to take prescribed pain medication.

In addition, none of the institutions provided a palliative care unit. While there may have been attempts to provide palliative resources on an individual basis, this was seriously restricted because of the prisons' security policies. Without a palliative care unit, there were difficulties administering the strong medication available in the outside community to people in similar situations. The lack of a proper palliative care unit also meant that medical staff were not available at all times (only 19.8% believed that there was a nurse available around the clock), there was no special housing for people who were terminally ill or in severe pain, and there was no adjusted infrastructure. There is a CSC guideline called Hospice Palliative Care Guidelines for Correctional Service Canada (Correctional Service Canada 2009), which I have obtained through the *Access to Information Act*. This document offers instructions to different staff members regarding how to interact with dying prisoners and emphasizes the need for a team of individuals to help with end-of-life care. However, the material makes apparent that palliative care is not systematic, and dying prisoners are housed in the same facilities as everyone else and thus subjected to the same security rules and medical regulations.

People reporting pain also tended to report difficulty walking (53.7%, as opposed to 9.5% who were not in pain), getting into and out of bed (21.1% versus 9.5%), using the stairs (51.2% versus 13.5%), and standing for a prolonged time (37.4% versus 10.8%). The percentages take into account only the difficulties reported by people who were still required to perform these activities. Another 6.6% reported difficulties, but requirements had been modified to meet their needs; 6.1% had a peer caregiver to help them with different tasks, while 56.9% had requested items to help them with these activities. Only 21.3% of the total sample received what they had asked for, usually walking aids or medical devices. The CSC's National Essential Health Services Framework (Correctional Service Canada 2015), obtained through the *Access to Information Act,* contained the procedure to be followed for approval of the medical equipment and supplies that may be granted to

prisoners. However, regardless of the medical reasons for a request, supplies such as pillows, mattresses, orthopaedic shoes, heating pads, and hot water bottles are never available. Braces and walking aids are available, but the data suggest that they are actually quite difficult to obtain (ibid.: 10–11). There also appeared to be marked differences among institutions in how they dispensed medical supplies. For example, in one of the medium-security institutions, prisoners reported being quite satisfied with how their requests were fulfilled. However, at a different institution, the majority of the prisoners reported that they never even asked for medical supplies anymore because it was common knowledge that "the doctor is not allowed to prescribe any."

The high number of falls in the previous year is also a concern given the previously mentioned relationship between falls and pain. A full 35.0% of the participants had fallen at least once in the previous year, and 15.7% of the participants had fallen on ice. The fact that ice was not cleaned properly or salted in winter, as well as the lack of a safe recreation yard for prisoners during the winter months, is worrisome.

A final point worth noting relates to managerial responses to pain and illness. Pain has been statistically correlated with physical disability and physical conditions. In turn, people with physical illnesses and disabilities have reported significantly more time spent in segregation than those who did not report such conditions (Table 11). Only a small number reported spending time in segregation for their own protection (8%). It is not clear whether segregation and discipline are used to manage people's health or whether people become sicker in segregation. One could theorize that it may be both. However, knowing that segregation has no therapeutic benefits, policies should be rethought.

In addition, people suffering from physical illnesses and disabilities reported significantly more incidents of victimization from both staff and

Table 11: Time spent in segregation by number of physical conditions

Time Spent in Segregation	Number of Conditions (%)			
	1–4	5–7	8–16	Total
No	61 (38.1)	60 (37.5)	39 (24.4)	160 (100.0)
Yes	8 (21.6)	12 (32.4)	17 (45.9)	37 (100.0)

Chi-square = 7.467, $df = 2$, $p = .024$

Table 12: Distribution of physical conditions by abuse by staff (No., %)

Number of Physical Conditions	Abuse by Staff		
	No	Yes	Total
1–4	44 (60.9)	29 (39.1)	69 (100.0)
5–7	37 (51.4)	35 (48.6)	72 (100.0)
8–16	20 (35.7)	36 (64.3)	56 (100.0)

Chi-square = 7.883, $df = 2$, $p = .019$

Table 13: Distribution of physical conditions by abuse by peers (No., %)

Number of Physical Conditions	Abuse by Peers		
	No	Yes	Total
1–4	46 (66.7)	23 (33.3)	69 (100.0)
5–7	31 (43.1)	41 (56.9)	72 (100.0)
8–16	18 (32.1)	38 (67.9)	56 (100.0)

Chi-square = 15.970, $df = 2$, $p < .001$

peers (Tables 12 and 13). Such abuse included name-calling, threats, physical violence, and sexual assaults. In about half of the institutions, prisoners reported that a few of the staff members were systematically harassing people with disabilities or who were unable to move because of pain. Most of them stated that they got used to the name-calling, but they had difficulties with the practical jokes. In a few cases, prisoners reported that some officers would steal, move, or tie their wheelchairs to a table as a "prank."

3. Pain management and health care in the legal context

The data presented above indicate several things. First, numerous older prisoners report chronic pain, which appears to be associated with age-related diseases. It is reasonable to infer that chronic pain is likely higher in this age group. Second, many people suffering from chronic pain do not appear to receive appropriate treatment, and the environmental conditions may increase their suffering. Third, when chronic pain is not fully treated, it appears to have direct and indirect repercussions on other aspects of life such as quality of sleep, drug abuse, discipline, and victimization. When interpreted in a legal context, the data suggest that there are potential issues with compliance with the law and that these issues will need to be addressed through CSC policy reform.

CSC activity is regulated by the CCRA. This is a broad framework that covers everything from intake and assessment in federal institutions to health care, discipline and solitary confinement, grievance procedure, and oversight by the Office of the Correctional Investigator. These provisions are mandatory for all CSC institutions, and they are implemented with the help of administrative directives (commissioner's directives, or CDs) and procedures that emanate from the CSC's National Headquarters. These documents do not have legal force, but they set out the CSC's policies and provide details on how the legal provisions ought to be implemented at the institutional level.

When prisoners have a complaint, they may file a grievance with the administration, and a judicial review request may be subsequently brought in the Federal Court upon an unfavourable response (CCRA, s. 90). Finally, CSC activity is bound by the Constitution and, in particular, by the Charter. Prisoners retain all rights that are compatible with incarceration, and correctional practices need to adhere to human rights norms (Arbour 1996: 181; Jackson 2002; Parkes and Pate 2006: 274–75; Parkes 2007; Kerr 2014; Arbel 2015: 134). When an individual believes her rights have been infringed, she may bring a Charter challenge directly to court without having to exhaust the grievance procedure first.

CSC practices in regard to pain management and health care for older prisoners need to be influenced by the legal and constitutional framework in which they exist. According to s. 86 of the CCRA, the CSC is under an obligation to provide every prisoner with essential health care as well as reasonable access to non-essential health care. In addition, the provision of health care should conform to professionally accepted standards. At the institutional level, the CCRA is implemented with the help of commissioner's directives (CDs) and related procedures, which need to be in accordance with the statute and the Charter. These CDs and procedures are thus meant to set a framework to uniformly regulate issues among CSC institutions. CD 800, Health Services (2011), is intended to bring clarity to the CCRA's health care provision and to detail the manner in which health care is administered within the CSC. However, it does neither of these things, and it is instead a two-page document filled with broad general statements.

The National Essential Health Services Framework (Correctional Service Canada 2015) brings more clarity. This document – in essence a guideline – explains what essential health care is: assessment and screening upon intake, intermediate mental health care, acute and

chronic health care, and planning for health care upon release (ibid.: 7). It also details the types of mental health and dental services available and the medical supplies that may be obtained by prisoners (Correctional Service Canada 2015: annexes A, B, D). However, it does not clarify the language used in the legislation and CDs – in particular, the references made to "acceptable standards of the profession" or "comparable standards of care." CD 805, Administration of Medication (2003), describes the process of medication distribution and sets out as a general rule that, aside from those in maximum security, prisoners are to pick up prescription medication, daily and in person. Age and pain are not factored into this rule. The list of medications available to prisoners, including pain medication, can be found in the CSC's National Drug Formulary (Correctional Service Canada 2013a). This document is the CSC's official list of drugs that prison physicians may prescribe. It confirms that, aside from Tylenol 3 and methadone, there is no pain medication available (Office of the Correctional Investigator 2015).

Without more detailed CDs, it is difficult to assess how the CCRA's medical provisions are being respected or implemented. Regardless of these gaps in the administrative framework, it would appear that chronic pain treatment and end-of-life care fall under essential health care (Correctional Service Canada 2015: 7), which is mandatory according to the statute (CCRA, s. 86). An in-depth study of the management of chronic pain would need to be undertaken to assess how pain management is treated in the community at "acceptable standards of the profession." However, it is reasonable to expect that there is more than Tylenol 3 available in the community and that people in pain are not being sent to segregation or expected to pick up medication daily by standing outside for hours. Thus, in the future, both the policy regarding the treatment of chronic pain and the CSC's practices in this regard may form the object of legal scrutiny under s. 86 of the CCRA.

S. 4(h) of the CCRA states that correctional policies, programs, and practices need to respect gender, ethnic, cultural, and linguistic differences and be responsive to the special needs of women and indigenous peoples as well as to the needs of *other groups of offenders with special requirements* (emphasis added). S. 70 of the act states that the CSC must take reasonable steps to ensure that the prison environment and its living and working conditions are safe, healthy, and free of practices that undermine a person's future reintegration into the community. The data collected point to the fact that CSC policies may not actually take into consideration some problems of older prisoners. The particular effects of age on health and the physical capacities of seniors do not

appear to factor into service performance and policy development. For instance, there is no mention of older prisoners in any medical or other type of CDs and regulations.

In contrast, there are CDs recognizing the differences that women, indigenous, and ethnocultural prisoners present compared to the mainstream population (Commissioner's Directive 577, 2013; 578, 2013; 702, 2013; 767, 2013; 800, 2011; 805, 2003; 821, 2009). A similar CD is needed for older prisoners since they appear to have special needs too. In addition, an administrative framework that accounts for their enhanced medical and programming needs, created in accordance with gerontology studies, would eliminate the differences in the treatment of older prisoners that currently exist among institutions. Such a framework would also raise awareness about the vulnerabilities of older people and might play a role in preventing the victimization of this group by staff as well as disciplinary responses to their illness-induced disruptive behaviour. Such practices may, in fact, be contrary to s. 70 of the CCRA, and efforts need to be made towards their systematic suppression.

As stated above, compliance with Charter rights is mandatory when devising any form of federal policy. However, the data collected for this study suggest that there may be some issues regarding the compliance of CSC policies, or their implementation, with the human rights framework. Three Charter sections come specifically to mind in the context of pain management. First, s. 12 guarantees everyone's right to be free from cruel and unusual treatment and punishment. This section has been interpreted to apply to conditions of confinement (*R v Smith* [1987]; *Trang v Alberta [Edmonton Remand Centre]* [2010]; *R v Munoz* [2006]). Thus, if certain conditions are so grossly disproportionate as to outrage the standard of decency, they may be found to be unconstitutional. Requesting someone in chronic pain to stand outdoors for an hour daily to pick up pain medication, which is often ineffective, might therefore constitute cruel and unusual treatment. Furthermore, if effective treatment or medical supplies that would ease the pain associated with the diseases of old age are indeed not generally available, and if the institutions' environment or infrastructure adds disproportionately to the challenges these prisoners face, such treatment may grossly exceed the punishment to which these people have been sentenced.

Second, s. 7 of the Charter states that "everyone has the right to life, liberty and security of the person and the right not to be deprived thereof except in accordance with the principles of fundamental justice." While this section has generally been applied to legislation, as opposed to

policy, there is no prohibition that would forbid courts from considering a challenge to prison policies under it. S. 7 has been interpreted as protecting physical liberty, the right not to be exposed to health risks, to have control over one's body, and to psychological integrity (Hogg 2013: 44–47, 47–48). In the past, it was found that legislation indirectly limiting access to medical care (*Chaoulli v Quebec [Attorney General]* [2005]), as well as ministerial decisions that restrict access to health care (*Canada [Attorney General] v PHS Community Services Society* [2011]), endanger life and security of the person in a manner incompatible with the principles of fundamental justice. For prisoners who essentially lack any control over their medical treatment, it is possible that some policies related to pain management (and, in particular, the prohibition of a wide variety of painkillers, assistive devices, and cell-to-cell distribution of medication) may, in certain circumstances, be found to endanger the life and security of the person.

Third, s. 15 of the Charter states that "every individual is equal before the law and under the law and has the right to the equal protection and equal benefit of the law without discrimination and, in particular, without discrimination based on race, national or ethnic origin, colour, religion, sex, age or mental or physical disability." S. 15 has been interpreted to apply to both direct and indirect discrimination (*Law v Canada [Minister of Employment and Immigration]* [1999]). As such, treating everyone the same does not ensure that s. 15 is respected. When the same treatment has disproportionate effects on a certain category of people based on their race, nationality, religion, sex, age, or mental or physical disability, the state may take affirmative action for the benefit of the disadvantaged group, especially since s. 15(2) insulates affirmative action programs from s. 15 challenges (*Eldridge v British Columbia [Attorney General]* [1997]; *R v Kapp* [2008]). Thus, when the same correctional policies and practices (such as distribution of medication, availability of supplies, types of discipline, etc.) are applied on a one-size-fits-all basis, without consideration of the fact that this may place considerable hardship on aging people, concerns regarding indirect age-based discrimination emerge.

Litigation, including Charter litigation, has been used before to force redress in correctional settings and compliance with human rights norms. At the moment, the use of solitary confinement for people with mental health issues is being litigated in both Ontario and British Columbia (CBC News Online 2015; Fine 2015; Metha 2015) following suicides in segregation, increased empirical research, and media outcry. However, as Michael Jackson remarked more than 15 years ago

when discussing the legality of solitary confinement and the administrative procedure that led to it, the strength of the Charter should not come from its litigation potential. Rather, its strength should come from the values with which it widely and systematically infuses governmental practices and policies and from "the climate and culture of respect it creates amongst both governments and citizens for fundamental human rights and freedoms" (Jackson 2002: 62). Litigation should instead occur in exceptional situations, while Charter values and rights should be found in all aspects of public life.

It is in this context that I suggest that some prison practices and policies need amending to ensure protection for older people. While my suggestion originates from my interviews with older prisoners, I am not the first to make it. The correctional investigator has also been reiterating the need for age-driven policies for the last five years (Sapers 2011: 20–25; 2012: 14; 2014: 15–18). Reform should be undertaken before litigation becomes the only feasible solution to enhancing older prisoners' rights.

4. Policy suggestions

The data derived from this study have their limitations, and they cannot be said to offer a comprehensive picture of the overall legality of the CSC's medical or other policies. However, they do offer a unique glimpse into the life of older prisoners living with chronic pain. Based on these accounts, the great medical needs of aging prisoners do not appear to be met with any regularity. Improving chronic pain management is more than providing access to better pain medication. While more diverse painkillers, a safer environment, better infrastructure, and a rethinking of medication distribution would go a long way, many policies will need to include consideration for the increasing number of aging bodies, their limitations, and the challenges they face. After all, the definition of essential health care and how it should be provided for a 20-year-old may be very different from what is appropriate for a 70-year-old. In the future, evaluating medical necessities by the same yardstick, without systematically considering age as a factor in correctional policies and practices, may lead to moral dilemmas and legal challenges analogous to those presented above. To prevent that from happening, some recommendations will be provided below that may help align correctional policies with the needs of older prisoners and their rights.

4.1 Improvement of commissioner's directives

Commissioner's directives (CDs) are administrative documents meant to set a framework for uniformly regulating issues among CSC institutions. A CD regulating the treatment of older prisoners behind bars would go a long way towards protecting this group's needs. There are CDs that recognize the differences of women, indigenous, and disabled prisoners compared to the mainstream population. Hence, it is the duty of each correctional institution to adapt to those needs in accordance with the CDs' guidelines. A similar CD is needed for older prisoners. The correctional investigator has already remarked that aging people, the mentally ill, and those in need of palliative care are some of the most vulnerable prison populations (Sapers 2014: 15). The indiscriminate application of the same medical practices across all age groups fails to account for seniors' particular problems and potentially enhanced medical needs.

It would not be surprising if future medical research proves that such a uniform application is medically inadequate and may not respond to the needs of older people. A correctional framework that accounts for enhanced medical and programming needs, created in accordance with gerontology studies, would eliminate treatment differences that currently exist among institutions, and it would ensure a minimum of protection in accordance with human rights. A CD on managing the problems of older prisoners would also reflect the CSC's understanding of such problems as well as its commitment to act in accordance with these people's needs, and it would serve as guidance for CSC staff members who deal with such people and their issues on a daily basis.

In addition to a CD addressing seniors' needs, the already existing directives require improvement. These health care CDs are extremely important, but at the moment, they are vague and very difficult to apply. There is little guidance regarding what primary or essential health care is. It is also not clear what "acceptable standards of the profession" are. However, these concepts are key to determining what prisoners are entitled to. This is why, for example, chronic diseases are being managed by granting prisoners medical equipment in some institutions, but the doctor is completely forbidden to prescribe them in other institutions. The CDs and standing operating practices should not be a mere reiteration of the existing legislation. They should instead clarify it and provide for a relevant framework.

4.2 Reconfiguration of the health care system

The Office of the Correctional Investigator noted in its last few reports that prison health care needs to be reformed with an aging population in mind (Sapers 2011: 25; 2014: 16; 2015: 11). The insufficient treatment options for chronic pain due to "ill-defined security, administrative, or institutional concerns" (Office of the Correctional Investigator 2015: n.p.) have been noted by the Office based on an extensive qualitative review of the CSC's National Drug Formulary. Based on this review, the Office recommended that the CSC amend its formulary in areas such as chronic pain management, where treatment options appear to be lacking (Office of the Correctional Investigator 2015; Sapers 2015: 10). Previously, the correctional investigator mentioned that neither pain management nor assistive medical devices for the aging exist in satisfactory quantities and quality (Sapers 2011: 22). He also noted that, in this environment, there is a need for staff members and specialists trained in gerontology and palliative care (Sapers 2011: 25).

The findings of this study confirm and add to these concerns raised by the correctional investigator. They reinforce the need for a restructuring of prison health care. Considering the growing number of older prisoners and the CSC's lack of experience with them, this restructuring should be done in consultation with gerontology specialists. However, a few things should be considered as starting points.

First, the medication available for pain management is insufficient and of limited diversity. The little medication available appears to lead to pain going untreated, which, in turn, appears to alter the quality of life of older prisoners, who cannot rest properly and are turning in higher numbers to drug and alcohol abuse.

Second, the consequences of ineffective treatment of pain and chronic diseases, as well as medication, may have unique impacts on the well-being of older people. Hence, the prison doctor should be able to consult with a gerontology specialist on a regular basis. The CSC should contract with gerontology specialists, who should regularly visit institutions with a higher number of older prisoners. This would be similar to CSC contracts with other specialists, such as dentists and psychiatrists. Where gerontologists cannot be brought on site, they should be available through tele-medicine. This is also not an unusual practice as the CSC already uses tele-psychiatry in some of its remote locations. In addition, in institutions with high numbers of seniors, a nurse trained in gerontology should be available at least during the day. Consulting with

gerontology specialists can prove crucial in determining which behaviour needs to be responded to with treatment or with discipline. For example, it appears common that disruptive behaviour in older prisoners is caused by mental or physical problems. Solitary confinement and other forms of punishment are not appropriate responses in such cases.

Third, in light of the increased number of chronic and acute diseases leading to the pain and other complications that seniors face, all prison facilities should have a nurse on site at all times. Under half of the prisons I visited had a nurse available 24/7, and some institutions are in remote locations, where even ambulances take longer to arrive.

Fourth, pain management means more than an adequate range of effective painkillers. The current list of assistive devices available is restrictive. Supplies such as extra pillows, medical mattresses, heating pads, and orthopaedic shoes are currently never prescribed. Others, such as braces, can be prescribed, but the interviews with older prisoners show that such prescriptions vary from institution to institution. Clearly, these rules have not been made with the problems of aging prisoners in mind. They need to be reconsidered, perhaps with the help of gerontology specialists.

Fifth, distribution of medication for the elderly needs to be redesigned. It is counter-intuitive to ask someone in pain to stand in line for an hour, outside, rain or shine, to pick up his pain medication. Of the seniors I interviewed, 90% reported taking prescription medication. Clearly, they are the most likely population to pick up medication daily when they are being afflicted by the pain associated with aging. If, for security reasons, they cannot be given a month's worth of medication at a time, then a nurse should bring their medication every day to their cells. This should be an integrated part of pain and disease management. While such reform is in progress, seniors should be given priority in picking up their medication, and pill distribution should begin for them half an hour or so earlier than for everyone else.

4.3 Creation of seniors-only units

A senior-centred health care system would be more achievable if at least some of the institutions offered seniors-only units. Such arrangements would also address other age-related concerns such as vulnerability, victimization, and appropriate infrastructure. An overwhelming number of the participants in this study (93%) indicated that they believed their quality of life would increase if they were housed in

seniors-only units. This may be explained by the high rates of victimization that some of the seniors encountered. However, none of the institutions that I visited provided such units, or even a seniors' lounge for daytime activities. Some institutions had a quieter unit, where they generally housed the more vulnerable individuals. However, even in those institutions, the participants indicated that only so many seniors would fit in those units and that many were left on the outside. There was also a tendency to house younger, vulnerable prisoners there as a mild form of protective custody. In addition, in maximum security, a notoriously dangerous place, seniors tended to be placed in protective custody or on a mental health range. However, protective custody meant that a prisoner was locked up for 23 hours daily. Also, stigma was associated with this type of accommodation. Once an individual was placed in protective custody, he could not be released into the general population without serious repercussions to his well-being.

A seniors-only unit can be created in a manner that offers appropriate stimulation and socialization. It would also provide managerial benefits. Older prisoners reported relatively low disciplinary incidents (31%, with only 6.1% for violent behaviour) and relatively low rates of time spent in segregation (23.4%, with only 20% for violent behaviour). They also reported good relationships with staff (89.3%). For his part, the correctional investigator reported that older prisoners are, as a rule, a low-risk population (Sapers 2011: 23). Both my study and his report confirmed that disruptive behaviour in this population tends to be associated with illness (ibid.). Thus, the security cost in seniors-only units could be lower, in favour of higher investment in health and programming. It would allow for specialized medical care without the same concern about drug abuse or dealing. Medication could be distributed in a more age-sensitive manner, and the infrastructure could be adapted to be more disability-friendly. Such accommodations would not have to be available in all institutions, but prisons that cannot offer them should not house seniors. As an interim measure, participants indicated that even a seniors' lounge where they can spend their daytime without fear of being bullied would be an improvement over the current state of affairs.

Some U.S. models of older prisoner–care units (True Grit at the Nevada Correctional Centre; Ohio's Hocking Correctional Facility; Angola Prison, Louisiana; Pine Bluff, Arkansas; Whitworth Detention Center, Georgia; the Minnesota Correctional Facility's Stillwater seniors' dormitory; Mississippi State Penitentiary; and Old Men's Colony, West Virginia) could be used as examples for enhancing correctional

practices, especially in the areas of pain management, mental health, and end-of-life care (Aday 2003; Rikard and Rosenberg 2007).

4.4 Mandatory staff training on geriatric matters

Data suggest that some seniors are being stigmatized and that their vulnerability due to age and disability is exploited inside prisons. It is unacceptable to have correctional staff members making fun of incontinent individuals. It is equally unacceptable to steal prisoners' walking aids to play tricks on them. Name-calling by staff members was reported by the participants as part of their day-to-day living. While calling prisoners "Old fart" and "Pops" may not be regarded as a big deal in the correctional setting, and prisoners learn to ignore it, it still has negative psychological consequences. Name-calling reminds older people that they are more vulnerable and so, somehow, less worthy of respect.

In Ohio, geriatric correctional training called "Try Another Way" was introduced, and positive results were reported (Rikard and Rosenberg 2007; Kerbs and Jolley 2014). Correctional officers are not just security guards; they should also be role models, and a prison environment is only as good as its front-line workers. It might be hard for officers to understand that, with the aging of the population, care needs to be combined with security, more so than before. This is why proper training is of primary importance.

4.5 Creation of prison hospices/palliative care units

Currently, there are no hospice beds available in Canadian prisons, and palliative care is not systematic (Correctional Service Canada 2009; Sapers 2014). Palliative care is sometimes given to prisoners, but that happens because of the efforts of different agencies and volunteers, not because of the CSC (Sapers 2011: 24). Coupled with the fact that compassionate release options are highly restrictive (CCRA, s. 121), the situation of terminally ill prisoners is not very good. Compassionate release is not available to people serving life sentences, and it is rarely used even for other groups (Sapers 2013: 20).

In contrast, prison hospices and palliative care units have flourished throughout the U.S. (Angola Prison, Louisiana; Maryland Hospice Program; Federal Medical Center, Carswell Ft. Worth, Texas; Broward Correctional Institution, Florida; Oregon State Penitentiary; United States Medical Center for Federal Prisoners, Missouri; Vacaville State Prison, California; Michael Unit, Tennessee Colony, Texas; Dixon

Correctional Center, Illinois) in response to the increasing number of people who die in prison (Delgado and Humm-Delgado 2009).

While there are not as many terminally ill prisoners in Canadian prisons as in the U.S., there are enough to justify at least one such unit per region. All prisoners approaching death should be released or housed in a palliative care unit. Security should be relaxed, medical care enhanced, palliative care specialists available 24/7, and family visits strongly encouraged and facilitated. These prisoners should have access to legal advice for the writing of wills and advance directives. An alternative, or perhaps a better, solution would be to create palliative care units in correctional community centres. These centres are institutions where individuals are housed if they are on parole or under other types of releases. The community centres are still correctional institutions, but security is more flexible, and a significant number of older and sick prisoners are already housed there (Sapers 2014: 11–17). This would, however, mean a significant improvement in the compassionate release mechanism and a commitment to send most terminally ill prisoners to centres that include palliative care units.

5. Conclusion

The aging of the prison population is still an under-explored and emerging issue, and it will continue to present increasing burdens on correctional systems in the future. At present, this group of prisoners is the fastest growing, and their needs, based on the little information currently available, appear to be both great and different from those of the mainstream prison population. The study that I conducted, while far from sufficient for establishing with certainty the medical needs of, and the CSC's limitations in providing for, older prisoners, does illustrate how prisoners perceive aging, how they deal with chronic pain, and how chronic pain affects their life and adjustment to prison. These findings are aligned with some of the findings or suppositions of the Office of the Correctional Investigator, and it is likely that future research will also confirm them. Should this be the case, compliance of the correctional system with the legal framework in general, and the human rights one in particular, might be called into question. The current study points to problems pertaining to the enhanced hardship that older prisoners face in serving their sentences due to chronic pain, age-associated diseases, and lack of an age-sensitive environment. Arguments may be accordingly made that such issues are not part of the sentence rendered by the judge, that they make the experience of older

people harsher than that of their younger counterparts, and that the older prisoner's life and health is ultimately threatened by less than satisfactory and age-inappropriate "essential health care."

As mentioned, more research is needed. It is, however, likely that most studies would confirm that age-sensitive policies are required. Hence, it is advisable that the CSC use the information currently available and begin a systematic reform of its policies, especially its medical policies. Such reform would not only be humane, but would also prepare the CSC for an expected increase in the number of aging prisoners and minimize the likelihood of potential future litigation on such issues.

Note

1 Tylenol 3 "is used to treat mild-to-moderate pain associated with conditions such as headache, dental pain, muscle pain, painful menstruation, pain following an accident, and pain following operations," MedBroadcast, http://www.medbroadcast.com/.

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This is Exhibit **"C"** to the
Affidavit of Adelina Iftene sworn
before me this 13th day of May, 2020.

A Commissioner, etc.

Health status of prisoners in Canada

Narrative review

Fiona Kouyoumdjian MD PhD CCFP FRCPC **Andrée Schuler** PhD **Flora I. Matheson** PhD **Stephen W. Hwang** MD MPH FRCPC

Abstract

Objective To review the literature for quantitative research on the health status of persons in custody in provincial, territorial, and federal correctional facilities in Canada, and summarize recent evidence.

Quality of evidence A search was performed in research databases and the websites of relevant Canadian governmental and non-governmental organizations for quantitative studies of health conducted between 1993 and 2014. Studies were included that provided quantitative data on health status for youth or adults who had been detained or incarcerated in a jail or prison in Canada.

Main message The health status of this population is poor compared with the general Canadian population, as indicated by data on social determinants of health, mortality in custody, mental health, substance use, communicable diseases, and sexual and reproductive health. Little is known about mortality after release, chronic diseases, injury, reproductive health, and health care access and quality.

Conclusion Health status data should be used to improve health care and to intervene to improve health for persons while in custody and after release, with potential benefits for all Canadians.

EDITOR'S KEY POINTS

- The health of persons who experience detention or incarceration in provincial, territorial, and federal facilities is poor compared with the general Canadian population.
- Health status data can be used to improve health care services and health for this population, with potential benefits for all Canadians, such as decreasing health care costs, improving health in the general population, improving public safety, and decreasing re-incarceration. The time in custody provides an opportunity to intervene.
- Information on health status is also important for defining areas of focus for improving health and health care. Health care in correctional facilities is largely delivered by government authorities in Canada, which makes the lack of data on some key indicators of health striking.

POINTS DE REPÈRE DU RÉDACTEUR

- L'état de santé des personnes en détention ou incarcérées dans les établissements provinciaux, territoriaux et fédéraux est médiocre par rapport à celui de la population canadienne en général.
- Il est possible d'utiliser les données sur l'état de santé pour améliorer les services médicaux et la santé dans cette population et, ce faisant, apporter potentiellement des avantages à tous les Canadiens en réduisant les coûts des soins de santé, en améliorant la santé et la sécurité publique dans l'ensemble de la population et en diminuant les incarcérations répétées. Le temps passé en détention donne l'occasion d'intervenir.
- Les renseignements sur l'état de santé revêtent aussi de l'importance pour définir les domaines où il est prioritaire d'améliorer la santé et les soins. Au Canada, les soins de santé dans les établissements correctionnels sont majoritairement fournis par les autorités gouvernementales et il est donc étonnant que les données sur certains indicateurs clés soient insuffisantes.

This article has been peer reviewed.
Cet article a fait l'objet d'une révision par des pairs.
Can Fam Physician 2016;62:215-22

L'état de santé des détenus au Canada

Révision narrative

Résumé

Objectif Passer en revue la documentation portant sur les recherches quantitatives concernant l'état de santé des personnes en détention dans les établissements correctionnels provinciaux, territoriaux et fédéraux au Canada et faire la synthèse des données probantes récentes.

Qualité des données Une recension a été effectuée dans les bases de données de recherche et les sites web des organisations gouvernementales et non gouvernementales canadiennes pour trouver des études quantitatives sur la santé réalisées entre 1993 et 2014. Les études qui comportaient des données quantitatives sur l'état de santé des jeunes ou des adultes détenus ou incarcérés dans une prison ou un établissement correctionnel au Canada ont été retenues.

Message principal L'état de santé de cette population est médiocre par rapport à celui de la population canadienne en général, comme le font valoir les données sur les déterminants sociaux de la santé, la mortalité en détention, la santé mentale, la toxicomanie, les maladies transmissibles et la santé sexuelle et de la reproduction. On en sait très peu à propos de la mortalité, des maladies chroniques, des blessures, de la santé de la reproduction, de même qu'en ce qui a trait à l'accessibilité et à la qualité des soins de santé après la libération.

Conclusion On devrait utiliser les données sur l'état de santé pour améliorer les soins de santé et intervenir pour que ces personnes soient en meilleure santé pendant et après leur détention, ce qui pourrait être bénéfique pour tous les Canadiens.

More than 11 million people are imprisoned worldwide at any given time,[1] and more than 30 million move through the prison system annually.[2] In Canada, there are more than 250 000 adult admissions each year to correctional facilities, about 8000 of which are to federal custody, and there are 14 000 youth admissions each year.[3,4] On an average day, there are about 40 000 people in correctional facilities.[5-7]

In Canada, the federal and provincial or territorial governments share jurisdiction over correctional institutions. Persons who are sentenced to less than 2 years or who are detained before sentencing (remanded) serve time in provincial and territorial facilities, whereas persons who are sentenced to 2 years or longer serve time in federal facilities. Health care in custody might be delivered by the governmental authority responsible for health, as in Nova Scotia and Alberta, by the governmental authority responsible for corrections, as in federal facilities and in Ontario, or contracted out to a private company, as in British Columbia.

Standards for health care in federal facilities are defined in the federal *Corrections and Conditional Release Act*.[8] In provincial facilities, federal legislation such as the *Canada Health Act* remains applicable to health care delivery,[9] and provincial or territorial legislation might also apply (eg, the *Ontario Health Protection and Promotion Act*[10]). The United Nations states that "Prisoners shall have access to the health services available in the country without discrimination on the grounds of their legal situation."[11] However, this obligation is not consistently met in Canada.[12-16]

Given the large number of persons in custody each year in Canada and that the median length of detention is less than 1 month,[3] most physicians in Canada likely encounter people either while in custody or after release. Knowledge about the health of this population is important to ensure appropriate care and to inform programs and policies to improve health. In this article, we describe the health status of people who experience detention or incarceration in correctional facilities in Canada, and we highlight opportunities to improve health.

Quality of evidence

We performed a search of quantitative studies of health conducted between 1993 and 2014. We searched MEDLINE, PsycINFO, EMBASE, the Cochrane Library, Social Sciences Abstracts, Social Services Abstracts, Sociological Abstracts, CINAHL, Criminal Justice Abstracts, ERIC, ProQuest Criminal Justice, ProQuest Dissertations and Theses, Web of Science, and Scopus in April 2014, and we also searched the websites of relevant Canadian governmental and non-governmental organizations. The search strategy is available from the corresponding author (F.K.) on request.

We included studies that provided quantitative data on health status[17,18] for youth and adults who had been detained or incarcerated in a jail or prison in Canada. We included studies that were conducted from 1993 to 2014 in order to capture data that reflect the current health status of this population.

Two reviewers (F.K. and A.S.) independently reviewed titles and abstracts for eligibility for inclusion, and 1 reviewer (F.K. or A.S.) reviewed each full article and extracted relevant data. Where the same data were reported across multiple publications, we included the publication that was most recent or that reported more comprehensive data. In some cases in which many studies had been conducted on a given risk factor or condition, we reported only data from key studies (eg, studies that were more recent or that had larger samples), as the main goal of our study was to describe the health status of this population.

Main message

Health status

Social determinants of health: More than 50% of those admitted to sentenced custody are younger than 35 years of age, compared with less than one-third of the Canadian population, and the median age of those admitted to remand ranges between 28 and 33 years across the provinces and territories.[3] About 1 in 10 adult admissions to federal, provincial, or territorial custody are for women,[3] and 1 in 5 youth admissions are for girls.[4] About 1 in 4 admissions are for aboriginal persons, while they make up only 4% of the general population.[3,4]

Most persons in custody have experienced substantial adverse events in childhood, such as witnessing family violence, having 1 or more parents absent, or being involved with the child welfare system.[19-32] At least half report a history of childhood physical, sexual, or emotional abuse.[19,21-23,25,28-50] About 15% to 20% of aboriginal persons in federal facilities have attended residential schools.[29,51]

The socioeconomic status of this population is low, as indicated by a lack of housing,[30,52-55] low employment rates,[22,26,30,52,54,56-58] low educational achievement,[30,58] and low income status.[58,59] One-fifth of men in provincial custody in Toronto, Ont, in 2009 and 2010 reported being homeless at the time of admission,[54] and more than half of youth in custody in British Columbia in 2012 and 2013 had been homeless at some time.[22] Most adults in custody have not completed high school[30,58] (eg, more than 55% of people admitted to federal custody in 2011 had less than a grade 10 education[30]), whereas only 19% of all Canadian adults have not obtained a high school diploma.[60]

Mortality: A large number of persons die in custody each year[61,62]: 536 persons died in federal custody between 2003 and 2013, and 327 died in provincial or territorial custody between 2001 and 2010.[63,64] Mortality rates are higher for persons in custody than for the general population[62]: in Ontario between 1990 and 1998, the crude mortality rate for men in federal facilities was 420.1 per 100 000 and in provincial facilities it was 211.5 per 100 000, compared with a rate of 187.5 per 100 000 in men with a similar age distribution in the general population. This is remarkable, as persons in custody are protected from many types of unintentional injuries, which are the leading cause of death in the general population for persons aged 25 to 44.[65] Rates of suicide and homicide are particularly high compared with the general population,[63,64] with suicide rates of 70 per 100 000 in federal custody and 43 per 100 000 in provincial custody compared with the overall Canadian rate of 10.2 per 100 000, and homicide rates of 22 per 100 000 in federal custody and 2.3 per 100 000 in provincial custody compared with the overall Canadian rate of 1.6 per 100 000.

International data consistently show high mortality rates subsequent to release from custody,[2] including from preventable causes such as overdose[66-71]; however, there are no Canadian data on rates or causes of death after release.

Mental health and substance use: Most persons in correctional facilities have mental disorders as defined by the *Diagnostic and Statistical Manual of Mental Disorders*.[22,23,28,32,35,39,52,58,72-84] Among men in provincial custody in Edmonton, Alta, lifetime prevalence rates and the corresponding rates in the general population of men were 91.7% versus 43.7% for any disorder, 87.2% versus 39.6% for substance use disorders, 56.7% versus 8.6% for antisocial personality, 22.8% versus 12.0% for affective disorders, 2.2% versus 0.5% for schizophrenia, and 1.1% versus 0.4% for cognitive impairment.[73] Similarly, men in federal detention in British Columbia in 1999 had lifetime rates 2 to 3 times greater than men in a community sample with respect to mood disorders, schizophrenia, anxiety disorders, substance use disorders, and eating disorders.[83] In 2 studies, more than 4 of 5 youth in detention in British Columbia and Ontario, respectively, met criteria for at least 1 disorder in the *Diagnostic and Statistical Manual of Mental Disorders*,[28,32] compared with 30.6% in the general community sample in the Ontario study.[32]

The recent tragic and preventable deaths of young persons in federal custody[85,86] have brought international attention to the high rates of suicide and self-injury in persons in custody in Canada.[19,22,23,38,45,52,55,73,74,87-98] Most studies have found that more than 1 in 5 persons in custody have attempted suicide.[38,52,73,74,88-90,92,94,95,99] Of men in provincial custody in Edmonton, 22.8% had attempted suicide, which was 7.1 times the expected rate.[73] In 2012 and 2013, 13% of youth in custody in British Columbia had seriously considered suicide and 10% had attempted suicide in the past year.[22]

Regarding substance use, many persons in custody report having initiated alcohol and drug use at a young age.[22,23,29,55,100,101] More than two-thirds of adults and youth in custody are current smokers[22,97,102] compared with 16% of all Canadians.[103] Alcohol use is very common in this population, as is risk behaviour such as binge drinking and drinking and driving.[21,22,24,48,55,92,104-107] Regarding drug use, most people report recent use at the time of admission to custody,[22,52,57,100,101,108,109] and injection drug use is common,[52,53,56,97,108-120] with about 1 in 10 adults reporting having injected in the months before admission and 1 in 20 youth reporting ever injecting.[20,21,52,53,108,109,114,115,121] People continue to use drugs in custody,[22,56,57,97,112,114,122-124] including by injection.[56,97,107,109,113,114,117-119,125]

Time in custody might serve as a unique opportunity to offer services and information to persons using substances who might otherwise be hard to reach. There is good evidence for interventions in custody and after release to reduce smoking,[126] drug use, and associated risk behaviour after release.[127]

Communicable diseases: Tuberculosis is relatively common in persons in federal custody, at 22.4 active cases per 100 000 compared with 4.6 per 100 000 in the general population.[128] Of persons in federal custody in 2007 and 2008, 15.9% were infected with latent tuberculosis, and the estimated annual rate of skin test conversion during incarceration was 1.2%.[129]

Several large serologic studies have identified that blood-borne infections are very common in adults in custody.[117,119,121,130-135] About 30% of those in federal facilities and 15% of men and 30% of women in provincial facilities are infected with hepatitis C,[118,119,129,130,132,134] and between 1% and 2% of men and 1% and 9% of women are infected with HIV.[117-119,129-131,133,136] There is evidence that people contract blood-borne infections while in custody, eg, the estimated incidence rate of hepatitis C for men in federal custody in 2007 was 16 infections per 1000 person-years.[109,137] Sharing needles and tattooing and piercing equipment, including in custody, likely contributes to these high rates.[21,53,97,114,115,118,119,121,137,138]

Sexually transmitted infections, such as chlamydia and gonorrhea, are also prevalent.[21,22,48,49,108,129,139] About 1 in 7 youth in British Columbia in 2012 and 2013 and 1 in 7 men in a provincial facility in Ontario in 2009 reported a history of sexually transmitted infections.[22,108,139] In 2007 and 2008, 0.9% of men and 2.8% of women in federal custody were diagnosed with chlamydia, 0.1% of men and 0.6% of women with gonorrhea, and 0.1% of men and 0.9% of women with syphilis.[129] In the 2009 Ontario study, 2.9% of men had positive test results for chlamydia and 0.6% for gonorrhea on admission.[139]

Vaccination rates might be suboptimal in this population,[140] and Canadian and international research indicates that recommended vaccinations could be effectively delivered while in custody.[127,140,141]

Chronic diseases: Little is known about chronic diseases in this population. There is some evidence that cardiovascular disease, diabetes, and asthma and other respiratory diseases occur at higher than expected rates,[53,63] but high-quality data are lacking. Three studies have identified an epilepsy prevalence between 1% and 4%.[21,48,74] While no data are available on cancer incidence or prevalence, 2 studies described the results of cervical cancer screening.[49,142] One found abnormal test results in 16% of girls,[49] and the other found that the proportion of findings of high-grade lesions was higher than in the general population.[142]

Sexual and reproductive health: Most people in custody report having been sexually active in the months preceding admission to custody,[22,48,53,109,113,119,143] and a minority of persons report having sex while in custody.[97,109,137] Sexual risk behaviour is common, such as early sexual debut,[22,121] a high number of lifetime sexual partners,[22,23,113,139] inconsistent condom use,[22,23,97,117,119,121,139,144] sex with high-risk partners such as persons who inject drugs,[119-121,137,145] and involvement in commercial sex.[56,113,116,117,119,120,146]

Little is known about the reproductive health status of people who experience detention or incarceration. More than half of adults have had children,[38,57,116,147] and about 1 in 3 youth in British Columbia in 2012 and 2013 had been pregnant (for girls) or caused a pregnancy (for boys).[22] A 2014 study in Ontario found that women in provincial custody had been pregnant an average of 4 times, at least 5% were currently pregnant, and more than half had had a therapeutic abortion.[148] Given that only 1 in 5 women who were sexually active and did not want to get pregnant were using contraception before admission to custody,[148] interventions to improve access to contraception might be appropriate in this population.[149]

Injury: Limited data suggest that rates of unintentional injury are high and are often associated with substantial consequences.[21,22,25,36,48,150] More than 1 in 2 youth in British Columbia in 2012 and 2013 had been injured seriously enough in the year before entering custody to require medical attention.[22] Three studies found that head injury was common in this population,[25,36,150] and in 2 studies more than half of men had evidence of traumatic brain injury.[25,150]

Health care

Health care use: Recent data are lacking on health care use. In the 1990s, most persons in federal custody saw a family physician while in custody[53,97] at a rate higher than expected for the general population.[53] Of those in federal custody, 5% had visited the emergency department during their incarceration, with a mean of 0.1 visits per year, and 3% had been admitted to a community hospital and 10% to a regional hospital.[53] The mean number of visits to a dentist was 1.7 per year.[53]

No Canadian data are available on access to primary care or general medical care in the community before admission or after release from custody. Such data could inform the role of health care services in custody, eg, whether preventive care services such as screening could reasonably be deferred until after release for those with a short length of stay or whether care in custody should be more comprehensive. Recent US data reveal low rates of primary care access and high rates of emergency department use and hospitalization after release.[151-153]

Rates of outpatient mental health care before admission vary across studies.[52,92,154] Overall, 6.3% of men admitted to a Quebec provincial facility in the 1990s reported previous psychological treatment,[92] 11.3% of 97 women in British Columbia in 1999 had had a mental health assessment and 28.9% had accessed mental health treatment,[52] and 8.7% of women and 5.9% of men admitted to federal custody in 2007 and 2008 had used psychiatric outpatient services.[154] A large number of persons report previous hospitalization for psychiatric illness. The rate of psychiatric hospitalization before admission was 9.2% of 97 women in custody in British Columbia in 1999,[52] and 30.1% of women and 14.5% of men admitted to federal custody in 2007 and 2008.[154] About half of those in federal custody receive some mental health service in custody,[30,63,97] and the psychiatric hospitalization rate in 2000 to 2001 was 69 per 1000 inmates, with an average length of stay ranging across regions from 147 to 232 days.[53]

Disease screening: In federal facilities, screening rates for tuberculosis and blood-borne infections are high, with recent data revealing that more than 70% of persons were screened for HIV, hepatitis C, and tuberculosis during their current incarceration.[109,129] Screening for blood-borne infections might occur less frequently in provincial facilities,[113] which could explain a relatively high proportion of persons not knowing about their HIV and hepatitis C infection status.[141]

Screening for mental health problems is typically done as part of routine intake procedures,[155] and there is some evidence that existing screening tools in some

jurisdictions might not adequately identify mental health problems, including risk of suicide.[94,156]

Only 15% of women in British Columbia in 1995 and less than 50% of girls in Ontario from 2003 to 2006 had Papanicolaou testing in custody.[49,142] Of women in custody in British Columbia in 2000 and 2001, 60% had been screened in the 30 months before admission, and of those who participated in a Pap testing intervention, only 50% were rescreened within 3 years.[116] No data are available on colorectal and breast cancer screening.

Treatment: A large proportion of persons in custody use prescribed medications,[38,157,158] in particular psychotropic medications.[52,82,92] At the time of intake to federal custody in 2007 to 2008, about 1 in 3 women and 1 in 5 men were using prescribed psychiatric medication,[154] and in 2013, 63% of women in federal custody were using prescribed psychotropic medication.[63]

The HIV treatment rate for persons with HIV in federal custody in 2007 to 2008 was 64.4%,[129] and almost half of those being treated for HIV in 2007 had missed their medications while in federal custody for at least 1 day because of temporary unavailability of medications at institutional pharmacies or transfers between institutions.[137] Studies of persons in federal custody have identified high rates of hepatitis C treatment adherence[159] and completion[160] in custody, high rates of treatment continuity after release with the support of a tailored program,[161] and similar treatment effectiveness rates to those in the community.[137,159-163]

Limitations

There are several limitations to the data presented and to this review. As noted elsewhere,[164] most of the studies conducted to date on the health status of this population have been cross-sectional, which might be associated with oversampling of persons who are in custody for longer periods. Most studies did not include a representative sample of persons in custody in Canada, and focused only on persons in federal custody or population subgroups. These issues might have affected the internal validity of the included studies and the generalizability of estimates to the whole population of persons in custody. While we used a broad and comprehensive search strategy, we might have missed some relevant studies, including those published outside of our search period and those in the gray literature. Similar to most narrative reviews, we did not appraise the quality of included studies, as our main goal was to provide a broad perspective on the health status of this population.[165]

Conclusion

Canadians in correctional facilities have poor health across a range of health status indicators, a finding that is consistent with international data on persons who experience imprisonment.[166] This information is relevant to physicians who assess and treat persons while in custody or after release, as it might inform history taking, counseling regarding pretest probability, investigations, and management strategies.

Information on health status is also important for defining areas of focus for improving health and health care. Health care in correctional facilities is largely delivered by government authorities in Canada, which makes the lack of data on some key indicators of health striking, including on mortality after release, chronic diseases, injury, and health care access and quality. Among other measures, the implementation of electronic medical records, which are still not available in correctional facilities in many jurisdictions, could facilitate the collection and management of data on many health status indicators.

The time in custody provides an opportunity to intervene to improve health, and an emerging literature on effective interventions in custody and after release suggests starting points for change,[127] such as linkage with primary care and navigation services at the time of release from custody.[152,167] Improving health in people who experience detention and incarceration is an important goal, and could lead to valuable secondary benefits for society, such as decreasing health care costs,[168] improving health in the general population,[168-173] improving public safety,[168] and decreasing re-incarceration.[168,174,175]

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Contributors

Dr Kouyoumdjian led the study and drafted the manuscript.
Drs Kouyoumdjian and **Schuler** conducted the review and extracted data.
All authors contributed to the study design and manuscript preparation.

Competing interests

None declared

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This is Exhibit **"D"** to the
Affidavit of Adelina Iftene sworn
before me this 13th day of May, 2020.

A Commissioner, etc.

IMPRISONING THE PANDEMIC IN CANADA (v3.4)

Confirmed COVID-19 Cases Linked to Canadian Carceral Institutions as of 26 April 2020 at 7:30am EST

CANADA-WIDE

Correctional Service Canada prisoners = 235
Canadian Border Services Agency detainees = 0
Provincial-territorial level prisoners = 74
Sub-total – prisoners = 309

Correctional Service Canada employees = 105
Canadian Border Services Agency employees = 1
Provincial-territorial level employees = 27
Sub-total – employees = 133

Correctional Service Canada contractors = 0
Canadian Border Services Agency contractors = 1
Provincial-territorial level contractors = 1
Sub-total – contractors = 2

Total cases = 444

FEDERAL / CBSA

Laval Immigration Holding Centre
(Laval, Quebec)
Detainees = 0
Employees = 0
Contractors = 1
Total cases = 1

Sources: La Presse – 7 April 2020

Toronto Immigration Holding Centre
(Toronto, Ontario)
Detainees = 0
Employees = 1
Contractors = 0
Total cases = 1

Sources: TVO – 30 March 2020

FEDERAL / CSC

Port-Cartier Institution
(Port-Cartier, Quebec)
Prisoners = 15
Employees = 26
Total cases = 41

Sources: Correctional Service Canada – 25 April 2020 / CTV News – 24 April 2020

Donnacona Institution
(Donnacona, Quebec)
Prisoners = 0
Employees = 2
Total cases = 2

Source: Journal de Québec – 12 April 2020

Drummond Institution
(Drummondville, Quebec)
Prisoners = 0
Employees = 2
Total cases = 2

Source: The Canadian Press – 16 April 2020

Joliette Institution for Women
(Joliette, Quebec)
Prisoners = 51
Employees = 49
Total cases = 100

Sources: Correctional Service Canada – 25 April 2020 / CTV News – 21 April 2020

Federal Training Centre Medium
(Laval, Quebec)
Prisoners = 56
Employees = 10
Total cases = 66

Sources: Correctional Service Canada – 25 April 2020 / CTV News – 21 April 2020

Beaver Creek Institution
(Gravenhurst, Ontario)
Prisoners = 0
Employees = 1
Total cases = 1

Source: Global News – 11 April 2020

Grand Valley Institution for Women
(Kitchener, Ontario)
Prisoners = 8
Employees = 2
Total cases = 10

Sources: Correctional Service Canada – 25 April 2020 / CTV News – 18 April 2020

Mission Medium Institution
(Mission, British Columbia)
Prisoners = 105
Employees = 12
Total cases = 117

Sources: Correctional Service Canada – 25 April 2020 / CTV News – 25 April 2020

Fraser Valley Institution for Women
(Mission, British Columbia)
Prisoners = 0
Employees = 1
Total cases = 1

Sources: News 1130 – 18 April 2020

PROVINCIAL-TERRITORIAL

Central Nova Scotia Correctional Facility
(Dartmouth, Nova Scotia)
Prisoners = 1
Employees = 0
Total cases = 1

Source: Halifax Examiner – 20 April 2020

Établissement de détention de Sherbrooke
(Sherbrooke, Quebec)
Prisoners = 1
Employees = 0
Total cases = 1

Source: Radio-Canada – 26 March 2020

Établissement de détention de Saint-Jérôme
(Saint-Jérôme, Quebec)

Prisoners = 0
Employees = 1
Total cases = 1

Source: La Presse – 24 April 2020

Établissement de détention de Montréal – Bordeaux
(Montreal, Quebec)

Prisoners = 1 (+1)
Employees = 4 (+3)
Total cases = 5

Source: La Presse – 24 April 2020

Palais de justice de Montréal
(Montreal, Quebec)

Prisoners = 0
Employees = 2
Total cases = 2

Source: La Presse – 24 April 2020

Établissement de detention de Laval
(Quebec)

Prisoners = 0
Employees = 1
Total cases = 1

Source: La Presse – 24 April 2020

Toronto South Detention Centre
(Toronto, Ontario)
Prisoners = 3
Employees = 1
Total cases = 4

Source: CBC News – 7 April 2020

Ontario Correctional Institute
(Brampton, Ontario)
Prisoners = 65 (+3)
Employees = 10
Total cases = 75

Source: CityNews – 22 April 2020 / Canadian Press – 23 April 2020

Hamilton-Wentworth Detention Centre
(Hamilton, Ontario)
Prisoners = 1 (+1)
Employees = 1
Total cases = 2

Source: Hamilton Spectator – 27 March 2020 / Hamilton Spectator – 24 April 2020

South West Detention Centre
(Windsor, Ontario)
Prisoners = 0
Employees = 0
Contractors = 1
Total cases = 1

Source: Windsor Star – 20 March 2020

Monteith Correctional Complex
(Iroquois Falls, Ontario)
Prisoners = 1
Employees = 0
Total cases = 1

Source: CBC News – 7 April 2020

Saskatoon Correctional Centre
(Saskatoon, Saskatchewan)
Prisoners = 0
Employees = 6
Total cases = 6

Source: Global News – 3 April 2020

Okanagan Correctional Centre
(Oliver, British Columbia)
Prisoners = 1
Employees = 0
Total cases = 1

Source: CTV News – 2 April 2020

North Fraser Pretrial Centre
(Port Coquitlam, British Columbia)
Prisoners = 0
Employees = 1
Total cases = 1

Source: News 1130 – 16 April 2020

Data compiled by Justin Piché, PhD (Associate Professor, Criminology, University of Ottawa / Member, Criminalization and Punishment Education Project – 613-793-1093 / justin.piche@uottawa.ca)

This is Exhibit **"E"** to the
Affidavit of Adelina Iftene sworn
before me this 13th day of May, 2020.

A Commissioner, etc.

Preliminary Estimates of the Prevalence of Selected Underlying Health Conditions Among Patients with Coronavirus Disease 2019 — United States, February 12–March 28, 2020

CDC COVID-19 Response Team

On March 31, 2020, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

On March 11, 2020, the World Health Organization declared Coronavirus Disease 2019 (COVID-19) a pandemic (*1*). As of March 28, 2020, a total of 571,678 confirmed COVID-19 cases and 26,494 deaths have been reported worldwide (*2*). Reports from China and Italy suggest that risk factors for severe disease include older age and the presence of at least one of several underlying health conditions (*3*,*4*). U.S. older adults, including those aged ≥65 years and particularly those aged ≥85 years, also appear to be at higher risk for severe COVID-19–associated outcomes; however, data describing underlying health conditions among U.S. COVID-19 patients have not yet been reported (*5*). As of March 28, 2020, U.S. states and territories have reported 122,653 U.S. COVID-19 cases to CDC, including 7,162 (5.8%) for whom data on underlying health conditions and other known risk factors for severe outcomes from respiratory infections were reported. Among these 7,162 cases, 2,692 (37.6%) patients had one or more underlying health condition or risk factor, and 4,470 (62.4%) had none of these conditions reported. The percentage of COVID-19 patients with at least one underlying health condition or risk factor was higher among those requiring intensive care unit (ICU) admission (358 of 457, 78%) and those requiring hospitalization without ICU admission (732 of 1,037, 71%) than that among those who were not hospitalized (1,388 of 5,143, 27%). The most commonly reported conditions were diabetes mellitus, chronic lung disease, and cardiovascular disease. These preliminary findings suggest that in the United States, persons with underlying health conditions or other recognized risk factors for severe outcomes from respiratory infections appear to be at a higher risk for severe disease from COVID-19 than are persons without these conditions.

Data from laboratory-confirmed COVID-19 cases reported to CDC from 50 states, four U.S. territories and affiliated islands, the District of Columbia, and New York City with February 12–March 28, 2020 onset dates were analyzed. Cases among persons repatriated to the United States from Wuhan, China, and the Diamond Princess cruise ship were excluded. For cases with missing onset dates, date of onset was estimated by subtracting 4 days (median interval from symptom onset to specimen collection date among cases with known dates in these data) from the earliest specimen collection. Public health departments reported cases to CDC using a standardized case report form that captures information (yes, no, or unknown) on the following conditions and potential risk factors: chronic lung disease (inclusive of asthma, chronic obstructive pulmonary disease [COPD], and emphysema); diabetes mellitus; cardiovascular disease; chronic renal disease; chronic liver disease; immunocompromised condition; neurologic disorder, neurodevelopmental, or intellectual disability; pregnancy; current smoking status; former smoking status; or other chronic disease (*6*). Data reported to CDC are preliminary and can be updated by health departments over time; critical data elements might be missing at the time of initial report; thus, this analysis is descriptive, and no statistical comparisons could be made.

The percentages of patients of all ages with underlying health conditions who were not hospitalized, hospitalized without ICU admission, and hospitalized with ICU admission were calculated. Percentages of hospitalizations with and without ICU admission were estimated for persons aged ≥19 years with and without underlying health conditions. This part of the analysis was limited to persons aged ≥19 years because of the small sample size of cases in children with reported underlying health conditions (N = 32). To account for missing data among these preliminary reports, ranges were estimated with a lower bound including cases with both known and unknown status for hospitalization with and without ICU admission as the denominator and an upper bound using only cases with known outcome status as the denominator. Because of small sample size and missing data on underlying health conditions among COVID-19 patients who died, case-fatality rates for persons with and without underlying conditions were not estimated.

As of March 28, 2020, a total of 122,653 laboratory-confirmed COVID-19 cases (Figure) and 2,112 deaths were reported to CDC. Case report forms were submitted to CDC for 74,439 (60.7%) cases. Data on presence or absence of underlying health conditions and other recognized risk factors for severe outcomes from respiratory infections (i.e., smoking and pregnancy) were available for 7,162 (5.8%) patients (Table 1). Approximately one third of these patients (2,692, 37.6%), had at least one underlying condition or risk factor. Diabetes mellitus (784, 10.9%), chronic lung disease (656, 9.2%), and cardiovascular disease (647, 9.0%) were the

most frequently reported conditions among all cases. Among 457 ICU admissions and 1,037 non-ICU hospitalizations, 358 (78%) and 732 (71%), respectively occurred among persons with one or more reported underlying health condition. In contrast, 1,388 of 5,143 (27%) COVID-19 patients who were not hospitalized were reported to have at least one underlying health condition.

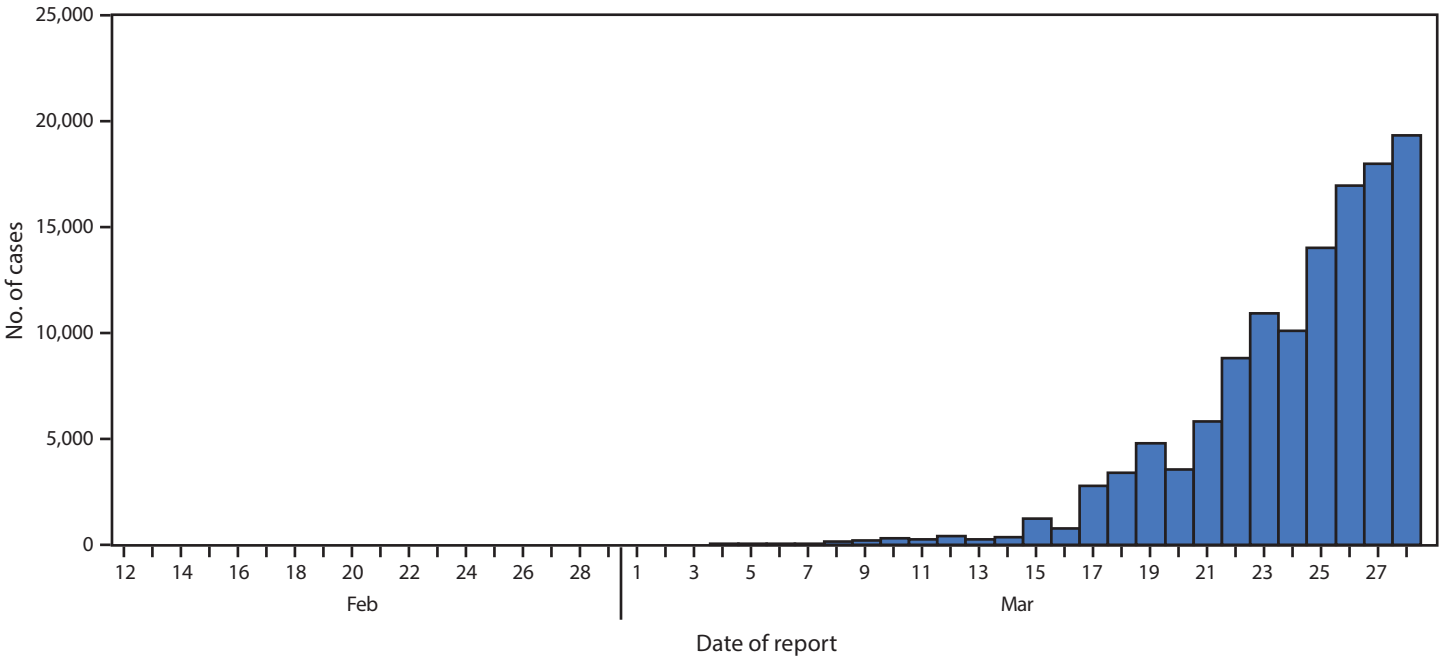
Among patients aged ≥19 years, the percentage of non-ICU hospitalizations was higher among those with underlying health conditions (27.3%–29.8%) than among those without underlying health conditions (7.2%–7.8%); the percentage of cases that resulted in an ICU admission was also higher for those with underlying health conditions (13.3%–14.5%) than those without these conditions (2.2%–2.4%) (Table 2). Small numbers of COVID-19 patients aged <19 years were reported to be hospitalized (48) or admitted to an ICU (eight). In contrast, 335 patients aged <19 years were not hospitalized and 1,342 had missing data on hospitalization. Among all COVID-19 patients with complete information on underlying conditions or risk factors, 184 deaths occurred (all among patients aged ≥19 years); 173 deaths (94%) were reported among patients with at least one underlying condition.

Discussion

Among 122,653 U.S. COVID-19 cases reported to CDC as of March 28, 2020, 7,162 (5.8%) patients had data available pertaining to underlying health conditions or potential risk factors; among these patients, higher percentages of patients with underlying conditions were admitted to the hospital and to an ICU than patients without reported underlying conditions. These results are consistent with findings from China and Italy, which suggest that patients with underlying health conditions and risk factors, including, but not limited to, diabetes mellitus, hypertension, COPD, coronary artery disease, cerebrovascular disease, chronic renal disease, and smoking, might be at higher risk for severe disease or death from COVID-19 (*3*,*4*). This analysis was limited by small numbers and missing data because of the burden placed on reporting health departments with rapidly rising case counts, and these findings might change as additional data become available.

It is not yet known whether the severity or level of control of underlying health conditions affects the risk for severe disease associated with COVID-19. Many of these underlying health conditions are common in the United States: based on self-reported 2018 data, the prevalence of diagnosed diabetes among U.S. adults was 10.1% (*7*), and the U.S. age-adjusted prevalence of all types of heart disease (excluding hypertension without other heart disease) was 10.6% in 2017 (*8*). The age-adjusted prevalence of COPD among U.S. adults is 5.9% (*9*), and in 2018, the U.S. estimated prevalence of current asthma among persons of all ages was 7.9% (*7*). CDC continues to develop and update resources for persons with underlying

FIGURE. Daily number of reported COVID-19 cases* — United States, February 12–March 28, 2020†



* Cases among persons repatriated to the United States from Wuhan, China, and the Diamond Princess cruise ship are excluded.
† Cumulative number of COVID-19 cases reported daily by jurisdictions to CDC using aggregate case count was 122,653 through March 28, 2020.

TABLE 1. Reported outcomes among COVID-19 patients of all ages, by hospitalization status, underlying health condition, and risk factor for severe outcome from respiratory infection — United States, February 12–March 28, 2020

Underlying health condition/Risk factor for severe outcomes from respiratory infection (no., % with condition)	No. (%)			
	Not hospitalized	Hospitalized, non-ICU	ICU admission	Hospitalization status unknown
Total with case report form (N = 74,439)	**12,217**	**5,285**	**1,069**	**55,868**
Missing or unknown status for all conditions (67,277)	**7,074**	**4,248**	**612**	**55,343**
Total with completed information (7,162)	**5,143**	**1,037**	**457**	**525**
One or more conditions (2,692, 37.6%)	1,388 (27)	732 (71)	358 (78)	214 (41)
Diabetes mellitus (784, 10.9%)	331 (6)	251 (24)	148 (32)	54 (10)
Chronic lung disease* (656, 9.2%)	363 (7)	152 (15)	94 (21)	47 (9)
Cardiovascular disease (647, 9.0%)	239 (5)	242 (23)	132 (29)	34 (6)
Immunocompromised condition (264, 3.7%)	141 (3)	63 (6)	41 (9)	19 (4)
Chronic renal disease (213, 3.0%)	51 (1)	95 (9)	56 (12)	11 (2)
Pregnancy (143, 2.0%)	72 (1)	31 (3)	4 (1)	36 (7)
Neurologic disorder, neurodevelopmental, intellectual disability (52, 0.7%)†	17 (0.3)	25 (2)	7 (2)	3 (1)
Chronic liver disease (41, 0.6%)	24 (1)	9 (1)	7 (2)	1 (0.2)
Other chronic disease (1,182, 16.5%)§	583 (11)	359 (35)	170 (37)	70 (13)
Former smoker (165, 2.3%)	80 (2)	45 (4)	33 (7)	7 (1)
Current smoker (96, 1.3%)	61 (1)	22 (2)	5 (1)	8 (2)
None of the above conditions¶ (4,470, 62.4%)	3,755 (73)	305 (29)	99 (22)	311 (59)

Abbreviation: ICU = intensive care unit.
* Includes any of the following: asthma, chronic obstructive pulmonary disease, and emphysema.
† For neurologic disorder, neurodevelopmental, and intellectual disability, the following information was specified: dementia, memory loss, or Alzheimer's disease (17); seizure disorder (5); Parkinson's disease (4); migraine/headache (4); stroke (3); autism (2); aneurysm (2); multiple sclerosis (2); neuropathy (2); hereditary spastic paraplegia (1); myasthenia gravis (1); intracranial hemorrhage (1); and altered mental status (1).
§ For other chronic disease, the following information was specified: hypertension (113); thyroid disease (37); gastrointestinal disorder (32); hyperlipidemia (29); cancer or history of cancer (29); rheumatologic disorder (19); hematologic disorder (17); obesity (17); arthritis, nonrheumatoid, including not otherwise specified (16); musculoskeletal disorder other than arthritis (10); mental health condition (9); urologic disorder (7); cerebrovascular disease (7); obstructive sleep apnea (7); fibromyalgia (7); gynecologic disorder (6); embolism, pulmonary or venous (5); ophthalmic disorder (2); hypertriglyceridemia (1); endocrine (1); substance abuse disorder (1); dermatologic disorder (1); genetic disorder (1).
¶ All listed chronic conditions, including other chronic disease, were marked as not present.

TABLE 2. Hospitalization with and without intensive care unit (ICU) admission, by age group among COVID-19 patients aged ≥19 years with and without reported underlying health conditions — United States, February 12–March 28, 2020*

Age group (yrs)	Hospitalized without ICU admission, No. (% range†)		ICU admission, No. (% range†)	
	Underlying condition present/reported§		Underlying condition present/reported§	
	Yes	No	Yes	No
19–64	285 (18.1–19.9)	197 (6.2–6.7)	134 (8.5–9.4)	58 (1.8–2.0)
≥65	425 (41.7–44.5)	58 (16.8–18.3)	212 (20.8–22.2)	20 (5.8–6.3)
Total ≥19	**710 (27.3–29.8)**	**255 (7.2–7.8)**	**346 (13.3–14.5)**	**78 (2.2–2.4)**

* Includes COVID-19 patients aged ≥19 years with known status on underlying conditions.
† Lower bound of range = number of persons hospitalized or admitted to an ICU among total in row stratum; upper bound of range = number of persons hospitalized or admitted to an ICU among total in row stratum with known outcome status: hospitalization or ICU admission status.
§ Includes any of following underlying health conditions or risk factors: chronic lung disease (including asthma, chronic obstructive pulmonary disease, and emphysema); diabetes mellitus; cardiovascular disease; chronic renal disease; chronic liver disease; immunocompromised condition; neurologic disorder, neurodevelopmental, or intellectual disability; pregnancy; current smoker; former smoker; or other chronic disease.

health conditions to reduce the risk of acquiring COVID-19 (*10*). The estimated higher prevalence of these conditions among those in this early group of U.S. COVID-19 patients and the potentially higher risk for more severe disease from COVID-19 associated with the presence of underlying conditions highlight the importance of COVID-19 prevention in persons with underlying conditions.

The findings in this report are subject to at least six limitations. First, these data are preliminary, and the analysis was limited by missing data related to the health department reporting burden associated with rapidly rising case counts and delays in completion of information requiring medical chart review; these findings might change as additional data become available. Information on underlying conditions was only available for 7,162 (5.8%) of 122,653 cases reported to CDC. It cannot be assumed that those with missing information are similar to those with data on either hospitalizations or underlying health conditions. Second, these data are subject to bias in outcome ascertainment because of short follow-up time. Some outcomes might be underestimated, and long-term

outcomes cannot be assessed in this analysis. Third, because of the limited availability of testing in many jurisdictions during this period, this analysis is likely biased toward more severe cases, and findings might change as testing becomes more widespread. Fourth, because of the descriptive nature of these data, attack rates among persons with and without underlying health conditions could not be compared, and thus the risk difference of severe disease with COVID-19 between these groups could not be estimated. Fifth, no conclusions could be drawn about underlying conditions that were not included in the case report form or about different conditions that were reported in a single, umbrella category. For example, asthma and COPD were included in a chronic lung disease category. Finally, for some underlying health conditions and risk factors, including neurologic disorders, chronic liver disease, being a current smoker, and pregnancy, few severe outcomes were reported; therefore, conclusions cannot be drawn about the risk for severe COVID-19 among persons in these groups.

Persons in the United States with underlying health conditions appear to be at higher risk for more severe COVID-19, consistent with findings from other countries. Persons with underlying health conditions who have symptoms of COVID-19, including fever, cough, or shortness of breath, should immediately contact their health care provider. These persons should take steps to protect themselves from COVID-19, through washing their hands; cleaning and disinfecting high-touch surfaces; and social distancing, including staying at home, avoiding crowds, gatherings, and travel, and avoiding contact with persons who are ill. Maintaining at least a 30-day supply of medication, a 2-week supply of food and other necessities, and knowledge of COVID-19 symptoms are recommended for those with underlying health conditions (*10*). All persons should take steps to protect themselves from COVID-19 and to protect others. All persons who are ill should stay home, except to get medical care; should not go to work; and should stay away from others. This is especially important for those who work with persons with underlying conditions or who otherwise are at high risk for severe outcomes from COVID-19. Community mitigation strategies, which aim to slow the spread of COVID-19, are important to protect all persons from COVID-19, especially persons with underlying health conditions and other persons at risk for severe COVID-19–associated disease (https://www.cdc.gov/coronavirus/2019-ncov/downloads/community-mitigation-strategy.pdf).

Acknowledgments

State, local, and territorial health departments; clinical staff members caring for patients.

Summary

What is already known about this topic?

Published reports from China and Italy suggest that risk factors for severe COVID-19 disease include underlying health conditions, but data describing underlying health conditions among U.S. COVID-19 patients have not yet been reported.

What is added by this report?

Based on preliminary U.S. data, persons with underlying health conditions such as diabetes mellitus, chronic lung disease, and cardiovascular disease, appear to be at higher risk for severe COVID-19–associated disease than persons without these conditions.

What are the implications for public health practice?

Strategies to protect all persons and especially those with underlying health conditions, including social distancing and handwashing, should be implemented by all communities and all persons to help slow the spread of COVID-19.

CDC COVID-19 Response Team

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All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

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This is Exhibit **"F"** to the
Affidavit of Adelina Iftene sworn
before me this 13th day of May, 2020.

A Commissioner, etc.

Centers for Disease Control and Prevention
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Severe Outcomes Among Patients with Coronavirus Disease 2019 (COVID-19) — United States, February 12–March 16, 2020

CDC COVID-19 Response Team

Globally, approximately 170,000 confirmed cases of coronavirus disease 2019 (COVID-19) caused by the 2019 novel coronavirus (SARS-CoV-2) have been reported, including an estimated 7,000 deaths in approximately 150 countries (*1*). On March 11, 2020, the World Health Organization declared the COVID-19 outbreak a pandemic (*2*). Data from China have indicated that older adults, particularly those with serious underlying health conditions, are at higher risk for severe COVID-19–associated illness and death than are younger persons (*3*). Although the majority of reported COVID-19 cases in China were mild (81%), approximately 80% of deaths occurred among adults aged ≥60 years; only one (0.1%) death occurred in a person aged ≤19 years (*3*). In this report, COVID-19 cases in the United States that occurred during February 12–March 16, 2020 and severity of disease (hospitalization, admission to intensive care unit [ICU], and death) were analyzed by age group. As of March 16, a total of 4,226 COVID-19 cases in the United States had been reported to CDC, with multiple cases reported among older adults living in long-term care facilities (*4*). Overall, 31% of cases, 45% of hospitalizations, 53% of ICU admissions, and 80% of deaths associated with COVID-19 were among adults aged ≥65 years with the highest percentage of severe outcomes among persons aged ≥85 years. In contrast, no ICU admissions or deaths were reported among persons aged ≤19 years. Similar to reports from other countries, this finding suggests that the risk for serious disease and death from COVID-19 is higher in older age groups.

Data from cases reported from 49 states, the District of Columbia, and three U.S. territories (*5*) to CDC during February 12–March 16 were analyzed. Cases among persons repatriated to the United States from Wuhan, China and from Japan (including patients repatriated from cruise ships) were excluded. States and jurisdictions voluntarily reported data on laboratory-confirmed cases of COVID-19 using previously developed data collection forms (*6*). The cases described in this report include both COVID-19 cases confirmed by state or local public health laboratories as well as those with a positive test at the state or local public health laboratories and confirmation at CDC. No data on serious underlying health conditions were available. Data on these cases are preliminary and are missing for some key characteristics of interest, including hospitalization status (1,514), ICU admission (2,253), death (2,001), and age (386). Because of these missing data, the percentages of hospitalizations, ICU admissions, and deaths (case-fatality percentages) were estimated as a range. The lower bound of these percentages was estimated by using all cases within each age group as denominators. The corresponding upper bound of these percentages was estimated by using only cases with known information on each outcome as denominators.

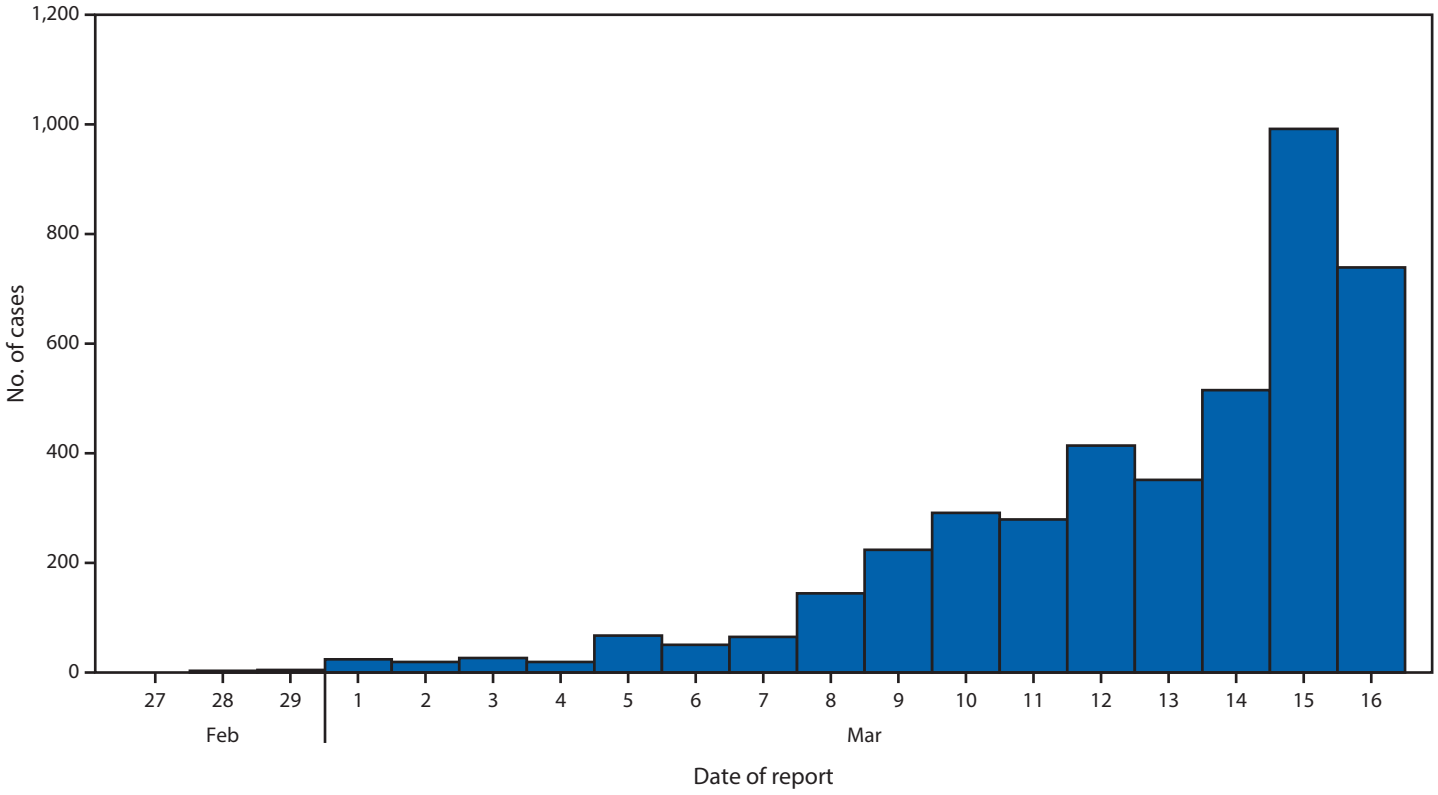
As of March 16, a total of 4,226 COVID-19 cases had been reported in the United States, with reports increasing to 500 or more cases per day beginning March 14 (Figure 1). Among 2,449 patients with known age, 6% were aged ≥85, 25% were aged 65–84 years, 18% each were aged 55–64 years and 45–54 years, and 29% were aged 20–44 years (Figure 2). Only 5% of cases occurred in persons aged 0–19 years.

Among 508 (12%) patients known to have been hospitalized, 9% were aged ≥85 years, 36% were aged 65–84 years, 17% were aged 55–64 years, 18% were 45–54 years, and 20% were aged 20–44 years. Less than 1% of hospitalizations were among persons aged ≤19 years (Figure 2). The percentage of persons hospitalized increased with age, from 2%–3% among persons aged ≤9 years, to ≥31% among adults aged ≥85 years. (Table).

Among 121 patients known to have been admitted to an ICU, 7% of cases were reported among adults ≥85 years, 46% among adults aged 65–84 years, 36% among adults aged 45–64 years, and 12% among adults aged 20–44 years (Figure 2). No ICU admissions were reported among persons

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

FIGURE 1. Number of new coronavirus disease 2019 (COVID-19) cases reported daily*,† (N = 4,226) — United States, February 12–March 16, 2020



* Includes both COVID-19 cases confirmed by state or local public health laboratories, as well as those testing positive at the state or local public health laboratories and confirmed at CDC.
† Cases identified before February 28 were aggregated and reported during March 1–3.

aged ≤19 years. Percentages of ICU admissions were lowest among adults aged 20–44 years (2%–4%) and highest among adults aged 75–84 years (11%–31%) (Table).

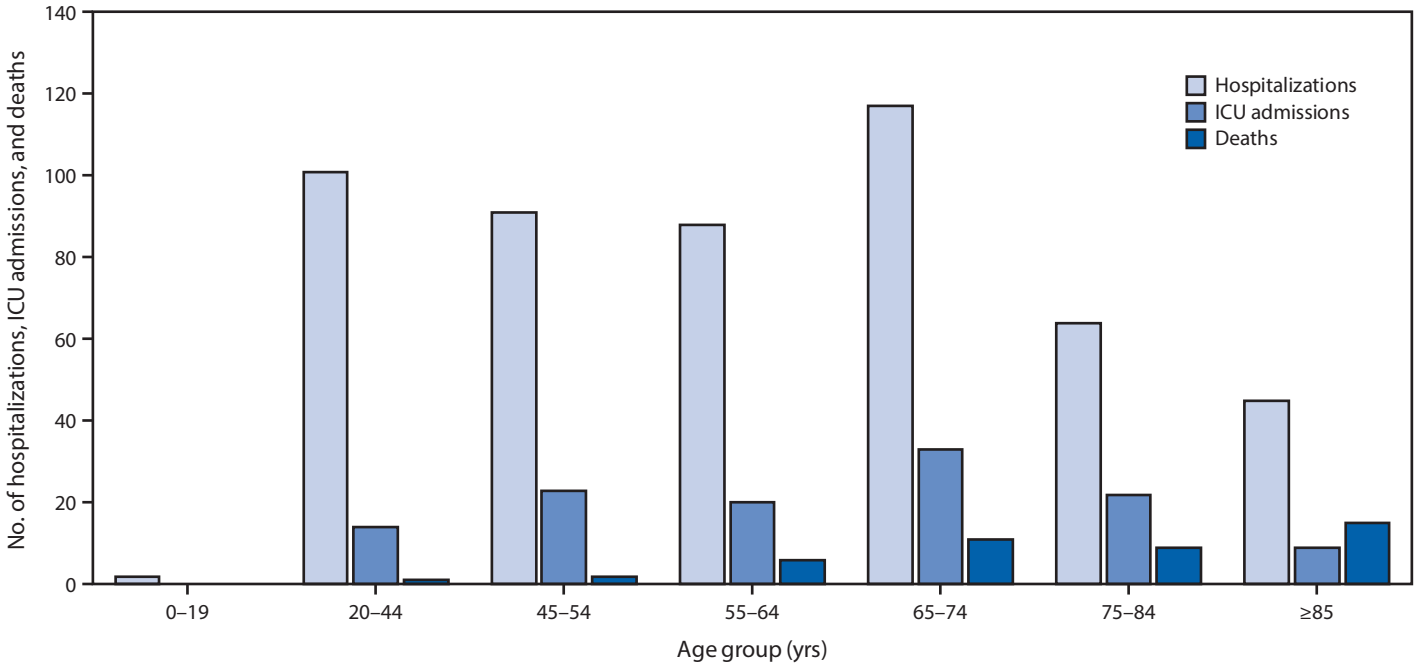
Among 44 cases with known outcome, 15 (34%) deaths were reported among adults aged ≥85 years, 20 (46%) among adults aged 65–84 years, and nine (20%) among adults aged 20–64 years. Case-fatality percentages increased with increasing age, from no deaths reported among persons aged ≤19 years to highest percentages (10%–27%) among adults aged ≥85 years (Table) (Figure 2).

Discussion

Since February 12, 4,226 COVID-19 cases were reported in the United States; 31% of cases, 45% of hospitalizations, 53% of ICU admissions, and 80% of deaths occurred among adults aged ≥65 years with the highest percentage of severe outcomes among persons aged ≥85 years. These findings are similar to data from China, which indicated >80% of deaths occurred among persons aged ≥60 years (*3*). These preliminary data also demonstrate that severe illness leading to hospitalization, including ICU admission and death, can occur in adults of any age with COVID-19. In contrast, persons aged ≤19 years appear to have milder COVID-19 illness, with almost no hospitalizations or deaths reported to date in the United States in this age group. Given the spread of COVID-19 in many U.S. communities, CDC continues to update current recommendations and develop new resources and guidance, including for adults aged ≥65 years as well as those involved in their care (*7*,*8*).

Approximately 49 million U.S. persons are aged ≥65 years (*9*), and many of these adults, who are at risk for severe COVID-19–associated illness, might depend on services and support to maintain their health and independence. To prepare for potential COVID-19 illness among persons at high risk, family members and caregivers of older adults should know what medications they are taking and ensure that food and required medical supplies are available. Long-term care facilities should be particularly vigilant to prevent the introduction and spread of COVID-19 (*10*). In addition, clinicians who care for adults should be aware that COVID-19 can result in severe disease among persons of all ages. Persons with suspected or confirmed COVID-19 should monitor their symptoms and call their provider for guidance if symptoms worsen or seek emergency care for persistent severe symptoms. Additional guidance is available

FIGURE 2. COVID-19 hospitalizations,* intensive care unit (ICU) admissions,† and deaths,§ by age group — United States, February 12–March 16, 2020



* Hospitalization status missing or unknown for 1,514 cases.
† ICU status missing or unknown for 2,253 cases.
§ Illness outcome or death missing or unknown for 2,001 cases.

for health care providers on CDC's website (https://www.cdc.gov/coronavirus/2019-nCoV/hcp/index.html).

This report describes the current epidemiology of COVID-19 in the United States, using preliminary data. The findings in this report are subject to at least five limitations. First, data were missing for key variables of interest. Data on age and outcomes, including hospitalization, ICU admission, and death, were missing for 9%–53% of cases, which likely resulted in an underestimation of these outcomes. Second, further time for follow-up is needed to ascertain outcomes among active cases. Third, the initial approach to testing was to identify patients among those with travel histories or persons with more severe disease, and these data might overestimate the prevalence of severe disease. Fourth, data on other risk factors, including serious underlying health conditions that could increase risk for complications and severe illness, were unavailable at the time of this analysis. Finally, limited testing to date underscores the importance of ongoing surveillance of COVID-19 cases. Additional investigation will increase the understanding about persons who are at risk for severe illness and death from COVID-19 and inform clinical guidance and community-based mitigation measures.*

* https://www.cdc.gov/coronavirus/2019-ncov/downloads/community-mitigation-strategy.pdf.

TABLE. Hospitalization, intensive care unit (ICU) admission, and case–fatality percentages for reported COVID–19 cases, by age group — United States, February 12–March 16, 2020

Age group (yrs) (no. of cases)	%*		
	Hospitalization	ICU admission	Case-fatality
0–19 (123)	1.6–2.5	0	0
20–44 (705)	14.3–20.8	2.0–4.2	0.1–0.2
45–54 (429)	21.2–28.3	5.4–10.4	0.5–0.8
55–64 (429)	20.5–30.1	4.7–11.2	1.4–2.6
65–74 (409)	28.6–43.5	8.1–18.8	2.7–4.9
75–84 (210)	30.5–58.7	10.5–31.0	4.3–10.5
≥85 (144)	31.3–70.3	6.3–29.0	10.4–27.3
Total (2,449)	**20.7–31.4**	**4.9–11.5**	**1.8–3.4**

* Lower bound of range = number of persons hospitalized, admitted to ICU, or who died among total in age group; upper bound of range = number of persons hospitalized, admitted to ICU, or who died among total in age group with known hospitalization status, ICU admission status, or death.

The risk for serious disease and death in COVID-19 cases among persons in the United States increases with age. Social distancing is recommended for all ages to slow the spread of the virus, protect the health care system, and help protect vulnerable older adults. Further, older adults should maintain adequate supplies of nonperishable foods and at least a 30-day supply of necessary medications, take precautions to keep space between themselves and others, stay away from those who are sick, avoid crowds as much as possible, avoid cruise travel and

Summary

What is already known about this topic?

Early data from China suggest that a majority of coronavirus disease 2019 (COVID-19) deaths have occurred among adults aged ≥60 years and among persons with serious underlying health conditions.

What is added by this report?

This first preliminary description of outcomes among patients with COVID-19 in the United States indicates that fatality was highest in persons aged ≥85, ranging from 10% to 27%, followed by 3% to 11% among persons aged 65–84 years, 1% to 3% among persons aged 55-64 years, <1% among persons aged 20–54 years, and no fatalities among persons aged ≤19 years.

What are the implications for public health practice?

COVID-19 can result in severe disease, including hospitalization, admission to an intensive care unit, and death, especially among older adults. Everyone can take actions, such as social distancing, to help slow the spread of COVID-19 and protect older adults from severe illness.

nonessential air travel, and stay home as much as possible to further reduce the risk of being exposed (*7*). Persons of all ages and communities can take actions to help slow the spread of COVID-19 and protect older adults.[†]

[†] https://www.whitehouse.gov/wp-content/uploads/2020/03/03.16.20_coronavirus-guidance_8.5x11_315PM.pdf.

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This is Exhibit **"G"** to the
Affidavit of Adelina Iftene sworn
before me this 13th day of May, 2020.

A Commissioner, etc.

11

INCARCERATION IN CANADA: RISKS TO AND OPPORTUNITIES FOR PUBLIC HEALTH

Adelina Iftene*

I. INTRODUCTION: PRISON HEALTH AS PUBLIC HEALTH

> Prison populations contain a high prevalence of people with serious and often life-threatening conditions. Sooner or later most prisoners will return to the community, carrying back with them new diseases and untreated conditions that may pose a threat to community health and add to the burden of disease in the community. Thus there is a compelling interest on the part of society that this vulnerable group receive health protection and treatment for any ill health.[1]

The health and well-being of marginalized communities is an intrinsic part of national and global health.[2] Public health strategies take into account the risk factors — including "social determinants of health" — that influence health and disproportionately impact members of marginalized communities.[3] Marginalized groups are also overrepresented in the criminal justice and prison systems.[4]

Every year, about 400,000 people are admitted to a prison in Canada. On average, there are about 40,000 people in a correctional

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* [bio to come]

1 Alex Gatherer, Stefan Enggist & Lars Møller, "The Essentials about Prisons and Health" in Stefan Enggist *et al*., eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 1 at 2.

2 On this issue, see Martha Jackman, "Law as a Tool for Addressing Social Determinant of Health" in this volume at 91-130.

3 *Ibid.*, at 93.

4 See *e.g.*, Law Council of Australia, *The Justice Project: Final Report – Part 1: Prisoners and Detainees* (August 2018) at 5 -18, online: https://www.lawcouncil.asn.au/files/web-pdf/Justice%20Project/Final%20Report/Prisoners%20and%20Detainees%20%28Part%201%29.pdf.

facility daily.[5] In 2017, Canada ranked 140 out of 222 countries (from highest to lowest) in terms of incarceration numbers.[6] With a rate of 114 per 100,000, Canada has one of the highest incarceration rates among countries of comparable level of development.[7]

Not coincidentally, the social determinants for health are also determinants for criminalization and incarceration.[8] For instance, adverse childhood events such as physical and sexual abuse, institutionalization (including residential schools), witnessing family violence, absent parents and racial discrimination are significant determinants of criminalization and incarceration.[9] Indigenous people[10] are significantly overrepresented in prisons and their number is increasing.[11] In addition, most individuals experiencing incarceration have a low socio-economic status, low educational level[12] and low income.[13] Finally, most people enter prisons with a high burden of disease and often engage in high-risk behaviour before and after admission to correctional facilities (*e.g.*, smoking,

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5 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 216.

6 Public Safety Canada, *2017 Annual Report — Corrections and Conditional Release: Statistical Overview* (Ottawa: Public Safety Canada Portfolio Corrections Statistics Committee, July 2018) at 5, online: https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ccrso-2017/ccrso-2017-en.pdf.

7 *Ibid.*

8 See *e.g.*, Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 216-17; Law Council of Australia, *The Justice Project: Final Report – Part 1: Prisoners and Detainees* (August 2018) at 5-17, online: https://www.lawcouncil.asn.au/files/web-pdf/Justice%20Project/Final%20Report/Prisoners%20and%20Detainees%20%28Part%201%29.pdf.

9 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 216.

10 Indigenous is used in this chapter as a "pan" word including the narrower terms of First Nations, Aboriginal, Inuit and Métis. "Aboriginal" is used in this chapter only when paraphrasing correctional legislation and policy documents that still use this term as an umbrella term. For a definition of "Indigenous" and of each of the narrower terms, see Janna Promislow & Naiomi Metallic, "Realizing Aboriginal Administrative Law" in Colleen M. Flood & Lorne Sossin, eds., *Administrative Law in Context*, 3d ed. (Toronto: Emond Publishing, 2018) 87 at 88-89.

11 Public Safety Canada, *2017 Annual Report — Corrections and Conditional Release: Statistical Overview* (Ottawa: Public Safety Canada Portfolio Corrections Statistics Committee, July 2018) at 63, online: https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ccrso-2017/ccrso-2017-en.pdf.

12 Of those in federal corrections, 55% have less than a grade 10 education and 19% of all incarcerated adults have not obtained a high school diploma: see Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 217; Independent Review of Ontario Corrections, *Corrections in Ontario: Directions for Reform* (Toronto: Queen's Printer for Ontario, September 2017) at 200.

13 Many of these individuals are also homeless: see Kouyoumdjian *et al.*, *ibid.*

injecting drugs, overuse of alcohol, *etc*.).[14] Most incarcerated individuals have had little access to primary or secondary health care, have poor self-care skills, and do not have access to education or information about those skills.[15] For many, imprisonment is the first encounter they have with health care.

Quite apart from the burdens individuals enter prisons with, imprisonment in and of itself present numerous risks to health: prison violence, isolation, poor nutrition, little opportunity for exercise, lack of stimulating programming, conditions that may lead to family breakdown, challenging infrastructure, overcrowding, and poor access to and quality of health services and related supports.[16] In such environments, the risk of contracting communicable diseases, overdose, death due to preventable and treatable diseases, worsening of mental health and other health conditions, and self-harm and suicide is significantly higher than in the community.[17]

The vast majority of individuals are eventually released from prison. In fact, most incarcerated individuals spend a brief period of time in prison and the turnover is fast. Over half of the sentences imposed by adult courts are a month or less, and only 3.2% of sentences result in a federal prison sentence (two years or more).[18] Not only are health opportunities often not advanced by incarceration, but rather, individuals tend to come out of prison in worse health than when they went in. Thus, their return often negatively impacts the public health of the communities they return to.

Given the demographics of prisoners, the risks incarceration creates[19] and the opportunities it presents for providing screening and

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14 Kouyoumdjian *et al.*, *ibid.*, at 217.

15 Sungwoo Lim *et al.*, "Risks of Drug-Related Death, Suicide, and Homicide During the Immediate Post-Release Period Among People Released From New York City Jails, 2001–2005" (2012) 175:6 Am. J. Epidemiol. 519 at 547; John Howard Society of Ontario, "Fractured Care: Public Health Opportunities in Ontario's Correctional Institutions" (2016) at 8, online: http://johnhoward.on.ca/wp-content/uploads/2016/04/Fractured-Care-Final.pdf. See also Stuart A. Kinner & Jesse T. Young, "Understanding and Improving the Health of People Who Experience Incarceration: An Overview and Synthesis" (2018) 40 Epidemiol. Rev. 4 at 4; Dora M. Dumont, "Public Health and the Epidemic of Incarceration" (2012) 33 Annu. Rev. Public Health 325 at 328.

16 Jens Modvig, "Violence, Sexual Abuse and Torture in Prisons" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) at 19-24.

17 See *e.g.*, Fiona Kouyoumdjian & Kathryin E. McIsaac, "Persons in correctional facilities in Canada: A key population for hepatitis C prevention and control" (2015) 106:6 Can. J. Public Health e454.

18 Public Safety Canada, *2017 Annual Report — Corrections and Conditional Release: Statistical Overview* (Ottawa: Public Safety Canada Portfolio Corrections Statistics Committee, July 2018) at 11, online: https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ccrso-2017/ccrso-2017-en.pdf.

19 All forms of detention, including involuntary admission in a mental health institution and detention outside the criminal law context. REFERNCE TO MH CHAPTER HERE Rather,

treatment for a high concentration of marginalized individuals, prison health is an essential component of public health. On one hand, the goals of public health cannot be fully achieved without prison policies, laws and practices that reflect the intrinsic connection between the two and create an environment that promotes and prioritizes health. On the other hand, the public safety goals of incarceration cannot be achieved without addressing the root causes of criminalization, which include poor health, and in particular the lack of mental health care, addiction treatment and broader societal inequities. Failing to advance the health of incarcerated people and to mitigate the risks prison presents makes safe community reintegration and rehabilitation illusory, perpetuates the cycle of criminalization and endangers the health of the communities in which released individuals reside (which are often themselves marginalized communities).

Part II provides an overview of the prison systems in Canada and the legislation and policies governing prison health care. Part III addresses five major prison sources of risk and opportunity for public health, namely: prevention, containment and treatment of communicable diseases; harm reduction and drug overdoses; mental illness and solitary confinement; prevention and treatment of non-communicable diseases; and the impact of incarceration on mother and child health outcomes. Special attention is paid to Indigenous individuals: Indigenous prisoners tend to be highly marginalized upon admission and in poorer health,[20] face stricter prison conditions, spend longer time in prison, and have a higher incidence of mental illness, addictions and self-harming behaviour. Thus, Indigenous people will feel the effects of any gap in care most strongly. For each of the five areas, epidemiological data is provided, as well as an overview and critique of the approaches taken by various correctional and other authorities in Canada and their impacts on public health. This review of the legislation, policies and practices disconnect from public health goals will illustrate the resulting issues given the prison demographic and the risks this environment creates.

Part IV reflects briefly on the legal implications raised by the failure of correctional authorities to account for individual and public health goals. It concludes with proposals for legislators and administrators to minimize the risks of incarceration and increase the opportunity to promote public health during incarceration.

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it explores the health of the prison population, and its significant and adverse impact on the health of communities, the cost of health and child care, and health equity.

20 See Chapter 10 of this collection: Constance MacIntosh, "The Intersection of Indigenous Public Health with Law and Policy in Canada".

II. PRISON HEALTH CARE, LAW AND POLICY

The main stated purpose of imprisonment is to create a safe society. For instance, the federal *Corrections and Conditional Release Act*[21] states that the purpose of the federal correctional system is to contribute to the maintenance of a just, peaceful and safe society by carrying out court sentences and assisting in the rehabilitation of those in federal custody.[22] Provincial correctional legislation that specifically includes a purpose articulates it in language similar to the CCRA.[23]

While public safety is one of the main goals of incarceration, as discussed in the remainder of this chapter, the Canadian and provincial governments often fail to take action that supports the interconnectivity between public safety and public health. They also fail to demonstrate an understanding that the former cannot be achieved without ensuring that correctional practices also meet the goals of public health (including prevention, treating existing conditions, minimizing risks to community, advancing social justice, *etc*.).[24]

(a) Canadian Prison Systems and Prison Demographics

(i) Provincial Prison Systems

The *Criminal Code*[25] specifies that individuals sentenced to under two years' imprisonment will serve their time in provincial or territorial prisons. Every province and territory has its own correctional system and legislation, and so such systems are not uniformly regulated in Canada. Aside from prisons, the provincial correctional system also includes jails and detention centres.[26] There are about 160 provincial and territorial facilities with different levels of security in Canada. Some treatment

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21 S.C. 1992, c. 20 (the "CCRA").

22 *Ibid.*, ss. 3 and 3.1.

23 *Correctional Services Act*, C.C.S.M. c. C230, s. 2(1); *Corrections Act*, R.S.A. 2000, c. C-29, s. 2; *Ministry of Correctional Services Act*, R.S.O. 1990, c. M.22, s. 5.

24 On the goals of public safety, see the Foreword to this collection: Lawrence O. Gostin, "The Core Values of Public Health and Ethics".

25 R.S.C. 1985, c. C-46, s. 743.1(3).

26 A prison is a facility where sentenced individuals serve time. A jail is a place where people charged with a crime await a further proceeding (remanded). "Detention centre" is a broad term that includes the types of facilities where individuals who have not been convicted of a crime are placed (and await, for example, a deportation hearing or a mental health evaluation; it can sometimes also designate a place holding remanded individuals). Due to lack of space, many provincial facilities serve both as prisons, jails and/or detention centres (even though this practice is against international standards such as the *Mandela Rules*). It is why, in Canada, the terms prison/jail/detention centre are sometimes used interchangeably. "Penitentiary" is a very specific term and refers to federal prisons, where individuals serve time when sentenced to two years or more in prison.

centres (prison hospitals) are also available. Jails and detention centres are the point of entry into the correctional systems and are classified as maximum security.[27]

In 2015–2016, there were 25,405 people in provincial prisons and the number has been on the rise. The incarceration statistics in provincial systems varies across provinces, with Manitoba registering the highest number of prisoners and Nova Scotia the lowest.[28] The remanded individuals exceed the number of sentenced prisoners. In 2015–2016, on any given day there were 14,899 people on remand, compared to 10,091 people serving their sentence in custody; thus, the remanded population accounted for 60% of the custodial population.[29] Women accounted for 14% of the remand population and 11% of those serving a custodial sentence.[30] Indigenous individuals accounted for 26% of all admissions to provincial custody, while they represent 3% of the Canadian population.[31] Indigenous women were the most overrepresented, accounting for 38% of the women in custody.[32]

(ii) Federal Prison System

All individuals sentenced to two years or more of time served in custody, according to the *Criminal Code*, are placed under federal correctional authority.[33] There are 43 penitentiaries[34] administered by a federal governmental agency, the Correctional Service of Canada ("CSC"),[35] which responds directly to the Minister of Public Safety Canada. For administrative purposes, the country is divided into five regions (Atlantic, Quebec, Ontario, Prairies and Pacific), each with its own headquarters. CSC's national headquarters is in Ottawa, and its Commissioner directs the agency. CSC institutions include penitentiaries for men and women, five mental health treatment centres (one in each

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27 See *e.g.*, Ministry of Community Safety and Correctional Services, "Institutional Services Policy and Procedures Manual: Administration: General Administration: Facility Profiles: Facility Types" (Government of Ontario, July 2012). See also Howard Sapers, "Corrections in Ontario: Directions for Reform" (Independent Review of Ontario Corrections, September 2017) at 88-89.

28 Statistics Canada, "Adult correctional statistics in Canada, 2015/2016", prepared by Julie Reitano, Canadian Centre for Justice Statistics, Catalogue No. 85-002-X (March 1, 2017) at 3, online: https://www150.statcan.gc.ca/n1/en/pub/85-002-x/2017001/article/14700-eng.pdf?st=ZWxNDhn6.

29 *Ibid.*, at 4.

30 *Ibid.*, at 5.

31 *Ibid.*

32 *Ibid.*

33 *Criminal Code*, R.S.C. 1985, c. C-46, s. 743.1(1).

34 These are the numbers as of November 11, 2016, available under the "Facilities & Security" tab on the Correctional Service Canada website: http://www.csc-scc.gc.ca/facilities-and-security/index-eng.shtml.

35 *Corrections and Conditional Release Act*, S.C. 1992, c. 20, s. 5.

region) and Aboriginal Healing Lodges. Each institution is either minimum, medium or maximum security, except the Healing Lodges, which can only house minimum- or medium-security prisoners.[36] Some of the women's institutions have multiple security designations. CSC is responsible for all service delivery, including health care. Thus, none of the health services provided in federal corrections are delivered by provincial health authorities.

In 2017, 14,159 men and women[37] were in federal custody. While the number of individuals in federal custody is lower than that in provincial systems, individuals spend significantly more time in custody. In 2017, over half of the federally incarcerated individuals were in prison for longer than five years,[38] and 24%[39] were serving a life sentence. Indigenous prisoners, accounting for 26.8% of incarcerated individuals[40] (a 35.8% increase over 10 years),[41] were overrepresented among people serving a life or long sentence,[42] and in higher forms of security.[43]

(b) Legislation and Policies

(i) International Standards

International standards and guidelines take a public health approach to prison health care.[44] These standards recognize that for individuals to be better prepared for life after release, they need to have access to health care comparable to that in the community. In addition, they need to be provided with the care (including immunizations), education (including health information, self-care and support to reduce unhealthy behaviour such as smoking and substance abuse) and work skills (to ensure their economic stability) that many of them did not have access to in the

36 *Ibid.*

37 Public Safety Canada, *2017 Annual Report — Corrections and Conditional Release: Statistical Overview* (Ottawa: Public Safety Canada Portfolio Corrections Statistics Committee, July 2018) at 34, Table C1, online: https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ccrso-2017/ccrso-2017-en.pdf.

38 *Ibid.*, at 41.

39 *Ibid.*, at 59.

40 *Ibid.*, at 52.

41 *Ibid.*, at 63.

42 *Ibid.*, at 61.

43 *Ibid.*, at 55.

44 See *e.g.*, *United Nations Standard Minimum Rules for the Treatment of Prisoners (the Nelson Mandela Rules)*, U.N. GA Res. 70/175 (December 17, 2015); World Health Organization Europe, *Declaration on Prison Health as Part of Public Health* (adopted in Moscow on October 24, 2003), online: http://www.euro.who.int/__data/assets/pdf_file/0007/98971/E94242.pdf.

community.[45] In other words, correctional authorities should support more than the provision of treatment for existing health conditions; they should aim to create an environment that promotes the well-being of those incarcerated.[46]

The *United Nations Standard Minimum Rules for the Protection of Prisoners*, known as the *Mandela Rules*, illustrate the strong relationship between public health and public safety.[47] Furthermore, the *Mandela Rules* create standards for food[48] and exercise,[49] and provide extensive rules on health care delivery, including intake health assessment to mother-child programs, timely access to qualified physicians, emergency care and mental health services.[50] Notably, the *Mandela Rules* require that comparable standards of care exist between prison and community,[51] and drive home the significance of adequate prison care from a public health perspective.

Other international documents reiterate the need to provide prisoners with care comparable to that in the community.[52] There are also various guidelines that require medical professionals working in prison to act independently, without bias, and to treat the individual primarily as a patient and not as a prisoner, providing services at the same level as in the community[53] (at least for those services under their control).

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45 Alex Gatherer, Stefan Enggist & Lars Møller, "The essentials about prisons and health" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) at 304.

46 Andrew Coyle, "Standards in prison health: The prisoner as a patient" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) at 6.

47 *United Nations Standard for Minimum Rules for the Treatment of Prisoners (the Nelson Mandela Rules)*, U.N. Doc. A/RES/70/175 (December 17, 2015), Rule 4:

> 1. The purposes of a sentence of imprisonment or similar measures deprivative of a person's liberty are primarily to protect society against crime and to reduce recidivism. Those purposes can be achieved only if the period of imprisonment is used to ensure, so far as possible, the reintegration of such persons into society upon release so that they can lead a law-abiding and self-supporting life.
> 2. To this end, prison administrations and other competent authorities should offer education, vocational training and work, as well as other forms of assistance that are appropriate and available, including those of a remedial, moral, spiritual, social and health- and sports-based nature. All such programmes, activities and services should be delivered in line with the individual treatment needs of prisoners.

48 *Ibid.*, Rule 22.

49 *Ibid.*, Rule 23.

50 *Ibid.*, Rules 24-35.

51 *Ibid.*

52 *International Covenant on Economic, Social and Cultural Rights* (December 16, 1966), 993 U.N.T.S. 3 (entered into force January 3, 1976), art. 12; *Basic Principles for the Treatment of Prisoners*, U.N. GA Res. 45/111 (December 14, 1990), Principle 9; UNCRPD OR, 11th Sess., UNCRPD/C/11/D/8/2012; Communication No. 8/2012 (June 18, 2014).

53 *Principles of Medical Ethics relevant to the Role of Health Personnel, particularly Physicians, in the Protection of Prisoners and Detainees against Torture and Other Cruel,*

The World Health Organization ("WHO"), in its *Moscow Declaration on Prison Health as Part of Public Health*, addresses key links between prison and public health.[54] Specifically, it notes that prisons contain an overrepresentation of the most marginalized individuals; that releasing people to community without having provided them with adequate treatment increases the risk of the spread of communicable diseases; and that the unhealthy conditions that exist in most prisons are problematic.[55] In the same document, the WHO also makes recommendations for addressing some of these issues, including improving health care, such as mental health services, and working towards improving conditions of confinement and reducing the risk of infections in prison.[56]

Unfortunately, international guidelines and conventions are not directly enforceable in Canada, despite Canada being a United Nations and WHO Member State that has signed or committed to all of the above instruments.[57] Canada and its provinces do not consistently respect the international standards, and often fail to provide adequate health care to incarcerated persons and a prison environment that promotes health and well-being.[58] Furthermore, prison health care is not systematically guided by public health principles and goals, and the existing legislation and policies, depending on jurisdiction, make little to no reference to the rippling effects of incarceration on communities.

(ii) Federal Legislation

Federally, the CCRA and its corresponding *Correctional and Conditional Release Regulations*[59] are the key pieces of legislation that govern correctional matters. Section 86 of the CCRA states that an individual must have access to essential health care and reasonable access to non-essential health care, both of which are to be provided at "professionally accepted standards".[60]

Inhuman Treatment or Punishment, U.N. GA Res. 37/194 (December 18, 1982); *International Council of Prison Medical Services*, *Oath of Athens*, *Prison Health Care Practitioners* (inaugurated September 10, 1979; revised 1995).

54 World Health Organization Europe, *Declaration on Prison Health as Part of Public Health* (adopted in Moscow on October 24, 2003), online: http://www.euro.who.int/__data/assets/pdf_file/0007/98971/E94242.pdf.

55 Ibid.

56 Ibid

57 On this, see also Martha Jackman, "Law as a Tool for Addressing Social Determinants of Health", Chapter 4 of this volume.

58 See *e.g.*, Adam Miller, "Health Care Inequality" (2013) 185:6 C.M.A.J. E249.

59 SOR/92-620.

60 *Corrections and Conditional Release Act*, S.C. 1992, c. 20, s. 86.

Neither the CCRA, its Regulations, nor other policy documents define what falls under "essential health care" and "non-essential health care". While their meaning should depend on individual needs, the determination of essential/non-essential in the prison context may often be arbitrary without further clarification. Without a definition of these concepts, or at least a mention that they depend on individual needs, each institution decides what is essential and what is not essential. For instance, in some institutions certain conditions are treated and in others they are not, because they are not deemed essential. These conditions have, over time, included sex reassignment surgery and other related treatment, pain management, end of life care, *etc*.[61] Doctors lack authority to decide for their patients, and their ability to fulfil their duties at accepted levels of the profession may be impaired by institutional barriers (such as approvals from prison administration who do not have health care training; security; budget considerations given that provincial coverage does not apply to incarcerated people). Finally, it is noteworthy that most international documents dedicate numerous provisions to health care delivery; for instance, while the *Mandela Rules* provide over 20 rules on health care, the CCRA only has two general provisions on health issues.[62] Commissioner's Directives ("CD") are policy documents meant to help implement the CCRA at the institutional level. Out of over 150 Directives, four pertain, to a certain degree, to health issues: CD 705-3, "Immediate Needs Identification and Admissions Interviews";[63] CD 768, "Institutional Mother-Child Program";[64] CD 800, "Health Services";[65] and CD 843, "Interventions to Preserve Life and Prevent Serious Bodily Harm".[66] The Directives are of mandatory application in all CSC institutions; however, they are very difficult to enforce or to determine accountability when they are not enforced, as their provisions are general and many of them are qualified by "where/if possible". In addition, CSC has a number of health guidelines that establish some standards on issues such as: consent to

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61 See *e.g.*, Adelina Iftene, "The Pains of Incarceration: Aging, Rights, and Policy in Federal Penitentiaries" (2017) 59:1 Can. J. Corr. 63; *Kavanagh v. Canada (Attorney General)*, [2001] C.H.R.D. No. 21, 41 C.H.R.R. D/119 (Can. Human Rights Tribunal) (transition surgery was not offered in any CSC facility because it was deemed "non-essential" without any other explanation. The Canadian Human Rights Tribunal disagreed.).

62 *Corrections and Conditional Release Act*, S.C. 1992, c. 20, ss. 86 and 87.

63 Correctional Service Canada, Commissioner's Directive CD 705-3, "Immediate Needs Identification and Admission Interviews" (January 22, 2018), online: https://www.csc-scc.gc.ca/005/006/705-3-cd-eng.shtml.

64 Correctional Service Canada, Commissioner's Directive CD 768, "Institutional Mother-Child Program" (April 18, 2016), online: https://www.csc-scc.gc.ca/lois-et-reglements/768-cd-eng.shtml.

65 Correctional Service Canada, Commissioner's Directive CD 800, "Health Services" (April 27, 2015), online: https://www.csc-scc.gc.ca/politiques-et-lois/800-cd-eng.shtml.

66 Correctional Service Canada, Commissioner's Directive CD 843, "Interventions to Preserve Life and Prevent Serious Bodily Harm" (August 1, 2017), online: https://www.csc-scc.gc.ca/acts-and-regulations/843-cd-eng.shtml.

medical treatment;[67] response to medical emergencies;[68] gender dysphoria;[69] bleach distribution;[70] cleaning blood;[71] medical assistance in dying;[72] and intellectual disability.[73]

In 2015, CSC released a Public Health Strategy.[74] This document fails to establish any concrete steps on how public health goals will be achieved, by when or by whom, and does not commit any budget to the "strategy". Despite these failures, the strategy does show some awareness of the public health risks and opportunities incarceration creates, and sets as a vision "improved offender health that contributes to the safety of Canadians".[75] Seven public health strategic areas are identified: infectious diseases prevention and control; health promotion and education; surveillance and knowledge sharing; Aboriginal and women offender health; healthy environments; public health competencies; and visibility and accountability.

While it is laudable that these key areas have been identified, these new goals are not attainable while health care and health promotion continues to constitute a small percentage of the federal correctional budget.[76] CSC's progress and regress in these areas will be discussed in Section C of this part, "Prison Health Care Delivery".

(iii) Provincial Legislation

Most provinces have some correctional legislation that references health care delivery, but such provisions tend to be brief. Generally, the

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67 Correctional Service Canada, Guideline 800-3, "Consent to Health Service Assessment, Treatment and Release of Information" (April 27, 2015), online: https://www.csc-scc.gc.ca/politiques-et-lois/800-3-gl-eng.shtml.

68 Correctional Service Canada, Guideline 800-4, "Response to Medical Emergencies" (January 30, 2017), online: https://www.csc-scc.gc.ca/politiques-et-lois/800-4-gl-eng.shtml.

69 Correctional Service Canada, Guideline 800-5, "Gender Dysphoria" (January 9, 2017), online: https://www.csc-scc.gc.ca/politiques-et-lois/800-5-gl-eng.shtml.

70 Correctional Service Canada, Guideline 800-6, "Bleach Distribution" (December 4, 2017), online: https://www.csc-scc.gc.ca/acts-and-regulations/800-6-gl-en.shtml.

71 Correctional Service Canada, Guideline 800-7, "Cleaning Blood and/or Other Bodily Fluid Spills" (April 27, 2015), online: https://www.csc-scc.gc.ca/acts-and-regulations/800-7-gl-eng.shtml.

72 Correctional Service Canada, Guideline 800-9, "Medical Assistance in Dying" (November 29, 2017), online: https://www.csc-scc.gc.ca/acts-and-regulations/800-9-gl-en.shtml.

73 Correctional Service Canada, Guideline 800-10, "Intellectual Disability" (May 28, 2018), online: https://www.csc-scc.gc.ca/politiques-et-lois/800-10-gl-en.shtml.

74 Correctional Service Canada, "Public Health Strategy for Offenders" (March 5, 2015), online: https://www.csc-scc.gc.ca/002/006/phs-eng.shtml.

75 *Ibid.*

76 Ministry of Public Safety and Emergency Preparedness, *Correctional Service of Canada: 2019-20 Departmental Plan*, Catalogue No. PS81-13E-PDF (2019) at 25, online: https://www.csc-scc.gc.ca/publications/092/005007-2607-en.pdf.

legislation is outdated, does not use public health correctional approaches and rarely references prisoners' rights of any kind.[77]

Howard Sapers was appointed in 2015 as an Independent Reviewer for Ontario Corrections. He was mandated to support the progressive creation of a piece of legislation that: included a more robust regulation of solitary confinement and prohibited its use for individuals with mental illnesses; established in clearer terms health care entitlements,[78] prisoners' rights and accommodation for Indigenous individuals;[79] and used language that often emulated the language used by international instruments. However, with the change in government in 2017, the legislation never received royal assent (though it may come into force on royal assent in the future).

Human rights legislation,[80] as well as the *Canadian Charter of Rights and Freedoms*,[81] applies to those in custody. For instance, as discussed in Part IV of this chapter, a number of Charter sections, including sections 7 and 15, may be breached by numerous provisions and practices that lead to inequity in prison health care delivery, and which create unjustified risks to the health of those in custody, and, by extension, to the community to which they will be released.

(c) Prison Health Care Delivery

(i) Provincial Systems

The health care delivery models differ from province to province. Nova Scotia and Alberta have split responsibilities between the department or ministry responsible for justice and public safety and the one responsible for health.[82] Thus, in their correctional institutions, health care is delivered by the mainstream provincial health authorities. In British Columbia, health care is contracted out by corrections to the Provincial Health Services Authority.[83] In the rest of the provinces, the

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77 See *e.g.*, *Correctional Services Act, 2012*, S.S. 2012, c. C-39.2; *Correctional Services Act*, C.C.S.M. c. C230; *Corrections Act*, R.S.N.B. 2011, c. 132; *An Act respecting the Québec correctional system*, CQLR, c. S-40.1; *Corrections Act, 2009*, S.Y. 2009, c. 3.

78 *Correctional Services Transformation Act, 2018*, S.O. 2018, c. 6, Sch. 2, ss. 48-64.

79 *Ibid.*, ss. 28-31.

80 See *e.g.*, *Canadian Human Rights Act*, R.S.C. 1985, c. H-6; *Alberta Human Rights Act*, R.S.A. 2000, c. A-25.5; *Human Rights Act*, R.S.N.S. 1989, c. 214.

81 Part I of the *Constitution Act, 1982*, being Schedule B to the *Canada Act 1982* (U.K.), 1982, c. 11 (the "Charter").

82 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 216; *Correctional Services Act*, S.N.S. 2005, c. 37, s. 25.

83 British Columbia, Ministry of Public Safety and Solicitor General, "A Profile of BC Corrections: Reduce Reoffending, Protect Communities 2017" (Victoria: Ministry of Public Safety and Solicitor General, 2017) at 31, online: https://www2.gov.bc.ca/assets/gov/law-

provision of health care is bifurcated and it is the responsibility of the ministry in charge of corrections.[84] This bifurcation is often criticized as leading to substandard health care and creating a lack of accountability of health care providers.[85]

However, regardless of the model of health care delivery, health services in provincial prison are substandard to community health services and inferior to those in federal corrections. Very few health services are available on-site, and most times individuals must be escorted into the community to receive health treatment. Most provinces struggle with[86] recruiting health professionals, very long assessment times (which are not compliant with the international standards requiring individuals to be seen within 24 hours from intake) and the fact that people are discontinued from their medication when entering provincial institutions (which has devastating effects, regardless of how little time an individual spends in prison). They also struggle with high levels of overcrowding, violence and unsafe substance use.

(ii) Federal System

CSC provides health care services for federally incarcerated individuals. Provincial health ministries are not involved in federal correctional health care, and federal facilities do not come under the same accreditation process as community facilities.[87] Health care only becomes a provincial responsibility upon the individual's release.

According to CSC documents, there are four main types of health facilities within federal correctional settings: institutional health units (*e.g.*, ambulatory care centres), CSC regional hospitals, CSC reception centres (where individuals are sent after sentencing for risk assessment, before it is decided in what institution they will serve) and CSC regional

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crime-and-justice/criminal-justice/corrections/reports-publications/bc-corrections-profile.pdf.

84 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 216.

85 See *e.g.*, John Howard Society of Ontario, "Fractured Care: Public Health Opportunities in Ontario's Correctional Institutions" (2016) at 8, online: http://johnhoward.on.ca/wp-content/uploads/2016/04/Fractured-Care-Final.pdf.

86 See *e.g.*, John Howard Society, *ibid*.; Marlene Jesso *et al.*, "Newfoundland and Labrador Corrections and Community Services: Deaths in Custody Review", report prepared for the Newfoundland and Labrador Minister of Justice and Public Safety (December 12, 2018) at 36-42, online: https://www.justice.gov.nl.ca/just/publications/pdf/Death_Custody_Review.pdf; Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 217-18.

87 Daniel Antonowicz & John Winterdyk, "A Review of Deaths in Custody in Three Canadian Provinces" (2014) 56 Can. J. Corr. 85 at 89.

treatment centres ("RTC") (for mental health).[88] Following sentencing, a health assessment is conducted in addition to a risk assessment at the region's assessment unit. The health assessments should include mental health assessment, tuberculosis ("TB") assessment and comprehensive health assessment.[89] The purpose is to identify the medical needs of the individual and to place him or her in a prison that provides the services that the individual's needs demand.

At the institutional level, primary care is offered on-site, generally by nursing staff. This is the most common level of care in prison. In some institutions, but not all, there is a 24-hour nurse present. The nurse makes assessments, provides counselling, dispenses medication, takes blood samples, gives immunizations and does blood pressure checks, among other things. When deemed appropriate, the nurse may set an appointment for the individual with the primary care prison physician. Other services, such as x-rays, dental and optometrist care, and psychotherapy, are available at pre-arranged times of varying frequency. There is also a range of specialist physicians who make regular visits to institutions depending on need, location and availability. For major surgeries and specialized treatments (*e.g.*, chemotherapy), people are generally transferred to community hospitals.[90]

Four of the five regions have regional hospitals. In the fifth, the Prairies, in-patients with a variety of health conditions are instead transferred to the chronic wing of its mental health treatment facility. The regional hospitals are intended to provide care for a mixture of acute and chronic patients who generally stay there between 4 days to 18 months. However, the use of these services is severely limited by resources, space and distance considerations.

For mental health issues, incarcerated individuals may be sent to an in-patient RTC. These are hybrid facilities: they constitute a penitentiary, but three of them also operate as a hospital under provincial mental health legislation. They are multi-level security facilities, and four of them operate within other CSC institutions (aside from the Prairies). The average stay at these treatment centres is between 147 and 232 days.[91] RTCs offer assessments and stabilization of acutely disordered individuals (*e.g.*, psychotic, suicidal, *etc*.), rehabilitation of people with chronic conditions, and treatment for violent and sexual offenders. Some are also transferred to provincial mental health systems, but this is subject to the

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88 Correctional Service Canada, Commissioner's Directive CD 800, "Health Services" (April 27, 2015), online: https://www.csc-scc.gc.ca/politiques-et-lois/800-cd-eng.shtml.

89 *Ibid.*

90 *Ibid.*, at paras. 11-13.

91 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2010–2011* (2011) at 14, online: http://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20102011-eng.pdf.

approval of the individual provincial facility. However, the majority of those with mental health problems, especially those with non-acute symptoms, remain in their own institutions where they receive pharmacological interventions if ordered by a physician. Mental health will be discussed in more detail in Part III, "Specific Public Health Issues in Prisons".

Research conducted on health care in prisons provides evidence that the delivery of health care has serious gaps. For example, the lack of health professionals across institutions leads to long waiting times for seeing a nurse or a doctor, even for urgent matters.[92] Most institutions do not have a nurse on-site at all times.[93] Interruptions to medication provision have been regularly noted.[94] There appear to be serious issues with respect to the availability of appropriate medications, especially in relation to the management of pain.[95]

Like provincial institutions, there are significant challenges associated with the prison environment beyond the quality and quantity of health services, which nevertheless add to the challenges respecting delivery of health services. Challenging infrastructure, double bunking and overcrowding, lack of meaningful programming and exercise, inadequate nutrition, isolation, burn out due to prolonged incarceration, and insufficient harm reduction services further deteriorate the health of an already at-risk population.[96] The next section addresses five specific areas that create risks to prison populations and, by extension, to the community at large.

III. SPECIFIC PUBLIC HEALTH ISSUES IN PRISONS

(a) Communicable Diseases

(i) Epidemiological Data

Globally, countries with lower rates of incarceration tend to have lower rates of communicable diseases among their population.[97] This may

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92 Correctional Service Canada, "Document A 2017-0302" (2018), a document received in response to a request under the *Access to Information Act*, R.S.C. 1985, c. A-1.

93 Adelina Iftene, "The Pains of Incarceration: Aging, Rights, and Policy in Federal Penitentiaries" (2017) 59:1 Can. J. Corr. 63 at 73.

94 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 219; Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2014–2015* (2015) at 9, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20142015-eng.pdf.

95 Office of the Correctional Investigator of Canada, *ibid.*

96 Unlike for provincial systems, up-to-date data is available on these federal deficiencies. The Office of the Correctional Investigator, a statutory governmental monitoring mechanism for corrections, issues annual reports. These reports can be found online: http://www.oci-bec.gc.ca/index-eng.aspx.

97 Stuart A. Kinner & Jesse T. Young, "Understanding and Improving the Health of People Who Experience Incarceration: An Overview and Synthesis" (2018) 40 Epidemiol. Rev. 4 at 6.

be explained by the fact that all of these diseases are at a higher risk of transmission among prison populations due to risky behaviours (*e.g.*, unsafe drug use, unsafe tattoos, unprotected sex) and unhealthy environments (*e.g.*, overcrowding, violence). Communicable diseases include blood-borne diseases such as human immunodeficiency virus ("HIV"), hepatitis C ("HCV") and hepatitis B ("HBV"),[98] as well as opportunistic diseases (*i.e.*, one that takes advantage of an opportunity not normally available, such as a weakened immune system, and which is thus common in people with immunodeficiency) such as TB,[99] and other infectious diseases such as influenza, measles, mumps, rubella, viral hepatitis, tetanus diphtheria and sexually transmitted infections ("STIs").[100]

Rates of communicable diseases in Canadian federal prisons are generally higher than those in the community. Some examples include a TB rate of 22%, compared to 4.6% in the community,[101] and an HCV rate of 31%, compared to 1%, or 39 times lower in the community.[102] The highest HCV rates in prison were among women (37%), and particularly Indigenous women (45%).[103] The HIV/AIDS rate was 4.6%, or 15 times more frequent than in the community.[104] The highest HIV/AIDS rates were once again reported among Indigenous women, who were infected with HIV at a proportion of 11.7%.[105] In provincial institutions, 15% of men and 30% of women live with HCV, and 1-2% of men and 1-9% of women (depending on the province) with HIV.[106] While many individuals enter prisons carrying these diseases, there is also evidence suggesting that people contract diseases, including blood-borne diseases, while in

98 Fabienne Hariga, "HIV and other bloodborne viruses in prisons" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) at 45-55.

99 Masoud Dara, Dato Chorgoliani & Pierpaolo de Colombani, "TB prevention and control care in prisons" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) at 56-72.

100 Sven Todts, "Infectious diseases in prison" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) at 73-77.

101 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 217.

102 *Ibid.*

103 Correctional Service Canada, "Health Services Quick Facts: Hepatitis C Virus (HCV) Age, Gender and Indigenous Ancestry" (September 2016), online: https://www.csc-scc.gc.ca/publications/092/005007-3037-eng.pdf.

104 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 217.

105 Canadian HIV/AIDS Legal Network, "Brief to the Standing Senate Committee on Human Rights regarding its study on human rights of prisoners in the correctional system: The public health and human rights rationale for prison-based needle and syringe programs", prepared by Sandra Ka Hon Chu (Toronto: AIDSLAW, June 23, 2017) at 1, online: https://sencanada.ca/content/sen/committee/421/RIDR/Briefs/LegalNetworkandPASAN_e.pdf.

106 *Ibid.*, at 2.

prison.[107] For instance, a study conducted in Vancouver indicated that 21% of those infected with HIV and living in Vancouver at the time of the study contracted it while in prison.[108]

(ii) Prevention and Treatment

Prison in this context is both a risk and an opportunity. It is a risk due to poor prison conditions and management, as well as a lack of harm reduction services such as safe tattooing and prison needle safe exchange programs ("PNSPs"), which contribute to the spread of communicable diseases among prison populations. The generally short periods of time spent in custody followed by release to the community elevate the risk of the spread of these diseases outside prison walls.

Prison can also be an opportunity to prevent or contain the spread of such diseases. The WHO recommends that all prisoners be vaccinated for influenza, measles, mumps, rubella, viral hepatitis and tetanus diphtheria, and screened for STIs, HCV, HIV/AIDS and TB upon admission to prison and yearly thereafter if negative. Prisons with PNSP, safe tattooing programs, prevention for sexual abuse in prison, and programs to discreetly distribute condoms, dental dams, personal towels, bleach, toothbrushes and combs as well as adequate education on how to use these items would greatly support such prevention and containment.[109]

For individuals who test positively, a course of treatment started immediately, in keeping with availability in the community, would protect the health of the prison population but also, ultimately, the population at large.[110] Upon release, individuals ought to be linked with community resources and ensure that their treatment is not discontinued.[111]

However, like with other health care services, individuals currently often experience discontinuation in treatment upon release. For instance, after serving time in federal prisons and in some provincial prisons (such

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[107] Correctional Service Canada, "Health Services Quick Facts: Infectious Disease Surveillance 2014 Human Immunodeficiency Virus (HIV)" (September 2016), online: https://www.csc-scc.gc.ca/publications/092/005007-3035-eng.pdf; Correctional Service Canada, "Health Services Quick Facts: Infectious Disease Surveillance 2014 Hepatitis C Virus (HCV)" (September 2016), online: https://www.csc-scc.gc.ca/publications/092/005007-3038-eng.pdf.

[108] Canadian HIV/AIDS Legal Network, "Brief to the Standing Senate Committee on Human Rights regarding its study on human rights of prisoners in the correctional system: The public health and human rights rationale for prison-based needle and syringe programs", prepared by Sandra Ka Hon Chu (Toronto: AIDSLAW, June 23, 2017) at 2, online: https://sencanada.ca/content/sen/committee/421/RIDR/Briefs/LegalNetworkandPASAN_e.pdf.

[109] Fabienne Hariga, "HIV and other bloodborne viruses in prison" in Stefan Enggist *et al.*, eds., *Prisons and Health*, (Copenhagen: World Health Organization, 2014) at 45-53.

[110] *Ibid*.

[111] *Ibid.*

as Nova Scotia), they are no longer under the care of the GP they had been pre-incarceration. Sometimes, individuals who served a long time in prison do not have a health card, and many of them lack information on where to access health services. All of these often make it very difficult for individuals to access specialized health care or to continue treatment in the community. If the individual is released to a smaller community, such as an Indigenous community, it is nearly impossible for him or her to access such services, which are often scarce for everybody in those communities. It is why there needs to be systematic support for release individuals in general, and for those living in Indigenous communities in particular. Otherwise, not only that the opportunity to improve marginalized individuals' health is missed, but also the risk to the public health of Indigenous and other communities increases upon the release of each infected individual.

As mentioned above, CSC lists infectious disease prevention, management and control as the first priority of their 2015 Public Health Strategy.[112] In the same framework, CSC states that it looks to enhance its harm reduction strategies and to improve relations with community stakeholders in order to ensure better continuity of care upon release.[113] CSC also plans to create protocols delineating roles and responsibilities of branches and individuals in implementing this strategy. No such protocols or policy documents regarding control and management of communicable diseases are in place as of yet.

CSC offers vaccinations for Hepatitis A, HBV and influenza to all individuals upon admission and throughout their stay.[114] There is no data on the actual rates of immunization. Testing for communicable diseases, specifically TB, HCV and STIs, is available on a voluntary basis. In 2014,[115] the rate of people tested for HCV upon admission was 78% and 20% for follow-up testing.[116] The same rates were reported for HIV testing.[117]

Following a dramatic decrease in treatment and diagnosis of HCV due to funding cuts (where CSC placed a cap of 240 for people treated

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112 Correctional Service Canada, "Public Health Strategy for Offenders" (March 5, 2015), online: https://www.csc-scc.gc.ca/002/006/phs-eng.shtml.

113 *Ibid.*

114 Correctional Service Canada, "Infectious Disease Surveillance in Canadian Federal Penitentiaries 2005-2006" (March 3, 2015), online: https://www.csc-scc.gc.ca/publications/infdscfp-2005-06/p5-eng.shtml#l18.

115 This is the last CSC data available.

116 Correctional Service Canada, "Health Services Quick Facts: Infectious Disease Surveillance 2014 Hepatitis C Virus (HCV)" (September 2016), online: https://www.csc-scc.gc.ca/publications/092/005007-3038-eng.pdf.

117 Correctional Service Canada, "Health Services Quick Facts: Infectious Disease Surveillance 2014 Human Immunodeficiency Virus (HIV)" (September 2016), online: https://www.csc-scc.gc.ca/publications/092/005007-3035-eng.pdf;

annually),[118] CSC has increased its budget to four times its original for HCV treatment in 2017–2018, and all diagnosed individuals are now eligible for treatment. The number of people treated annually has reached 606.[119] Some studies suggest that high rates of treatment adherence and completion have been registered, as well as high rates of treatment continuity upon release.[120] However, other sources have reported, for the same period of time, that access to HCV treatment remained inconsistent, that there was a waiting list and that the treatment was not available in all Healing Lodges.[121]

HIV treatment is technically available in federal prisons. CSC estimates that between 2016 and 2017, "96% of newly admitted inmates accepted a voluntary blood test for HIV; 94% of inmates known to have HIV were on treatment; and 91% had viral suppression".[122] However, this treatment, like HCV, is not available in all Healing Lodges, which is of concern given the higher rates of infection among Indigenous women.[123] There were also numerous reports that half of those receiving treatment had interruptions in HIV treatment upon intake, during incarceration and upon release.[124] While, theoretically, individuals should not be placed in segregation based on HIV/HCV status, such practices have been reported.[125]

Harm reduction items available in some but not all federal prisons include: condoms, dental dams, lubricant, bleach, opioid substance therapy, educational materials and health promotion.[126] For a long time, CSC resisted introducing a needle exchange program, despite evidence

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118 Laura Eggerston, "Federal inmates treated for Hep C declined by 29%" (2015) 187:18 C.M.A.J. 1345 at 1345; Paul Webster, "Prisons face Hep C treatment funding crisis" (2016) 188:3 C.M.A.J. 178 at 178-79.

119 Paul Webster, "Dramatic budget increase for hepatitis treatment in prisons" (2017) 189:32 C.M.A.J. E1052 at E1052.

120 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 219.

121 Canadian HIV/AIDS Legal Network, "Indigenous Communities and HIV and HCV in Federal Prisons: Questions and Answers" (Toronto: AIDSLAW, April 2017) at 7, online: https://caan.ca/wp-content/uploads/2017/06/KYR_prison_EN_apr2_web-1.pdf.

122 CATIE, "HIV in Canada: A primer for service providers", online: https://www.catie.ca/en/hiv-canada/2/2-3/2-3-8.

123 Canadian HIV/AIDS Legal Network, "Indigenous Communities and HIV and HCV in Federal Prisons: Questions and Answers" (Toronto: AIDSLAW, April 2017) at 8, online: https://caan.ca/wp-content/uploads/2017/06/KYR_prison_EN_apr2_web-1.pdf.

124 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 219. See also *ibid*.

125 *Ibid.*, at 9.

126 Correctional Service Canada, "Infectious Disease Surveillance in Canadian Federal Penitentiaries 2005-2006" (March 3, 2015), online: https://www.csc-scc.gc.ca/publications/infdscfp-2005-06/p5-eng.shtml#l18.

that it is the best program for reducing the transmission of blood-borne diseases and that public health goals cannot be achieved without one.[127]

The Canadian HIV/AIDS Legal Network filed a suit against the federal government seeking the implementation of PNSPs. In part as a result of this, CSC introduced on May 8, 2018 a pilot of the PNSP in two of its institutions in Ontario and New Brunswick.[128] The best practices learned at these institutions are meant to inform a national roll-out.[129] The court case was adjourned until September 2019.[130] However, the Legal Network plans to continue with the case because "this program is sorely inadequate".[131] Despite the introduction of the needle exchange program, CSC has also maintained its aim of promoting a drug-free environment and of eradicating drug use in prison, which it maintained for so long was incompatible with a PNSP (discussed further in the next section).

In addition to drug injection, unsafe tattooing is another source of infection in prisons. Tattooing was prohibited by CSC, which sent the

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127 Canadian HIV/AIDS Legal Network, "Brief to the Standing Senate Committee on Human Rights regarding its study on human rights of prisoners in the correctional system: The public health and human rights rationale for prison-based needle and syringe programs", prepared by Sandra Ka Hon Chu (Toronto: AIDSLAW, June 23, 2017) at 1, online: https://sencanada.ca/content/sen/committee/421/RIDR/Briefs/LegalNetworkandPASAN_e.pdf; Emily van der Meulen *et al.*, "On Point: Recommendations for Prison-Based Needle and Syringe Programs in Canada" (January 2016), prepared for Ryerson University Department of Criminology, Canadian HIV/AIDS Legal Network, and Prisoners with HIV/AIDS Support Action Network; UNODC, ILO, UNDP, WHO & UNAIDS, "Policy Brief: HIV prevention, treatment and care in prisons and other closed settings: A comprehensive package of interventions" (June 2013) at Recommendation , online: https://www.unodc.org/documents/hiv-aids/HIV_comprehensive_package_prison_2013_eBook.pdf; Sandra Chu, "Clean Switch: The Case for Prison Needle and Syringe Programs in Canada" (December 2009) HIV/AIDS Pol'y & L. Rev. 14(2); World Health Organization Europe, "The Madrid Recommendation: Health protection in prisons as an essential part of public health" (Copenhagen: World Health Organization Regional Office for Europe, 2010), online: https://apps.who.int/iris/bitstream/handle/10665/108579/E93574.pdf?sequence=1&isAllowed=y.

128 News provided by the Union of Canadian Correctional Officers noted that there are six institutions offering PNSP; however, at the time of writing this could not be confirmed: Union of Canadian Correctional Officers, "Prison Needle Exchange Program – Handling Needles: Not Our Job!" *Cision* (June 7, 2019), online: https://www.newswire.ca/news-releases/prison-needle-exchange-program-handling-needles-not-our-job--882785802.html.

129 Ontario HIV Treatment Network, "Prison-based Needle and Syringe Exchange Program Launching in Federal Prisons" (May 15, 2018), online: http://www.ohtn.on.ca/prison-based-needle-and-syringe-program-launching-in-federal-prisons/; CATIE, "HIV in Canada: A primer for service providers", online: https://www.catie.ca/en/hiv-canada/2/2-3/2-3-8.

130 *Simons v. Canada (Minister of Public Safety and Correctional Service)*, [2018] O.J. No. 3223, 2018 ONSC 3741 (Ont. S.C.J.).

131 Canadian HIV/AIDS Legal Network, "Open Letter to the Government of Canada on the Evaluation of its 'Prison Needle Exchange Program'" by Dr. Ahmed Bayoumi *et al.* (Toronto: AIDSLAW, March 20, 2019), online: http://www.aidslaw.ca/site/open-letter-to-the-government-of-canada-on-the-evaluation-of-its-prison-needle-exchange-program/?lang=en.

practice underground. The Office of the Correctional Investigator ("OCI") found that there were at least 16 confirmed HIV or HCV infections between 2011 and 2017 due to unsafe tattooing.[132] In 2005, CSC introduced a safe tattooing pilot in a number of federal prisons. The harm reduction results were positive; however, the program was terminated in 2007 without any explanation.[133] Given this history, as well as the maintenance of its drug-free policy, there is concern that this will be the fate of the PNSP pilot as well.

There is little to no data on screening, testing and treatment for provincial institutions.[134] It does appear that screening for blood-borne diseases is less frequent in these facilities, and thus a large proportion of these people do not know their HCV and HIV status.[135] Neither screening nor treatment is available for HCV in most provinces.[136] None of the provinces have PSNPs or safe tattooing programs,[137] and there is no data on the consistency with which bleach and condoms are distributed.

Informal reports from medical personnel and formerly incarcerated individuals indicate that even where screening is available, a positive result is rarely followed by treatment. For example, while testing is available for both HIV and HCV in Nova Scotia, only treatment for HIV is currently available.[138] Similar informal reports from these individuals and from institutions such as the Dalhousie Legal Aid Clinic state that, at least in Nova Scotia, individuals are routinely discontinued from pre-admission treatment. There are reports of numerous individuals having waited months before being seen or being released before they ever saw a health practitioner.

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132 Office of the Correctional Investigator of Canada, *Office of the Correctional Investigator: Annual Report 2016–2017* (2017) at 18, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20162017-eng.pdf.

133 *Ibid.*

134 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 219.

135 *Ibid.*

136 Fiona Kouyoumdjian & Kathryin E. McIsaac, "Persons in correctional facilities in Canada: A key population for hepatitis C prevention and control" (2015) 106:6 Can. J. Public Health e454 at e455.

137 Canadian Treatment Action Council, "Access to HCV Treatment in Federal Institutions" (2017) at 11, online: https://ctac.ca/wp-content/uploads/2018/01/Access-to-Treatment-in-Federal-Institutions-Web-1.pdf.

138 Moira Donovan, "Lack of hep C treatment for N.S. inmates missed opportunity in disease control: Advocates" *CBC News* (March 9, 2018), online: https://www.cbc.ca/news/canada/nova-scotia/hep-c-nova-scotia-inmates-treatment-1.4568429.

Discontinuation of HIV treatment upon admission has also been reported in Ontario jails,[139] while screening and early intervention strategies are infrequent.[140] The health care system works on a reactive model and tends to only respond to acute situations.[141] In its report on health care, the John Howard Society of Ontario found that there was a disregard for prisoner health care, that institutions struggled to maintain the standard of care and that they fostered indifference for the impact prison health care had on communities.[142]

Available data suggests significant gaps at the provincial level in terms of preventing, screening and treating blood-borne diseases. The risk of contracting a disease in prison, coupled with the failure to treat individuals while incarcerated and to ensure that their care continues upon release, creates public health risks for the communities. This risk is particularly heightened by the provincial prison systems, because they incarcerate significantly more people than the federal system, the turnaround of individuals is much quicker and the health care delivery is often worse than in federal prisons.

(b) Addictions and Harm Reduction

Substance use and addictions pose a significant threat to public health. First, any type of substance addiction negatively impacts quality of life by increasing the risk of developing a host of conditions, such as heart disease, cancer, depression and more. These associated conditions add costs on both the prison and community health care systems and burdens families and caregivers. Second, substance use increases mortality both in prison and upon release, either because users develop significant medical conditions or because they overdose. Third, substance use increases the risk of violence in prison. Fourth, substance use increases the spread of communicable diseases, mainly by unsafe injection practices, but also due to the associated violence (*e.g.*, fights, sexual assault). Fifth, individuals are at a higher risk of developing an addiction while in prison due to stress and lack of meaningful activities, and they are less likely to quit while in prison. Thus, upon release, they bring their addictions to the community, with all the related risks and costs.

(i) Epidemiological Data

International data shows that 3-26% of incarcerated drug[143] users first used drugs while in prison, while up to 21% first injected drugs while

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139 John Howard Society of Ontario, "Fractured Care: Public Health Opportunities in Ontario's Correctional Institutions" (2016) at 12, online: http://johnhoward.on.ca/wp-content/uploads/2016/04/Fractured-Care-Final.pdf.

140 *Ibid.*, at 16.

141 *Ibid.*, at 14.

142 *Ibid*.

143 In this context, "drugs" refers to illegal drugs or drugs used without a medical prescription.

in prison.[144] Many incarcerated people report using drugs at the time of admission, and 1 in 10 report injecting drugs in the months prior to incarceration.[145] CSC data suggests that 34% of men and 25% of women have used drugs since arriving at their institution; 17% of those men and 14% of those women reported drug use by injection.[146] In the same study, approximately half of those who injected drugs reported sharing injection equipment, including with people who had HIV, HCV or an unknown infection status.[147] Data from the OCI shows that 52.5% of incarcerated people show signs of substance dependency.[148] In one Ontario provincial jail, out of 500 incarcerated individuals, 56% reported use of meth, crack or cocaine in the year prior to incarceration and 12.2% had injected drugs.[149]

Data on death in Canadian federal custody indicates that 76% of deaths were related to substance use and smoking.[150] In 2015–2016, there were seven deaths due to overdose in federal institutions, and in the seven years prior, there were 23.[151] The increase in 2015–2016 was due in part to the Fentanyl crisis: six out of seven deaths were attributed to Fentanyl.[152] Of those who overdosed over the seven-year period, 13% were Indigenous and all were male.[153] There is no official data available past 2016, yet based on news reports it appears that overdoses continue to

144 Heino Stöver & Andrej Kastelic, "Drug treatment and harm reduction in prisons" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 113 at 115.

145 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 217.

146 Correctional Service Canada, "Summary of Emerging Findings from the 2007 National Inmate Infectious Diseases and Risk-Behaviours Survey", report prepared by Dianne Zakaria *et al.* (March 2010) at iii, online: https://www.csc-scc.gc.ca/005/008/092/005008-0211-01-eng.pdf.

147 Correctional Service Canada, "Summary of Emerging Findings from the 2007 National Inmate Infectious Diseases and Risk-Behaviours Survey", report prepared by Dianne Zakaria *et al.* (March 2010), online: https://www.csc-scc.gc.ca/005/008/092/005008-0211-01-eng.pdf.

148 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2014–2015* (2015) at 7, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20142015-eng.pdf.

149 Fiona G. Kouyoumdjian *et al.*, "Drug use prior to incarceration and associated socio-behavioural factors among males in a provincial correctional facility in Ontario, Canada" (2014) 105 Can. J. Public Health 198 at 199, online: https://pdfs.semanticscholar.org/c5cc/f68ce31b27880db6c36d83da72a70f79f6c5.pdf.

150 Office of the Correctional Investigator of Canada, *Office of the Correctional Investigator Annual Report: 2017-2018* (2018) at 34, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20172018-eng.pdf.

151 Correctional Service Canada, *Annual Report on Deaths in Custody: 2015/2016 (N^o SR-17-02)* (November 2017) at 44, online: https://www.csc-scc.gc.ca/research/092/005008-3010-en.pdf.

152 *Ibid.*, at 43.

153 *Ibid.*, at 44.

occur in high numbers, also in part due to the Fentanyl crisis. For instance, it was reported that in a single penitentiary in Quebec, there were 37 overdoses in three months in 2018,[154] while in an Ontario penitentiary there were 11 overdoses reported in one month in 2018.[155]

Provincial facilities face the same crisis, even though official statistics are lacking. In Alberta, there were 145 overdoses in 2015[156] and 122 from January 2016 to end of November 2017.[157] In Ontario, CTV News reported 10 overdoses in one week in a single detention centre in 2017.[158] In Manitoba, there were 47 deaths by overdose in provincial facilities in 2016.[159] Numerous other reports have noted overdoses in provincial jails across the country in the last five years.[160] The WHO

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154 "Opioid crisis: 37 overdoses at Donnacona penitentiary over 3-month period" *CBC News* (April 6, 2019), online: https://www.cbc.ca/news/canada/montreal/opioid-overdose-donnacona-prison-quebec-1.5087763.

155 Ian MacAlpine, "Prison sees 11 overdoses since mid-April" *The Kingston Whig-Standard* (May 7, 2018), online: https://www.thewhig.com/2018/05/07/prison-sees-11-overdoses-since-mid-april/wcm/3dd0bd19-de60-2306-937c-f110c4b79583.

156 The Canadian Press, "Alberta prison overdoses prompt officials to question whether fentanyl to blame" *Global News* (August 20, 2015), online: https://globalnews.ca/news/2176750/alberta-prison-overdoses-prompt-officials-to-question-whether-fentanyl-to-blame/.

157 Kim Smith, "Opioid overdoses a growing concern for workers in Alberta correctional facilities: 'It's disturbing'" *Global News* (December 27, 2017), online: https://globalnews.ca/news/3935678/opioid-overdoses-a-growing-concern-for-workers-in-alberta-correctional-facilities-its-disturbing/.

158 CTV News, "Inmates claim Ontario detention centre plagued by fentanyl-related overdoses" (May 14, 2017), online: https://www.ctvnews.ca/canada/inmates-claim-ontario-detention-centre-plagued-by-fentanyl-related-overdoses-1.3413162. For reports of overdoses in other Ontario jails, see CTV News, "Fatal inmate overdoses highlight drug smuggling problem in Ontario jails" (February 19, 2015), online: https://www.ctvnews.ca/canada/fatal-inmate-overdoses-highlight-drug-smuggling-problem-in-ontario-jails-1.2243627.

159 Josh Crabb, "New Manitoba numbers released on fentanyl overdose deaths" *CTV News Winnipeg* (May 10, 2017), online: https://winnipeg.ctvnews.ca/new-manitoba-numbers-released-on-fentanyl-overdose-deaths-1.3407035.

160 Amy Dempsey, "Toronto superjail sees second inmate death in a week" *The Toronto Star* (February 17, 2015), online: https://www.thestar.com/news/crime/2015/02/17/toronto-superjail-sees-second-inmate-death-in-a-week.html; Jake Kivanc, "Two Inmates Overdosed at a Yellowknife Prison But Authorities Don't Know on What" *The Vice* (December 3, 2015), online: https://www.vice.com/en_ca/article/mvxkxy/two-inmates-overdosed-at-a-yellowknife-prison-but-authorities-dont-know-on-what; Nicole O'Reilly & Molly Hayes, "Dying behind bars: Overdose deaths in Ontario jails" *The Hamilton Spectator* (December 12, 2015), online: https://www.thespec.com/news-story/6181126-dying-behind-bars-overdose-deaths-in-ontario-jails/; Allan Benner, "Province investigating detention centre overdoses" *St. Catherines Standard* (March 26, 2018), online: https://www.stcatharines standard.ca/news-story/8352239-province-investigating-detention-centre-overdoses/; Ariana Kelland, "2 recent overdoses in HMP, prison official confirms" *CBC News* (May 10, 2017), online: https://www.cbc.ca/news/canada/newfoundland-labrador/overdoses-hmp-fentanyl-1.4108304; CBC News, "Fentanyl-laced drugs suspected as cause of nine overdoses at Saskatoon jail in two weeks" (November 23, 2018), online: https://www.cbc.ca/news/canada/saskatoon/saskatoon-jail-drug-overdose-fentanyl-

recommends that front-line workers should have access to, and be trained to administer, the opioid antagonist naloxone in order to respond to emergencies.[161] Officers, however, do not always receive this training across Canada, nor is naloxone always available to them.

Finally, data shows that individuals are significantly more likely to die of an overdose immediately following release due to a decrease in tolerance as a result of abstinence, consumption of different drugs while in prison, or due to a discontinuation in substitute treatments upon release. Data in British Columbia shows that 66% of those who died of overdoses in the community between 2016 and 2017 had been released from provincial prisons.[162] In Ontario, a study indicates that between 2007 and 2013, 1 in 10 people released from provincial custody died of an overdose within one year of release. About 20% of those occurred one week after release, and 9% within two days.[163] That means that released individuals are 12 times more likely to die of a drug overdose compared to the general public.[164]

(ii) Security Approaches to Substance Use

All Canadian prisons have a drug-free policy. At the federal level, the drug-free stance infiltrates both the legislation and the policies. The CSC National Drug Strategy states that regardless of the existence of an addiction, the prisoner is "expected to remain 'drug and alcohol free' for the duration of his or her incarceration".[165] The prisoner will be monitored, and disciplinary sanctions applied if he or she does not respect the policy.[166]

Breaches of this policy have negative consequences on the individual, including a suspension or restrictions on receiving visits, limitations on potential prison jobs and programs, and ineligibility for early release. The charges and the disciplinary sanctions will go on the

1.4918207; Salmaan Farooqui, "Inmate dies of fentanyl overdose at Calgary Correctional Centre" *Calgary Herald* (June 9, 2016), online: https://calgaryherald.com/news/local-news/inmate-dies-of-fentanyl-overdose-at-calgary-correctional-centre.

161 World Health Organization, *Community Management of Opioid Overdose* (Geneva: World Health Organization, 2014) at 8.

162 Andrea Woo, "Two-thirds of B.C. overdose victims spent time in prison, report finds" *The Globe and Mail* (April 5, 2018), online: https://www.theglobeandmail.com/canada/british-columbia/article-two-thirds-of-bc-overdose-victims-spent-time-in-prison-report-finds/.

163 Emily Groot *et al*., "Drug Toxicity Deaths after Release from Incarceration in Ontario, 2006-2013: Review of Coroner's Cases" (2016) 11:7 PLoS One 1 at 3-4, online: https://doi.org/10.1371/journal.pone.0157512.

164 *Ibid*.

165 Correctional Service Canada, Commissioner's Directive CD 585, "National Drug Strategy" (May 8, 2007) at para. 9, online: https://www.csc-scc.gc.ca/acts-and-regulations/585-cd-eng.shtml.

166 *Ibid*., at paras. 22-27.

individual's record and will negatively impact his or her chances of obtaining early release without exceptions. While not listed, many persons have informally reported that the use of segregation is a common punishment for a drug-related charge.

To enforce this policy, all federal institutions follow the Urinalysis Program.[167] The policy states that each institution shall create a random list of at least 10% of the prison's population to be tested monthly. The analysis is done by contracted toxicologists, and the collection is done under direct observation.[168] In addition to the random sample, a urinalysis is authorized when required for participation in a prescribed program or when the officer "has reasonable grounds to suspect that an offender has breached an abstinence condition of his/her conditional release or long-term supervision order". [169]

Both policies, as well as the CCRA,[170] reiterate that failure to provide a sample or a positive result on the urinalysis are considered major disciplinary offences, thus leading to very serious consequences.[171] Most provincial legislation also includes provisions regarding mandatory urinalyses. Failure to submit to testing or a positive result will have disciplinary consequences.[172]

This strict drug-free policy, coupled with involuntary urinalyses and disciplinary measures, leads to health hazards and departs from public health preventive goals. First, the sudden discontinuing of the use of substances upon admission is dangerous, and detoxification should only occur in specialized facilities, under supervision and care.[173] Perhaps this is because the individual may go into withdrawal, which could have negative and potentially fatal consequences on health. If the individual survives withdrawal, there is no evidence that they will not return to use

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167 *Ibid.*, at para. 10; Correctional Service Canada, Commissioner's Directive CD 566-10, "Urinalysis Testing" (June 18, 2015), online: https://www.csc-scc.gc.ca/acts-and-regulations/566-10-cd-eng.shtml.

168 Commissioner's Directive CD 566-10, *ibid*., at paras. 2 and 44.

169 *Ibid*., at para. 6(a)(ii) ; *Corrections and Conditional Release Act*, S.C. 1992, c. 20, ss. 54(c), 55(a), (b).

170 *CCRA*, *ibid.*, s. 40(k), (l).

171 Correctional Service Canada, Commissioner's Directive, CD 585, "National Drug Strategy" (May 8, 2007) at para. 23, online: https://www.csc-scc.gc.ca/acts-and-regulations/585-cd-eng.shtml; Correctional Service Canada, Commissioner's Directive 566-10, "Urinalysis Testing" (June 18, 2015) at paras. 58 and 59, online: https://www.csc-scc.gc.ca/acts-and-regulations/566-10-cd-eng.shtml.

172 See *e.g.*, *Correctional Services Act*, C.C.S.M. c. C230, s. 16(1); *Corrections Act*, R.S.A. 2000, c. C-29, s. 14(2)-(3); *Correction Act*, S.B.C. 2004, c. 46, s. 20.

173 Heino Stöver & Andrej Kastelic, "Drug treatment and harm reduction in prisons" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 113 at 118.

upon release. In fact, the decrease in tolerance is one of the reasons why the rates of overdose are so high upon release.[174]

Second, this policy dissuades people from asking for help with their addictions. As discussed below, Opioid Substitute Therapy ("OST") is available in federal penitentiaries, and to a lesser extent in provincial jails. However, there have been reports that requests for OST have led to disciplinary charges under the CCRA and the two corresponding policies.[175]

Third, the drug-free policy may negatively impact the successful implementation of other harm reduction initiatives such as PNSP (discussed above) and safe injection sites. CSC has indicated that they are piloting a prevention site in an Alberta institution,[176] in light of the high number of recent overdoses and the Fentanyl crisis. It appears that this latter initiative has wider support from the Union of Canadian Correctional Officers than the PNSP program, which has been met with significant resistance from the Union.[177] It remains to be seen to what degree these important initiatives will be expanded or whether they will have the same fate as the safe tattooing pilot.

(iii) Therapeutic Approaches to Opioid Dependency

It has been proven time and again that zero tolerance is ineffective in addressing opioid dependency.[178] From a public health standpoint, OST appears to be the best option.[179] OST is available, under different models,

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174 On this see, *e.g.*, Emily Groot *et al.*, "Drug Toxicity Deaths after Release from Incarceration in Ontario, 2006-2013: Review of Coroner's Cases" (2016) 11:7 PLoS One 1, online: https://doi.org/10.1371/journal.pone.0157512.

175 Canadian HIV/AIDS Legal Network, "Indigenous Communities and HIV and HCV in Federal Prisons: Questions and Answers" (Toronto: AIDSLAW, April 2017) at 8-9, online: https://caan.ca/wp-content/uploads/2017/06/KYR_prison_EN_apr2_web-1.pdf.

176 Tyler Dawson, "Federal prison in Alberta expected to be first to open supervised drug injection site" *National Post* (June 7, 2019), online: https://nationalpost.com/news/canada/federal-prison-in-alberta-expected-to-be-first-to-open-supervised-drug-injection-site.

177 CBC News, "Corrections officers protest needle exchange program in federal prisons" (May 1, 2019), online: https://www.cbc.ca/news/canada/kitchener-waterloo/grand-valley-institution-for-women-needle-exchange-supervised-consumption-site-1.5118468.

178 Stuart A. Kinner & Jesse T. Young, "Understanding and Improving the Health of People Who Experience Incarceration: An Overview and Synthesis" (2018) 40 Epidemiol. Rev. 4 at 6.

179 Heino Stöver & Andrej Kastelic, "Drug treatment and harm reduction in prisons" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 113 at 118; L. Degenhardt *et al.*, "The impact of opioid substitution therapy on mortality post-release from prison: Retrospective data linkage study" (2014) 109:8 Addiction 1306; S.M. Bird *et al.*, "Impact of opioid substitution therapy for Scotland's prisoners on drug-related deaths soon after prisoner release" (2015) 110:10 Addiction 1617.

in communities across Canada, in all provinces and territories.[180] Studies show that among those undergoing OST, there has been a significant reduction in the use of illegal opioids, injecting, syringe sharing and the risk of overdose.[181] For those in prison, it has also increased the treatment uptake upon release[182] and decreased the risk of dying of an overdose.[183]

In federal prisons, a methadone program is available for those who are eligible for it. Individuals who are already on methadone when they enter prison will be allowed to remain on the drug. People can also begin the program while in prison if they have been diagnosed with dependence on intravenous opioids, have a history of failed attempts at treatment, and agree to the terms and conditions of OST.[184]

In and of themselves, these requirements seem problematic. By "treatment", CSC is referring to attempts towards abstinence or detoxication. However, managed detoxification is not available in prisons. Furthermore, there is evidence that the relapse rate is high after detoxification programs and these are effective only for a minority of users. The WHO recommends that OST be the starting point and be widely available for everyone in prisons.[185]

There is a long waiting list for those starting the OST program in federal prisons. Some categories of opioid-dependant individuals have priority and should be immediately started on OST. These include pregnant women, those at risk of relapse, individuals who are HIV-positive or who require HCV treatment, have a history in the last three months of a life-threatening overdose directly related to the opioid dependency, or will be released within the next six months.[186]

Individuals who are on OST in prison should be supported by liaising with a community provider prior to release so that they are not cut

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180 Janine Luce & Carol Strike, "A Cross-Canada Scan of Methadone Maintenance Treatment Policy Developments: A Report Prepared for the Canadian Executive Council on Addictions" (April 2011), online: https://www.ceca-cect.ca/pdf/CECA%20MMT%20Policy%20Scan%20April%202011.pdf.

181 Dagmar Hedrich *et al.*, "The effectiveness of opioid maintenance treatment in prison settings: A systematic review" (2012) 107:3 Addiction 501 at 514.

182 *Ibid.*, at 511.

183 S.M. Bird *et al.*, "Impact of opioid substitution therapy for Scotland's prisoners on drug-related deaths soon after prisoner release" (2015) 110:10 Addiction at 1617-24.

184 Correctional Service Canada, *Specific Guidelines for the Treatment of Opiate Dependence (Methadone/Suboxone®)*, cited in Canadian HIV/AIDS Legal Network, "Indigenous Communities and HIV and HCV in Federal Prisons: Questions and Answers" (Toronto: AIDSLAW, April 2017) at 9, online: https://caan.ca/wp-content/uploads/2017/06/KYR_prison_EN_apr2_web-1.pdf.

185 Heino Stöver & Andrej Kastelic, "Drug treatment and harm reduction in prisons" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 113 at 121-22.

186 *Ibid.*

off.[187] That has not always been the case.[188] In addition, not all Healing Lodges offer an OST program.[189] There have also been reports of individuals being cut off methadone as punishment for poor behaviour.[190] Withholding treatment as a disciplinary method is unethical and a public health hazard.

There is little to no information regarding OST or other treatments in provincial systems. Support groups such as Alcoholics Anonymous or Narcotics Anonymous are generally available due to the work of community volunteer groups. In some places, including Ontario and federal facilities, cognitive-behavioural therapy is available; however, evidence shows that this does not reduce substance use after release.[191] The only program shown to reduce mortality in prison and post-release is OST.[192] In Nova Scotia, an individual entering a provincial jail while on methadone is permitted to continue. However, the policy does not allow for the inception of OST while in prison. This appears to be a common practice across the globe.[193] It is nonetheless a problematic practice given that many incarcerated people come from marginalized communities and face challenges accessing health care in their communities. In other provinces, prison treatment for addictions is altogether non-existent.[194] In Ontario, OST is available but there are many barriers in accessing it both during incarceration and upon release.[195]

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187 Canadian HIV/AIDS Legal Network, "Indigenous Communities and HIV and HCV in Federal Prisons: Questions and Answers" (Toronto: AIDSLAW, April 2017) at 10, online: https://caan.ca/wp-content/uploads/2017/06/KYR_prison_EN_apr2_web-1.pdf.

188 *Ibid.*

189 *Ibid.*

190 *Ibid.*

191 L.G. Forsberg *et al.*, "Motivational interviewing delivered by existing prison staff: A randomized controlled study of effectiveness on substance use after release" (2011) 46:12 Subst. Use Misuse 1477; C. Zlotnick, J. Johnson & L.M. Najavits, "Randomized controlled pilot study of cognitive-behavioral therapy in a sample of incarcerated women with substance use disorder and PTSD" (2009) 40:4 Behav. Ther. 325.

192 L. Degenhardt *et al.*, "The impact of opioid substitution therapy on mortality post-release from prison: Retrospective data linkage study" (2014) 109:8 Addiction 1306; Janine Luce & Carol Strike, "A Cross-Canada Scan of Methadone Maintenance Treatment Policy Developments: A Report Prepared for the Canadian Executive Council on Addictions" (April 2011), online: https://www.ceca-cect.ca/pdf/CECA%20MMT%20Policy%20Scan%20April%202011.pdf.

193 Heino Stöver & Andrej Kastelic, "Drug treatment and harm reduction in prisons" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 113 at 121-22.

194 Marlene Jesso *et al.*, "Newfoundland and Labrador Corrections and Community Services: Deaths in Custody Review", report prepared for the Newfoundland and Labrador Minister of Justice and Public Safety (December 12, 2018) at 46, online: https://www.justice.gov.nl.ca/just/publications/pdf/Death_Custody_Review.pdf.

195 Emily Groot *et al.*, "Drug Toxicity Deaths after Release from Incarceration in Ontario, 2006-2013: Review of Coroner's Cases" (2016) 11:7 PLoS One 1 at 3-4, online: https://doi.org/10.1371/journal.pone.0157512.

Thus, there are gaps in the availability of OST during incarceration and post-incarceration, a lack of other harm reduction methods such as safe injection sites and PNSPs, together with mandatory urinalyses and disciplinary responses to addictions. These endanger the lives and health of incarcerated persons, correctional workers and, by extension, the communities to which they return.

As discussed in Part IV of this chapter, the drug-free policy and its corresponding practices, including a lack of safe injection sites, PNSPs, inconsistent availability of OST, discontinuity in care upon intake and release, difficulties responding adequately to overdoses, as well as the disciplinary responses to addictions, all raise significant ethical and legal concerns, especially related to statutory and Charter breaches. In addition, while Canadian data is lacking, it is known that Indigenous prisoners have higher and different needs for addiction treatment.[196] Gaps in such interventions disproportionately impact these individuals.

(c) Mental Health and Solitary Confinement

(i) Epidemiological Data

The rates of mental health needs, as well as rates of suicide attempts and substance use and addictions, both in federal and provincial systems, are much higher than in the general population, as exemplified below in this section. The prison environment, coupled with inadequate health services, exacerbates mental illness symptoms and, more often than not, individuals return to the community in worse mental shape than when they entered prison. In addition to the devastating effects on the individual, this negatively impacts the public health of the community the individual returns to: it poses a public safety risk and it burdens the health care system and families.

A study conducted by CSC among men indicated that over 70% lived with mental illnesses and addictions: 44.1% lived with anti-social personality disorder, 16.9% with mood disorders, 3.3% with psychosis, 29.5% with anxiety disorders and 15.9% with borderline personality disorder.[197] Rates of Fetal Alcohol Spectrum Disorder[198] ("FASD") can

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196 Heino Stöver & Andrej Kastelic, "Drug treatment and harm reduction in prisons" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) at 139.

197 Correctional Service Canada, "National Prevalence of Mental Disorders among Incoming Federally-Sentenced Men Offenders", report prepared by J.N. Beaudette, J. Power & L.A. Stewart (Research Report, R-357) (February 2015).

198 Fetal Alcohol Spectrum Disorder is not itself classified as a mental illness; however, it is disproportionately associated with mental illness, and it is sometimes misdiagnosed as one. See *e.g.*, Jacqueline Pei, Kennedy Denys, Janet Hughes & Carmen Rasmussen, "Mental health issues in fetal alcohol spectrum disorder" (2011) 20:5 Journal of Mental Health 438.

vary between 9.8% and 23.3%. A CSC study showed that in 2011, 10% of all admissions met all criteria for FASD, and 15% met at least some criteria.[199] This rate is 10 times higher than in the general population.[200]

Of all those federally incarcerated, 6.7% had a history of self-harm, while the rate among Indigenous individuals was 9.1%, and among women was 11.7%.[201] In 2013–2014 there were 578 self-harm incidents from 60 different people. Over a 10-year period, the average of prison suicides per year was 10.[202]

Men in provincial custody in Alberta were found to have a rate of mental illness of 91.7%, compared to 43.7% in the general population, and in particular 56.7% (versus 8.6%) for anti-social personality disorder, 22.8% (versus 12.0%) for affective disorders, 2.2% (versus 0.5%) for schizophrenia) and 1.1% (versus 0.4%) for cognitive impairment. Attempted suicides had a rate of 22.8%, which was a rate over seven times higher than that of the general population.[203] In British Columbia, the rate of mental illness was two to three times higher for provincial prisoners than for the general population, especially for mood disorders, schizophrenia, anxiety disorders and eating disorders.[204] In Ontario provincial institutions, 41.1% of prisoners presented at least one severe symptom of mental illness. Women and Indigenous individuals presented higher rates of mental illness and more numbers of severe symptoms than non-Indigenous men.[205]

(ii) Mental Health Services

Given the high rates of individuals with undiagnosed and misdiagnosed mental illness entering institutions, prisons have been deemed by experts as a unique opportunity for screening, diagnosis and

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199 Correctional Services Canada, "Fetal Alcohol Spectrum Disorder (FASD) in a correctional population: Prevalence, screening and characteristics", report prepared by P.H. MacPherson, A.E. Chudley & B.A. Grant (Research Report R-247) (June 2011).

200 *Ibid*.

201 Office of the Correctional Investigator of Canada, "Administrative Segregation in Federal Corrections: 10 Year Trends", Catalogue Number: PS104-12/2015E-PDF (2015) at 12.

202 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2014–2015* (2015) at 19, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20142015-eng.pdf.

203 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 217.

204 *Ibid.*

205 Gregory P. Brown, John P. Hirdes & Brant E. Fries, "Measuring the prevalence of current, severe symptoms of mental health problems in a Canadian correctional population: Implications for delivery of mental health services for inmates" (2015) 59:1 Int'l J. Off. Ther. & Comp. Crim. 27 at 41-43.

treatment of mental illness in individuals, particularly those from marginalized communities.[206]

As discussed below, "essential health care" is offered in insufficient quality and quantity, while non-essential health care is almost non-existent. Provision of adequate mental health services is very challenging given the significant understaffing and security barriers. CSC encounters difficulties in recruiting competent psychiatrists and psychologists. In 2013, a third of psychologist positions were vacant. These positions were sometimes filled by non-licensed staff, unable to deliver the same range of services as a licensed psychologist.[207]

The RTCs provide treatment for prisoners in an acute stage of mental illness (*e.g.*, psychotic episodes, suicidality). Due to the lack of beds, however, the care they provide rarely extends past that. There is no treatment centre for women. Rather, women with acute psychiatric conditions are often treated in male RTCs and isolated from the rest of the prisoners in a segregation-like environment.[208] Currently, there are under 200 RTC beds for men and under 20 for women.[209] A few years prior, the OCI estimated that the CSC would need 500 acute psychiatric beds and 1,000 intermediate ones merely to meet the demands at that point in time.[210] An independent review of RTCs found that there is one psychiatrist for 49 beds, one psychologist for 33 beds and one nurse for 51 beds.[211] The independent reviewer also found that both officers and mental health staff are not trained to deal with forensic patients, the assessment tools used to screen patients and admit them to RTCs are inadequate and clinically irrelevant, the physical infrastructure is "seriously problematic", and an increasing number of RTC beds are used for aging prisoners who are unsafe in prisons.[212]

A recent report from Newfoundland and Labrador found that 29% of the mental health needs were met in institutions, and that most people did not have

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206 Graham Durcan & Jan Cees Zwemstra, "Mental health in prison" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 87 at 91.

207 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2012–2013* (2013) at 16, online: http://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20122013-eng.pdf.

208 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2014–2015* (2015) at 14, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20142015-eng.pdf.

209 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2017–2018* (2018) at 21, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20172018-eng.pdf.

210 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2014–2015* (2015) at 14-15, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20142015-eng.pdf.

211 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2017–2018* (2018) at 21, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20172018-eng.pdf.

212 *Ibid.*, at 22.

access to mental health medication due to security constraints.[213] The Commission that wrote this report found that the suicide assessment tool was inadequate and that it was a contributing cause to the high suicide rates.[214] Due to significant understaffing, there were long wait times for seeing a psychiatrist and the focus was on acute situations. As a result, the most common response to mental illness and suicidal ideation was segregation, suicide watch and the suicide gown.[215] Finally, the Commission noted that discontinuation of treatment between prison and release was very common. Once incarcerated, individuals automatically lost their primary care provider in the community. As a result, upon release, they would have no health care provider.[216]

In Ontario, as a result of a human rights claim by a person with a mental health disability, the province entered into a settlement (known as the *Jahn* settlement) that contained 10 public interest remedies.[217] These remedies included the obligation to screen every incoming prisoner for mental health issues, to provide mental health training to all officers, to have adequately trained and sufficient medical personnel, and to provide an adequate treatment plan to all those in need.[218] Yet, the province failed to enforce these remedies. In January 2018, the province and the Ontario Human Rights Commission reached an agreement to appoint the Honourable Justice David Cole and Professor Kelly Hannah-Moffatt to monitor and provide advice on the implementation of these remedies, respectively. Justice Cole's report is due in September 2019.[219] In addition to pointing out the significant gaps in health care in provincial institution, the *Jahn* case is relevant from another perspective. The case stands for the reluctance of correctional institutions to live up to their obligations.

(iii) Disciplinary Responses to Mental Illness

In the absence of proper training and adequate resources for addressing mental illness, the most common response is the use of force and/or disciplinary measures. The OCI has reiterated concerns regarding the common

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213 Marlene Jesso *et al.*, "Newfoundland and Labrador Corrections and Community Services: Deaths in Custody Review", report prepared for the Newfoundland and Labrador Minister of Justice and Public Safety (December 12, 2018) at 42-44, online: https://www.justice.gov.nl.ca/just/publications/pdf/Death_Custody_Review.pdf.

214 *Ibid.*, at 50.

215 *Ibid.*, at 50-51.

216 *Ibid.*, at 52.

217 *Jahn v. Ontario (Minister of Community Safety and Correctional Services)*, Sch. A (September 24, 2013, Ont. Human Rights Tribunal), online: http://www.ohrc.on.ca/sites/default/files/Jahn%20Schedule%20A_accessible.pdf.

218 *Ibid.*, at 1-3.

219 Ontario Ministry of the Solicitor General, "Jahn Settlement: Special Advisors Appointed for Adult Corrections" (October 31, 2018), online: http://www.mcscs.jus.gov.on.ca/english/Corrections/JahnSettlement.html.

use of restraints to prevent prisoners from harming themselves.[220] These restraints (known as Pinel Restraints) are used as "medical devices" (implying some therapeutic purpose) but they are neither authorized nor put on by medical personnel. Rather, the decision to use restraints is at the discretion of the warden, and the restraints are secured by correctional officers.[221]

In addition, while "use of force" incidents must be reported, the use of restraints to prevent self-harm are not deemed "use of force" but rather "consensual" or "cooperative" use of force, and are not reported. As the OCI pointed out, this does not meet any legal standard of voluntary, valid and informed consent.[222] These practices, as well as the CSC policies that mandate such practices, fly in the face of international prison standards that require that restraints only be used as a last resort, and never as punishment or retaliation.[223]

(iv) Solitary Confinement and Mental Illness[224]

International standards prohibit the use of solitary confinement (isolation for upwards of 22 hours without meaningful human contact) of any form (disciplinary, administrative, clinical) for people with mental disabilities.[225] Prolonged solitary confinement (over 15 consecutive days)[226] constitutes "cruel and unusual punishment" and is prohibited.[227] Solitary confinement shall only be used as a last resort, and never for people suffering from mental or physical illnesses as it can exacerbate their symptoms.[228]

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220 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2016–2017* (2017) at 12, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20162017-eng.pdf.

221 Correctional Service Canada, Commissioner's Directive CD 567, "Management of Incidents" (January 15, 2018), online: https://www.csc-scc.gc.ca/politiques-et-lois/567-cd-eng.shtml; Correctional Service Canada, Commissioner's Directive CD 843, "Interventions to Preserve Life and Prevent Serious Bodily Harm" (August 1, 2017), online: https://www.csc-scc.gc.ca/acts-and-regulations/843-cd-eng.shtml; Correctional Service Canada, Guideline 800-2, "Physical Restraints for Medical Purposes" (November 18, 2013), online: https://www.csc-scc.gc.ca/acts-and-regulations/800-2-gl-eng.shtml.

222 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2016–2017* (2017) at 13, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20162017-eng.pdf.

223 *United Nations Standard Minimum Rules for the Treatment of Prisoners (the Nelson Mandela Rules)*, U.N. GA Res. 70/175 (17 December 2015), Rule 47(2)(b).

224 In this chapter, solitary confinement is discussed separately from disciplinary responses to mental illness (above), because, while solitary confinement can be of disciplinary nature, it can also be enforced for non-disciplinary reasons. Both disciplinary and non-disciplinary forms have similar effects on individual and public health, as discussed here. See also Chapter 12 of this edition, C. Tess Sheldon, "Public Mental Health Law in Canada".

225 *United Nations Standard Minimum Rules for the Treatment of Prisoners (the Nelson Mandela Rules)*, U.N. GA Res. 70/175 (17 December 2015), Rule 44.

226 *Ibid*.

227 *Ibid.*, Rule 43(1).

228 *Ibid*., Rule 45(2).

In Canada, solitary confinement is often referred to in the legislation as closed confinement,[229] segregated confinement[230] or segregation (disciplinary if as a result of an offence, or administrative for any other reason).[231]All correctional legislation in Canada permits the use of some form of segregation, with varying degrees of limits.[232]

The CCRA regulates disciplinary segregation as a form of punishment limited to 30 days, not exceeding 45 days.[233] Administration segregation has no cap and can be used when:

> (*a*) the inmate has acted, has attempted to act or intends to act in a manner that jeopardizes the security of the penitentiary or the safety of any person and allowing the inmate to associate with other inmates would jeopardize the security of the penitentiary or the safety of any person;
>
> (*b*) allowing the inmate to associate with other inmates would interfere with an investigation that could lead to a criminal charge or a charge under subsection 41(2) of a serious disciplinary offence; or
>
> (*c*) allowing the inmate to associate with other inmates would jeopardize the inmate's safety.[234]

Commissioner's Directive CD 709, "Administrative Segregation" imposes a prohibition of administrative segregation for individuals who have "serious mental illness with significant impairment".[235] However, this legislation is not compliant with international standards, as it ignores the prohibition on prolonged segregation and fails to prohibit segregation for people with any mental disorders.[236] As of March 31, 2017, there were 414 people in segregation, of whom 36.5% were Indigenous. The average length of stay was 23 consecutive days,[237] falling squarely within the UN definition of prohibited prolonged segregation.[238] Such approaches are

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229 *Correctional Services Act*, S.N.S. 2005, c. 37, ss. 74-75.

230 *Corrections Act*, R.S.N.W.T. 1988, c. C-22, s. 22.

231 *Corrections and Conditional Release Act*, S.C. 1992, c. 20, s. 31.

232 *Correctional Services Act*, C.C.S.M. c. C230, s. 41(1); *Correctional Services Act*, S.N.S. 2005, c. 37, ss. 74-75; *Corrections Act*, R.S.N.W.T. 1988, c. C-22, s. 22.

233 *Corrections and Conditional Release Act*, S.C. 1992, c. 20, s. 44(1)(f).

234 *Ibid.*, s. 31(3).

235 Correctional Service Canada, Commissioner's Directive CD 709, "Administrative Segregation" (August 1, 2017), online: https://www.csc-scc.gc.ca/lois-et-reglements/709-cd-eng.shtml.

236 *United Nations Standard Minimum Rules for the Treatment of Prisoners (the Nelson Mandela Rules)*, U.N. GA Res. 70/175 (December 17, 2015), Rules 15 and 46.

237 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2017–2018* (2018) at 40-41, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20172018-eng.pdf.

238 *United Nations Standard for Minimum Rules for the Treatment of Prisoners (The Nelson Mandela Rules)*, U.N. GA Res. 70/175 (17 December 2015), Rule 43(1).

detrimental to the mental health of individuals, to their reintegration and to the community to which they return.

Individuals with mental disorders are more likely to be segregated, and segregated individuals are more likely to develop mental illnesses or to have their symptoms exacerbated.[239] The psychological effects of segregation range from acute to chronic, depending on the length of time and whether individuals had any previous history of mental illness or trauma. They include anxiety (from tension to full-blown panic attacks), depression (from low mood to clinical depression), anger (from irritability to rage), cognitive disturbances (from lack of concentration to confused states), perceptual distortions (from hypersensitivity to hallucinations), paranoia and psychosis (from obsessional thoughts to full-blown psychosis), and self-harm and suicide.[240] The acute symptoms become chronic through the passage of time spent in segregation and the chances of successful reintegration in society decreases. The constellation of unique symptoms has been called "isolation syndrome", described as "an acute organized brain syndrome: delirium, characterized by a decreased level of alertness, EEG abnormalities … perceptual and cognitive disturbances, fearfulness, paranoia, and agitation; and random, impulsive and self-destructive behaviour".[241]

The lack of beds and sufficient staff in RTCs causes most individuals to be diverted to segregation or clinical seclusion cells.[242] Individuals who attempt self-harm or are deemed at risk for self-harm are placed under suicide watch, which is in essence a more restrictive form of segregation. According to CSC policy, the individual will be placed in an observation cell with only a security gown, a security mattress and blanket, fluids and finger foods, and hygiene items that do not present a risk.[243] The notorious case of Ashley Smith, who died in an observation cell while correctional officers watched, is but one example of the fact that such treatment does not prevent harm. Rather, such treatment and environment are potentially harmful and unsafe, and deepen emotional distress.[244] This does not constitute "treatment".[245]

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239 Sharon Shalev, "Solitary confinement as a prison health issue" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 27 at 29.

240 *Ibid.*, at 28.

241 *Ibid*., at 29.

242 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2017–2018* (2018) at 21, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20172018-eng.pdf.

243 Correctional Service Canada, Guideline 800-2, "Physical Restraints for Medical Purposes" (November 18, 2013), online: https://www.csc-scc.gc.ca/acts-and-regulations/800-2-gl-eng.shtml.

244 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2016–2017* (2017) at 13, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20162017-eng.pdf.

245 On what constitutes treatment see, *e.g.*, World Health Organization, *Diagnosis and Management Guidelines for Mental Disorders in Primary Care* (Toronto: Hogrefe & Huber

Unfortunately, segregation continues to be the norm for a number of reasons. First, it is a management tool: absent the ability to control behaviour by treatment, individuals are isolated from everyone else. Second, people with mental illnesses tend to act out more, and as a result, they receive punishments which include disciplinary segregation. Third, they are more vulnerable, and therefore placed in segregation for their own protection.

A study showed that in 2015, 48.1% of all those incarcerated and 55.9% of Indigenous prisoners had at some point experienced segregation. The people most likely to experience segregation were those with cognitive issues (68.8% versus 47.5%), with diagnosed mental illnesses (63.2% versus 48%) and with lower mental ability (61.6% versus 47.8%). Of those who have been in RTCs, 68.6% experienced segregation; 78.9% of the women with RTC history have experienced segregation, and 72.5% of Indigenous individuals who have been in RTCs have also been in segregation.[246] The risk of self-harm and suicide is much higher for those in segregation or those who have experienced segregation: 86.6% of prisoners, 85% of women and 88.5% of Indigenous individuals engaging in self-harm had a history of segregation.[247]

Two recent cases have found that the current federal regime violates section 7 of the Charter because of a lack of procedural fairness in the review of administrative segregation.[248] Specifically, the trial judge's findings in *British Columbia Civil Liberties Assn. v. Canada (Attorney General)*, upheld by the British Columbia Court of Appeal, mentioned the devastating effects of solitary confinement on individuals.[249] The court

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Publishers, 1996). In Canada, the Mental Health Commission of Canada has developed numerous resources and training tools for people who provide care to individual with a mental disability; see the Commission's Resource section online: https://www.mentalhealthcommission.ca/English/resources.

246 Office of the Correctional Investigator of Canada, "Administrative Segregation in Federal Corrections: 10 Year Trends", Catalogue Number: PS104-12/2015E-PDF (Ottawa: OCI, 2015) at 23.

247 *Ibid.*, at 12.

248 *Canadian Civil Liberties Assn. v. Canada (Attorney General)*, [2017] O.J. No. 6592, 2017 ONSC 7941 (Ont. S.C.J.); *Canadian Civil Liberties Assn. v. Canada (Attorney General)*, [2019] O.J. No. 1537, 2019 ONCA 243 (Ont. C.A.); *British Columbia Civil Liberties Assn. v. Canada (Attorney General)*, [2018] B.C.J. No. 53, 2018 BCSC 62 at para. 431 (B.C.S.C.); *British Columbia Civil Liberties Assn. v. Canada (Attorney General)*, [2019] B.C.J. No. 8, 2019 BCCA 5 (B.C.C.A.).

249 [2018] B.C.J. No. 53, 2018 BCSC 62 at para. 247 (B.C.S.C.):

> I find as a fact that administrative segregation as enacted by s. 31 of the CCRA is a form of solitary confinement that places all Canadian federal inmates subject to it at significant risk of serious psychological harm, including mental pain and suffering, and increased incidence of self-harm and suicide. Some of the specific harms include anxiety, withdrawal, hypersensitivity, cognitive dysfunction, hallucinations, loss of control, irritability, aggression, rage, paranoia, hopelessness, a sense of impending emotional breakdown, self-mutilation, and suicidal ideation and behaviour. The risks of

also found that the current regime violates section 15 in respect to persons with mental illness and Indigenous individuals, both of whom are overrepresented in segregation,[250] and stated that there are far less impairing alternatives for people with mental illnesses.[251]

As a result of this litigation, the federal government proposed and the Parliament passed a new Bill to amend the CCRA, which would replace segregation with "structured intervention units".[252] However, individuals will continue to be isolated without meaningful human contact for 22 hours a day, and there will be no time cap or judicial oversight, as it is not "segregation".[253] The Court of Appeal in *B.C. Civil Liberties Assn.* has expressed doubt whether the new Bill conforms with the Charter. Neither the new Bill nor the *B.C. Civil Liberties Assn.* decision addresses the significant issues of clinical segregation, which is just as damaging as administrative segregation.[254]

Of the provinces, only Ontario has available data on segregation, mainly as a result of the *Jahn* settlement, which mandated strict monitoring of the use of segregation.[255] Over two months in 2018, 3,086 people (or 23%) were in segregation, including 249 people over the age of 50;[256] 12% were Indigenous; 14% were Black; and 21% had been in segregation more than once. The duration of stay in segregation varied from 1 day to 598 consecutive days for men, and between 1 day and 405 days for women.[257]

In addition, a recent report put together by the Independent Reviewer of Ontario Corrections ("IROC") illustrated that 7% of the provincial prison population was placed in segregation on any given day.[258] Of these, 16% were there for medical protection, 24% for

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these harms are intensified in the case of mentally ill inmates. However, all inmates subject to segregation are subject to the risk of harm to some degree.

250 *Ibid.*, at para. 601.

251 *Ibid.*, at para. 593.

252 Bill C-83, *An Act to amend the Corrections and Conditional Release Act and another Act*, royal assent June 21, 2019: S.C. 2019, c. 27, s. 10 (amending ss. 31-37 of the *Corrections and Conditional Release Act*).

253 *Ibid.*, s. 10 (amending s. 36(1)(b) of the *Corrections and Conditional Release Act*).

254 Sheila Wildeman, "The other solitary: Psychiatric segregation needs to end, too" *The Globe and Mail* (January 31, 2018), online: https://www.theglobeandmail.com/opinion/the-other-solitary-abusing-mental-health-based-confinement/article37806269/.

255 Ontario Ministry of the Solicitor General, "Jahn Settlement: Special Advisors Appointed for Adult Corrections" (October 31, 2018), online: http://www.mcscs.jus.gov.on.ca/english/Corrections/JahnSettlement.html.

256 *Ibid.*

257 *Ibid.*

258 Independent Review of Ontario Corrections, *Segregation in Ontario* (Toronto: Queen's Printer for Ontario, March 2017) at 37, online: http://www.mcscs.jus.gov.on.ca/sites/default/files/content/mcscs/docs/IROC%20Segregation%20Report%20ENGLISH%20FINAL_0.pdf.

protection from other prisoners and 7% without any apparent reason.[259] Moreover, the IROC report shows that 49% of those in segregation had a mental health alert and 41% had a suicide alert.[260] Individuals with mental illnesses spent approximately 30% more time in segregation.[261] Since mental health care is often non-existent, segregation is the default for managing individuals with mental health risks, at risk of suicide or with mobility problems.[262] Most of the pre-trial detainees in Ontario (accounting for 64% of provincially incarcerated people) were in segregation.[263] This is likely the case in all provinces: individuals on remand have not been sentenced, hence they have not been assessed for risk and compellability. However, that means that their mental health status is also often unknown.

(d) Non-Communicable Diseases[264]

Cardiovascular diseases, cancer, diabetes and chronic respiratory diseases are connected with socio-economic status.[265] Thus, individuals entering prisons are predisposed to such diseases. Adequately screening for, preventing and addressing non-communicable diseases (especially in provincial prisons where the turnaround is quick) means fewer sick individuals in prison and upon release, fewer and easier-to-manage symptoms, lower cost on health care systems, fewer burdens on families of incarcerated people, and increased public safety.[266] In other words, non-communicable diseases also have direct consequences on community public health.

(i) Epidemiological Data

Prison populations are aging. In prison research, 50 years is often used as the lower limit of seniority, recognizing that every incarcerated individual tends to present the health problems of someone 10–15 years

259 *Ibid*., at 39.
260 *Ibid*., at 42.
261 *Ibid*., at 43.
262 *Ibid.*, at 65-66.
263 *Ibid*.
264 Mental health issues are also non-communicable. However, mental health issues and physical non-communicable diseases have been discussed separate for the purpose of chapter organization: each of them has unique consequences which deserve separate attention.
265 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 216; Correctional Service Canada, "Social Determinants of Physical Health Conditions among Incoming Canadian Federal Inmates" Number B-59 (June 2015), online: https://www.csc-scc.gc.ca/research/005008-b59-eng.shtml.
266 Fiona Kouyoumdjian & Kathryin E. McIsaac, "Persons in correctional facilities in Canada: A key population for hepatitis C prevention and control" (2015) 106:6 Can. J. Public Health e454 at e456.

older in the community.[267] In 2007–2008, the number of federally incarcerated people over 50 was 10.1%.[268] By 2017, that rate had increased to 25% and it is still on the rise.[269]

This means that the number of non-communicable diseases, including chronic diseases and diseases associated with aging, are also increasing,[270] as well as the number of expected natural deaths in custody. Regardless, this has been one of the most ignored prison health sectors. As a result, there is little data on non-communicable diseases among federal prisoners and even less for provincial prisoners.[271]

There is evidence that almost all diseases have higher rates in prisons and are at a more advanced stage.[272] For instance, a study on 10-year cancer prevalence in Ontario prisons indicates that the rates of cancer are higher for a number of types, such as lung, liver, head, neck and cervical,[273] and that mortality is also higher.[274]

A CSC study demonstrated that certain groups of individuals are more predisposed to chronic illnesses and present higher rates at the time of admission: Indigenous individuals, older people and individuals with a history of injecting drugs.[275] Given that all of these groups are overrepresented in prisons and on the rise, likely so is the number of non-

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267 Correctional Investigator of Canada & Canadian Human Rights Commission, *Aging and Dying in Prison: An Investigation into the Experiences of Older Individuals in Federal Custody,*(Ottawa: CSC & CHRC, February 28, 2019) at 3-4, online: http://www.oci-bec.gc.ca/cnt/rpt/pdf/oth-aut/oth-aut20190228-eng.pdf; Fiona Kouyoumdjian *et al.*, "Do people who experience incarceration age more quickly? Exploratory analyses using retrospective cohort data on mortality from Ontario, Canada" (2017) 12:4 PLoS One 1 at 1-2; Brie Williams, Cyrus Ahalt & Robert Greifinger, "The older prisoner and complex chronic medical care" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 165 at 165.

268 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2014–2015* (2015) at 11, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20142015-eng.pdf.

269 Correctional Investigator of Canada & Canadian Human Rights Commission, *Aging and Dying in Prison: An Investigation into the Experiences of Older Individuals in Federal Custody* (Ottawa: CSC & CHRC, February 29, 2019) at 3, online: http://www.oci-bec.gc.ca/cnt/rpt/pdf/oth-aut/oth-aut20190228-eng.pdf.

270 Dora M. Dumont, "Public Health and the Epidemic of Incarceration" (2012) 33 Annu. Rev. Public Health 325 at 328; Stuart A. Kinner & Jesse T. Young, "Understanding and Improving the Health of People Who Experience Incarceration: An Overview and Synthesis" (2018) 40 Epidemiol. Rev. 4 at 6.

271 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 218.

272 *Ibid.*

273 Fiona Kouyoumdjian *et al.*, "Cancer prevalence, incidence and mortality of those experiencing incarceration in Ontario" (2017) 12:2 PLoS One 1 at 7.

274 *Ibid.*, at 8.

275 Lynn A. Stewart *et al*., "Chronic health conditions reported by male inmates newly admitted to Canadian federal penitentiaries" (2015) 3:1 C.M.A.J. 97 at 101.

communicable diseases. Some of the rates reported by the study include: central nervous system issues (51% Indigenous, 38.2% non-Indigenous); musculoskeletal issues including arthritis, back pain and osteoporosis (25% Indigenous, 28.7% non-Indigenous); respiratory issues including bronchitis, pneumonia and asthma (16.5% Indigenous, 20.1% non-Indigenous); cardiovascular diseases (15% non-Indigenous, 20.6% Indigenous); diabetes (3.6% non-Indigenous, 4.3% Indigenous); ulcers (2.7% non-Indigenous, 3.3% Indigenous); prostate problems (2.5% non-Indigenous, 2.9% Indigenous); and cancer history (0.9% non-Indigenous, 2% Indigenous).[276]

Cancer (36%), cardiovascular-related (29%) and respiratory-related (11%) are the leading causes of death for those who died a natural death in custody.[277] Approximately 66% of all deaths in custody are "natural deaths", defined in contrast to "non-natural deaths", which include suicide, homicide, accident, overdose, staff intervention and deaths from undetermined causes.[278] From 2000–2001 to 2015–2016, the number of natural deaths in custody per year ranged from a low of 25 in 2000–2001 to a high of 48 in 2008–2009, with an average of 35.[279]

(ii) Access to Treatment

In 2014, the OCI Annual Report raised a number of concerns regarding the health service provision, especially around the physical infrastructure that affects the ability to provide safe and optimal care and resource allocation.[280] The OCI was also concerned with the difficulties CSC has faced in meeting the needs of aging prisoners and in satisfying infection prevention and control standards. It also noted that health care needs are viewed as secondary to security, which raises ethical concerns.[281]

Other barriers to satisfactory treatment in federal custody include a lack of adequate training, overcrowding and a lack of escorting officers,

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276 *Ibid.*, at 99.

277 Correctional Service Canada, *Annual Report on Deaths in Custody: 2015/2016 (N^o SR-17-02)* (November 2017) at Table 6, online: https://www.csc-scc.gc.ca/research/092/005008-3010-en.pdf.

278 *Ibid.*, at 5-6. "Death in custody" is defined as a death occurring in a federal correctional facility: see *ibid*., at 5.

279 Public Safety Canada, *2017 Annual Report: Corrections and Conditional Release — Statistical Overview* (Ottawa: Public Works and Government Services Canada, July 2018) at 3, online: https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ccrso-2017/ccrso-2017-en.pdf.

280 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2013–2014* (2014) at 12, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20132014-eng.pdf.

281 *Ibid.*

resulting in difficulties taking people to community specialists.[282] Often times, individuals admitted to federal prisons are discontinued from the medication they were on while in the community and the same happens upon release.[283]

Medication is an issue both in terms of availability and distribution. The CSC National Drug Formulary[284] is restrictive and the autonomy of physicians to prescribe a course of treatment appears to be restricted due to what the OCI has characterized as "ill-defined security, administrative or operational concerns".[285] For instance, the Formulary provides only a limited set of options for the management of chronic pain, and the options that are available are not always the most efficient form of treatment.[286] Requests from physicians for drugs that are not on the Formulary are denied so often that physicians usually stop prescribing anything other than what the Formulary permits.[287] Tylenol 3 is often the only prescription medication available. Morphine is only available in some institutions and, even then, only sometimes.[288] One study reported that, of 197 participants, 91 (46%) reported significant and constant pain. While most of the participants were receiving prescription medication, only 49 (25%) reported that the pain was managed satisfactorily.[289] Furthermore, medication distribution only takes place once or twice daily and under direct supervision, so dosages are adjusted to accommodate for this. Therefore, certain classes or dosages of medication simply cannot be used, regardless of how sick the individual is and how inefficient the alternative treatment is.[290]

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282 Adam Miller, "Health Care Inequality" (2013) 185:6 C.M.A.J. E249.

283 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2014–2015* (2015) at 8, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20142015-eng.pdf; Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2017–2018* (2018) at 18, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20172018-eng.pdf.

284 Correctional Service Canada, *National Drug Formulary* (2016), a document received in response to a request under the *Access to Information Act*, R.S.C. 1985, c. A-1.

285 Office of the Correctional Investigator of Canada, *Annual Report of the Office of Correctional Investigator: 2014–2015* (2015) at 9, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20142015-eng.pdf. See also Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2017–2018* (2018) at 18, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20172018-eng.pdf.

286 Office of the Correctional Investigator of Canada, "National Drug Formulary Investigation: Summary of Findings and Recommendations" (January 27, 2015), online: https://www.oci-bec.gc.ca/cnt/rpt/oth-aut/oth-aut20150127-eng.aspx.

287 *Ibid*.

288 Adelina Iftene, "The Pains of Incarceration: Aging, Rights, and Policy in Federal Penitentiaries" (2017) 59:1 Can. J. Corr. 63 at 72.

289 *Ibid.*, at 70.

290 Office of the Correctional Investigator of Canada, "National Drug Formulary Investigation: Summary of Findings and Recommendations" (January 27, 2015), online: https://www.oci-bec.gc.ca/cnt/rpt/oth-aut/oth-aut20150127-eng.aspx.

In addition, in most institutions, medication must be picked up in person by standing in line, sometimes for an hour or more. In some institutions, lines form outside, regardless of the weather.[291] In one study, this was reported as the most common cause of individuals skipping their daily prescribed medication; some would choose to forfeit their medication when their symptoms were too bad, standing was too difficult or the weather was too severe.[292]

In a mortality review investigation, the OCI investigators found significant issues in how the reviewed cases were managed pre-death.[293] The independent medical consultant who reviewed a subset of the mortality reports for the OCI concluded that "[i]n nearly half (seven cases), the review of the health care records raised issues regarding the quality of health care provided to the deceased inmates".[294] Significant issues existed relating to accurate diagnostics (one person's lung tumour was misdiagnosed for two years) and treatment (one person was given a treatment contraindicated for his comorbidity).[295] Issues have also been raised regarding the voluntariness of consent and the distinctions between voluntary, implied and compelled consent made by medical professionals, mainly because the CSC medical records are poor and there is a generalized lack of progress notes or follow-up information.[296]

While official reports are missing, there is evidence that the same issues exist at the provincial level, particularly related to regular discontinuation of medication upon admission and lack of access to treatment.[297] Prisoners in Nova Scotia released a list of demands during a peaceful protest that took place in the fall of 2018, which they sent directly to the *Halifax Examiner*.[298] Better health care led the list because:

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291 Adelina Iftene, "The Pains of Incarceration: Aging, Rights, and Policy in Federal Penitentiaries" (2017) 59:1 Can. J. Corr. 63 at 73.

292 *Ibid*.

293 Office of the Correctional Investigator of Canada, *An Investigation of the Correctional Service's Mortality Review Process* (December 18, 2013) at 9, online: https://oci-bec.gc.ca/cnt/rpt/pdf/oth-aut/oth-aut20131218-eng.pdf.

294 *Ibid.*, at 17.

295 *Ibid.*, at 18.

296 *Ibid*., at 17.

297 Jonny Wakefield & Claire Theobald, "Provincial inmates say they suffered when jail doctors switched them off community prescribed medications" *Edmonton Journal* (February 11, 2018), online: https://edmontonjournal.com/news/local-news/provincial-inmates-say-they-suffered-when-jail-doctors-switched-them-off-community-prescribed-medications.

298 El Jones, "The prisoners at the Burnside jail are engaged in a non-violent protest; here is their statement" *Halifax Examiner* (August 19, 2018), online: https://www.halifaxexaminer.ca/province-house/the-prisoners-at-the-burnside-jail-are-engaged-in-a-non-violent-protest-here-is-their-statement/.

> Some of the issues we are facing in our health care include: having medication cut off or delays in providing necessary medication; long waits for x-rays and other medical services; lack of care for chronic and serious illnesses; access to specialist appointments; having our medical complaints dismissed; not enough medical staff; not receiving compassionate care.[299]

(iii) Environment as a Missed Opportunity and a Risk Factor

Some of the prison living conditions may also act as risk factors: overcrowding, inadequate food, lack of physical activity, lack of proper treatment due to security concerns, and understaffing. On the other hand, many of the non-communicable diseases are easily preventable by removing certain risk factors such as smoking, harmful alcohol consumption, unhealthy diets and inadequate physical activity.[300] Thus, once again, prison can be an opportunity to help individuals distance themselves from such risk factors,[301] thereby improving the health of the incarcerated people and of the communities impacted by their release.

(A) Living Conditions

The *Mandela Rules* require that double bunking be avoided[302] and that "all sleeping accommodation shall meet all requirements of health, due regard being paid to climatic conditions and particularly to cubic content of air, minimum floor space, lighting, heating and ventilation".[303] In Canada, however, many institutions continue to be overcrowded;[304] double bunking is a reality, and individuals with chronic conditions continue to share a single room or are allocated to the top bunk. Environmental mismatch negatively impacts the quality of life of geriatric prisoners or people with limited functional status, and may worsen symptoms (such as pain) and lead to advanced stages of their various

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299 *Ibid*., Demand 1.

300 Emma Plugge, Ruth Elwood Martin & Paul Hayton, "Noncommunicable diseases and prisoners" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 81 at 81.

301 *Ibid.*, at 83-84.

302 *United Nations Standard Minimum Rules for the Treatment of Prisoners (the Nelson Mandela Rules)*, U.N. GA Res. 70/175 (December 17, 2015), Rule 12.

303 *Ibid.*, Rule 13.

304 Office of the Auditor General of Canada, *2014 Spring Report of the Auditor General of Canada* (Ottawa: Auditor General of Canada, 2014), online: http://www.oag-bvg.gc.ca/internet/English/parl_oag_201405_04_e_39335.html. See also reports of overcrowding in provincial jails: The Canadian Press, "'Welcome to hell': Inside Canada's most decrepit prison, Baffin Correctional Centre" *National Post* (May 19, 2015), online: https://nationalpost.com/news/canada/welcome-to-hell-inside-canadas-most-decrepit-prison-baffin-correctional-centre; Farshad Azadian, "Canada's epidemic of overcrowded prisons" *In Defence of Marxism* (January 22, 2015), online: http://www.marxist.com/canadas-epidemic-of-overcrowded-prisons.htm.

diseases.[305] For instance, some institutions do not have elevators (individuals must go up and down the stairs daily) and lack accessible washrooms, despite housing high proportion a large number of elderly or disabled individuals.[306]

Many prisons do not have proper ventilation in summer or adequate heating in winter. As a result of a peaceful protest against their conditions of confinement, in fall 2018, prisoners in Nova Scotia stated in a manifesto: "We call upon the province to improve the conditions in the jail. In the recent heat wave, the health of prisoners was endangered, particularly prisoners with existing or chronic health issues."[307]

(B) Food

Nutrition is key in the health of individuals and communities. Healthy nutrition goes a long way in preventing diseases, minimizing symptoms of illnesses and promoting the well-being of communities. The *Mandela Rules* require that "[e]very prisoner shall be provided by the prison administration at the usual hours with food of nutritional value adequate for health and strength, of wholesome quality and well prepared and served".[308] The WHO also recognizes that, as a matter of ensuring public health, incarcerated people must receive healthy food, education on nutrition and have any eating disorders addressed.[309]

Yet, food is one of the leading reasons for complaints in federal prisons (in provincial prisons such complaints are not monitored). In an effort to cut the costs, "food is prepared in industrial-sized kettles and tanks up to two weeks in advance, chilled in bulk packaging, stored frozen then shipped to the institutions for 'retherming'. Finishing kitchens add food items to the meal that must be prepared or served fresh."[310] The

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305 Brie Williams, Cyrus Ahalt & Robert Greifinger, "The older prisoner and complex chronic medical care" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 165 at 168.

306 Adelina Iftene, "Employing Older Prisoner Empirical Data to Test a Novel s. 7 Charter Claim" (2017) 40:2 Dal. L.J. 497 at 514.

307 El Jones, "The prisoners at the Burnside jail are engaged in a non-violent protest; here is their statement" *Halifax Examiner* (August 19, 2018), Demand 7, online: https://www.halifaxexaminer.ca/province-house/the-prisoners-at-the-burnside-jail-are-engaged-in-a-non-violent-protest-here-is-their-statement/.

308 *United Nations Standard Minimum Rules for the Treatment of Prisoners (the Nelson Mandela Rules)*, U.N. GA Res. 70/175 (December 17, 2015), Rule 22(1).

309 Emma Plugge, Ruth Elwood Martin & Paul Hayton, "Noncommunicable diseases and prisoners" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 81 at 83.

310 Office of the Correctional Investigator of Canada, *Annual Report of the Office of the Correctional Investigator: 2017–2018* (2018) at 38, online: https://www.oci-bec.gc.ca/cnt/rpt/pdf/annrpt/annrpt20172018-eng.pdf.

vegetable selection was reduced, the meat was replaced with bulkier cuts and fresh milk was replaced with powder milk. While the $5/day meals must amount to 2,600 calories, this is often insufficient for young men.[311] As a result of these changes, food has become even more of a commodity worth stealing or trading.[312] This increases the violence in prisons, and negatively impacts the health of individuals already in poor health.

In Nova Scotia, the prisoner protest manifesto that resulted from the 2018 peaceful protest stated:

> We call for the province to respect the dietary needs of prisoners from different cultures. We have struggled in getting menus for religious prisoners. Prisoners have become ill including suffering serious nutritional deficits, and health damage. This is unacceptable and a violation of our religious rights.[313]
>
> And
>
> We call for healthy items to be added to the canteen. Prisoners supplement the meals provided by the prison with these items that we purchase using our own money or money given to us by our families. We do not believe that providing us only with items filled with sugar and chemicals helps promote our health. Junk food is being eliminated from schools, hospitals, and other institutions, so why are people in prison limited to these unhealthy options?[314]

Cutting food costs shows a reckless disregard towards the well-being of incarcerated individuals, as does the government's failure to recognize the impact these cuts have on public health and on health care expenses, both in prison and in the community.

(C) Exercise

Recognizing the importance of exercise on mental and physical well-being, the *Mandela Rules* require that each prisoner should have at least one hour of suitable outdoor exercise, weather permitting. To this end, each institution should have adequate space, installations and equipment.[315]

However, exercise is particularly challenging for those who are older and who often find that the gym equipment is inadequate for their

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311 *Ibid*., at 46.

312 *Ibid.*, at 38-39.

313 El Jones, "The prisoners at the Burnside jail are engaged in a non-violent protest; here is their statement" *Halifax Examiner* (August 19, 2018), Demand 6, online: https://www.halifaxexaminer.ca/province-house/the-prisoners-at-the-burnside-jail-are-engaged-in-a-non-violent-protest-here-is-their-statement/.

314 *Ibid.*, Demand 8.

315 *United Nations Standard Minimum Rules for the Treatment of Prisoners (the Nelson Mandela Rules)*, U.N. GA Res. 70/175 (December 17, 2015), Rule 23.

needs, and that the gym is an unsafe place for them because of violence and bullying.[316] While some people walked in the yard for exercise, this also tended to be problematic, when the yards were inadequately cleared of snow and ice in the winter, and the risk of falling was high.[317]

The prisoners engaged in the peaceful protest in Nova Scotia prisons added exercise on their list of demands:

> Exercise is necessary for our physical and mental health. We remind the province that we live in a province with winter. We require equipment so we can work out indoors. Exercise helps reduce stress, keeps us occupied in healthy ways, and helps us deal with the prison environment.
>
> We often do not receive the yard time we are entitled to under the Corrections Act. This is a violation of the rights we already have. We call for adequate time for fresh air, exercise, and sunlight.[318]

(D) Smoking

Smoking is banned in all provincial and federal institutions. Just like with any other substance, individuals entering prisons are expected to stop smoking completely, regardless of long they have smoked or their level of nicotine addiction.[319]

The ban came after a court ruled in favoured of a federally incarcerated individual who complained about the dangers he was exposed to as a result second-hand smoke.[320] As a result of the ban, many of the communal spaces are now smoke-free, which may have improved the air quality in prisons.[321] However, like with other substances,

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316 Adelina Iftene, "Employing Older Prisoner Empirical Data to Test a Novel s. 7 Charter Claim" (2017) 40:2 Dal. L.J. 497 at 514.

317 *Ibid.*; Brie Williams, Cyrus Ahalt & Robert Greifinger, "The older prisoner and complex chronic medical care" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 165 at 167.

318 El Jones, "The prisoners at the Burnside jail are engaged in a non-violent protest; here is their statement" *Halifax Examiner* (August 19, 2018), Demand 3, online: https://www.halifaxexaminer.ca/province-house/the-prisoners-at-the-burnside-jail-are-engaged-in-a-non-violent-protest-here-is-their-statement/.

319 See *e.g.*, Correctional Service Canada, Commissioner's Directive CD 259, "Exposure to Second Hand Smoke" (April 17, 2014), online: https://www.csc-scc.gc.ca/acts-and-regulations/259-cd-eng.shtml.

320 *Maljkovich v. Canada*, [2005] F.C.J. No. 1679, 2005 FC 1398 (F.C.). Previous to *Maljkovich* there was a ban on indoor smoking in federal institutions; following this case, CSC implemented a complete ban in its institutions, and provincial governments gradually followed suit.

321 A Swiss study conducted in three prisons after a smoke ban was instated showed that in one prison the air quality improved but in two it did not (presumably because prisoners continue to smoke illicitly): Jean-François Etter *et al.*, "Implementation and impact of anti-smoking interventions in three prisons in the absence of appropriate legislation" (2012) 55 Prev. Med. 475 at 478-79.

individuals continue to smoke, even at the risk of a disciplinary sanction. Moreover, it is likely that some people pick up smoking for the first time while in prison due to the social aspect of smoking, but also to help mitigate the stress and boredom associated with incarceration.

There is no Canadian data available on the number of smokers in prisons or the places where illicit smoking occurs.[322] Studies in other jurisdictions indicated higher rates of smoking in prison than the community, even in the facilities where smoking was banned.[323] Other data showed that of 200 people released from a smoke-free institution, 83% returned to smoking within a timeframe of one day to six months from release.[324]

Medical researchers have concluded that bans alone are not successful in having individuals stop smoking. While environmental restrictions are important, they need to be accompanied by systematic prison support for smoking cessation, including information sessions, counselling, provision of various incentives and nicotine substitutes.[325] It is also important that adequate programming, activities and work is provided to all incarcerated individuals in order to reduce boredom and stress, which are related to smoking. In provincial institutions, where medical services and other supports are often substandard, there are likely no smoking cessation supports in place, no specific information is not available. In federal prisons, the policy states that nicotine gum is available for purchase through the canteen and that information on smoking cessation can be obtained from health services.[326] It is unclear how individuals can seek information, when the policy also states that any individual in violation of the policy is subjected to the disciplinary

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322 Quebec was the last province to altogether ban smoking. A study showed that during the period smoking was banned only indoors, 80% of the provincially incarcerated individuals in Quebec were smokers, and that 93% continued to smoke indoors despite the ban: Benoit Lasnier *et al.*, "Implementing an Indoor Smoking Ban in Prison: Enforcement Issues and Effects on Tobacco Use, Exposure to Second-hand Smoke and Health of Inmates" (2011) 102:4 Can. J. Public Health 249.

323 See *e.g.*, Onur Turan & Pakize Ayse Turan, "Smoking-Related Behaviors and Effectiveness of Smoking Cessation Therapy Among Prisoners and Prison Staff" (2016) 61:4 Respir. Care 434 at 435-36.

324 Benoit Lasnier *et al.*, "Implementing an Indoor Smoking Ban in Prison: Enforcement Issues and Effects on Tobacco Use, Exposure to Second-hand Smoke and Health of Inmates" (2011) 102:4 Can. J. Public Health 249.

325 Onur Turan & Pakize Ayse Turan, "Smoking-Related Behaviors and Effectiveness of Smoking Cessation Therapy Among Prisoners and Prison Staff" (2016) 61:4 Respir. Care 434 at 437; Catherine Ritter *et al.*, "Smoking in prisons: The need for effective and acceptable interventions" (2011) 32:1 J. Public Health Policy 32 at 39-40.

326 Correctional Service Canada, Commissioner's Directive CD 259, "Exposure to Second Hand Smoke" (2014) at paras. 8 and 9, online: https://www.csc-scc.gc.ca/acts-and-regulations/259-cd-eng.shtml.

process.[327] Thus, there does not appear to be any concerted effort to encourage and support for long-lasting smoking cessation among federally or provincially incarcerated individuals.

Systematic support could be essential both for reducing the number of smokers in prison and for ensuring that upon release individuals will not return to smoking. Considering the high concentration of smokers in prisons, as well as the association between smoking and second-hand smoke and numerous diseases, a high rate of cessation success among this group would have a long-term positive effect in improving the health of communities.

(e) Mothers in Prison

(i) Demographics and Risks to Mothers and Children

Women are an increasing prison demographic. In the provinces and territories, 16% of the 2017 admissions were women, and in federal prisons in 2016, there were 695 women.[328] The number of women admitted to federal corrections has increased by 30% over a decade.[329] Incarcerated women in Ontario provincial facilities have an average of four children; 5% of incarcerated women are currently pregnant; and half of the women had undergone a therapeutic abortion.[330]

There is a gap in the information concerning supports available to incarcerated pregnant women in federal and provincial institutions or these women's experiences. Occasionally, there have been headlines about birth tragedies resulting from improper care during incarceration. For instance, Julie Bilbotta gave birth on the floor in a segregation cell while her screams were ignored by officers. Her baby died at birth due to respiratory problems. Her suit against the Ontario government resulted in a settlement.[331] In Nova Scotia, Bianca Mercer was placed in solitary confinement while four months pregnant. Despite medical evidence that there were issues with the fetus, officers refused to believe her when she was complaining that something was wrong. Her baby died in utero.[332]

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327 *Ibid.*, at para. 13.

328 Public Safety Canada, *2017 Annual Report: Corrections and Conditional Release Statistical Overview* (Ottawa: Public Safety Canada Portfolio Corrections Statistics Committee, 2018) at 39, Figure C4, online: https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ccrso-2017/ccrso-2017-en.pdf.

329 *Ibid.*, at 39, Figure C4.

330 Fiona Kouyoumdjian *et al.*, "Health Status of Prisoners" (2016) 62 Can. Fam. Physician 215 at 218.

331 Martha Jane Paynter & Erna Snelgrove-Clarke, "Breastfeeding Support for Criminalized Women in Canada" (2017) J. Hum. Lact. 1 at 1.

332 Maggie Rahr, "A Prison Pregnancy" *The Deep* (2018), online: https://thedeepmag.ca/aprisonpregnancy/.

Federal and provincial institutions generally do not have special programs for pregnant women.[333] Women receive regular check-ups and are sent for ultrasounds, but are otherwise subject to living in the same space, eating the same food and following the same programs as other prisoners. There are no federal or provincial correctional policies addressing the needs and entitlements of pregnant or postpartum women.[334] In some provinces, there are non-governmental organizations that have clearance to visit institutions and support pregnant women. For instance, in Nova Scotia, Women's Wellness Within works with incarcerated women in federal and provincial institutions throughout pregnancy, after abortions and after giving birth, providing them with support and education on breastfeeding and infant care.[335]

In addition to perinatal and birth issues, there are numerous postpartum issues. Separation has devastating health effects on mothers and children alike, and medical research shows that close physical contact is the best practice for both.[336] For mothers, separation may lead to depression, anxiety, feelings of loneliness and suicidal ideation.[337] Postpartum women are given milk-binding pills and antidepressants, and many turn to substance use as a coping strategy.[338]

There is evidence that 20,000 children are affected by maternal incarceration in Canada in a variety of ways.[339] After birth, the WHO recommends that all children be fed breastmilk exclusively for a minimum of six months and up to two years.[340] Babies who are not breastfed may develop diabetes, allergies, gastrointestinal and respiratory infections.[341] Furthermore, the separation of children from mothers has been linked to attachment issues for children, development deficits, feelings of neglect with life-long implications, higher risk of anti-social and delinquent

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333 See *e.g.*, Martha Jane Paynter & Erna Snelgrove-Clarke, "Breastfeeding Support for Criminalized Women in Canada" (2017) J. Hum. Lact. 1 at 2.

334 Martha Jane Paynter, "Policy and Legal Protection for Breastfeeding and Incarcerated Women in Canada" (2018) J. Hum. Lact. 1 at 3.

335 Women's Wellness Within, online: https://www.womenswellnesswithin.org/.

336 Martha Jane Paynter *et al.*, "Maternal health outcomes for incarcerated women: A scoping review" (2019) J.C.N. 1 at 2-3; *Inglis v. British Columbia (Ministry of Public Safety)*, [2013] B.C.J. No. 2708, 2013 BCSC 2309 at para. 205 (B.C.S.C.).

337 Paynter *et al.*, *ibid*., at 2-3; Kayliah Miller, "Canada's Mother-Child Program and Incarcerated Aboriginal Mothers: How and Why the Program is Inaccessible to Aboriginal Female Offenders" (2017) 37 C.F.L.Q. 1 at 3.

338 Dr. Ruth Elwood Martin & Brenda Tole, "Supporting the Health of Mothers and Their Babies in the Context of Incarceration" (2017) The Vanier Institute of the Family at 4.

339 *Ibid.*

340 *Ibid.* On issue of breastfeeding in prison, see Martha Jane Paynter *et al.*, "Maternal health outcomes for incarcerated women: A scoping review" (2019) J.C.N. 1 at 4.

341 Ibid.

behaviour into adulthood, poorer educational outcomes, and a higher risk of offending and incarceration.[342]

Thus, incarceration of mothers and separation from their babies has significant public health implications. Not only does it impact the immediate health of both women and children and drive up the cost of health care, but the community will suffer the consequences of these children being more likely to engage in risky or anti-social behaviour.

(ii) Mother-Child Programs

There is an argument to be made that most women, and especially mothers, could likely be rendered community sentences, as opposed to imprisonment, at little to no risk to society, if provided with adequate support for rehabilitation and raising their children, including adequate financial, social and mental health support. This would likely lead to more desirable outcomes for mothers, their children and the community which, as discussed below, may be impacted by the consequences of mother-child separation. Absent that, the mother-child programs, where children can live the first years of their lives in prison with their mothers, have been deemed the best option for allowing mother-child attachment.[343]

Rule 48 of the *UN Rules for the Treatment of Women Prisoners and Non-custodial Measures for Women Offenders with their Community* (known as the *Bangkok Rules*) emphasizes the importance of pregnant and breastfeeding women receiving adequate health care and diets.[344] General health care entitlements and human rights against discrimination apply to

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342 *Inglis v. British Columbia (Ministry of Public Safety)*, [2013] B.C.J. No. 2708, 2013 BCSC 2309 at para. 204 (B.C.S.C.).

343 Dr. Ruth Elwood Martin & Brenda Tole, "Supporting the Health of Mothers and Their Babies in the Context of Incarceration" (2017) The Vanier Institute of the Family.

344 *United Nations Rules for the Treatment of Women Prisoners and Non-custodial Measures for Women Offenders with their Community (the Bangkok Rules)*, U.N. GA Res. 2010/16, U.N. Doc. A/C.3/65/L.5 (October 6, 2010), Rule 48:

> 1. Pregnant or breastfeeding women prisoners shall receive advice on their health and diet under a programme to be drawn up and monitored by a qualified health practitioner. Adequate and timely food, a healthy environment and regular exercise opportunities shall be provided free of charge for pregnant women, babies, children and breastfeeding mothers.
> 2. Women prisoners shall not be discouraged from breastfeeding their children, unless there are specific health reasons to do so.
> 3. The medical and nutritional needs of women prisoners who have recently given birth, but whose babies are not with them in prison, shall be included in treatment programmes.

incarcerated mothers and pregnant women,[345] yet there is minimal specific mentioning of health care for new mothers.

There are currently only two mother-child programs in Canada, federally and in British Columbia. The *Correctional Services Act* of Manitoba states that a mother may be allowed to care for her infant in prison;[346] however, there has been no child registered as staying with their incarcerated mother in any Manitoba provincial facility.[347]

British Columbia is the only province that has a functional mother-child program, running since 1973. The program closed in 2008, but was reinstated when, in 2013, a judge found that the closing of the program violated sections 15 and 7 of the Charter because it threatened the security and lives of the mothers and children and it discriminated against new mothers.[348] The mother-child program in Allouette, British Columbia has been fairly successful and is regarded as the best model in Canada.[349]

There is a mother-child program at the federal level. However, it has been criticized for its strict conditions that have a discriminatory effect.[350] According to Commissioner's Directive, CD 768, "Institutional Mother-Child Program":

- Only women inmates classified as minimum or medium security and who are housed in institutions that offer the program are eligible to participate.
- Women convicted of a crime involving a child are not eligible to participate in the program unless a psychiatric assessment, completed by a psychiatrist selected by the Institutional Head (after consultation with the child welfare authorities), determines that the inmate does not represent a danger to her child.
- The upper age limit of the child for full-time residency is four years (at the fourth birthday).

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345 *Corrections and Conditional Release Act*, S.C. 1992, c. 20, s. 86; *Canadian Charter of Rights and Freedoms*, Part I of the *Constitution Act, 1982*, s. 15, being Schedule B to the *Canada Act 1982* (U.K.), 1982, c. 11; *Correctional Services Act*, S.N.S. 2005, c. 37, ss. 28 and 47.

346 *Correctional Services Act*, C.C.S.M. c. C230, s. 36.

347 Martha Jane Paynter, "Policy and Legal Protection for Breastfeeding and Incarcerated Women in Canada" (2018) 34:2 J. Hum. Lact. 1 at 4.

348 *Inglis v. British Columbia (Ministry of Public Safety)*, [2013] B.C.J. No. 2708, 2013 BCSC 2309 (B.C.S.C.).

349 On the mother-child model in Allouette, B.C., see Dr. Ruth Elwood Martin & Brenda Tole, "Supporting the Health of Mothers and Their Babies in the Context of Incarceration" (2017) The Vanier Institute of the Family at 5-7; Ruth Elwood Martin *et al.*, eds., *Arresting Hope: Women Taking Action in Prison Health Inside Out* (Toronto: Inanna Publications and Education, 2014) at 102-17; Martha Jane Paynter, "Policy and Legal Protection for Breastfeeding and Incarcerated Women in Canada" (2018) 34:2 J. Hum. Lact. 1 at 4.

350 Kayliah Miller, "Canada's Mother-Child Program and Incarcerated Aboriginal Mothers: How and Why the Program is Inaccessible to Aboriginal Female Offenders" (2017) 37 C.F.L.Q. 1.

- The upper age limit of the child for part-time residency is twelve years of age (at the thirteenth birthday).[351]

The *Guidelines for the Implementation of Mother-Child Units in Canadian Correctional Facilities*,[352] created by the Collaborating Centre for Prison Health and Education at the University of British Columbia, illustrate a set of best practices and show awareness of the fact that prisons are an opportunity to provide marginalized mothers with pre- and post-natal education and support, appropriate nutrition, testing, and health care, including priority to Opioid Substitute Treatment ("OST"). Continuity of health care and support should be available upon release.

Nonetheless, these good practices appear hard to implement given the strict program restrictions CSC has in place. The policy excludes women who have been convicted of violent crimes, ignoring the fact that for many of the individuals in this group, the violent crime has been committed against abusive partners.[353] Also, this program is not available to women in maximum security. Both of these criteria place Indigenous women at a significant disadvantage. They are more likely to be in prison for a violent crime, including against a violent partner (75%), and to be classified as high security due to the discriminatory scale used for risk assessment.[354] Factors such as lack of employment, substance use and attitude towards authority lead to higher risk classification, and they are more prevalent among Indigenous women. Finally, the requirement that child protection services be involved is highly off-setting, especially for Indigenous women, who have had negative experiences with these authorities and have an ingrained distrust of the government (often mistaken for apprehension by correctional authorities).[355]

This means that federally incarcerated Indigenous women rarely, if ever, get to spend time with their children after birth. It is unfortunate, as

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351 Correctional Service Canada, Commissioner's Directive 768, "Institutional Mother-Child Program" (April 18, 2016), online: https://www.csc-scc.gc.ca/lois-et-reglements/768-cd-eng.shtml.

352 The Collaborating Centre for Prison Health and Education, University of British Columbia, *Guidelines for the Implementation of Mother-Child Units in Canadian Correctional Facilities* (November 2015) at 6-9, online: http://med-fom-familymed-ccphe.sites.olt.ubc.ca/files/2012/05/MCUGuidelines_Nov15_FINAL.pdf.

353 See *e.g.*, Kayliah Miller, "Canada's Mother-Child Program and Incarcerated Aboriginal Mothers: How and Why the Program is Inaccessible to Aboriginal Female Offenders" (2017) 37 C.F.L.Q. 1 at 13-15.

354 See *ibid.*, at 12-13; D'Arcy Leitch, "The Constitutionality of Classification: Indigenous Overrepresentation and Security Policy in Canadian Federal Penitentiaries" (2018) 41:2 Dal. L.J. 411. Issues with applying the same assessment tool to both non-Indigenous and Indigenous prisoners was found problematic in *Ewert v. Canada*, [2018] S.C.J. No. 30, [2018] 2 S.C.R. 165, 2018 SCC 30 (S.C.C.).

355 Adam Miller, "Health Care Inequality" (2013) 185:6 C.M.A.J. E249.

most of these women come from marginalized communities and would benefit from receiving post-natal education and support. In addition, separation makes it more likely that the child will end up in foster care, with devastating effects on the mother and the perpetuation of the institutionalization of Indigenous people.

IV. IMPLICATIONS OF THE CURRENT PRISON HEALTH REGIME

(a) Legal and Policy Implications

Health and other socio-economic inequities are major pre-determinants of criminalization. As long as these inequities are not addressed, the cycle of criminalization is perpetuated. However, health care and health promotion in prisons are often an afterthought in legislation, policies and practices. This shows a disregard not only to prisoners' rights and international commitments, but to the intrinsic connection between meeting correctional goals (such as reintegration, rehabilitation, deterrence, safe communities) and public health goals. In addition, individuals tend to come out of prison sicker than when they entered. An ill individual with a criminal record and no job cannot properly reintegrate and become a productive member of society. Moreover, individuals with poorer health will increase the cost of health care and negatively impact the health of the community.

Public safety is deeply rooted in public health, and public safety can only be fully achieved when public health goals are accounted for.[356] It is clear that neither the CCRA nor provincial correctional legislation meets the international prison standards in regard to the regulation of segregation, intake health care assessment and harm reduction methods in prisons. They also fail to comply with these standards on the issues of use of force *vis-à-vis* people with mental illnesses, testing and environmental conditions.

They may violate national laws as well. For instance, when it comes to harm reduction methods, the requirement that all essential health care services be available and provided at an "acceptable level of the profession" in accordance with section 86 of the *CCRA* is likely not met. For instance, OST in prisons falls short of what is available in the community, mostly in frequency and quantity. Failure to treat certain communicable diseases, long wait times for receiving treatment, or failure to ensure adequate health services for non-communicable diseases arguably also breach these provisions. Some would argue that health

[356] See also Janet E. Mosher, "Amid Justice Threats of Contagion" (2014) 51:3 Osgoode Hall L.J. 919 at 921.

services are deficient in certain communities as well. However, even when some individuals in the community encounter serious logistical difficulties in accessing health services, options are generally available (such as walk-in clinics, purchasing private care if they have the resources, going to the emergency room, *etc*.). Prisoners do not, even in theory, have such options and they are fully dependent on the services the correctional systems make available. In part due to these restrictions imposed by the state through incarceration, there may be an argument that prison systems owe a duty of care to prisoners that has no comparison in the community. In other words, due to this duty, "acceptable level of the profession" does not justify providing substandard services in prison, just because they are also substandard in the community.[357]

In addition, the absence of these services disproportionately impacts Indigenous prisoners, who are overrepresented both in prisons and in the at-risk categories. To make matters worse, the institutions created specifically for Indigenous prisoners, the Healing Lodges, often lack some of the minimal services available in regular prisons (such as OST, HIV and HCV treatment). This is in clear violation of CCRA provisions guaranteeing equal rights and accommodation for Indigenous individuals.[358] The duty of care owed by CSC to Indigenous prisoners under section 24 of the CCRA was recently reiterated by the Supreme Court of Canada in *Ewert v. Canada*.[359]

Many of the policies and practices discussed in this chapter also likely violate various Charter provisions. For instance, the discontinuation of the mother-child program was found to violate sections 7 and 15 of the Charter.[360] While this issue was rectified in British Columbia where the decision was binding, as the Charter applies to all provinces, it is unsettling to see that years since that case was decided, no other province has created this program, knowing that such failure is constitutionally suspect. The significant restrictions on the federal mother-child program have rendered the program almost inconsequential and appear to indirectly discriminate against Indigenous women. Thus, the federal program is also arguably in breach of the same Charter sections.

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357 A comprehensive analysis of the duties owed to incarcerated people is beyond the scope of this chapter. For detailed analyses of these duties see, *e.g.*, Adelina Iftene, *Punished for Aging: Vulnerability, Rights, and Access to Justice in Canadian Penitentiaries* (Toronto: University of Toronto Press, 2019); Adelina Iftene, Lynne Hanson & Allan Manson, "Tort Claims and Canadian Prisoners" (2014) 39:2 Queen's L.J. 655.

358 *Corrections and Conditional Release Act*, S.C. 1992, c. 20, s. 4(d); Correctional Service Canada, Commissioner's Directive 800, "Health Services" (April 27, 2015) at para. 10, online: https://www.csc-scc.gc.ca/politiques-et-lois/800-cd-eng.shtml.

359 [2018] S.C.J. No. 30, [2018] 2 S.C.R. 165, 2018 SCC 30 (S.C.C.).

360 *Inglis v. British Columbia (Minister of Public Safety)*, [2013] B.C.J. No. 2708, 2013 BCSC 2309 at paras. 501 and 614 (B.C.S.C.).

Indeterminate segregation and the segregation of those with mental disabilities in the federal correctional system were deemed in violation of section 7 and were not saved by section 1.[361] These arguments would apply to the provincial institutions, including pre-trial custody, where hundreds of people are detained daily without any mental health supports. In addition, the same should apply to the observation cells in which mentally ill or suicidal individuals are held without any substantial treatment. Finally, elsewhere, I have made the argument that the inadequate health services could lead to a novel section 7 claim for prisoners.[362]

In *British Columbia Civil Liberties Assn. v. Canada (Attorney General)*, as noted above, the court held that the segregation provisions allowing for indeterminate or prolonged segregation discriminate against Indigenous people, who are overrepresented in segregation, under section 15.[363] Years earlier, the Supreme Court of Canada found that illegal prohibitions, such as voting prohibitions, have disproportionate effects on Indigenous people, who are overrepresented in prisons.[364] This may apply to other policies and provisions that restrict access to health care and that endanger life and liberty under section 7. As discussed, Indigenous populations have higher rates of addiction and disease, and many Indigenous persons come from more marginalized communities, are placed in higher security institutions where the negative consequences on health are more significant, and are indirectly (through restricted policies) excluded from programs, such as the mother-child program. These may all constitute violations under section 15.

Such disproportionate and negative impacts also undermine reconciliation efforts, and perpetuate racism and the impoverishment and institutionalization of Indigenous people and communities. The Truth and Reconciliation Commission ("TRC") has defined reconciliation as "an ongoing process of establishing and maintaining respectful relationships. A critical part of this process involves repairing damaged trust by making apologies, providing individual and collective reparations, and following through with concrete actions that demonstrate real societal change."[365] The TRC specifically asked the government, as part of the reconciliation process, to identify and close the gaps in health outcomes for Indigenous

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361 *British Columbia Civil Liberties Assn. v. Canada (Attorney General)*, [2018] B.C.J. No. 53, 2018 BCSC 62 at para. 545 (B.C.S.C.).

362 Adelina Iftene, "Employing Older Prisoner Empirical Data to Test a Novel s. 7 Charter Claim" (2017) 40:2 Dal. L.J. 497.

363 *British Columbia Civil Liberties Assn. v. Canada (Attorney General)*, [2018] B.C.J. No. 53, 2018 BCSC 62 at para. 545 (B.C.S.C.).

364 *Sauvé v. Canada (Chief Electoral Officer)*, [2002] S.C.J. No. 66, 2002 SCC 68 at para. 60 (S.C.C.).

365 Truth and Reconciliation Commission of Canada, *Canada's Residential Schools: Reconciliation — The Final Report of the Truth and Reconciliation Commission of Canada*, vol. 6 (Montreal, QC & Kingston, ON: McGill-Queen's University Press, 2015) at 11.

individuals and communities,[366] to address the overrepresentation of Indigenous people in custody,[367] and to adequately address the issues Indigenous prisoners face.[368] In addition, the National Inquiry into Missing and Murdered Indigenous Women and Girls specifically mentioned both lack of access of health care and overincarceration as forms of violence that continue to inflict harm upon Indigenous women.[369]

Adopting a public health lens to incarceration would help close many of the gaps that currently exist in the provision of health care in prisons and which may lead to legal violations. More generally, a public health approach to corrections would not only improve the health of communities but would also enable governments to advance other essential goals, such as a consistent respect for the rule of law behind prison walls and working towards reconciliation.

(b) Recommendations

Further reframing correctional policy and practices through a public health lens would shift the focus to creating opportunity for marginalized individuals; investing in their living environment, health and programs at least as much as in the security; providing regular and tailored health education; and creating liaisons with communities for continuity of care post-discharge. This would better align public safety goals with public health and minimize the legal violations discussed earlier in this part.

Such reframing, however, will best begin with a sweeping legislative and policy reform that would frame many provisions and services around a "whole-prison approach"[370] and that would recognize that advancing public health ought to be as much of a goal of all correctional systems as advancing public safety. This approach would include:[371]

- Providing access to appropriate levels of care, including screening and immunization;
- Ensuring continuity and coordination of care upon release;

366 *Ibid.*, Call to Action 19, at 226.
367 *Ibid.*, Call to Action 30, at 228.
368 *Ibid.*, Call to Action 36, at 228.
369 National Inquiry into Missing and Murdered Indigenous Women and Girls, *Reclaiming Power and Place: The Final Report of the National Inquiry into Missing and Murdered Indigenous Women and Girls* (2019), vol. 1a at 413-98 and 635-48.
370 *Ibid.*, at 180-84.
371 This list is based on the suggestions provided by *ibid.*, at 180-81, and Andrew Fraser, "Primary health care in prisons" in Stefan Enggist *et al.*, eds., *Prisons and Health* (Copenhagen: World Health Organization, 2014) 173 at 177-79.

- Delivering adequate and tailored health care for the specific needs of marginalized populations including women, Indigenous, LGBT (lesbian, gay, bisexual and transsexual), elderly and people with disabilities;
- Employing competent and sufficient clinical staff;
- Offering sufficient resources, including drugs, to meet most needs;
- Creating links to community services, including mental health supports and services;
- Encouraging and providing opportunities to maintain family links;
- Providing support for mothers and their children, ideally outside of carceral settings;
- Creating opportunities for acquiring basic life skills, training for employment and purposeful activities programming;
- Providing adequate food, opportunities to exercise and access to fresh air;
- Creating a healthy living environment and providing trauma-informed services and supports;
- Ensuring that the living space has sufficient privacy, adequate lighting, ventilation, heating, cooling and access to sanitation in cells;
- Providing basic training for all staff on matters of health, health care and legal duties of care; and
- Creating links with welfare programs and entitlements after release.

Beyond public health aims, this approach would also recognize the shared humanity of everyone in our communities and uphold prisoner rights as human rights. Importantly, if done properly, this approach would work towards breaking the cycle of criminalization in individuals, families and communities, while emphasizing transitions and community resources or supports that help people stay in the community. Imprisonment will always have some negative effects on individuals and communities; thus, the best prison strategies are the ones that help decarcerate[372] people and ensure that they do not return to prison. A public health approach would support these important aims.

[372] "Decarceration" is the transfer of an individual from prison to the community. In penological studies, "decarceration" is often used to denote the process of transferring individuals into the community, while concomitantly creating community services and supports that, in comparison to prison, would better help the individual rehabilitate and integrate into society.

Court File No. T-539-20

FEDERAL COURT BETWEEN:

**CANADIAN CIVIL LIBERTIES ASSOCIATION,
CANADIAN PRISON LAW ASSOCIATION
HIV & AIDS LEGAL CLINIC ONTARIO,
HIV LEGAL NETWORK,
& SEAN JOHNSTON**

Applicants

– and –

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Counsel for the Applicants

FORM 52.2

Court File No. T-539-20

FEDERAL COURT

BETWEEN:

**CANADIAN CIVIL LIBERTIES ASSOCIATION,
CANADIAN PRISON LAW ASSOCIATION
HIV & AIDS LEGAL CLINIC ONTARIO,
HIV LEGAL NETWORK,
& SEAN JOHNSTON**

Applicants

– and –

THE ATTORNEY GENERAL OF CANADA

Respondent

Certificate Concerning Code of Conduct for Expert Witnesses

I, Dr. Adelina Iftene, having been named as an expert witness by the Applicants, certify that I have read the Code of Conduct for Expert Witnesses set out in the schedule to the *Federal Courts Rules* and agree to be bound by it.

May 13, 2020

Dr. Adelina Iftene

Adelina Iftene,
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Halifax, NS,
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phone: 902-499-9439

Court File Number: T-539-20

FEDERAL COURT

B E T W E E N:

**CANADIAN CIVIL LIBERTIES ASSOCIATION,
CANADIAN PRISON LAW ASSOCIATION,
HIV & AIDS LEGAL CLINIC ONTARIO,
HIV LEGAL NETWORK,
& SEAN JOHNSTON**

Applicants

-and-

THE ATTORNEY GENERAL OF CANADA

Respondent

AFFIDAVIT OF DR. AARON ORKIN

I, AARON ORKIN, MD MSc MPH PhD(c) CCFP(EM) FRCPC, physician specialist in Family Medicine, Emergency Medicine, and Public Health and Preventive Medicine, of the City of Toronto in the Province of Ontario, MAKE OATH AND SAY AS FOLLOWS:

1. I have personal knowledge of the matters to which I depose in this Affidavit. Where the information is not based on my personal knowledge, it is based upon information provided by others, as I describe below, which I believe to be credible and true.

2. I provide these statements in my capacity as an independent physician, epidemiologist and researcher, and NOT on behalf of nor as a representative of any of the organizations or institutions with which I am affiliated.

3. I am providing this Affidavit for the purpose of having the views of an epidemiologist be taken into account when decisions are being made with respect to the conditions in which individuals are held in custody and the release of individuals from custody during the COVID-19 pandemic, and for no other or improper purpose. I swear this Affidavit regarding the Application

brought by the Canadian Civil Liberties Association ("CCLA"), the Canadian Prison Law Association ("CPLA"), the HIV&AIDS Legal Clinic Ontario ("HALCO"), HIV Legal Network, and Sean Johnston, Federal Court File No. T-539-20.

4. This Affidavit includes the following exhibits:

a) **Exhibit A:** My *curriculum vitae.*

b) **Exhibit B:** Government of Ontario Technical Briefing, 3 April 2020

c) **Exhibit C:** Government of Ontario COVID-19 Modelling and Potential Scenarios, 20 April 2020.

d) **Exhibit D:** Public Health Ontario Epidemiological Summary, 6 June 2020

A. MY QUALIFICATIONS AND EXPERIENCE

5. I am a physician and epidemiologist, and Assistant Professor in the Department of Family and Community Medicine at the University of Toronto. I hold graduate degrees in History and Philosophy of Medicine (University of Oxford) and Public Health (University of Toronto). I completed fellowships in family medicine research (Northern Ontario School of Medicine) and Clinical Public Health (University of Toronto). I am a doctoral candidate in Clinical Epidemiology and Health Care Research at the Institute of Health Policy, Management and Evaluation at the University of Toronto.

6. My curriculum vitae is attached as **Exhibit A** to this, my Affidavit.

7. I understand that epidemiology has been defined by the courts as "the study, control and prevention of disease with respect to the population as a whole, or to defined groups thereof, as distinguished from disease in individuals". I understand that this definition of epidemiology was accepted in *Rothwell v. Raes* (1988), 68 O.R. (2d) 449, [1988] O.J. No. 1847 (H.C.J.) at para. 245, aff'd (1990), 2 O.R. (3d) 332, [1990] O.J. No. 2298 (C.A.), leave to appeal to the S.C.C. refused, [1991] S.C.C.A. No. 58. I agree with this definition.

8. The World Health Organization defines epidemiology as "the study of the distribution and determinants of health-related states or events (including disease), and the application of this study to the control of diseases and other health problems.[1]

9. I have been previously qualified as an expert witness, specifically with respect to the opioid crisis, opioid overdose first aid and overdose prevention, when I gave testimony at the inquest into the death of Bradley Chapman.

10. I practice emergency medicine at two Toronto hospitals (St. Joseph's Health Centre and Humber River Hospital), and I serve as the Population Medicine Lead for Inner City Health Associates, an organization providing health services to people experiencing homelessness across Toronto.

11. I am a clinician scientist. This means that I spend a large portion of my time on research. That research focuses on health equity and vulnerable populations, especially around the health of people experiencing homelessness, people who use drugs, and Indigenous communities. I have conducted research regarding the health status of individuals experiencing incarceration.

12. With respect to COVID-19, my experience and expertise includes the following:

a) I am the Medical Director of the St. Joseph's Health Centre COVID-19 Assessment Centre; and

b) I play a role in planning and implementing a response strategy for COVID-19 among people experiencing homelessness in Toronto as Population Medicine Lead for Inner City Health Associates, Toronto.

13. I have sworn two previous Affidavits regarding COVID-19 and congregate living facilities[2] which have been filed in various Ontario Court of Justice and Ontario Superior Court proceedings since the beginning of March 2020. I am informed that these proceedings have

[1] World Health Organization. "Health topics: Epidemiology". Available: https://www.who.int/topics/epidemiology/en/. Accessed 11 May 2020.

[2] ("Congregate setting" or "congregate living facility" are terms of art to refer to settings where people live together beyond a family unit such as long-term care facilities, school dormitories or children's camps, homeless shelters, military barracks, or correctional facilities.)

principally related to applications by criminal defendants for judicial interim release and their sentencing matters. I made an Affidavit generally available to the Criminal Lawyers' Association, which includes no reference to case-specific facts.

14. I am not aware of every court proceeding in which my Affidavit has been considered. I was not retained to offer my expert opinion in each individual case when my Affidavit was considered.

COVID-19 AND ITS GENERAL MANAGEMENT

15. COVID-19 is a novel coronavirus that was declared pandemic by the World Health Organization on March 11, 2020. "Pandemic" is declared when a new disease for which people do not have immunity spreads globally beyond expectations.

16. In Canada, every province and territory has declared a state of emergency in response to COVID-19. Health Canada has declared that the risk of infection and of health harms to Canadians from COVID-19 is "High."[3]

17. Ontario identified its first presumptive case of COVID-19 on January 25, 2020.[4]

18. On April 3, 2020, the Government of Ontario released a "Technical Briefing", a copy of which is attached as **Exhibit B** to this affidavit. This briefing suggested that peak number of ICU admissions would occur in early April 2020, requiring an approximate ICU capacity of 700 beds in Ontario.

19. On April 20, 2020, the Government of Ontario released a report "COVID-19: Modelling and Potential Scenarios", a copy of which is attached as **Exhibit C** to this affidavit. This report confirmed that the general Ontario epidemic did peak in early April, and also identified that "spread in long-term care and other congregate settings seems to be growing".

20. Therefore, COVID-19 epidemiology in the general Ontario population and in congregate settings do not follow the same trajectory. For example, Public Health Ontario's epidemiological

[3] Government of Canada. Coronavirus disease (COVID-19): Outbreak Update; Risk to Canadians. April 29, 2020. Available: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection.html#a3 Accessed April 29, 2020.
[4] See **Exhibit B**, p.7.

summary from 6 June 2020 (**Exhibit D**) shows that the daily count of COVID-associated deaths have remained roughly steady since mid-May. Therefore, in the general Ontario population, the most severe effects of COVID-19 appear to have plateaued. During this same period, however, the number of COVID-19 cases and outbreaks in congregate settings has climbed.[5] In my opinion, the epidemiology of COVID-19 in the general population and in congregate settings are separate phenomena — patterns in the general population may not forecast the epidemiology in congregate settings.

21. International experience demonstrates that people with medical comorbidities are more likely to require ICU admission or to die from COVID-19, if they contract COVID-19, than people who do not have these medical comorbidities.[6,7,8]

22. There is no specific treatment or therapy for COVID-19 to limit mild illness from deteriorating into severe disease requiring intensive care admission. Therefore, the COVID-19 pandemic cannot be managed or mitigated using clinical interventions. That is, the number of COVID-19 deaths cannot be reduced by providing mildly infected individuals with treatments or cures. The health impact of COVID-19 can only be managed through population health strategies.

23. The central strategy for the population health management of COVID-19 is referred to as "flattening the curve". The principle here is that measures can be taken to reduce the incidence of new cases, that is, the number of new people getting infected on any given day, even if we are less successful at reducing the number of overall cases that occur throughout the epidemic. This means that the health care system's most vital resources are not overwhelmed by a sudden bolus of sick people requiring intensive care and scarce resources. If the healthcare system is not overwhelmed, fewer deaths will occur because there is capacity to provide acute care to everyone who needs it.

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[5] See Government of Ontario, "How Ontario is responding to COVID-19" Available https://www.ontario.ca/page/how-ontario-is-responding-covid-19. Accessed 11 May 2020.

[6] Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, Barnaby DP, Becker LB, Chelico JD, Cohen SL, Cookingham J. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. Jama. 2020 Apr 22.

[7] Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, Liu L, Shan H, Lei CL, Hui DS, Du B. Clinical characteristics of coronavirus disease 2019 in China. New England journal of medicine. 2020 Apr 30;382(18):1708-20.

[8] Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. Jama. 2020 Feb 24.

24. The cornerstone of a flatten-the-curve strategy is physical distancing. This involves measures to reduce social contact. In Ontario, various public health orders have been put in place to implement these measures, such as cancelling schools, forbidding gatherings of more than 5 people, and closing all non-essential workplaces (see **Exhibit B** and **Exhibit C** for a timeline of emergency orders and interventions).

25. COVID-19 is not dissipating in the general population. We have flattened the curve, but roughly 99% of Canadians remain susceptible to infection.[9]

26. Two meters of physical distance between people is considered a minimum for appropriate physical distancing to reduce COVID-19 transmission. However, this distance has not been studied for prolonged exposure to an individual with contagious COVID-19, such as sleeping arrangements where individuals are within a short distance of each other for hours at a time. People who are in proximity for long periods of time may therefore require more separation to achieve sufficient health protections. Two meters of distancing also does not refer to vertical separation, such as on bunk beds where droplets would shower down over longer distances. There is mounting evidence that in the context of prolonged exposure, more physical distancing is required to prevent the spread of infection.[10,11] In my opinion, two meters of physical distance is reasonable to protect against short-term or transient exposure, such as walking past someone in a hallway or standing in line at the grocery store, but more distancing or physical separators are required if the goal is to inhibit disease transmission among congregated populations.

27. Crowding and physical distancing are therefore mutually exclusive concepts. In other words, the population health benefits of physical distancing cannot be realized in conditions of crowding or tight living quarters, particularly where the people living in close quarters are also sharing facilities such as sinks, toilets, showers and telephones or are involved in cleaning, laundry, or other services for one another.

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[9] Smith M, Upshur R, Downar J. Why a flatter curve doesn't mean we've won the COVID-19 battle. CBC.ca. Available: https://www.cbc.ca/news/opinion/opinion-covid-19-sir-model-1.5508215 Accessed 30 April 2020.

[10] Bourouiba L. Turbulent Gas Clouds and Respiratory Pathogen Emissions: Potential Implications for Reducing Transmission of COVID-19. JAMA. Published online March 26, 2020. doi:10.1001/jama.2020.4756

[11] Liu, Y., Ning, Z., Chen, Y. et al. Aerodynamic analysis of SARS-CoV-2 in two Wuhan hospitals. Nature (2020). https://doi.org/10.1038/s41586-020-2271-3

B. EXPONENTIAL GROWTH AND PROBABILITY

28. Understanding the challenge of controlling outbreaks in congregate settings requires an understanding of exponential growth patterns and probability. These two concepts govern the spread of infectious diseases.

29. Exponential growth is relevant because of the way that each infectious person causes other people to become infected. In the general public and across a range of available studies from Wuhan, China, each person with COVID-19 infects between 3.8 and 8.9 other people.[12] Studies from other parts of the world show slightly lower numbers, and most infectious disease models in Canada are using values between 2 and 5. Even under community-wide quarantine, a Canadian team has estimated that each person with COVID-19 infects 2.3 others.[13] This creates exponential growth.

30. Exponential growth of infectious disease outbreaks like COVID-19 creates extremely narrow opportunities for intervention. Problems seem very small and very manageable, and are then suddenly overwhelming. For example, when a facility has one or two cases, it seems possible to intervene and get things under control. However, one or two cases does not evolve slowly into three, four or five cases. It follows a doubling pattern where one or two cases tend first to become ten or twelve cases, and then rapidly evolve into dozens or hundreds of cases. This is especially hard to prevent when a large proportion of cases are asymptomatic because the small number of initial cases can go unnoticed. Responding appropriately therefore requires a kind of decisiveness and responsiveness that is likely counter-intuitive to administrators — we have to act immediately and decisively when a problem still appears controllable and suited to modest responses or even further assessment. From an operational perspective, preventing outbreaks of this kind requires that we take actions to prevent transmission when there is still little observed transmission.

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[12] Sanche S, Lin YT, Xu C, Romero-Severson E, Hengartner N, Ke R. High contagiousness and rapid spread of severe acute respiratory syndrome coronavirus 2. Emerg Infect Dis. 2020 Jul [*date cited*]. https://doi.org/10.3201/eid2607.200282

[13] Tuite AR, Fisman DN. Reporting, Epidemic Growth, and Reproduction Numbers for the 2019 Novel Coronavirus (2019-nCoV) Epidemic. Ann Intern Med. 2020;172:567–568. [Epub ahead of print 5 February 2020]. doi: https://doi.org/10.7326/M20-0358.

31. The second concept is probability. When we say that each infected person causes, for example, 2.3 other infections, this number refers to a distribution of values. That is, the stated value is a median across many infected individuals, and not a hard-and-fast rule for all infected individuals. This value has what we refer to as “a distribution”, or curve. The median means that half of the values are higher than the stated number, and half are lower than the stated number.

32. This probabilistic characteristic is particularly important at the beginning of an outbreak. If we have one or two cases, there is an even chance that these first individuals will infect many more than the average number, or that they will infect many less (i.e. the first person could infect 15 others, or could infect just one other.) There is no guarantee that the first few cases will be representative of the average pattern. This variation in the possible number of infections caused by an individual is multifactorial, involving (a) behavioural, factors (b) environmental factors, and (c) physiological/biological factors. Below, I describe each of these factors and the degree to which they are modifiable or unmodifiable in a congregate setting.

(a) The behavioural variation refers the fact that one contagious individual may self-isolate or see few people, and wear a mask and wash their hands rigorously, while another symptomatic individual might attend a large social gathering and not wear a mask or wash their hands. If the infectious individual self-isolates or interacts with few people, fewer secondary cases would be expected. If the infectious individual attends a large social gathering, more secondary cases would be expected. This difference can be largely controlled in a congregate facility where individual behavioural choices can be limited, such as a correctional facility or some long-term care facilities. However, shared essential facilities such as washrooms or dining facilities can limit the impact of behavioural measures. Therefore, behavioural factors are partially modifiable.

(b) The environmental variation refers to the fact that some contagious individuals may be positioned in a setting that is cleaned rigorously and facilitates physical distancing, while another individual may be in an environment that is more conducive to disease transmission. For example, one infectious individual might live in an environment with good air circulation and rigorous cleaning, and we would therefore expect few secondary cases. Another individual might live in an

environment with limited cleaning of shared spaces and poor air circulation, and more secondary cases would be expected to occur. This difference can be somewhat controlled in congregate facilities through interventions such as improved cleaning and hygiene, but structural elements of the environment (such as architecture and air circulation) are harder to adapt in response to an outbreak. Therefore, environmental factors are partially modifiable.

(c) The physiological/biological variation refers to the fact that some individuals will generate and shed lots of virus, while others will not. The factors that cause this variation from one patient to another are unclear[14] and cannot be controlled. Therefore, physiological/biological factors are unmodifiable.

33. Therefore, if we imagine a hypothetical set of many congregate settings that all implement environmental and behavioural controls to reduce disease transmission, there will still be variation in the number and extent of outbreaks across these facilities. This variation will exist regardless of whether any individual setting has implemented sufficient or insufficient environmental or behavioural controls, and regardless of whether individuals comply with those controls. If, on average, more facilities take more effective measures, and if, on average, more individuals are more compliant, then on average the number and extent of the outbreaks across the facilities will be reduced. However, a substantial portion of the expected outbreaks are a result of unmodifiable or partially modifiable variables, and we would expect outbreaks to occur regardless of the control measures put in place in response to those variables that we can modify.

34. The earliest stages of roughly half of all outbreaks in congregate settings will be slower than the median, while they might accelerate thereafter. It would be incorrect to attribute these differences at the early stages solely to the successes or failures in the implementation of behavioural and environmental controls because a substantial portion of the risk of an outbreak arises from unmodifiable factors. For example, it would be inaccurate to claim that an outbreak in one congregate setting got out of control because there was insufficient hand washing or physical distancing and that the outbreak in another similar setting stopped because there were strict controls such as a lockdown. Further, it would be impossible to conclusively attribute an observed

14 He, X., Lau, E.H.Y., Wu, P. et al. Temporal dynamics in viral shedding and transmissibility of COVID-19. Nat Med (2020). https://doi.org/10.1038/s41591-020-0869-5

difference in the size or extent of two outbreaks to differences in the implementation of control measures. The difference between these two hypothetical settings could be equally attributable to the variation in the disease transmission of the first cases — in one setting, an early case may spread the disease to many people (ie: a "super-spreader"), while in the other setting, the early cases may spread it less. This is just probability. Only when many dozens of people have the disease does the rate of spread average out to the expected number, but once an outbreak is this far gone, basic mitigation strategies such as hand hygiene or surface cleaning can no longer hold back the tide.

35. These phenomena have been observed in other congregate environments, including in correctional facilities in Canada and internationally. Here are some examples:

(a) Toronto's Willowdale Welcome Center is a shelter for newcomers to Toronto (mostly refugees), with a population of approximately 200. According to the City of Toronto's 29 April 2020 statistics, there have been 152 cases from this facility and 2 hospitalizations.[15] However, there have also been 8 other outbreaks ranging in size from 1 to 24 cases. With an understanding of probability and exponential growth, this kind of distribution of outbreak sizes is entirely predictable. So long as people are congregated and there is COVID-19 circulating, there will be a range of outbreaks of differing sizes. Small outbreaks are not evidence that those outbreaks are "under control" or that mitigation strategies were sufficient in those settings. Large outbreaks are also not evidence that mitigation strategies were implemented in those settings improperly. Rather, this variation is a normal consequence of exponential growth and probability.

(b) A recent analysis published by the United States Centers for Disease Control quantified this variability in 19 homeless shelters in four US cities[16]. The study divides the findings into three contexts:

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[15] Toronto Public Health. Active COVID-19 Outbreaks in Toronto Shelters, 29 April 2020. https://www.toronto.ca/wp-content/uploads/2020/04/869c-Toronto-Active-Shelter-Outbreaks-Apr-29.pdf Accessed 30 April 2020.

[16] Mosites E, Parker EM, Clarke KE, et al. Assessment of SARS-CoV-2 Infection Prevalence in Homeless Shelters — Four U.S. Cities, March 27–April 15, 2020. MMWR Morb Mortal Wkly Rep. ePub: 22 April 2020. DOI: http://dx.doi.org/10.15585/mmwr.mm6917e1

(i) Shelters where testing was conducted after a cluster of initial cases were identified. A cluster is a small group of related cases demonstrating local transmission. In these shelters, mass testing identified large outbreaks ranging from 17% to 66% of facility residents, depending on the facility.

(ii) Shelters where testing was conducted after a single case was identified. In these shelters, roughly 5% of shelter residents were found to be infected.

(iii) Shelters where broad testing was conducted with no initial cases at the shelter. This is effectively screening. In these shelters, on average, 4% of shelter residents were infected.

This study shows features of both the exponential and probabilistic spread in that single cases do not result in consistent spread in congregate settings, but once there is local spread (ie: a cluster) we see more consistent growth into outbreaks for various sizes. It also underscores the importance of mass testing in congregate settings as an essential way to know the extent of an outbreak because a small cluster of symptomatic cases can be indicative of outbreak involving the majority of the facility, even if few individuals are symptomatic.[17]

(c) Recent Correctional Service of Canada facility data[18] demonstrates that as of May 24, 2020, there have been substantial outbreaks at five federal facilities. In total, 359 prisoners are reported to have tested positive for COVID-19: in Quebec at the Federal Training Centre Multi Level (FTCML: 161 cases), Joliette Institution (JI: 54), and Port-Cartier Institution (PCI: 15); in Ontario at the Grand Valley Institution for Women (GVIW: 8); and in British Columbia at the Mission Medium Institution (MMI: 120). At the two largest outbreak sites (FTCML and MMI), the positive test rate was 47% and 40% respectively, while at the smaller outbreaks (JI, PCI, GVIW) the positive test rate was 71%, 62.5%, and 9%. If the small outbreaks were actually places where the outbreak was caught early or managed better, while the large outbreaks were an expression of system failures or protocol deviations,

[17] Baggett TP, Keyes H, Sporn N, Gaeta JM. Prevalence of SARS-CoV-2 Infection in Residents of a Large Homeless Shelter in Boston. JAMA. Published online April 27, 2020. doi:10.1001/jama.2020.6887

[18] Correctional Service of Canada, "Inmate COVID-19 testing in federal correctional institutions June 3, 2020", Available: https://www.csc-scc.gc.ca/001/006/001006-1014-en.shtml. Accessed 5 Jun 2020.

> we would expect to see that the large outbreaks were associated with consistently higher test positive rates than the small outbreaks. This is an expression of the challenges of exponential growth, especially in small congregate groups. By the time managers identify a problem and conduct testing, the bulk of transmission has already occurred.

36. In light of the nature of the disease, the methods of transmission, the available behavioural and environmental control strategies and their effectiveness, and the arrangement and physical nature of congregate living and operations, it is my professional opinion that outbreaks of various sizes and scales will continue to occur independent of the mitigation and outbreak management strategies taken at any given congregate setting. Given the nature of the disease, the nature of the congregate living, and the nature of the behavioural and environmental control strategies, the number and density of people congregated will remain a critical variable in determining the potential size and extent of outbreaks.

C. PEOPLE AND POPULATIONS EXPERIENCING INCARCERATION AND COVID-19

37. As a population, the health status of people experiencing incarceration in Canada is worse than the rest of the public.[19] People experiencing incarceration have more medical comorbidities than the rest of the population. That is, they have higher rates of chronic disease including cardiorespiratory disease, mental health challenges and addiction.

38. Given that people experiencing incarceration have more medical comorbidities, this means that people experiencing incarceration, as a group, have a higher chance of intensive-care admission or death if they get COVID-19 than an age-matched group of non-incarcerated people.[20] The same is true for other groups that live in congregate settings and who have more medical comorbidities than the population average, such as people who live in long-term care facilities, or people who live in homeless shelters.

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[19] Kouyoumdjian F, Schuler A, Matheson FI, Hwang SW. Health status of prisoners in Canada: Narrative review. Canadian Family Physician. 2016 Mar 1;62(3):215-22.

[20] Akiyama MJ, Spaulding AC, Rich JD. Flattening the curve for incarcerated populations—Covid-19 in jails and prisons. New England Journal of Medicine. 2020 Apr 2.

39. From a population health strategy perspective as well as an individual health perspective, in relation to COVID-19 transmission, there is no substitute for appropriate physical distancing in congregate settings. Lockdowns, hand hygiene, face masks, screening for symptoms on entry, cleaning and other interventions are all important. However, these are by definition secondary interventions aimed to reduce transmission within a population of a given density. They are by definition less effective than reducing the population density. Furthermore, the effectiveness of these other interventions can be overwhelmed when an outbreak takes hold in a high-density congregate environment. That is, as the viral load in a given environment increases in the air, on surfaces, and in the proportion of individuals infected, a given disinfection, PPE or hand washing intervention that was sufficient at a lesser viral load will become insufficient. Crowding is therefore hazardous to individual and community health in the context of COVID-19 regardless of the other interventions that are implemented in congregate settings.

40. "Not fully voluntary congregate settings" (like correctional facilities, where residents cannot choose to leave the facility and move to live elsewhere) are differentiated from other congregate settings in that they are still operating through the COVID-19 pandemic. Congregate settings include boarding schools, children's summer camps, holiday resorts and other such voluntary settings, but these facilities have been managed in the context of COVID-19 from a public health perspective by simply closing their operations. That is, they have been completely decongregated and depopulated. In my opinion, this goes to show just how preferable it is from a public health perspective to depopulate and decongregate settings where people gather, rather than resorting to secondary mitigation strategies. If other mitigation strategies were sufficient, entirely voluntary congregate settings such as cruise ships, boarding schools and vacation resorts might remain in operation by implementing these measures. "Not fully voluntary congregate settings" remain in operation because of their socially essential function and at least somewhat non-voluntary nature of their admissions.

41. Preventing outbreaks in congregate living facilities is a top priority for a flatten-the-curve strategy for the entire population and not merely for the people who live in congregate environments. There are four reasons for this:

(a) Outbreaks in tight spaces happen quickly and are extremely difficult to control once they occur.

(b) People living in congregate facilities tend to have underlying comorbidities that make them more vulnerable to severe outcomes (ICU admission or death) from COVID-19. This is true in long-term care facilities, homeless shelters, and prisons. This is not to suggest that the burden of comorbidities is the same in these settings or that long-term care, shelter and prison residents are the same. Rather, people who live in each of these congregate settings have, on average, worse health status than the general population.

(c) Outbreaks in congregate living facilities can overwhelm health care and public health systems, meaning that scarce resources are consumed by local congregate living outbreaks before the epidemic takes hold in the general population.

(d) Outbreaks in congregate living facilities serve as tinder for the fire in more generalized outbreaks. Unlike cruise ships with a complete separation from the general population, people in correctional settings include the staff who work there, who may transfer disease into the general population.

Therefore, preventing disease in congregate living facilities is critical for flattening the curve across the entire population. All this means that protecting congregate living settings and preventing outbreaks there is about protecting the health of the entire population.

42. Coronavirus survives between a few hours and a few days on surfaces such as plastic and metal.[21] For this reason, physical distancing measures have also included the closure of public facilities such as playgrounds and restaurants. Effectively, continuous cleaning is required to reduce disease transmission on high-touch surfaces where populations are gathered. I am familiar with the relentless work and resources required to implement this kind of cleaning in hospitals. For example, in high-touch patient care environments with patients who may have COVID-19, cleaning personnel are trained specifically in the use of personal protective equipment, and are positioned to clean rooms and surfaces effectively constantly and after every patient exits a room or space. I am not familiar with whether this kind of continuous cleaning occurs in correctional facilities in the context of a known or suspected outbreak.

[21] World Health Organization. Q&A on Coronaviruses (COVID-19). 17 April 2020. https://www.who.int/news-room/q-a-detail/q-a-coronaviruses Accessed 30 April 2020.

43. I have never attended inside a provincial or federal correctional institution. I do not have the personal experience nor the necessary information to assess whether the physical environment and architecture of a given correctional facility is sufficient to permit the physical distancing required to reduce COVID-19 transmission in correctional facilities. Making such an assessment is both a geometry problem and a human factors one. The requirement to produce at least two meters of separation suggests that this is strictly a geometry problem, because it would be possible under those circumstances to put four people in a square room with two meter walls provided that they each face the corner and never moved — an absurd proposition. Therefore, the movement patterns, activity, and other factors involved in the operation of a correctional facility are as important as the physical layout in determining whether physical distancing is possible. Shared toileting, washing, recreation, telecommunications, and dining facilities all complicate matters for infection control. For this reason, my opinion is that reducing populations in congregate settings wherever possible is critical to reduce the risk and extent of outbreaks in congregate settings (including corrections), irrespective of the architecture and other interventions taken. Other medical scientists have expressed the same opinion around "decarceration.[22]

44. I have been advised that:

a) Correctional Service Canada (CSC) has suspended all inter-regional and international transfers of inmates, but that some prisoners have been transferred between institutions within regions during the pandemic.

b) Some prisoners in federal custody, in minimum security settings, reside in smaller, contained houses of 6-10 individuals, and that CSC occasionally transferred new prisoners into these houses from other institutions or facilities during the pandemic.

If this is true, the transfer of individuals represents an instance where COVID-19 transmission could occur. For example, if an individual with unidentified, asymptomatic, or still incubating COVID-19 were transferred between institutions or into a "house", they could potentially expose other individuals (residents or staff) to COVID-19. There are strategies that could reduce the risk of transmission (but not eliminate it) if residents are moved into new settings. For example, an individual could rigorously isolate from others for 14 days prior to transfer, get tested for COVID-

[22] Akiyama MJ, Spaulding AC, Rich JD. Flattening the Curve for Incarcerated Populations—Covid-19 in Jails and Prisons. New England Journal of Medicine. 2020 Apr 2.

19 prior to transfer to help confirm that the individual does not have COVID-19, receive and confirm the negative result while still in isolation and prior to transfer, and then transfer to the other facility. I am not familiar with whether such a practice is in place.

45. I am advised that some prisoners in federal custody, in maximum security settings, reside in ranges of cells. Not all prisoners occupy a cell alone. Some cells are built for double occupancy. In some cells, two prisoners are housed in a cell originally designed for single occupancy. If this is true, careful assessments of the layout of the cells would be necessary to determine if sufficient physical distancing is possible for people occupying the same cell. As discussed in Paragraph 43, this is not merely a question of geometry or architecture, but also human factors and movement. In particular, it is not possible to sleep in bunk beds in a way that provides sufficient physical distancing for respiratory droplets (see Paragraph 26).

46. Insufficient physical distancing in prisons is hazardous to the health of people experiencing imprisonment. This is true for everyone in correctional facilities, but particularly true for people with underlying health problems. Therefore, reducing the population of individuals of any health status in correctional facilities is important to protect the health of those who must remain there for whatever reason, and especially important for protecting the health of people who must remain in correctional facilities who also have underlying health problems.

47. There is effectively no minimum population threshold for the decongregation of correctional facilities that would achieve sufficient physical distancing to allow the risk of COVID-19 in these settings to approximate the risk of individuals living outside these settings. As discussed in Paragraph 40, above, other congregate settings that are not characterized by essential or not fully voluntary admission have been regulated to depopulate in response to COVID-19 because the risks and harms associated with those gatherings are considered unacceptable or unhelpful epidemiologically. I am not aware of any correctional facility that has achieved the depopulation and other measures necessary to deliver appropriate physical distancing, and if such a facility existed it would, by definition, no longer be operating as a congregate living environment at all. Pragmatically speaking, sufficient physical distancing and not fully voluntary institutionalized congregate living are in my opinion mutually exclusive concepts.

48. The management and care of congregate populations raises hazards and threats to the health of corrections staff (and by extension, their families and others with whom they come in contact),

if they work in an environment with insufficient space between personnel and inmates. This is especially true once an outbreak takes hold, because there may not be capacity to transfer all people with COVID-19 out of correctional facilities and into hospitals. This hazard can be reduced and mitigated by reducing the degree of congregation, or by physical distancing.

49. A hazard for staff remains irrespective of the Personal Protective Equipment (PPE) or other protections are made available to corrections staff. The same phenomenon occurs in healthcare settings: even with optimal PPE supply, breaches and infections occur often. PPE does not offer the wearer a hermetic seal separating them from viral exposure, and the risk of infection increases as the viral load surrounding the wearer increases. In the context of a widespread outbreak, the risk to staff becomes substantial. Appropriate and safe PPE donning and doffing requires ongoing training, vigilance and quality assurance, and in settings with a high density of COVID-19 infected individuals, maintaining personal protection sometimes requires dedicated infection prevention and control personnel. This is what we have in hospital environments, and occupational infections are still common. I am not familiar with whether this kind of PPE training and quality assurance occurs in correctional facilities in the context of a known or suspected outbreak.

50. Sufficient infectious disease isolation of infected individuals is difficult to achieve in a congregate setting. Proper isolation of an individual with COVID-19 requires that the infected individual have a separate room, separate toilet, separate dining and separate bathing facilities, or that shared facilities be used separately and cleaned thoroughly by an appropriately protected individual between users. Isolation also requires that the infected individual wear a mask if they are less than two meters from another non-infected individual, wash their hands, and engage in proper hand hygiene. In congregate settings, isolation also involves various complexities related to cleaning and transport of items such as used dining ware, linens, laundry, etc. because all of these items can carry live virus.

51. Despite physical distancing and other efforts, COVID-19 outbreaks have occurred and will continue to occur in correctional facilities. Due to limitations on the availability and suitability of hospital and health care spaces, it is likely that people in correctional facilities with mild symptoms will need to convalesce and recover in isolation in those facilities. In the presence of individuals with active and known infection, outbreak control is even more critical and challenging than in the

context of initial infection prevention. There is a critical need for more space and physical distancing in advance of future outbreaks.

52. COVID-19 may generate human resources shortages in all areas, including among corrections personnel, due to self-isolation, illness and absenteeism. I do not know whether reducing populations in corrections facilities may also be necessary to maintain correctional facility standards with reduced staffing.

53. Every person who is discharged from a correctional facility to a private residence is an opportunity to flatten the curve and improve health for the individual involved, other inmates in the facility in question, staff at the facility in question, and the public. Decreasing the existing population in correctional facilities — especially those who are healthy and able to self-isolate in lower density private residences — will reduce the population density in correctional facilities and therefore reduce the risk of infection for both the individuals who are discharged from those facilities and the people who remain there.

54. From a medical and population health perspective, it is in the best interest of the community at large that an aggressive approach be taken to depopulating custodial facilities, be they jails, prisons, penitentiaries, reformatories or detention centers, and whether they be for males or females, youths or adults. So long as individuals are forced to congregate in relatively small spaces, one where they share washroom, dining, telephone and other facilities, and where people from the outside (new inmates, correctional staff, volunteers) occasionally populate the space, COVID-19 will have a fertile environment in which to spread both inside and then outside the facilities.

55. The state of health of a particular inmate is irrelevant to my recommendations. Whether an inmate is old or young, frail or robust, in good health or suffering from pre-existing conditions, my opinion would remain the same: with respect to the public health risk of the current COVID-19 pandemic, it would always be in the best interest not only of the inmate but of the community at large to release the inmate to a less populated environment such as their own home.

56. Depopulating a congregate living environment makes sense from a public health perspective only if the discharged individuals reside instead in a private residence or some other setting with greater health protections and decongregation. For example, transferring someone from a correctional facility to a homeless shelter, or from a homeless shelter to a long-term care facility, may be confer no benefit or even harm. My opinion regarding the public health benefit

of depopulating correctional facilities is therefore predicated on the idea that an individual released from a correctional facility has a private home or residence to go to and is able to comply with physical distancing in the community in the same manner as other average members of that community. That is, the net physical distancing at the community level achieved by discharging the individual from the correctional facility should be positive.

57. A judicial official, board or tribunal deciding whether or not to release somebody from custody will take various factors into account, and will have to balance public health and individual safety against factors outside of my area of expertise in determining what is in the community's best interest. My opinion is concerned only with what is in the community's best interest, from a medical and population health perspective, with respect to the imminent threat of a COVID-19 pandemic. Subject to other considerations, any solution that promotes and enables physical distancing between individuals is in the community's best interest with respect to COVID-19.

D. MEDICAL ISOLATION AND THE SECOND WAVE

58. According to some media, as of April 20, approximately 400 people in federal correctional institutions across Canada are presently under medical isolation, which has been described as being locked in a cell for all but 20 minutes per day.[23] I have been advised that this is the current practice for all prisoners at Mission Institution (the medium security facility) in British Columbia, a particular "hot spot", where approximately one-third of prisoners (120 of 297) have tested positive for COVID-19.

59. Apart from such extreme restrictions adopted in some institutions, I am informed that various recreational and visitation programs and congregate dining are presently closed at some other correctional facilities experiencing or attempting to prevent an outbreak, and that residents are therefore spending much more time in their cells.

60. I cannot opine on whether these measures are sustainable from a staffing, operational, mental health, or rights-of-the-incarcerated perspective. For the purposes of this opinion, I have been asked to assume that at some point in the next 18 months, medical isolation and lockdown in

[23] City News. Canada's prison ombudsman calls coronavirus isolation 'extremely concerning'. Available: https://toronto.citynews.ca/2020/04/24/canadas-prison-ombudsman-calls-covid-isolation-extremely-concerning/ Accessed: 30 April 2020

correctional facilities will need to end and correctional institutions will need to resume more regular operations, including visitation, programming, and congregate dining.

61. Given that roughly 99% of the population remains susceptible to COVID-19[24], and given that a COVID-19 vaccine is still speculative and at least 18 months away from availability at scale,[25] and assuming that broad facility-wide lock-downs, medical isolation, and many of the other protections will need to end, my opinion is that the risk of COVID-19 outbreaks in these facilities will increase when those protections are reduced. An aggressive approach to depopulation is therefore also necessary to counteract the increased risk of COVID-19 transmission in these facilities accompanying the resumption of more normal activities. When normal activities resume, especially if other restrictive measures outside of correctional facilities have also been relaxed, the risk of outbreaks and their size and severity in the correctional setting will, by definition, increase. This creates what is known as the "second wave" — the outbreaks that occur when existing restrictions are relaxed. The second wave of outbreaks in correctional facilities is still in our future. If mitigation measures must be relaxed without reducing populations further, I would expect that the second wave of outbreaks in correctional facilities to be larger than the outbreaks we are experiencing presently.

62. Assuming the current restrictions are currently having some limited role in attenuating the spread of COVID-19 within the current correctional facility population, it follows logically that safely relaxing those restrictions will require smaller populations in those facilities so that the spread of infection will not increase alongside the greater freedoms permitted to the incarcerated. Smaller populations and lower density will be important for preventing and mitigating outbreaks during this second wave. Strategically and epidemiologically speaking, it is crucial to reduce correctional facility density further so that we can more safely relax restrictions in those settings.

63. Stated differently, even if I were to assume that the current population of inmates in federal correctional institutes was sufficiently low to control the spread of COVID-19

[2424] Smith M, Upshur R, Downar J. Why a flatter curve doesn't mean we've won the COVID-19 battle. CBC.ca. Available: https://www.cbc.ca/news/opinion/opinion-covid-19-sir-model-1.5508215 Accessed 30 April 2020.
[25] Gates, B. What you need to know about the COVID-19 vaccine. GatesNotes.com. 30 April 2020. Available: https://www.gatesnotes.com/Health/What-you-need-to-know-about-the-COVID-19-vaccine Accessed 1 May 2020.

(something I do not believe to be true), that level of control is only achievable when coupled with the other measures that are currently in place. If any of these measures need to be relaxed before the risks of COVID-19 have subsided, the risk of contracting COVID-19 spread in jails will increase. At that stage, further population reductions will be all the more crucial, and are therefore necessary before existing restrictions can be relaxed.

E. THE IMPACT OF EXISTING INTERVENTIONS

64. I am advised that CSC is making efforts,[26,27] like those pursued in Ontario's provincial correctional facilities, to reduce infections and limit outbreaks. These measures include outbreak management, medical care, specific accommodations for medically vulnerable people, screening of residents and staff, visitor screening and restrictions, halting communal eating and serving, and limiting or cancelling activities and programmes which involve physical proximity between prisoners or prisoners and staff members. These efforts are, in my opinion, absolutely necessary. They are not, however, sufficient in an environment without sufficient physical distancing.

65. These measures are strategically identical to the measures that are being taken in other congregate living and health care environments, such as hospitals, long-term care facilities and retirement homes. It is this strategic similarity that highlights the insufficiency — not the sufficiency — of these interventions. Despite these measures, outbreaks continue to occur across Ontario hospitals, long-term care facilities, and retirement homes. This is not mainly because the interventions are ineffective or improper, but because attempting to eliminate COVID-19 transmission in congregate settings is nearly impossible. The interventions reduce transmission, they do not eliminate it. No long-term care facility, ICU or retirement home could be said to be completely safe with respect to COVID-19 merely because operators and residents were following outbreak management guidance. Therefore, my opinion is that although these measures are essential, the risk of an outbreak in any given facility remains serious and significant.

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[26] Correctional service of Canada, "COVID-19 Preparedness and Plans" (March 30, 2020), https://www.csc-scc.gc.ca/001/006/001006-1017-en.shtml Retrieved May 25, 2020

[27] Office of the Correctional Investigator, "COVID-19 Status Update" (April 23, 2020), https://www.oci-bec.gc.ca/cnt/rpt/pdf/oth-aut/oth-aut20200423-eng.pdf Retrieved May 25, 2020

66. Therefore, while we maximize hygiene, training, cleaning and physical distancing, from a medical and population health perspective, judicious and deliberate reductions in correctional facility populations is the preferred and primary approach necessary to serve collective needs of individuals in correctional facilities, the population in correctional facilities, staff in correctional facilities, and the community at large.

AFFIRMED BEFORE ME by video conference

From the City of Toronto

in the Province of Ontario,

To the City of Toronto,

in the Province of Ontario,

On 8 JUNE 2020

Commissioner For Taking Affidavits

VANORA SIMPSON

AARON ORKIN

THIS IS **EXHIBIT "A"** TO THE

AFFIDAVIT OF DR. AARON ORKIN

AFFIRMED BEFORE ME by video conference

THIS 8th DAY OF JUNE , 2020.

A Commissioner for Taking Oaths

VANORA SIMPSON

Aaron M. Orkin BASci MD MSc MPH PhD(c) CCFP(EM) FRCPC

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Born 24 August 1982, Vancouver BC
Pronoun: he/him
Canadian Citizen
Fluent in spoken and written English and French

Education

University of Toronto, Institute of Health Policy, Management, and Evaluation — *2014 - present*
- Doctoral Candidate, Clinical Epidemiology & Health Care Research
- Supervisor: Dr. Ross Upshur

University of Toronto, Dalla Lana School of Public Health — *2011 – 2013*
- Master of Public Health (Epidemiology), Collaborative Program in Resuscitation Sciences.
- Massey College Junior Fellow (2012 – 2013)

University of Oxford, Linacre College, Oxford, United Kingdom. — *2009 - 2010*
Master of Sciences, History of Science, Medicine & Technology.
- Thesis: 'Enacting Nonmodern Doctorhood: Médecins Sans Frontières and the Birth of the Medico-Humanitarian Profession'. Supervisor: Prof Mark Harrison

McMaster University, Hamilton. Doctor of Medicine. — *2004 - 2007*

McMaster University, Hamilton. Bachelor of Arts & Science. — *2001 - 2004*

Medical Licensure & Certifications

Independent Medical License: College of Physicians & Surgeons of Ontario, No. 86358 — *2009 - present*

Certificant: College of Family Physicians of Canada, Added Competency in Emergency Medicine, "CCFP(EM)" — *2015*

Fellow: Royal College of Physicians & Surgeons of Canada, Public Health & Preventive Medicine, "FRCPC" — *2014*

Certificant: College of Family Physicians of Canada, "CCFP". — *2009*

Licentiate: Medical Council of Canada. — *2008*

Medical Residencies & Fellowships

Dalla Lana School of Public Health and *St. Michael's Hospital*, Clinical Public Health and Emergency Medicine Fellowship — *2015 - 2016*

University of Toronto, Royal College of Physicians & Surgeons Clinician Investigator — *2014 - present*

University of Toronto Dalla Lana School of Public Health, Public Health & Preventive Medicine Residency, Toronto. — *2010 - 2014*

Northern Ontario School of Medicine, Family Medicine Research Fellowship. — *2010*

Northern Ontario School of Medicine, Family Medicine Residency, Thunder Bay — *2007 - 2009*

Medical & Clinical Employment

Staff Physician. *2009 - present*

- Inner City Health Associates, Toronto (Public Health and Preventive Medicine: 2019 – present)
- St. Joseph's Health Centre Department of Emergency Medicine, Unity Health, Toronto (Emergency Medicine: 2019 – present)
- Humber River Hospital, Department of Emergency Medicine, Toronto, (Emergency Medicine: 2011 – 2016, 2019 - present)
- Mount Sinai Hospital, Department of Emergency Medicine, Toronto, (Emergency Medicine: 2016 –2019)
- Seaton House Shelter Infirmary, Inner City Health Associates, Toronto (Family Medicine: 2016 – 2019)
- Groves Memorial Hospital, Fergus, Ontario (Emergency Medicine: 2009 – 2012)

Locum Physician. *2009 – 2019*

- Muskoka Algonquin Health Centre, Huntsville, Ontario (2019)
- Taddle Creek Family Health Team, Toronto, Ontario (2010 – 2012)
- Marathon Family Health Team, Marathon, Ontario (2009 – 2012)
- Dilico Nishnawbek Family Health Team, Thunder Bay, Ontario (2009)
- Meno-Ya-Win Health Centre, Sioux Lookout, Ontario (2009 – 2011)

Professional Appointments

Medical Director. COVID-19 Assessment Centre, St. Joseph's Health Centre, Unity Health, Toronto. *2020 - present*

Population Medicine Lead. Inner City Health Associates, Toronto. *2019 - present*

Assistant Professor & Clinician Scientist. Department of Family and Community Medicine, Faculty of Medicine, University of Toronto. *2016 - present*

Faculty Affiliate. Centre for Rural and Northern Health Research, Laurentian University. *2017 - present*

Clinician Scientist. Department of Emergency Medicine, Sinai Health System, Toronto. *2016 - 2019*

Research Scholar: Division of Clinical Public Health, Dalla Lana School of Public Health, University of Toronto. Supervisor: Dr. Ross Upshur *2014 - 2015*

Assistant Professor: Division of Clinical Sciences, Northern Ontario School of Medicine. *2010 - 2015*

Co-Chief Resident: Public Health & Preventive Medicine, University of Toronto. Six-month term with appointment to Residency Program Committee. *2012*

Editorial Fellow: *Annals of Family Medicine.* Editor-in-Chief: Dr. Kurt Stange *2014 - 2015*

Medical Director: Camp Pathfinder. Historic canoe camp, Algonquin Park, Ontario. *2013 - present*

Medical Director: Canoe North Adventures. Mono, Ontario and Norman Wells, NWT. *2016 - present*

President. Remote Health Initiative. Ontario non-profit corporation for the delivery of health services and education in low-resource settings. *2011 - present*

Selected Honours & Awards

Dr. Walter Mackenzie Visiting Professorship Award — *2018*
- University of Alberta Faculty of Medicine & Dentistry ($1000).

Department of Family and Community Medicine Graduate Investigator Award — *2017 - present*
- University of Toronto faculty graduate studies award ($100,000 over 5 years).

Canadian Institutes of Health Research Fellowship — *2016 - present*
- Institute of Population and Public Health ($250,000 over 5 years)

Canadian Institutes of Health Research Travel Award — *2016*
- Institute of Aboriginal Peoples Health ($1300)

Edward Christie Stevens Fellowship and *Joseph M. West Family Memorial Fund Award* — *2014*
- University of Toronto Postgraduate Medical Research Award ($6175)

C.P. Shah Resident Research in Public Health Preventive Medicine Award — *2014*
- University of Toronto award for resident research and scholarship.

Bart Harvey Resident Service in Public Health & Preventive Medicine Award — *2013*
- University of Toronto award for contribution to residency.

Wellcome Master's Scholarship for the History of Medicine — *2009*
- Full scholarship in the History of Medicine at University of Oxford (£22,000).

College of Family Physicians of Canada Murray Stalker Award — *2009*
- National award for leadership and academic skills ($2,000).

Family Medicine Resident Award for Scholarship, Northern Ontario School of Medicine — *2009*
- Best scholarly work of senior family medicine resident.

Northern Ontario School of Medicine Resident Leadership Award — *2009*
- Awarded for leadership and community contribution.

Commonwealth Master's Scholarship (Canada – United Kingdom) — *2008*
- International scholarship for graduate studies in philosophy of medicine (£40,000; forfeited to complete Canadian postgraduate medical training)

Honour "M" Award, McMaster University and Students' Union — *2007*
- McMaster's highest distinction for leadership and community contribution.

Dorothy Mann Award in Reproductive Biology, McMaster University — *2006*
- Awarded for outstanding international elective work in obstetrics.

W.B. Spaulding History of Medicine Award, McMaster University — *2006*
- Medical Student Award for research in the history of medicine

Millennium Scholarship National Laureate — *2001 - 2005*
- Canadian national university entrance scholarship for academic achievement, community service, leadership and innovation ($20,000).

McMaster University Dr. Harry Lyman Hooker Scholarship — *2001 - 2005*
- McMaster undergraduate entrance scholarship, Hamilton ($15,000).

Consulting & Proceedings

Office of the Chief Coroner of Ontario: Expert witness for the inquest into the death of Mr. Bradley Chapman (OCC: 2015_09519). Testimony concerning the opioid crisis, overdose first aid, homelessness, and stigma. *2018*

Government of the Northwest Territories: Community-based emergency care program development. *2017 - 2019*

Wilderness Medical Associates Canada: Curriculum consultant and instructor. *2005 - 2011*
- Founded a wilderness medicine elective now offered to students across Canada.

Committees & Working Groups

Lead: Population and Public Health Community of Practice, Canadian Network of the Health and Housing of People Experiencing Homelessness (CNH3) *2020 - present*

Member: International Liaison Committee on Resuscitation (ILCOR), First Aid Task Force *2019 - present*

Member: American Red Cross Scientific Advisory Committee, First Aid Subcouncil *2019 - present*

Member: Strategic Planning Committee, Inner City Health Associates *2019 - present*

Member: Annals of Family Medicine Editorial Advisory Board *2018 - present*

Writing Group Member: American Heart Association/Heart & Stroke Foundation Canada and Red Cross First Aid Guidelines 2019. *2018 - present*

Co-Chair: Windigo First Nations Council Community-Based Emergency Care Working Group, Sioux Lookout, Ontario. Co-chair Chief Frank McKay. *2017 - 2019*

Member: Ontario Addictions Advisory Panel, Canadian Mental Health Association. *2017 - 2019*

Member: City of Toronto Overdose Early Warning and Alert Committee, Toronto. *2017 - 2018*

Member: Public Health Physicians of Canada Opioid Crisis Working Group *2017 - 2018*

Physician Member: Inner City Family Health Team, Toronto *2016 - 2019*

Member: First Do No Harm Overdose and Overdose Death Prevention Project Team. Canadian Centre on Substance Abuse, Ottawa. *2015 - 2016*

Committee Member: Dalla Lana School of Public Health Strategic Planning Committee, Subcommittee on Synergy Between Population Health and Health Systems. *2015 - 2016*

Committee Member: Humber River Hospital Emergency Medicine Vision Committee *2015*

Co-Lead and Adjudicator: Ars Medica and *Canadian Medical Association Journal* Medical Humanities Poetry and Prose Competition *2014 - 2015*

Council Member: Dalla Lana School of Public Health Governing Council. Public Health & Preventive Medicine Residency Program Representative. *2014 - 2015*

Writing Group Member: Standard Protocol Item Recommendations for Interventional Trials (SPIRIT) Extension for N-of-1 Trials (SPENT). *2015 - present*

Writing Group Member: American Heart Association 2015 Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, Part 9: Special Resuscitation Situations. *2014 - 2015*

Evidence Reviewer: International Liaison Committee on Resuscitation. Basic Life Support Interventions: 'Resuscitation care for opioid-associated emergencies' and 'Opioid overdose bystander education'. Review in Travers AH *et al.*, Part 3: Adult Basic Life Support and Automated External Defibrillation, 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. *Circulation*. 2015;132[suppl 1]:S51–S83. DOI: 10.1161/CIR.0000000000000272.) *2014 - 2015*

Editor. *Ars Medica,* University of Toronto journal of medicine, arts and humanities. *2010 - present*

Project Advisor: Dignitas International, Aboriginal Health Initiatives. *2013 - 2015*

Member: Médecins Sans Frontières Association, Canada. *2011 - present*

Committee Member: Global Health Division Education Advisory Committee, Dalla Lana School of Public Health, University of Toronto, Canada. *2011 - 2013*

Member: Awards Committee, Public Health & Preventive Medicine Residency Program, University of Toronto *2014 - 2016*

Member: Ontario Opioid Overdose Prevention and Naloxone Access Working Group. *2012 - 2018*

Member: Royal College of Physicians and Surgeons Injury Control Advisory Committee *2013*

Chair. College of Family Physicians of Canada Section of Residents (CFPC-SOR) *2007 – 2009*
- Term as Chair-Elect (2007) and Chair (2008), with appointment to the CFPC Board of Directors and other CPFC committees.

Resident Teaching and Rounds Coordinator. Northern Ontario School of Medicine. *2008 – 2009*
- Initiation of a resident teaching program for undergraduate medical students.

Founder and Coordinator. McMaster Diversity Cafeteria Project. *2006*
Successfully initiated and implemented a $500,000 project to build McMaster University's Bridges Café, to cater to multicultural culinary needs.

Founder. McMaster Students Union Diversity Services *2006*

Research Funding

Study of Post-Hospital care for Opioid Overdoses that are Non-Fatal (SPOON) *2019 - present*
- A. Bayoumi and P. Leece (Principal Investigators), T. Antoniou, A. Caudarella, L. Challacombe, M. Firestone, T. Gomes, S. Guilcher, T. Guimond, C. Kendall, **A. Orkin**, J. Powis, C. Strike (Co-Investigators)
- Funding: Canadian Institutes of Health Research, $459,000.00, 3 years.

CRISM Implementation Science Program on Opioid Interventions and Services – QC/Maritimes *2017 - present*
- **A. Orkin** (co-investigator), J. Bruneau (Principal Investigator)
- Funding: Canadian Institutes of Health Research, $1,875,000.00, 5 years.

Enhancing care for people who use opioids through co-education for harm reduction and emergency care workers — *2018*

- C. Lim, **A. Orkin**, N. Primiani (co-Principal Investigators)
- Funding: Meta:Phi Project, Women's College Hospital, $36,000.00, 1 year.

Community-Based Emergency Care in Tsiigehtchic, Northwest Territories — *2018 - 2019*

- **A. Orkin** (Principal Investigator), D. VanderBurgh, S. Ritchie (co-Investigators)
- Funding: Government of the Northwest Territories, Department of Health and Social Services, $150,000.00, 1 year.

A blinded, randomized controlled trial of opioid analgesics for the management of acute fracture pain in older adults discharged from the emergency department. — *2017*

- C. Varner (Principal Investigator), S. McLeod, **A. Orkin**, D. Melady, Borgundvaag B. (co-Investigators)
- Funding: Canadian Association of Emergency Physicians: EM Advancement Fund, $10,000.00, 1 year.

Community-Based Emergency Care in Tsiigehtchic, Northwest Territories — *2017*

- **A. Orkin** (Principal Investigator), D. VanderBurgh, S. Ritchie (co-Investigators)
- Funding: Government of the Northwest Territories, Department of Health and Social Services, $37,245.00, 1 year.

Resuscitation in Motion (RiM) 2018 – From Research to Real Work Resuscitation – Dissemination and knowledge exchange for best practice — *2017-2018*

- L. Morrison (Principal Investigator), A Baker, S. Brooks, J. Buick, T. Chan, S. Cheskes, J. Christenson, K. Dainty, P. Dorian I. Drennan, B. Gruneau, S. Gupta, J. Jensen, S. Lin, **A. Orkin**, J. Parsons, S. Rizoli, L. Rose, O. Rotstein, D. Scales, B. Thoma, M. Welsford, C. Vaillancourt, S. Vaillancourt, P. Verbeek, M. Welsford, A. deCaen.
- Funding: Canadian Institutes of Health Research (Heath Services and Policy Research), $15,000, 1 year.

The Surviving Opioid Overdose with Naloxone Education and Resuscitation (SOON-ER) trial: a randomized study of an opioid overdose education and naloxone distribution intervention for laypeople in ambulatory and inpatient settings. — *2016-present*

- C. Strike, L. Morrison, D. Campbell, C. Handford, K. Sellen (Principal Investigators), S. Hopkins, R. Hunt, M. Klaiman, P. Leece, **A. Orkin**, J. Parsons, K. Sellen, R. Shahin, V. Stergiopoulos, K. Thorpe, S. Turner, D. Werb (co-Investigators).
- Funding: Canadian Institutes of Health Research (Neurosciences, Mental Health and Addiction), $844,772.00, 3 years. Canadian Centre on Substance Abuse, $11,630.00, 1 year non-peer reviewed contribution.

Community-Based Emergency Care: Developing a Prehospital Care System with the Windigo First Nations Council in Northwestern Ontario — *2015-2018*

- **A. Orkin** and D. VanderBurgh (Principal Investigators), S. Ritchie and N. Bocking (co-Investigators).
- Funding: Northern Ontario Academic Medical Association, $49,990, 2 years.

Community-Based Emergency Care Roundtable *2012 – 2014*

Knowledge translation for emergency management in remote and resource-poor communities.

- **A. Orkin** (Principal Investigator), D. VanderBurgh and S. Ritchie (Co-Investigators), J. Tait and J. Morris (Community Partners)
- Funding: Indigenous Health Research Development Program, $25,000, 1 year; Dignitas International, $5,000, 1 year.

Sachigo Lake Wilderness Emergency Response Education Initiative *2009 - 2013*

Emergency first response training collaboration in Sachigo Lake, a remote northern Ontario First Nations community.

- **A. Orkin** and D. Vanderburgh (co-principal investigators)
- Funding: Northern Ontario Academic Medical Association Innovation Fund, $98,000.00, 2 years. Canadian Institute of Health Research Meetings, Planning and Dissemination Grants – Aboriginal Health, $21,000.00, 2 years.

Surviving Opioid Overdose with Naloxone (SOON) Project and Roundtable *2012 - 2015*

Planning and knowledge translation initiative to enhance and study bystander naloxone administration for opioid overdose.

- H. Hu (Principal Investigator); L. Morrison, **A. Orkin**, P. Leece, K. Bingham, M. Klaiman (Co- Investigators)
- CIHR Partnerships for Health Systems Improvement Planning Grant, $24,922.00, 1 year.

The Access to Justice and Health Project *2011- 2013*

Hypothesis-generation and concept research on access to civil justice as a social determinant of health.

- **A. Orkin** and J. Baxter (Co-Primary Investigators); D. Cole (Faculty Supervisor)
- Funding: "Does Your Health Depend on Your Access to Justice?", CIHR Café Scientifique Spring 2012 Competition, $3,000.00

Marathon Maternity Oral History Project *2008 - 2014*

- Narrative medicine and social anthropology study of birthing experiences in rural Ontario, Marathon.
  - S. Newbery, **A. Orkin** (Co-Principal Investigators).
  - Funding: College of Family Physicians of Canada Janus Research Program, D.M. Robb Research Grant, $5,000.00, 1 year.

Peer-Reviewed Publications (Students and learners, research staff*, community partners§)

1. Kouyoumdjian FG, **Orkin AM**. "An imperative to improve health and access to healthcare in provincial prisons." *Healthcare Quarterly*. 2020;23(1).
2. Porcino A, Chan AW, Kravitz R, **Orkin AM**, Punja S, Ravaud P, Schmid C, Vohra S. "A SPIRIT Extension for N-of-1 Trials (SPENT)." *BMJ* 2020; 368; m122. doi.org/10.1136/bmj.m122.
3. Kouyoumdjian FG, Lee JY, **Orkin AM**, Cheng SY, Fung K, O'Shea T, Guyatt G. "Thirty-day readmission after medical-surgical hospitalization for people who experience imprisonment in Ontario, Canada: A retrospective cohort study." *PLOS One*. Jan 2020. doi.org/10.1371/journal.pone.0227588

4. Charlton NP, Pellegrino JL, Kule A, Slater TM, Epstein JL, Flores GE, Goolsby CA, **Orkin AM**, Singletary EM, Swain JM. "2019 American Heart Association and American Red Cross Focused Update for First Aid: Presyncope" *Circulation*. 2019;140:00–00. DOI: 10.1161/CIR.0000000000000730

5. **Orkin AM**, Campbell D, Handford C, et al. on behalf of the SOONER Investigators. "Protocol for a mixed methods feasibility study for the Surviving Opioid Overdose with Naloxone Education and Resuscitation (SOONER) Randomized Control Trial". *BMJ Open.* 2019;9:e029436. doi: 10.1136/bmjopen-2019-029436

6. Kouyoudjian F, Kim M, Kiran T, Cheng S, Fung K, **Orkin AM**, Kendall K, Green S, Matheson F, Kiefer L. "Attachment to primary care and team-based primary care: Retrospective cohort study of people who experienced imprisonment in Ontario." *Can. Fam. Phys.* Oct 2019, 65 (10) e433-e442.

7. Leece P, Chen C, Manson H, **Orkin AM**, Schwartz B, Juurlink D, Gomes T. "One-year mortality following emergency department visit for non-fatal opioid poisoning: A population-based analysis." *Annals of Emerg Med.* Sept 2019. doi.org/10.1016/j.annemergmed.2019.07.021

8. Tuinema J, **Orkin AM**, Cheng S, Fung K, Kouyoumdjian FG. "Emergency department use in people who experience imprisonment in Ontario, Canada: A retrospective cohort study." *Can J of Emerg Med.* Sept 2019.

9. **Orkin AM,** McArthur A, Venugopal J*, Kithulegoda N, Martiniuk A, Buchman D, Kouyoumdjian F, Rachlis B, Strike C, Upshur REG. "Defining and Measuring Health Equity in Research on Task Shifting in High-Income Countries: A Systematic Review." *Social Science and Medicine – Population Health.* Jan 2019. doi.org/10.1016/j.ssmph.2019.100366

10. Kouyoumdjian FG, Cheng S, Fung K, Humphreys-Mahaffey S, **Orkin AM**, Kendall C, Kiefer L, Matheson FI, Green S, Hwang SW. "Primary care utilization in people who experience imprisonment in Ontario Canada: A retrospective cohort study." *BMC Health Services Research.* 2018;18:845. doi.org/10.1186/s12913-018-3660-2

11. Kouyoumdjian FG, Cheng SY, Fung K, Kirk M, **Orkin AM**, McIsaac KE, Kendall C, Kiefer L, Matheson F, Green S, Hwang SW. "Health care utilization of people released from provincial prison in Ontario, Canada in 2010: A population-based cohort study." *PLOS One*, Aug 2018. https://doi.org/10.1371/journal.pone.0201592

12. Curran J, Ritchie SD, Beardy J[§], Vanderburgh D, Born K, Lewko J, **Orkin AM**. Conceptualizing and Managing medical emergencies where no formal paramedical service exists: Perspectives from a remote Indigenous Community in Canada. *International Journal of Environmental Research and Public Health.* 15(2):267, 2018.

13. **Orkin AM,** McArthur A, McDonald A, Mew E*, Martiniuk A, Buchman D, Kouyoumdjian F, Rachlis B, Strike C, Upshur REG. "Defining and measuring health equity effects in research on task shifting interventions in high-income countries: a systematic review protocol." *BMJ Open* 2018;8:e021172. doi: 10.1136/bmjopen-2017-021172

14. Buchman D, Leece P, **Orkin AM**. "The Epidemic as Stigma: The Bioethics and Biopolitics of Opioids." *The Journal of Law, Medicine and Ethics*. 2017(45):607-620. https://doi.org/10.1177/1073110517750600

15. Pellegrino J, Oliver E, **Orkin AM**, Marentette D, Snobelen P, Muise J, Mulligan J, Dr Buck E. "A call for revolution in first aid education: refining the Utstein formula for survival." *International Journal of First Aid Education*. 2017(1):1, doi: 10.21038/ijfa.2017.0001 .

16. Lacroix L, Thurgur L, **Orkin AM**, Perry JJ, Stiel IG. "Emergency department physician attitudes and perceived barriers to the implementation of take-home naloxone programs in Canadian emergency departments." *Canadian Journal of Emergency Medicine*. 2017(Sept):1-7. DOI: 10.1017/cem.2017.390

17. Nolan B, Ackery A, Mamakwa S, Glenn S, VanderBurg D, **Orkin A**, Kirlew M, Dell EM, Tien H. "Care of the Injured Patients at Remote Nursing Stations And During Aeromedical Transport" *Air Medical Journal*. 37(2018):161-164.

18. Buchman D, **Orkin AM**, Strike C, Upshur REG. "Overdose Education and Naloxone Distribution Programs and the Ethics of Task-Shifting", *Public Health Ethics*, phy001, https://doi.org/10.1093/phe/phy001. (Buchman and Orkin co-primary authors)

19. **Orkin AM**, Zhan C, Buick JE, Drennan IR, Klaiman M, Leece P, Morrison LJ. "Out-of-hospital cardiac arrest survival in drug-related versus cardiac causes in Ontario: a retrospective cohort study." *PLOS ONE*. 12(4): e0176441. https://doi.org/10.1371/journal.pone.0176441

20. Mew EJ*, Ritchie SD, VanderBurgh D, Beardy JL§, Gordon J§, Fortune M, Mamkwa S§, **Orkin AM**. "An Environmental Scan of Emergency Response Systems and Services in Remote First Nations Communities in Northern Ontario. *International Journal of Circumpolar Health*. 76:1, 1320208, DOI: 10.1080/22423982.2017.1320208.

21. **Orkin AM**, Bharmal A, Cram J, Kouyoumdjian FG, Pinto AD, Upshur REG. "Clinical Population Medicine: Integrating Clinical Medicine and Population Health in Practice" *Annals of Family Medicine*. 2017;15:405-409. https://doi.org/10.1370/afm.2143.

22. **Orkin AM,** Phillips WR, Stange KS. "Research Reporting Guidelines and the New *Annals* Instructions for Authors." *Annals of Family Medicine*. 2016(6);500-501. doi: 10.1370/afm.2008

23. **Orkin AM,** Buchman D. "Naloxone programs must reduce marginalization and improve access to comprehensive emergency care". *Addiction*. 2017(12);309-10.

24. **Orkin AM**, Curran JC, Fortune M, McArthur A, Mew E*, Ritchie S, Van De Velde S, VanderBurgh D. "Systematic review protocol: Health effects of training laypeople to deliver emergency care in underserviced populations" *BMJ Open*. 2016;6:e010609. doi:10.1136/bmjopen-2015-010609 (AO and JC coprimary authors).

25. Porcino A, Punja S, Chan A-W, Kravitz R, **Orkin A**, Ravaud P, Schmid C, Vohra S. "Protocol for a Systematic Review of N-of-1 trial protocol guidelines and protocol reporting guidelines." Systematic Reviews. 2017; 6:132. DOI 10.1186/s13643-017-0525-4.

26. Lavonas EJ, Drennan IR, Gabrielli A, Heffner AC, Hoyte CO, **Orkin AM**, Sawyer KN, Donnino MW. "Part 10: Special Circumstances of Resuscitation, 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care." *Circulation*. 2015;132[suppl 2]:S501–S518. DOI: 10.1161/CIR.0000000000000264.).

27. Salcido D, Torres C, Koller AC, **Orkin AM**, Schnicker RH, Morrison LJ, Nichol G, Stephens S, Menegazzi JJ. "Regional incidence and outcome of Out-of-hospital Cardiac Arrest Associated with Overdose." *Resuscitation*, 2016;99:13-19. DOI: http://dx.doi.org/10.1016/j.resuscitation.2015.11.010.

28. **Orkin AM**, VanderBurgh D, Ritchie SD, Curran JD, Beardy J§. "Community-Based Emergency Care: A model for pre-hospital care in remote Canadian communities." *Canadian Journal of Emergency Medicine*. 2016; 1-4. DOI:10.1017/cem.2016.339.

29. Kouyoumdjian F, Lai W, **Orkin AM**, Pek B. "A 25-year-old woman with diabetes in custody." *Canadian Medical Association Journal*. 2016. DOI:10.1503/cmaj.151232.

30. Leece P, **Orkin A**, Kahan M. "Tamper-resistant drugs cannot solve the opioid crisis?" *CMAJ* 2015. DOI:10.1503 /cmaj.150329

31. **Orkin AM**, Bingham K, Klaiman M, Leece P, Buick J, Kouyoumdjian F, Morrison L, Hu H. "An Agenda for Naloxone Distribution Research and Practice: Meeting Report of the Surviving Opioid Overdose with Naloxone (SOON) International Working Group. *Addictions Research and Therapy*, 6:212. doi: 10.4172/2155-6105.1000212. (AO, KB, MK, PL co-primary authors)

32. Leece P, **Orkin A**, Steele L, Shahin R. "Can naloxone prescription and overdose training for opioid users work in family practice? Perspectives of family physicians." *Canadian Family Physician.* 2015; 61(6):538-543.

33. **Orkin A,** Lay M, McLaughlin J, Schwandt M, Cole D. Medical Repatriation of Migrant Farm Workers in Ontario: Coding and Descriptive Analysis. *CMAJ Open,* Sept 2014. doi: 10.9778/cmajo.20140014

34. **Orkin A**, Newbery S. The Marathon Maternity Oral History Project: Exploring Rural Birthing through Narrative Methods. *Canadian Family Physician*. 2014; 60: 58.

    Orkin A, Newbery S. Narratives 1 to 11 of the Marathon Maternity Oral History Project. *Canadian Family Physician*. 2014; 60;e49-e90. (Each reviewed and indexed independently.)

    35. Penny Armitage: "I'm the 85th baby born in Marathon."
    36. Jennifer Coleman: "I deliver babies with the docs."
    37. Nancy Fitch: "Humanity isn't machines, you know."
    38. Jillian McPeake: "Look at that face!"
    39. Cheryl McWatch: "If you do it right, you'll feel it in your heart."
    40. Constance (Connie) McWatch: "I have a lot of blessings."
    41. Marie Michano: "That sense of being at home."
    42. Tracy Michano-Stewart: "A lifestyle type of thing."
    43. Ada Parsons: "Giving birth should be a special time"
    44. Rupa Patel: "We straddle those worlds."
    45. Patti Pella: "Someone knows your life story."

46. **Orkin A**, Leece P, Piggott T, Burt P, Copes R. Peak Event Analysis: A Novel Empirical Method for the Evaluation of Elevated Particulate Events. *BMC Environmental Health*. 2013;12:92.

47. Leece P, Hopkins S, Marshall C, **Orkin A**, Gassanov M, Shahin R. Development and implementation of an opioid overdose prevention and response program in Toronto, Ontario. *Canadian Journal of Public Health*. 2013;104(3):e200-e204.

48. VanderBurgh D, Jamieson R*, Ritchie S, **Orkin A**. Community First Aid: A Collaborative Education Program in a Remote Canadian Aboriginal Community. *Journal of Rural and Remote Health*. 2014; 14:2537.

49. Ritchie SD, Wabano MJ, Beardy J[§], Curran J, **Orkin A**, Vanderburgh D, Born K*, Young, NL. Community-Based Participatory Research and Realist Evaluation: Complimentary Approaches for Aboriginal Health and Adventure Therapy. Submitted to: C. Norton, G. Szabo, A. Rose, & H. Hooper (Eds.), Proceedings of the 6th International Adventure Therapy Conference 2012. Prague: European Science and Art Publishing, Feb 2013.
50. Ritchie S, Wabano MJ, Beardy J[§], Curran J, **Orkin A**, VanderBurgh D, Young N. Community-based participatory research with Indigenous communities: The proximity paradox. *Health and Place*. 2013 Nov;24:183-189. doi: 10.1016/j.healthplace.2013.09.008. Epub 2013 Oct 3.
51. **Orkin A**. "Push Hard, Push Fast"…if you're downtown? A Citation Review of Urban-centrism in American and European Basic Life Support Guidelines *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, 2013, 21:32.
52. Born K*, **Orkin A**, VanderBurgh D, Beardy J[§]. Teaching wilderness first aid in a remote first nations community: the story of the Sachigo Lake Wilderness First Response Education Initiative. *International Journal of Circumpolar Health* 2012, 71: 19002 http://dx.doi.org/10.3402/ijch.v71i0.19002
53. **Orkin A,** VanderBurgh D, Born K*, Strickland S, Webster M*, Beardy J[§]. 'Where there is no paramedic: The Sachigo Lake Wilderness Emergency Response Education Initiative.' *PLoS Medicine*. 2012; 9(10): e1001322. doi:10.1371/journal.pmed. 575 1001322.
54. **Orkin A**. 'South Africa's Womb', *Canadian Medical Association Journal*. 181(Jul 2009): 64-5.
55. **Orkin A,** Hoskins R. 'Rural medicine and rural training: addressing high-technology care.' *Canadian Journal of Rural Medicine*. 13:1(Winter 2008), 41-2.
56. **Orkin A**. 'The Dying of Carol Hill: A Medical Student's Reflections on Palliative Care.' *Journal of Palliative Care*. 22:4(Winter 2006), 312-4.
57. Aird P, Gora M, **Orkin A**. 'Experiencing medicine without the bells and whistles.' *Canadian Family Physician*. 52(Oct 2006), 1346-9.

Peer-Reviewed Publications in Press (Students and learners, research staff*, community partners[§])

58. **Orkin AM**, Venugopal J, Curran JD, Fortune MK, McArthur M, Mew E, Ritchie SD, Drennan IR, Exley A, Jamieson R, Johnson DE, MacPherson A, Martiniuk A, McDonald N, Osei-Ampofo M, Wegier P, Van de Velde S, VanderBurgh D. "Systematic review of the health effects of task shifting and training laypeople to deliver emergency care in underserved populations." Submitted to *The Lancet*. May 2020.
59. Phillips WR, Sturgiss ES, Hunik L, Glasziou P, olde Hartman T, **Orkin AM**, Reeve J, Russell GM, van Weel C. "Opportunities to improve the reporting of primary care research: An international survey of researchers." Submitted to *Annals of Family Medicine*. May 2020
60. Pellegrino J, Krob JL, **Orkin AM**. "First aid education for opioid overdose poisoning: Scoping Review." Submitted to *Health Education & Behaviour*. Apr 2020
61. Kaczorowski J, Bilodeau J, **Orkin AM**, Dong K, Daoust R, Kestler A. "Emergency department-initiated interventions for patients with opioid use disorder: a systematic review." Submitted to *Annals of Emergency Medicine*. April 2020.

62. Porcino AJ, Punja S, Chan AW, Kravitz R, **Orkin AM**, Ravaud P, Schmid CH, Vohra S. "Systematic review of N-of-1 trial protocol guidelines and protocol reporting guidelines." Submitted to *Trials*. Sept 2019.
63. VanderBurgh D, Savage D, Dubois S, Binguis N, Maxwell S, Bocking N, Farrell T, Tien H, Ritchie S, **Orkin AM**. "Medical Emergencies in Northern Ontario Remote First Nations: Using Air Ambulance Transport Data to Understand Epidemiology" In press *CMAJ Open*. Mar 2020.
64. Reid N, Chartier L, Orkin AM, Klaiman M, Naidoo K, Stergiopoulos V. "Rethinking involuntary admission for individuals presenting to Canadian Emergency Departments with life-threatening substance use disorders." In press *CJEM*. Apr 2020.

Books Edited & Invited Contributions to Edited Works

65. Vanderburgh D, Webster M, Burton J, Carriere B, Ritchie S, Russell J, Sorsa L, Boriss E, Orkin A. *Community-Based Emergency Care: Remote Community First Aid Textbook*. Toronto: Community-Based Emergency Care, 2019. (CC BY-NC-SA 4.0)
66. Vanderburgh D, Webster M, Burton J, Carriere B, Ritchie S, Russell J, Sorsa L, Boriss E, Orkin A. *Community-Based Emergency Care: Instructor Companion Book*. Toronto: Community-Based Emergency Care, 2019. (CC BY-NC-SA 4.0)
67. Piggott T, **Orkin A**. "Deconstructing the Concept of Special Populations for Health Care, Research and Policy." In *Under-Served: Health determinants of Indigenous, Inner-City and Migrant Populations in Canada*. Toronto: Canadian Scholars Press, 2018.
68. Ritchie SD, Wabano MJ, Beardy J, Curran J, **Orkin A**, Vanderburgh D, Born K, & Young NL. Community-Based Participatory Research and Realist Evaluation: Complimentary Approaches for Aboriginal Health and Adventure Therapy. In C. L. Norton, C. Carpenter, & A. Prior (Eds.), Adventure therapy around the globe: International perspectives and diverse approaches (pp. 195-217). Champaign, IL: Common Ground Publishing, 2015.
69. Crawford A, Kay R, Peterkin A, Roger R, Ruskin R with **Orkin A** (eds). *Body & Soul: Narratives of Healing from Ars Medica,* University of Toronto Press, Toronto, 2011.
    Published Reviews:
    Coulehan, J. "The truth lies between the lines." *CMAJ* 185 Mar 2013:327.
    Gelipter, D. "Book Review: Ars Medica" *Med Humanities* doi:10.1136/medhum-2012-010298
70. VanderBurgh D, **Orkin A**. 'Professors, Parents and Partners: A Novel Typology of Community Preceptors' in *Community-Based Medical Education*, Len Kelly (ed.), Radcliffe Press, Oxford, 2011.

Knowledge Translation & Reports

71. Xie E, Bond A, Hayman K, Hulme J, Sheikh H, **Orkin A**. "COVID-19 and persons experiencing homelessness or vulnerable housing". Ottawa: CAEP. Mar 2020.
72. Koh JJ, Klaiman M, Miles I, Cook J, Kumar T, Sheikh H, Dong K, Orkin AM, Shouldice E on behalf of the CAEP Opioid Task Force. "CAEP Position Statement: Emergency Department Management of People with Opioid Use Disorder". Ottawa: CAEP. *In review*. Feb 2020.

73. Woodin JA, **Orkin AM**, Singletary EM, Zideman DA. On behalf of the International Liaison Committee on Resuscitation First Aid Task Force. Cervical Spinal Motion Restriction Scoping Review and Task Force Insights [Internet] Brussels, Belgium: International Liaison Committee on Resuscitation (ILCOR) First Aid Task Force, 2019 December 15. Available from: http://ilcor.org

74. Pellegrino JL., Krob, J, **Orkin A**, Bhanji F, Bigham B, Bray J, Breckwoldt J, Cheng A, Duff J, Glerup Lauridsen K, Gilfoyle E, Hiese M, Iwami T, Lockey A, Ma M, Monsieurs K, Okamoto D, Yeung J, Finn J, Greif R. on behalf of the International Liaison Committee on Resuscitation Education, Implementation, and Teams Task Force. Opioid Overdose First Aid Education: Scoping Review and Task Force Insights [Internet] Brussels, Belgium: International Liaison Committee on Resuscitation (ILCOR) Education, Implementation, and Teams Task Force, 2020 January 03. Available from: http://ilcor.org

75. **Orkin AM** "Clinical Population Medicine: A Population Health Roadmap for Ontario Health Teams" 26 Nov 2019. *Longwoods.* https://www.longwoods.com/content/26010

76. **Orkin AM,** VanderBurgh D, Webster M, Russell J, Ritchie S. Tsiigehtchic Community-Based Emergency Care Program Evaluation, Report and Recommendations. Report for the Government of the Northwest Territories. Mar 2019. (Commissioned research report.)

77. **Orkin AM.** Expert report concerning the death of Mr. Bradley Chapman. Inquest of the Office of the Chief Coroner of Ontario No. 2015_09519. May 2018.

78. Dong K, Klaiman M, **Orkin AM.** ED Management of Opioid Addiction. *EMCases Podcast with Anton Helman.* Sept 2018. www.emergencymedicinecases.com

79. **Orkin AM**, Russell J, VanderBurgh D, Ritchie S. Tsiigehtchic Community-Based Emergency Care Consultation Report. Report for the Tsiigehtchic Charter Community, Gwichya Gwich'in Council and the Government of the Northwest Territories. Jun 2017. (Commissioned research report).

80. **Orkin AM**, Klaiman M. 'Naloxone Autoinjectors and Opioid Overdose' *EMRap Podcast with Rob Orman and Mel Herbert.* Oct 2016. www.emrap.org .

81. Drennan IR, **Orkin AM.** 'Prehospital Naloxone Administration for Opioid-Related Emergencies.' *Journal of Emergency Medical Services.* Mar 2016.

82. **Orkin A,** Baxter J, Cole D. *Does your health depend on your access to justice?* Public Café Scientifique and discussion panel. 31 Jan 2013, Toronto, Ontario.

83. **Orkin A**, VanderBurgh D, Ritchie S, Fortune M*. *Community-Based Emergency Care: An Open Report for Nishnawbe Aski Nation.* Thunder Bay: Northern Ontario School of Medicine, 2014. www.nosm.ca/cbec. 29-30 Oct 2013, Sioux Lookout, Ontario.

Peer Reviewed Abstracts & Presentations

(*Presenter if other than myself*, Students and learners, research staff*, community partners§)

Bilodeau J, Kaczorowski J, **Orkin AM**, Dong K, Kestler A. "L'efficacité des interventions visant les troubles consammations liés aux opioids dans les départements d'urgence: revue systématique de la littérature" 88e Congres de l'Acfas. 4 May 2020, Sherbrooke, PQ.

Orkin AM on behalf of the SOONER Investigators and Community Advisors. "Design and Findings of the Surviving Opioid Overdose with Naloxone Education and Resuscitation (SOONER) Feasibility Study" Poster. NAPCRG, 19 Nov 2019, Toronto.

Dong K, Van Pelt K, Scheuermeyer F, Moe J, Kaczorowski J, **Orkin AM**, Kestler A. "Emergency Physician Attitudes and Practices on Prescribing Buprenorphine/Naloxone: A National Survey" Poster. Can Soc. Addictions Med. Conference, 24 Oct 2019, Halifax.

Dong K, Salvalaggio G, Pugh A, Hyshka E, Xue J, Kaczorowski J, **Orkin AM**, Keslter A. "Emergency Department Physician Attitudes towards Buprenorphine Initiation in the ED: A Qualitative Study." Poster. Can Soc. Addictions Med Conference 24 Oct 2019, Halifax.

Phillips W, *Sturgiss E*, olde Hartman T, Russell G, Reeve J, **Orkin AM,** Glasziou P, van Weel C. "Improving the reporting of primary care research: Survey of needs of researchers, clinicians, patients and policymakers." Poster. NAPCRG, 17 Nov 2019, Toronto.

Orkin AM on behalf of the SOONER Investigators and Community Advisors. "Feasibility of the Surviving Opioid Overdose with Naloxone (SOONER) Trial." Ontario Node Canadian Research Initiative in Substance Misuse (CRISM) Summit, 10 Sept 2019, Toronto.

Primiani N, Lim C, Lall V, Wen S, **Orkin AM** on behalf of the Co-Education Working Group. "A pilot co-education workshop for harm reduction and emergency health providers" Poster, Department of Family and Community Medicine Conference, 5 April 2019.

Orkin AM, Curran J, Van de Velde S, VanderBurgh D. "Effects of training laypeople to deliver emergency care in underserviced populations: systematic review." Family Medicine Forum, 15 Nov 2018, Toronto.

Orkin AM, Sellen K, *et al.* on behalf of the SOONER Investigators. "Co-design of a naloxone distribution kit for family practice, emergency departments and addictions medicine." Family Medicine Forum, 15 Nov 2018, Toronto.

Gravel J, Foote J, Borgundvaag B, **Orkin AM.** "Treating acute pain in patients with opioid use disorder in the emergency department." Family Medicine Forum, 17 Nov 2018, Toronto.

Foote J, Chorny Y, **Orkin AM**. "Mitigating the opioid epidemic from the emergency room." Family Medicine Forum, 15 Nov 2018, Toronto.

Campbell D, **Orkin AM**, Klaiman M, Hopkins S, Shahin R *et al* on behalf of the SOONER Investigators. "The Surviving Opioid Overdose with Naloxone Education and Resuscitation Project: Combining design, simulation and resuscitation science to respond to the opioid crisis." Royal College of Physicians and Surgeons Simulation Summit, 28 Sept 2018.

Orkin A, Curran J, Ritchie S, Van de Velde S, VanderBurgh D. "Health effects of training laypeople to deliver emergency care in underserviced populations: preliminary results of a systematic review." Canadian Association of Emergency Physicians Conference, 27 May 2018, Calgary, Alberta.

Orkin A, Russell J*, VanderBurgh D, Ritchie S, Maxwell S§, McKay F§. "Community-Based Emergency Care: Developing an emergency first response program with remote Indigenous Communities". Indigenous Health Conference, 25 May 2018, Toronto, Ontario.

Orkin A, Klaiman M, Leece P, Hopkins S, Shahin R, Handford C, Campbell D, Parsons J, Strike C, Charles M*, Sniderman R*, Sellen K, Hunt R, Wright A§, Milos G§, Morrison L, on behalf of the SOONER Investigators. "Is it even possible? Feasibility study for the Surviving Opioid Overdose with Naloxone Education and Resuscitation (SOONER) Project" University of Toronto Division of Emergency Medicine Research Day, 23 May 2018, Toronto, Ontario.

Orkin A, Leece P, Hopkins S, Shahin R, Handford C, Campbell D, Parsons J, Strike C, Charles M, Sniderman R, Sellen K, Hunt R, Wright A, Milos G, Morrison L, on behalf of the SOONER Investigators. "The Surviving Opioid Overdose with Naloxone Education and Resuscitation (SOONER) Feasibility Study: Combining design, simulation, and resuscitation science to respond to the opioid crisis." Resuscitation in Motion, 2 May 2018, Toronto, Ontario.

Parsons J, **Orkin A**, Fowler M, Wright A, Burnett J, Scheuermeyer F. "First aid, rescue breathing and chest compressions in opioid overdose education programs: a brokered dialogue." Resuscitation in Motion, 2 May 2018, Toronto, Ontario.

Orkin A, Curran J, Ritchie S, van de Velde S, VanderBurgh D. "What is first aid really good for? Preliminary results and implications from a systematic review on the health impacts of first aid education in underserviced populations and low-resource settings." Plenary presentation. International First Aid Education Conference, 24 Apr 2018, Niagara Falls, Ontario.

Orkin A, Taylor T, Oliver E. "Qualitative insights for developing first aid education on drug overdose." International First Aid Education Conference, 24 Apr 2018, Niagara Falls, Ontario.

Leece P, Chen C, Manson M, **Orkin A**, Schwartz B, Juurlink D, Rosella L, Gomes T. One year mortality following emergency department visit for non-fatal opioid overdose in Ontario. Canadian Centre on Substance Use Conference, Nov 2017, Calgary.

Buchman DZ, **Orkin A.** Overdose education and naloxone distribution programs: Unintentionally entrenching stigma and inequities? Paper presented at the 26th Annual Bioethics Society Conference, May 2017, Toronto.

Varner C, McLeod S, **Orkin A**, Melady D, Borgundvaag B. A blinded, randomized controlled trial of opioid analgesics for the management of acute fracture pain in older adults discharged from the emergency department. *Canadian Journal of Emergency Medicine*. 2017; 19(S1). https://doi.org/10.1017/cem.2017.164

Leece P, Timmings C, Buchman D, **Orkin A**, Kahan M, Furlan A. Improving primary care opioid prescribing with an educational and self-monitoring strategy. Workshop. Canadian Society of Addiction Medicine Symposium. Oct 20-22, 2016, Montreal, Québec.

Lacroix L, Thurgur L, **Orkin A**, Stiell I. Emergency physician attitudes and perceived barriers to take-home naloxone programs in Canadian Emergency Departments. Poster. Canadian Association of Emergency Physicians, Québec City. 4 Jun2015.

Ritchie S, Mew E*, VanderBurgh D, **Orkin A.** Emergency Response Systems and Services in Remote First Nations Communities in Northern Ontario: An Environmental Scan. Northern Health Research Conference, Sault Ste. Marie, Jun2016.

Ritchie S, Mew E*, VanderBurgh D, **Orkin A.** Three-Pronged Approach to Address Gaps in Northern Ontario First Nations Emergency Services & Related Health Data. Northern Health Research Conference, Sault Ste. Marie, Jun2016.

Orkin A. Overdose education and naloxone distribution: How first aid can help address the opioid overdose epidemic. Oral Presentation. Canadian Emergency Care Conference, Red Cross and Heart and Stroke Canada, Toronto 22 Feb 2016.

Mew E*, Ritchie S, VanderBurgh D, **Orkin A**. Community-Based Emergency Care: Accounting for data inadequacies in remote health systems development. Poster. Chiefs of Ontario First Nation Health Research Symposium, Toronto, ON. 22 Feb 2016.

Orkin A, Zhan C, Buick J, Drennan I, Klaiman M, Leece P, Bingham K, Morrison LJ. Survival from drug-related out-of-hospital cardiac arrests: A retrospective cohort study. Clinician Investigator Trainee Association of Canada, Toronto, ON. 25 Nov 2015.

Orkin A, Phillips W, Peterson L, Acheson L, Balasubramanian B, Bayliss E, Cohen D, Ferrer R, Frey J, Gill J, Marino M, Williams R, Stange K. "Writing and publishing research using standardized reporting guidelines" North American Primary Care Research Group (NAPCRG), Oct 24-28, 2015, Cancun, Mexico.

Orkin A, Bingham K, Green S, Hodge M, Ivers N, Kouyoumdjian F, Nnorom O, Pinto A, Raza D, Svoboda T, Upshur R. "Clinical Population Medicine: Inventing collaborative models for population medicine and clinical practice." Family Medicine Forum, Toronto, 13 Nov 2015.

Orkin A, Stange K, Pimlott N, Phillips W, Peterson L and the *Annals of Family Medicine* Editors. "Improving Family Medicine Research With Standardized Reporting Guidelines." Family Medicine Forum, Toronto, 12 Nov 2015.

Orkin A. "Access to data as a form of resistance: Epidemiology of migrant farm worker medical repatriation." Ontario Public Interest Research Group Global Citizenship Conference, McMaster University, 21 Mar 2015, Hamilton, Ontario.

Klaiman M, Bingham K, Leece P, **Orkin A**, Morrison L, Hu H. Surviving Opioid Overdose with Naloxone (SOON): Results of an International Working Group. Poster. Canadian Association of Emergency Physicians, Edmonton AB. 2 Jun2015.

Orkin A, Zhan C, Buick J, Drennan I, Klaiman M, Leece P, Bingham K, Morrison LJ. Survival from drug-related out-of-hospital cardiac arrests: A retrospective cohort study. Canadian Association of Emergency Physicians, Edmonton, AB. 2 Jun2015.

Orkin A. and the Annals of Family Medicine Editorial team. "Shorter is Better — Writing Effective Research Reports," workshop at the annual meeting of the North American Primary Care Research Group (NAPCRG), New York City, Nov 23, 2014.

Orkin A. VanderBurgh D, Ritchie S, Beardy J§, Beardy J§. Community-Based Emergency Care: A novel approach to the development and delivery of first response medical services in remote First Nations communities. Canadian Risk and Hazards Network Symposium. Toronto, 23 Oct 2014.

Salcido D, Koller AC, Torres C, **Orkin A**, Schmicker RH, Morrison LJ, Nichol G, Stephens S, Menegazzi JJ and the Resuscitation Outcomes Consortium Investigators. 'Abstract 236: Regional Incidence and Outcomes of Out-of-Hospital Cardiac Arrest Associated with Overdose.' American Heart Association Resuscitation Science Symposium, Chicago Il, 15-16 Nov 2014. Abstract in *Circulation* 2014;130:A236.

Schwandt M, **Orkin A**, McLaughlin J, Lay M, Cole D. 'Medical Repatriation of Migrant Farm Workers in Canada.' International Safety and Health in Agricultural and Rural Populations Symposium, Saskatoon SK., 19 Oct 2014.

Klaiman M for the Surviving Opioid Overdose with Naloxone (SOON) Research Team. 'The SOON Project and Roundtable." University of Toronto Division of Emergency Medicine Research Day, Toronto, 27 May 2014.

Bingham K, *Klaiman M, Leece P*, **Orkin A**. 'Surviving Opioid Overdose with Naloxone.' Resuscitation in Motion Conference, St. Michael's Hospital, Toronto, 28 Apr 2014.

Schwandt M, **Orkin A**, McLaughlin J, Lay M*, Cole D. 'Medical Repatriation of Migrant Farm Workers in Canada.' PEGASUS Conference, Canadian Physicians for Research, Education and Peace, 2 May 2014.

Leece P, Gassanov M, **Orkin A**, Marchall C, Hopkins S, Shahin R. 'Engaging the community on opioid overdose: development, implementation, and evaluation of an overdose prevention and resuscitation training program' The Ontario Public Health Convention, Toronto, 3 Apr 2013.

Leece P, **Orkin A**, Hopkins S, Shahin R. 'Can naloxone prescription and overdose training save lives among opioid users in family practice?' Workshop. College of Family Physicians of Canada, Family Medicine Forum, Toronto, 19 Oct 2012.

Orkin A, Newbery S. "What do rural birthing stories teach us about rural birthing? The Marathon Maternity Oral History Project" WONCA Rendez-Vous 2012, Thunder Bay, 9 Oct 2012.

VanderBurgh D, **Orkin A**, S Ritchie, R Jamieson*, Mukhopadhyay B, Sacevich C, Beardy J§. "Where there is no paramedic: The Sachigo Lake Wilderness Emergency Response Education Initiative.' WONCA Rendez-Vous 2012, Thunder Bay, 11 Oct 2012.

Curran J, Ritchie S, VanderBurgh D, **Orkin A**. 'How does a first aid training program build resilience and community capacity for one First Nations community in Canada?' Rendez-Vous 2012, Thunder Bay, 10 Oct 2012.

Mukhopadhyay B, Jamieson R*, VanderBurgh D, **Orkin A**. 'First response in psychiatric crises: teaching and learning mental health first aid in a remote First Nation.' WONCA Rendez-Vous 2012, Thunder Bay, 11 Oct 2012.

Ritchie S, VanderBurgh D, **Orkin A**. 'Community-Based Participatory Research with First Nations Communities: The Proxomity Paradox' WONCA Rendez-Vous 2012, Thunder Bay, 10 Oct 2012.

Sacevich C, VanderBurgh D, **Orkin A**. "Automatic Electronic Defibrillators in Pre-hospital Rural and Remote Settings: What effect does prolonged transport time to hospital have on survival?" WONCA Rendez-Vous 2012, Thunder Bay, 10 Oct 2012.

Leece P, **Orkin A**. 'Bystander opioid overdose resuscitation and naloxone administration: What is the best training protocol?' Conference presentation, Resuscitation in Motion Conference, St. Michael's Hospital, Toronto 2012.

Orkin A, VanderBurgh D. 'A First Response Collaboration with a Remote First Nations Community: Building Local Resilience through Resuscitation Education.' Conference presentation, Resuscitation in Motion, St. Michael's Hospital, Toronto 2012.

Born K,* **Orkin A**, VanderBurgh D. 'The Sachigo Lake Wilderness Emergency Response Education Initiative.' Poster presentation, Canadian Association of Health Services and Policy Research, 8 May 2011.

Orkin A, Newbery S. 'Rural Birth Narratives: The Marathon Maternity Oral History Project' Presentation at the CFPC Family Medicine Forum, Vancouver, 13 Oct 2010.

Orkin A, VanderBurgh D, Born K*, Webster M*. 'Sachigo Lake Wilderness Medicine Program: A First Response Collaboration in a Remote Aboriginal Community.' Poster presentation at the CFPC Family Medicine Forum, Vancouver, 13 Oct 2010.

Orkin A, VanderBurgh D, Born K*. 'The Sachigo Lake Wilderness Emergency Response Education Initiative.' Presentation at the Ontario Training Center in Health Services and Policy Research, Toronto, 15 Oct 2010.

Orkin A, VanderBurgh D, Born K*. 'The Sachigo Lake Wilderness Medicine Program: Integrating Emergency First Response With Community-Based Research' Presentation at the University of Toronto Community Medicine and Public Health Research Forum, 1 Oct 2010.

Orkin A, VanderBurgh D, Born K*. 'The Sachigo Lake Wilderness Medicine Program.' Presentation at the CIHR Health Services Chair Workshop on Diversity: Healthcare Settings and Health Services Research, Toronto, 28 Apr 2010.

Orkin A. 'Medical Intervention: Médecins Sans Frontières and the Birth of the Medico-Humanitarian Profession.' Presentation at the Green-Templeton College Human Welfare Conference, University of Oxford, 16 May 2010.

Sandwith SM, McFarling M, **Orkin A**. 'Early Medical Student Exposure to Remote and Wilderness Medicine.' Poster presented at the 2008 Society of Rural Physicians of Canada conference, Halifax NS.

Invited and Non-Peer-Reviewed Presentations

Orkin A and Klaiman M. "Opioid Issues in the Emergency Department". Markham-Stoufville Hospital Emergency Medicine Rounds. Markham. 16 Apr 2019.

Orkin A, on behalf of the SOONER Investigators. "SOONER: Combining design, simulation and trial methods to bring naloxone into everyday practice" University of Toronto Department of Family and Community Medicine City-Wide Research Rounds. Toronto. 21 Mar 2019.

Orkin A. "Hacking health care: How lay people can treat sick patients, solve epidemics, and create healthier societies." University of Alberta Dr. Walter Mackenzie lecture. 11 Jun 2018.

Orkin A. "The SOONER Project: Combining design, simulation and trial methods to bring naloxone into everyday practice." Invited keynote. University of Alberta Department of Emergency Medicine Research Forum. 12 Jun 2018.

MacPherson A, **Orkin A**, Cassan P, Burke S. "Brace Yourselves: The role of prevention and safety education in emergency readiness and responding to crisis." Plenary panel. International First Aid Education Conference. 24 Apr 2018.

Orkin A, Sellen K. "A Timely Update on the SOONER Study" Presentation for the Canadian Centre on Substance Use and Addiction and the Canadian Joint Statement of Action Committee on the Opioid Crisis. 8 Feb 2018, Toronto, Ontario.

Orkin A. It is the context that kills. Invited address. Canadian National Opioid Summit. 18 Nov 2016, Ottawa ON.

Orkin A, VanderBurgh D, Beardy J§. Community-Based Emergency Care: A Novel approach to first response medical services in remote First Nations. Invited presentation. Chiefs of Ontario Health Forum. Toronto ON, 26 Feb 2014.

Orkin A. VanderBurgh D, Beardy J§, Beardy J§. Community-Based Emergency Care: Developing first response medical services with remote First Nations communities. Invited presentation. Assembly of First Nations National Public Health Expert Advisory Committee. Ottawa, 14 Jan 2015.

Goodchild M, Diabo, D, **Orkin A**, Swan T. Panel discussion: Aboriginal involvement in planning and preparing for disasters. Canada's Platform for Disaster Risk Reduction. Invited panelist. Toronto, 21 Oct 2014.

Orkin A, VanderBurgh D. 'Community-Based Emergency Care: First Response Innovations in Remote First Nations.' Invited poster. Ontario Ministry of Health and Long-Term Care Innovation Showcase, Toronto 28 Nov 2013.

Orkin A. "'A doctor is there to be a doctor, not advocate for the poor": Doctorhood and History of MSF.' Invited seminar, Joint Centre for Bioethics, University of Toronto, 9 Nov 2011.

Orkin A. 'Persistent Debates in the Work and Purpose of MSF.' Invited presentation. Doctors Without Borders USA (MSF), New York, NY, 8 Jul 2011.

Orkin A. 'Movement or Organization? Medical or Humanitarian? MSF and the Future of Humanitarianism'. Invited presentation. MSF-Canada Association General Assembly. Montreal, 14 May 2011.

Orkin A. 'Medical Intervention: An Alibi for Humanitarian Practice?' Invited presentation. MSF-Canada. Toronto, 4 May 2011.

Letters in Peer-Reviewed Journals

Orkin AM, Ivers NM. "Is reducing ED visits an important outcome?" Invited comment on Kiran et al, Emergency department use and enrollment in a medical home providing after-hours care. *Annals of Family Medicine*. Sept/Oct 2018,16:419-27; doi:10.1370/afm.2291.

Orkin AM, Ovens H, McLeod S, Varner C, Melady D, Thompson C, Penciner R, Sidhu K, Dushenski D, Borgundvaag B. "Letter in response to 'CJEM Debate Series: #Social Media — Social media has created emergency medicine celebrities who now influence practice more than published evidence." CJEM, 1-1. doi:10.1017/cem.2017.436

Orkin AM, Kelly L. "Acknowledging rural context, local and generalist care." *CMAJ*. 2016 Mar 1;188(4): 286. DOI:10.1503/cmaj.1150083

Orkin AM, Bingham K, Buick JE, Klaiman M, Leece P, Kouyoumdjian FG. "Quality Assessment Errors and Study Misclassification Threaten Systematic Review Validity: Community Opioid Overdose Prevention and Naloxone Distribution Programs Review: Re: Clark AK, Wilder CM, Winstanley EL. A systematic review of community opioid overdose prevention and naloxone distribution programs." *J Addict Med* 2014 May-June;8(3): 153-163. J Addict Med. 2015 Dec;9(6):502-3.

Kouyoumdjian FG, **Orkin A**, Dooling K, Schwandt M. Screening for HCV. *CMAJ*. 2014 Mar 4;186(4): 294.

McDonald N, Webster M, **Orkin A**, VanderBurgh D, Johnson DE. The Long Backboard vs. the Vacuum Mattress. *Prehosp Disaster Med*. 2014 Feb;29(1):110.

Orkin AM, Rajaram N, Schwandt M. Aboriginal populations and youth suicide. *CMAJ*. 2013 Oct 15;185(15):1347.

Schwandt M, **Orkin A**, McLaughlin J, Lay M, Cole D. 'Medical Repatriation of Migrant Farm Workers in Canada.' Accepted for presentation at the International Safety and Health in Agricultural and Rural Populations Symposium, Saskatoon SK., 19 Oct 2014.

Leece P, **Orkin A**. Opioid overdose fatality prevention. *JAMA*. 2013 Mar 6;309(9):873-4.

Orkin A. Letter to the editor. *Paediatr Child Health*. 2010 May;15(5):260.

Orkin AM, Kerr J. An unrealistic option. *Can Fam Physician*. 2008 Dec;54(12):1677-8.

Orkin AM. Subspecialties in family medicine: a question of values. *Can Fam Physician*. 2008 Sep;54(9):1231.

Orkin AM. Funding for Canadian health care research. *CMAJ*. 2008 Feb 12;178(4):349.

Other Writing

Orkin AM. Sidewalk Labs project is a public health opportunity. *The Toronto Star*. 30 Jun 2019.

Peer Review

Peer Reviewer (Peer review history and open reviews available at www.publons.com)

Annals of Family Medicine	*2017 - 2018*
CMAJ Open	*2016*
Addiction	*2016*
Canadian Family Physician	*2008 - 2016*
Open Medicine	*2012 - 2015*
Canadian Journal of Public Health	*2013 - 2015*
Drug and Alcohol Dependence	*2015*
BMC Health Services Research	*2014*

Teaching & Supervision Experience

Teaching and Continuing Professional Development Presentations

Orkin A, Sellen K. "Innovation and Design Thinking in Resuscitation Research - SOONER Project" Collaborative Program in Resuscitation Science, 27 Jan 2020.

Orkin A. "Population Medicine: What is it and why do we need it?" Institute of Health Policy, Management, and Evaluation Policy Rounds. 29 Jan 2019.

Orkin A on behalf of the SOONER Investigators. "Combining design, simulation and trial methods to bring naloxone distribution into everyday practice." Applied Health Research Centre rounds, St. Michael's Hospital, 12 Sept 2018.

Orkin A. "Making interdisciplinary work: Career notes from a PGY-12." University of Alberta Emergency Medicine Residency Program Workshop, 11 Jun2018.

Orkin A, Drennan I. "Responding to the Unexpected." University of Toronto Family Medicine Residency Program Rounds, 23 May 2018.

Orkin A, Leece P. "The Opioid Epidemic and Public Health" University of Toronto School of Medicine Public Health Interest Group, 23 Apr 2018.

Orkin A. "Bystander Resuscitation in Overdose: Naloxone Distribution and the SOONER Trial." Collaborative Program in Resuscitation Science, 2 Oct 2017.

Foote J, Orkin A. "Optimizing care for patients with opioid use disorder in the emergency department." Mt. Sinai Hospital Emergency Department Rounds, 31 May 2017.

Orkin A. "Designing first aid for the opioid epidemic." Presentation for the Public Health Agency of Canada Special Advisory Committee on the Epidemic of Opioid Overdoses. Ottawa, 30 May 2017.

Orkin A. "Task shifting for emergency care: Protocol for a mixed methods feasibility study and conceptual framework." St. Michael's Hospital Clinical and Population Research Rounds, 30 Mar 2017.

Orkin A. "Feasibility of the Surviving Opioid Overdose with Naloxone Education and Resuscitation (SOONER) Trial." St. Michael's Research Training Seminar, 24 Feb 2017.

Orkin A. "Overdose Education and Naloxone Distribution." Peterborough Regional Health Centre Emergency Department Grand Rounds, Peterborough, 24 Jan 2017.

Orkin A. "What is Clinical Public Health?" University Health Network and Dalla Lana School of Public Health Dietetics Program, Toronto, 24 Jan 2017.

Orkin A. "Stigma and resuscitation: The mysterious case of opioid overdose and naloxone distribution." Collaborative Program in Resuscitation Sciences, Foundations of Resuscitation Science Course, St. Michael's Hospital, Toronto, 9 Jan 2017.

Orkin A, VanderBurgh D. "Go Big or Go Home? Exploring Scale-Up in Health Programs." Public Health & Preventive Medicine Residency Program Rounds, Northern Ontario School of Medicine, 11 Nov 2016.

Young M., Orkin A., Malek A. "Overdose Prevention with Naloxone: National and Provincial Landscape. CAMH Opioid Resource Hub and Registered Nurses Association of Ontario Webinar. 14 Sept 2016.

Orkin A. "What is Clinical Public Health?" Introduction to Public Health Course, Dalla Lana School of Public Health, Toronto, 7 Sept 2016.

Orkin A. "Overdose education and naloxone distribution: How first aid can help address the opioid overdose epidemic." Collaborative Program in Resuscitation Sciences, Foundations of Resuscitation Science Course, St. Michael's Hospital, Toronto, 23 Jan 2016.

Orkin A. "Community-Based Emergency Care: What does First Response have to do with Public Health?" Public Health & Preventive Medicine Residency Program Rounds, Northern Ontario School of Medicine, 27 Nov 2015.

Orkin A. "Guideline Development and Practice at the Fringe." Collaborative Program in Resuscitation Sciences, Foundations of Resuscitation Science Course, St. Michael's Hospital, Toronto, 19 Jan 2015.

Orkin A, Leece P, Pinto A. "Recent and New Public Health & Preventive Medicine Graduate Panel on Research." Public Health & Preventive Medicine Resident Research Day, Dalla Lana School of Public Health, 28 Nov 2014.

Orkin A. "Quantitative Research and Evidence-Based Medicine Methods." Seminar for Empirical Approaches in Bioethics (MSC3003Y), Joint Centre for Bioethics, University of Toronto, 20 Nov 2014, 26 Nov 2015, 13 Oct 2016, 12 Oct 2017, 17 Jan 2019.

Orkin A. "Compost, Crowd-Sourcing and Computation: Medical Repatriation of Migrant Farm Workers in Canada." Presentation for Migration and Health (CHL3113H), Dalla Lana School of Public Health, University of Toronto, 3 Nov 2014.

Orkin A. "Geographically Remote First Nations Populations." Social Determinants of Health Panel for Community, Population & Public Health course, Undergraduate Medicine, University of Toronto, 27 Aug 2014.

Orkin A. "Remote and Isolated First Nations Communities." Social Determinants of Health Panel for Determinants of Community Health course, Undergraduate Medicine, University of Toronto, 14 May 2014.

Orkin A. "Rural vs. Urban: Equity Considerations in Resuscitation Guidelines and Services." Collaborative Program in Resuscitation Sciences Seminar, St. Michael's Hospital. Toronto, 12 Nov 2013.

Orkin A. "Rural and Remote Trauma: Hypotheses and Policy Recommendations in Progress" Presentation to the University of Toronto Trauma Research In Progress (TRIP) group. Toronto, 22 Nov 2012.

Orkin A. "My Research Matters *to Whom*? Upstream and Downstream Knowledge Translation" Collaborative Program in Resuscitation Sciences, St. Michael's Hospital. Toronto, 4 Mar 2013.

Research Supervision

- Resident research supervisor: Justin Burton, University of Toronto, Postgraduate family medicine. 'Community-based emergency care in Tsiigehtchic Northwest Territories.' *2018*
- Resident research supervisor: Gaibrie Stephen, University of Toronto, Postgraduate family medicine. 'Systematic review on the cost of managing non-urgent conditions in the emergency department vs. other outpatient ambulatory care settings.' *2018*
- Resident research supervisor: Jonathan Gravel, University of Toronto, Postgraduate family medicine. 'Managing acute pain in people who use opioids in the emergency department.' *2018*
- Masters of Public Health Practicum co-supervisor: Emma Mew. Community-Based Emergency Care Project *2017*
- Masters of Public Health Practicum supervisor: André McDonald. 'Defining and measuring health equity effects in research on task shifting interventions: a systematic review' *2017*
- Resident research co-supervisior: Dr. Aamir Bharmal and Dr. Jennifer Cram, University of Toronto, Postgraduate Medicine. 'Clinical Population Medicine: What it is and what it isn't'. Co-supervisors: R Upshur, A Pinto. *2016*
- Medical Student Research Supervisor: Jeffrey Curran, Northern Ontario School of Medicine, Undergraduate Medicine. 'Systematic Review: Health effects of training laypeople to deliver emergency care'. Co-supervisor: D VanderBurgh. *2015*
- Thesis Co-Supervisor: Jeffrey Curran. 'Building Resilience and Community Capacity: The Sachigo Lake Wilderness Emergency Response Education Initiative.' Master of Arts (Human Development) Laurentian University, Sudbury.

Committee: S Ritchie, D VanderBurgh, A Orkin, John Lewko. May 2014. http://www.webcitation.org/6So23fyp2 *2011 - 2014*

- Resident Research Supervisor: Baijayanta Mukhopadhyay. Northern Ontario School of Medicine Postgraduate Family Medicine. 'First response in psychiatric crises: teaching and learning mental health first aid in a remote First Nation.' (Resident awarded 2012 Physician Services Institute Resident Research Award) Co-supervisor: David VanderBurgh *2011 - 2013*
- Medical Student Research Supervisor: Calen Sacevich, Northern Ontario School of Medicine, Undergraduate Medicine.
  - 'Automatic Electronic Defibrillators in Pre-hospital Rural and Remote Settings: What effect does prolonged transport time to hospital have on survival.' Co-supervisor: D VanderBurgh. (Student awarded 2012 Heart and Stroke Foundation Hannah Pherril Summer Medical Student Scholarship for this research.) *2011 - 2013*
  - 'Access to Automated External Defibrillators in Remote Ontario First Nations Communities: A Survey of Local Health Directors.' Co-supervisor: D VanderBurgh.

- Research Supervisor: Shweta Dhawan. Migrant Farm Worker Medical Incidents Project. Data entry and literature review supervision. *2012*
- Thesis Co-Supervisor: Stephanie Kellowan. 'Autonomy and Choice: Gender Politics in Contemporary Breastfeeding.' Bachelor of Arts & Science Thesis, McMaster University, Hamilton. Co-supervisor: C Levitt. *2009 – 2010*

Research Judge: Research, Education Scholarship and Quality Improvement, Family Medicine Residency Program, University of Toronto *2016*

Workshop Tutor: University of Toronto Transition to Clerkship Outbreak Module *2013, 2014*

Instructor: Wilderness Advance Life Support and Medical Elective Instructor, Wilderness Medical Associates, Canada. *2008 - 2011*

Assistant Instructor: Introduction to Evidence-Based Medicine Workshop, Oxford University Centre for EBM. Senior instructor: Dr. Paul Glasziou. *2010*

Examiner: Observed Structured Clinical Examination (OSCE) and clinical skills, Northern Ontario School of Medicine and McMaster University. *2008 - 2012*

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CBC Radio Thunder Bay: "When 911 is not an option." Superior Morning with Lisa Laco. Interviewed with Deputy Grand Chief Alvin Fiddler of Nishnawbe Aski Nation. 30 Oct 2013.

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Labine, J. 'NOSM sees its first graduation' tbNewsWatch. Available www.tbnewswatch.com.

Professional Organizations & Affiliations

- Ontario Medical Association & Canadian Medical Association *2004 - present*
- College of Family Physicians of Canada *2006 - present*
- Royal College of Physicians and Surgeons of Canada *2013 - present*
- Society of Rural Physicians of Canada *2006 - 2017*
- Wilderness Medical Associates International *1998 - 2011*
- Canadian Doctors for Medicare *2007 - present*
- Canadian Public Health Association *2012 - present*
- Canadian Association of Emergency Physicians *2012 - present*
- Public Health Physicians of Canada *2012 - present*
- Canadian Point of Care Ultrasound Society (Independent practitioner) *2017 - present*

THIS IS **EXHIBIT "B"** TO THE

AFFIDAVIT OF DR. AARON ORKIN

AFFIRMED BEFORE ME by video conference

THIS 8th DAY OF JUNE , 2020.

A Commissioner for Taking Oaths

VANORA SIMPSON

COVID-19 Modelling

April 3, 2020

COVID-19 Update: Today's Presentation

- The information provided in this presentation was developed by several experts at Ontario Health, Public Health Ontario and researchers at Ontario universities, led by the COVID-19 Command Table.
- The objective of today's presentation is to share the modelling and projection data that the Command Table has been using to inform our work, and advising government on their response to COVID-19.
- We feel is it important to be transparent with the public about the challenges we are facing, and the important work we all need to do to flatten the curve.
- How this outbreak unfolds is in the hands of the public, in all of your hands – we can change the outcomes by how we all stay at home and physically distance ourselves.
- Recognizing that we get new information about this outbreak on a daily basis, we will continue to refine our models.
- Our public health measures so far have made a significant difference and we need everyone to stay focused on these in the weeks ahead: stay home, stop the spread, stay safe.

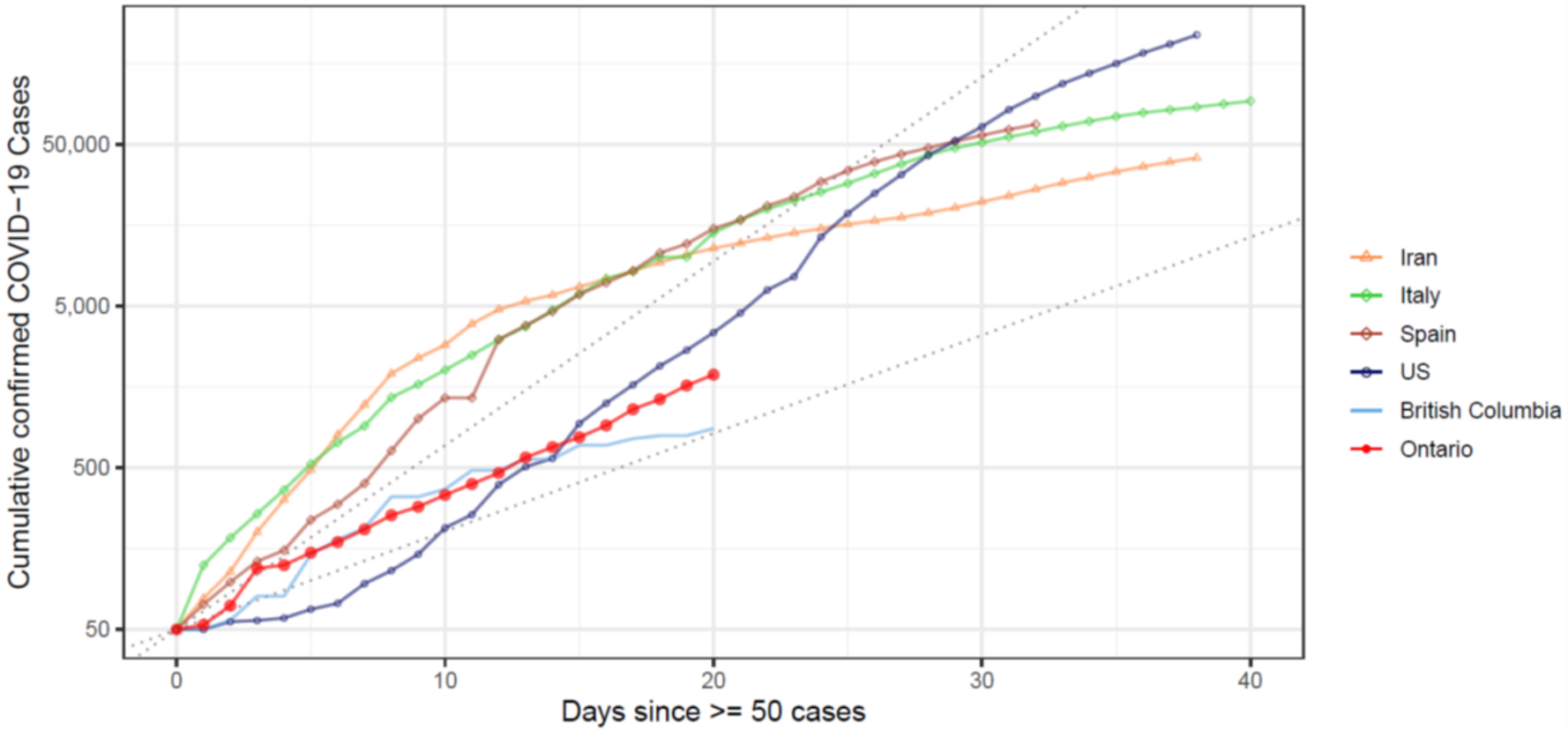
Current Status

COVID-19: Cases and Deaths by Age Group (January 15 to April 2, 2020)

Age Group	Cases	Deaths	Case Fatality Ratio (%)
19 and under	82	0	**0**
20-39	945	0	**0**
40-59	1,178	7	**0.6**
60-79	821	24	**2.9**
80 and over	226	36	**15.9**
Unknown	3	0	**0**
Total	**3,255**	**67**	**2.1**

Data Source: integrated Public Health Information System (iPHIS). Data extracted April 2, 2020 at 4pm

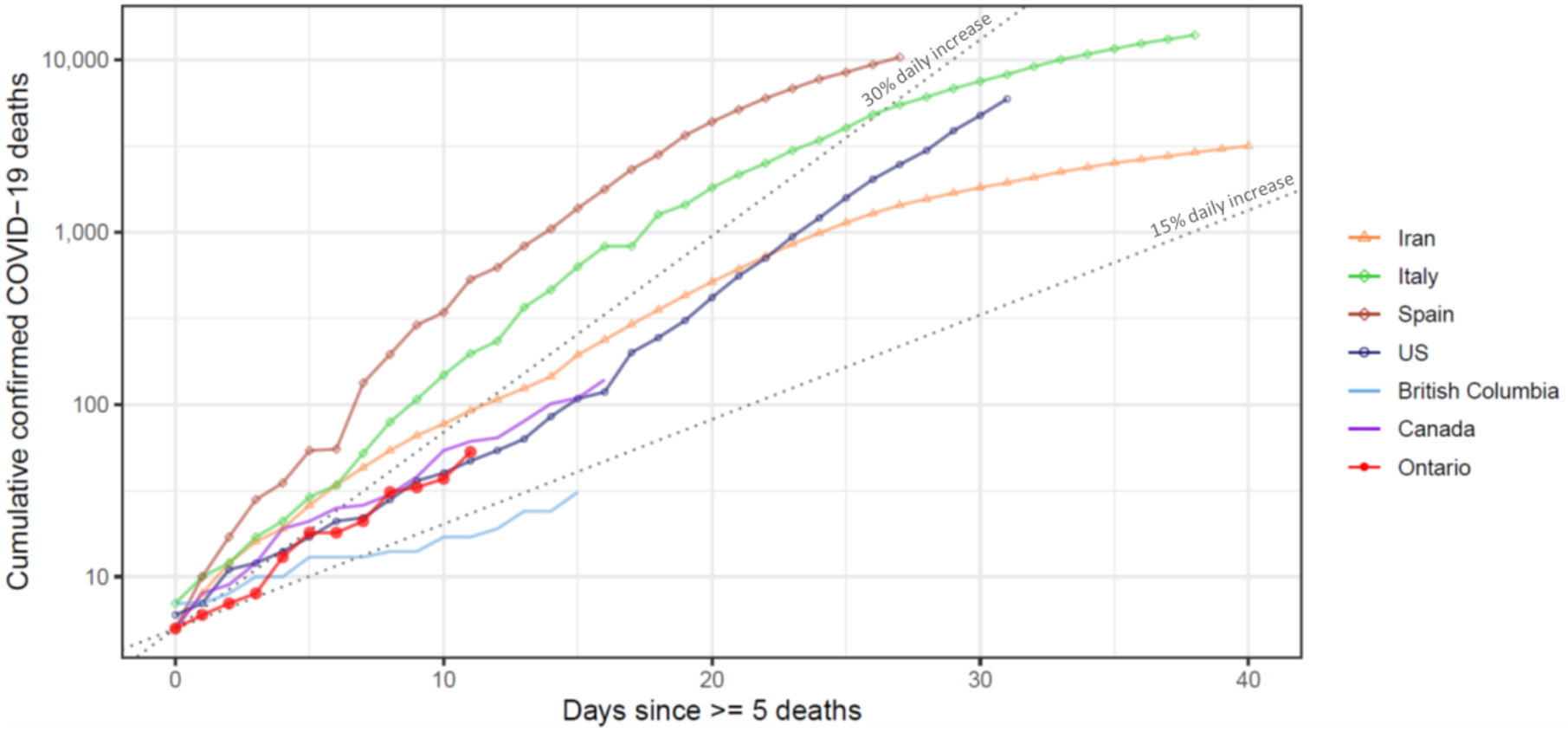
COVID-19: Cases in Ontario and Other Jurisdictions



Source: Johns Hopkins University, Centre for System Science and Engineering. Accessed April 1, 2020

Ontario

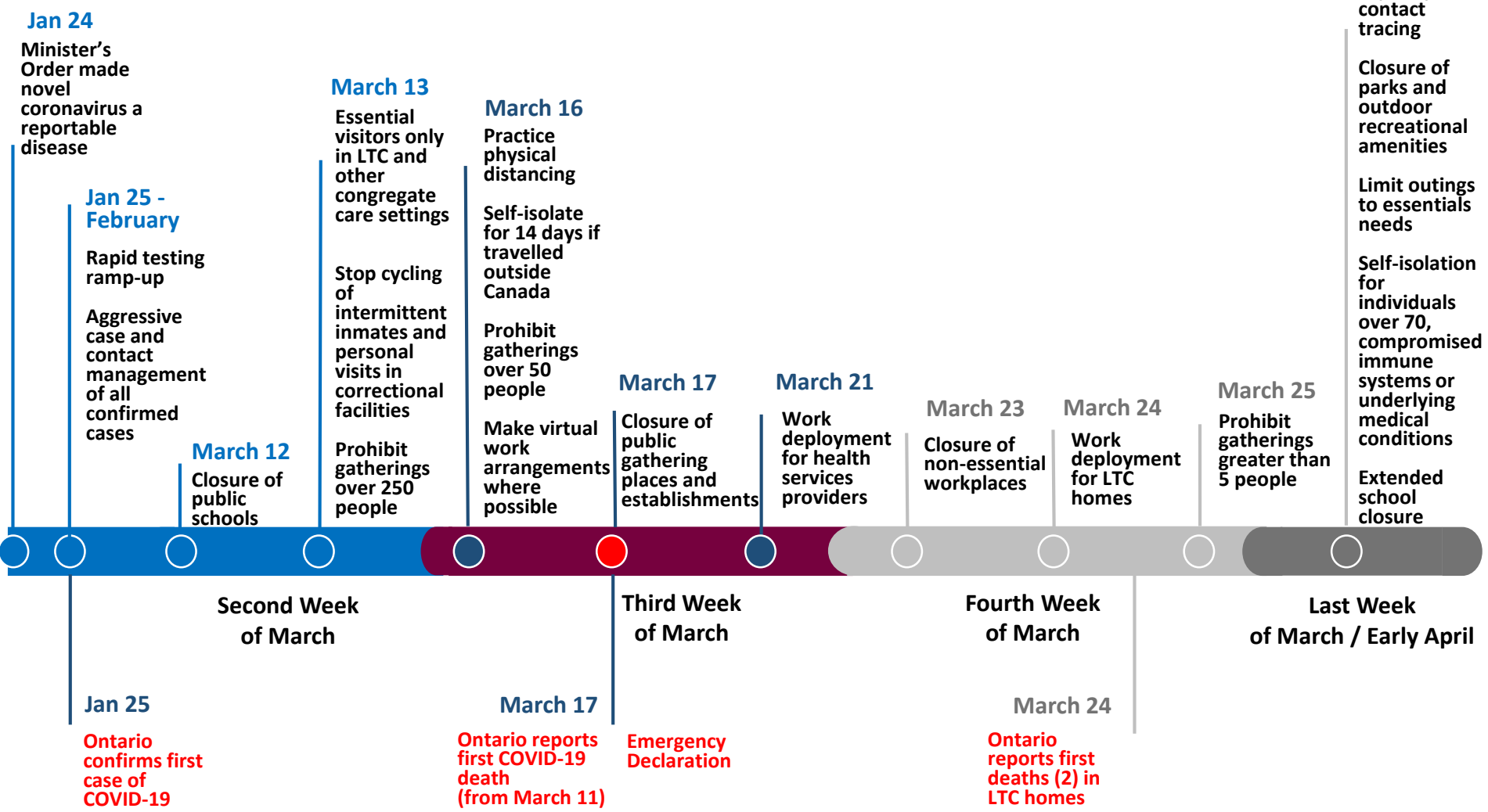
COVID-19: Deaths in Ontario and Other Jurisdictions



Source: Johns Hopkins University, Centre for System Science and Engineering. Accessed April 1, 2020

Ontario

COVID-19: Key Public Health Measures Timeline



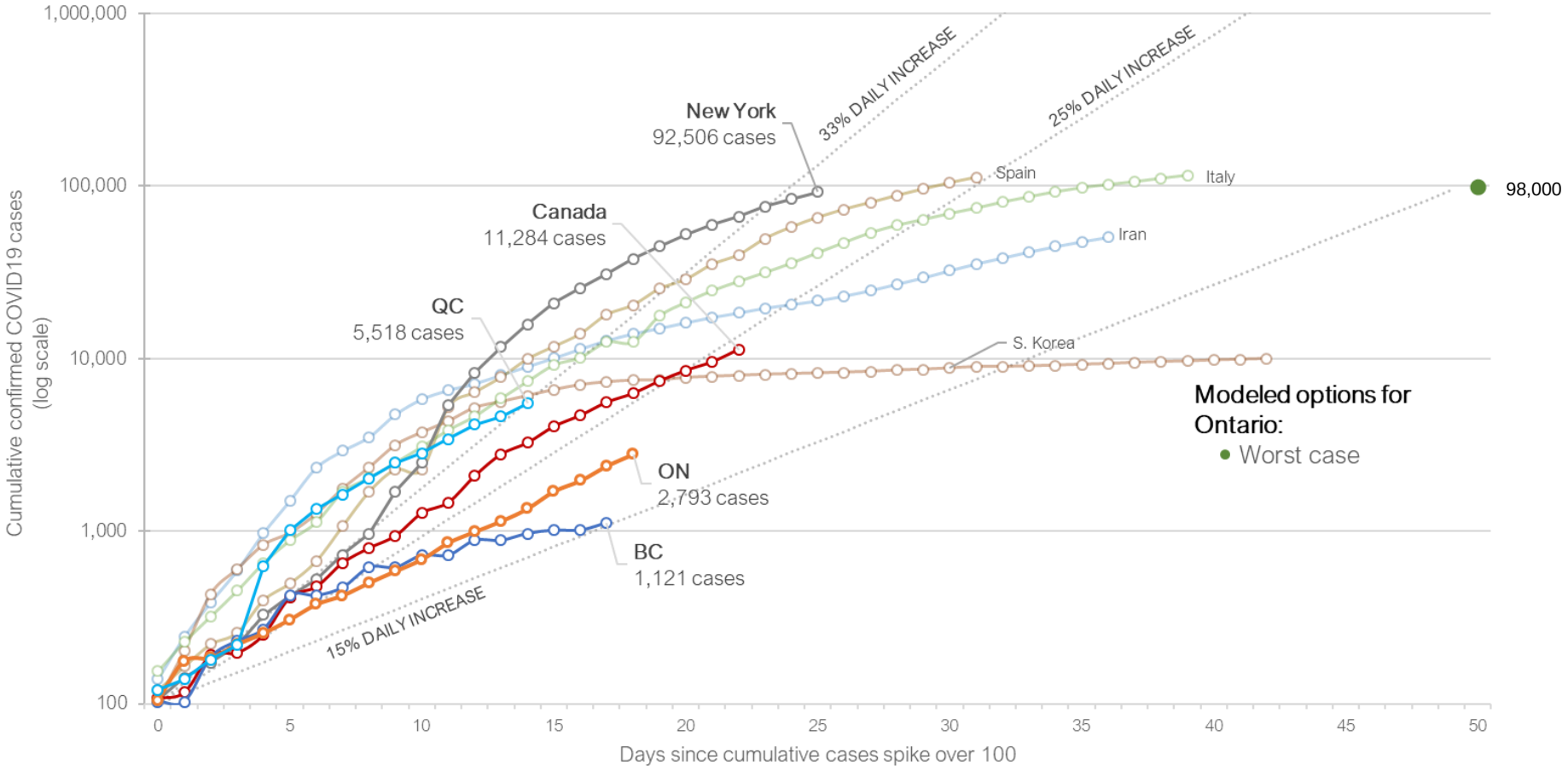
Ontario

Future Outlook

COVID-19: Using Models to Inform Ontario's Planning

- Models are used to help plan for what could happen.
- As with any model, the farther out predicted, the more uncertainty there is in the predictions.
- There is more confidence in the projections for the next 30 days than in the longer term projections.
- Assumptions were used to inform the model.
- Experts modelled how the disease spreads based on observed data and what is known from other countries.
- Any benefit seen in the model from improved public health measures assumes people follow those measures.
- If there are people with COVID-19 infections moving between health care facilities, there could be larger outbreaks.

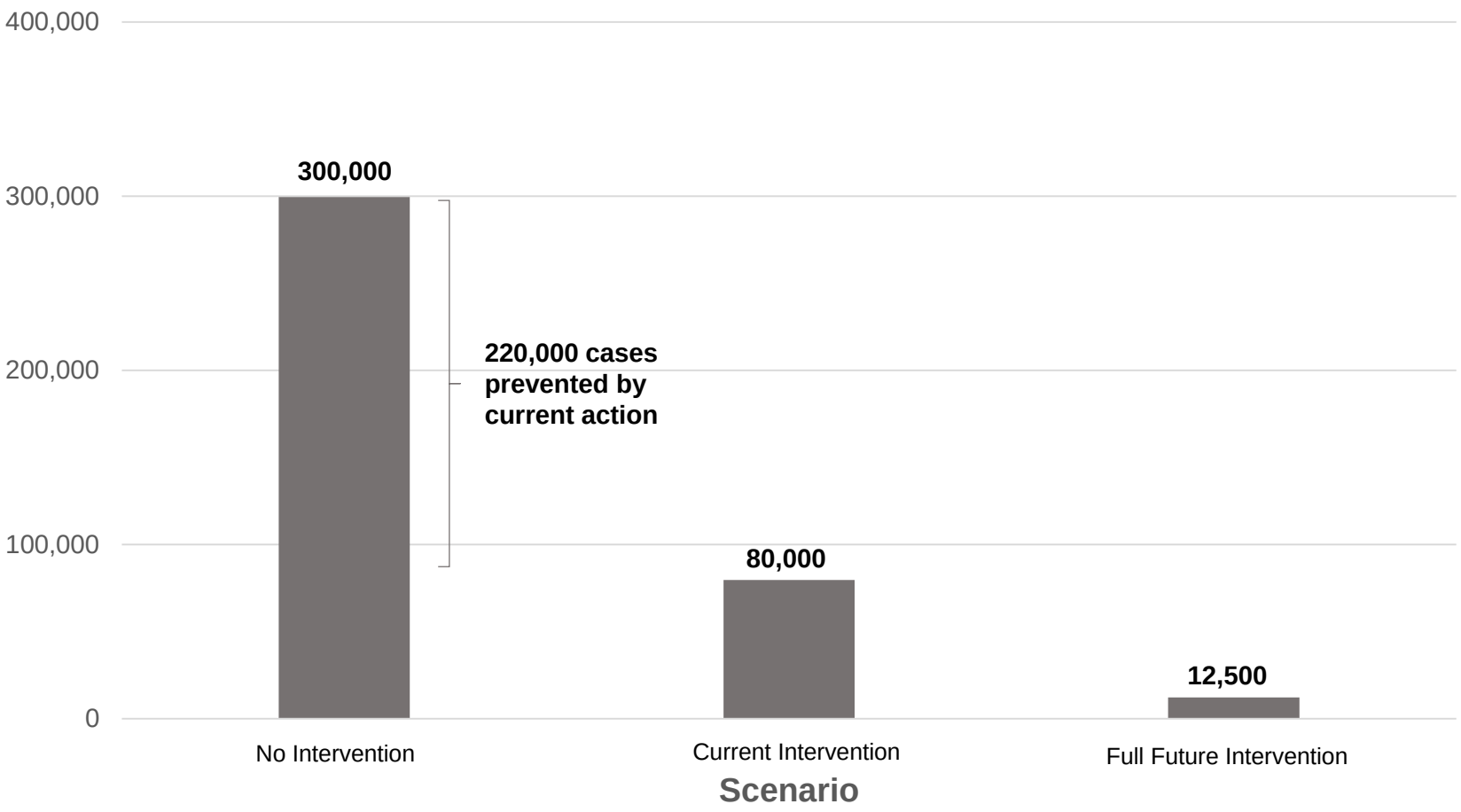
Cumulative Confirmed COVID-19 Cases, Number of Days since the 100th Case



Data from: Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. *The Lancet Infectious Diseases*, as of April 2, 2020. Data compiled by Johns Hopkins University from the following sources: WHO, CDC, ECDC, NHC, DXY, 1point3acres, Worldometers.info, BNO, state and national government health department, and local media reports.

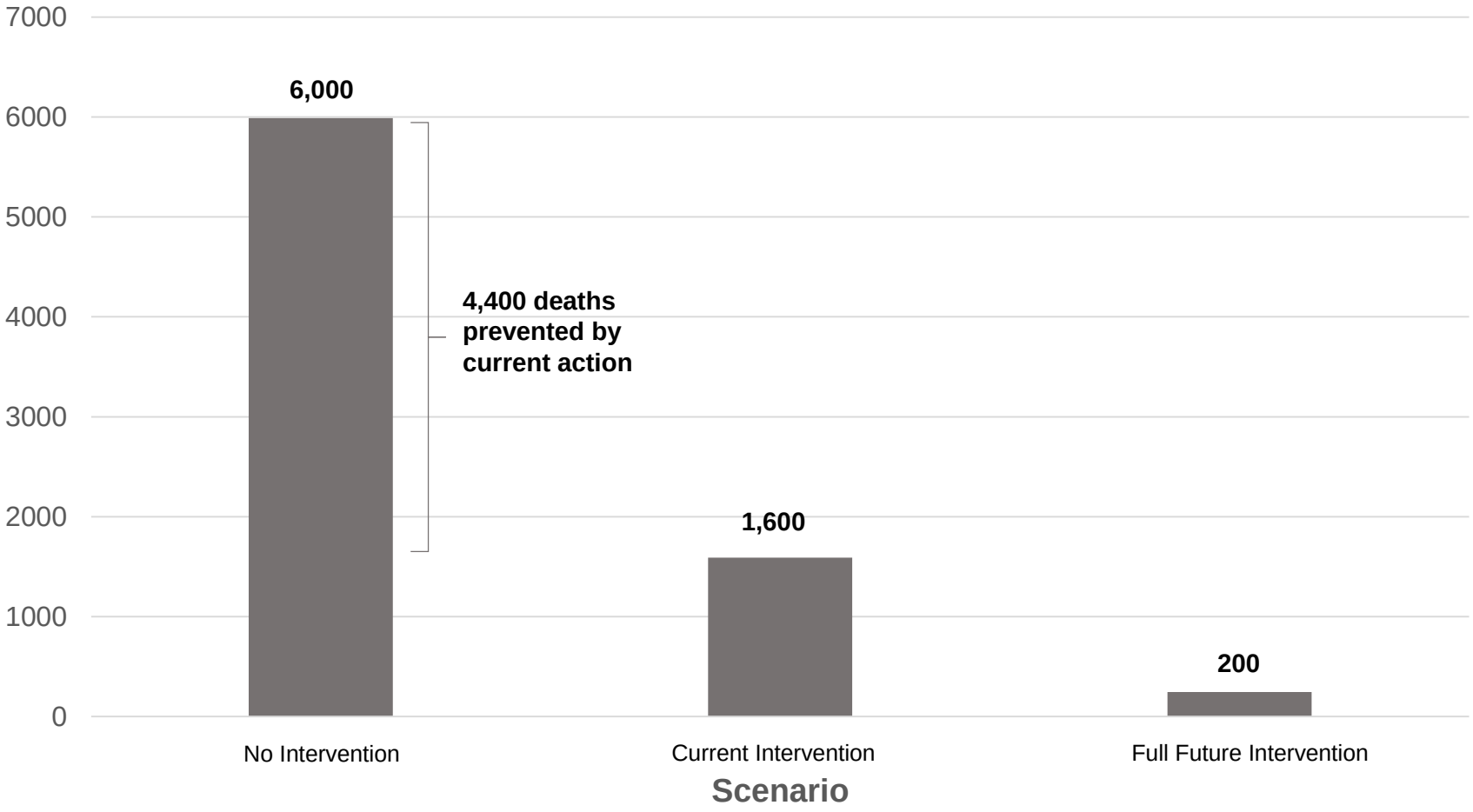
Ontario

Projected Ontario Cases by April 30, 2020



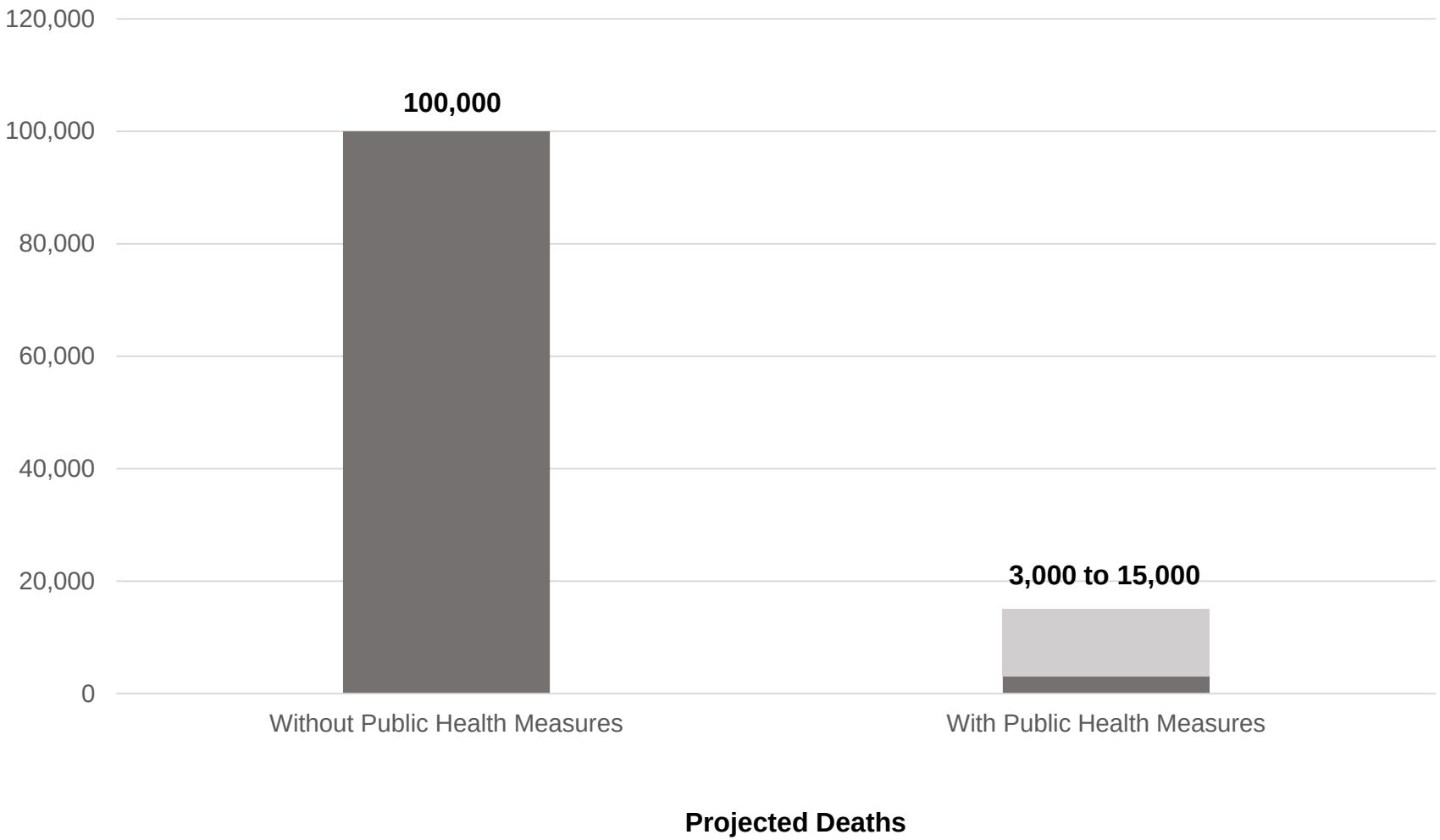
Ontario

Projected Ontario Deaths by April 30, 2020



Ontario

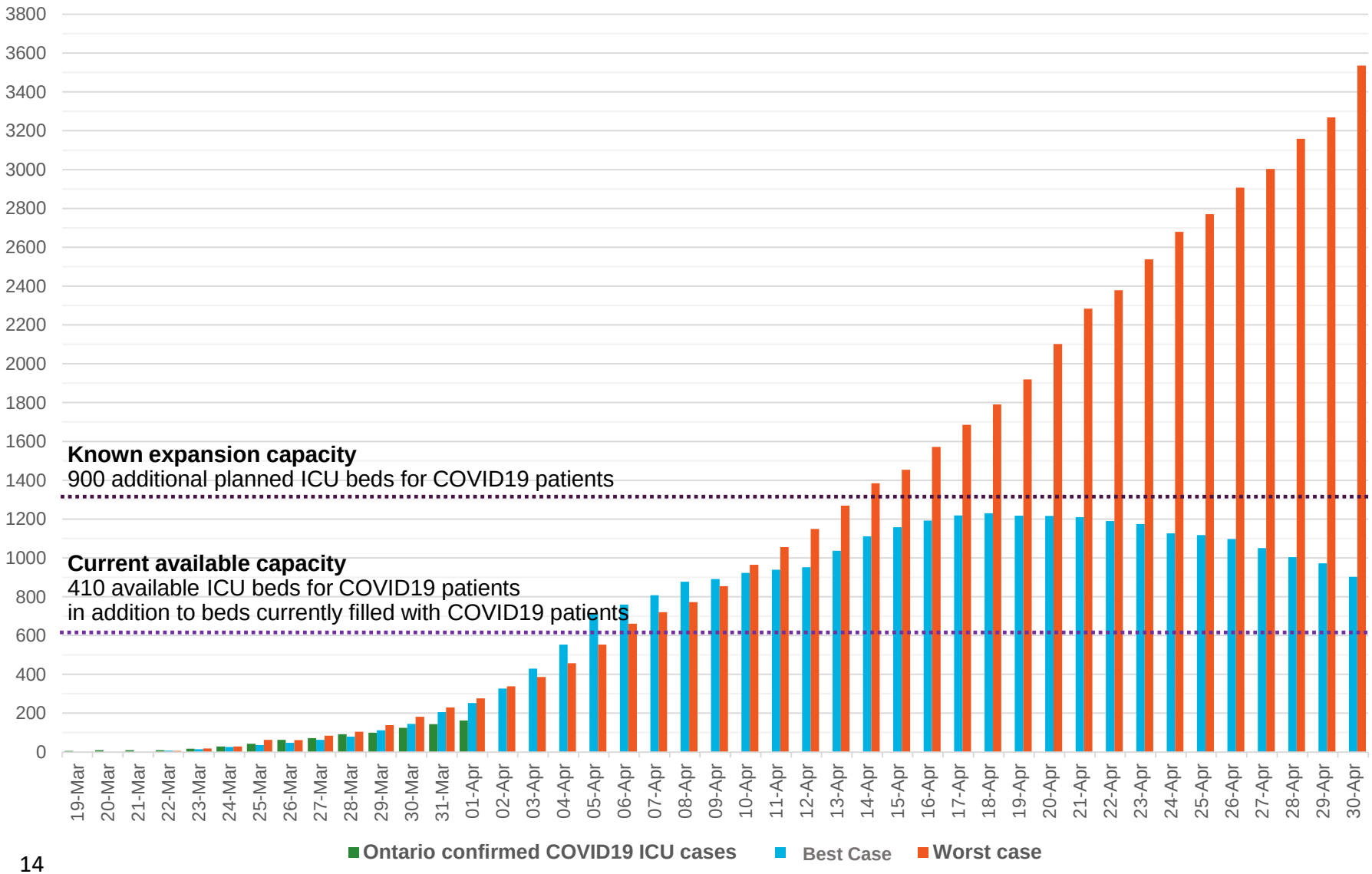
Projected Ontario Deaths over Course of Pandemic



Note: Range depends on implementation of maximum public health measures

Ontario

Ontario ICU Capacity for COVID-19



Looking Ahead

COVID-19: Slowing the Spread

- We need you to help us change the outcomes for Ontarians by staying at home and physically distancing.
- Our public health measures so far have made a difference and we need everyone to stay focused on these: stay home, stop the spread, stay safe.
- We need everyone to help stop the spread so we all must continue to fully adhere to the public health measures that have been put in place. We want to avoid the health care system being overwhelmed and the consequences to Ontarians, as we have seen in other jurisdictions in Europe and in the United States.

COVID-19: Additional Public Health Measures

Immediate Focus

- Enhanced capacity for case and contact tracing is underway.
- Increased testing for COVID-19, with a focus on long-term care, retirement homes and other congregate settings.

Future Measures

- Reduce the number and types of essential workplaces.
- Enhance focus on enforcement and fines for non-compliance.
- Expand direction/guidance on physical distancing, including retail settings.
- Enhanced support for elderly, homeless and other vulnerable populations and communities.
- Consider entry restrictions in some communities including First Nations.
- Human resource management (movement of health care workers between settings).
- Use of technology to reinforce self-isolation (alerts).
- Additional public education and communication (shelter in place with limited exceptions).

THIS IS **EXHIBIT "C"** TO THE

AFFIDAVIT OF DR. AARON ORKIN

AFFIRMED BEFORE ME by videoconference

THIS 8th DAY OF JUNE , 2020.

A Commissioner for Taking Oaths

VALORA SIMPSON

COVID-19:
Modelling and Potential Scenarios

April 20, 2020

COVID-19 Update: Today's Presentation

- The information and analysis provided was developed by several experts at Ontario Health, Public Health Ontario and researchers at Ontario universities, led and coordinated by the COVID-19 Command Table.

- Today's presentation will share the most up-to-date modelling and projections that Ontario's COVID-19 Command Table is using to inform the province's ongoing response.

- The government believes the public deserves to have access to the same information as it receives in regular briefings.

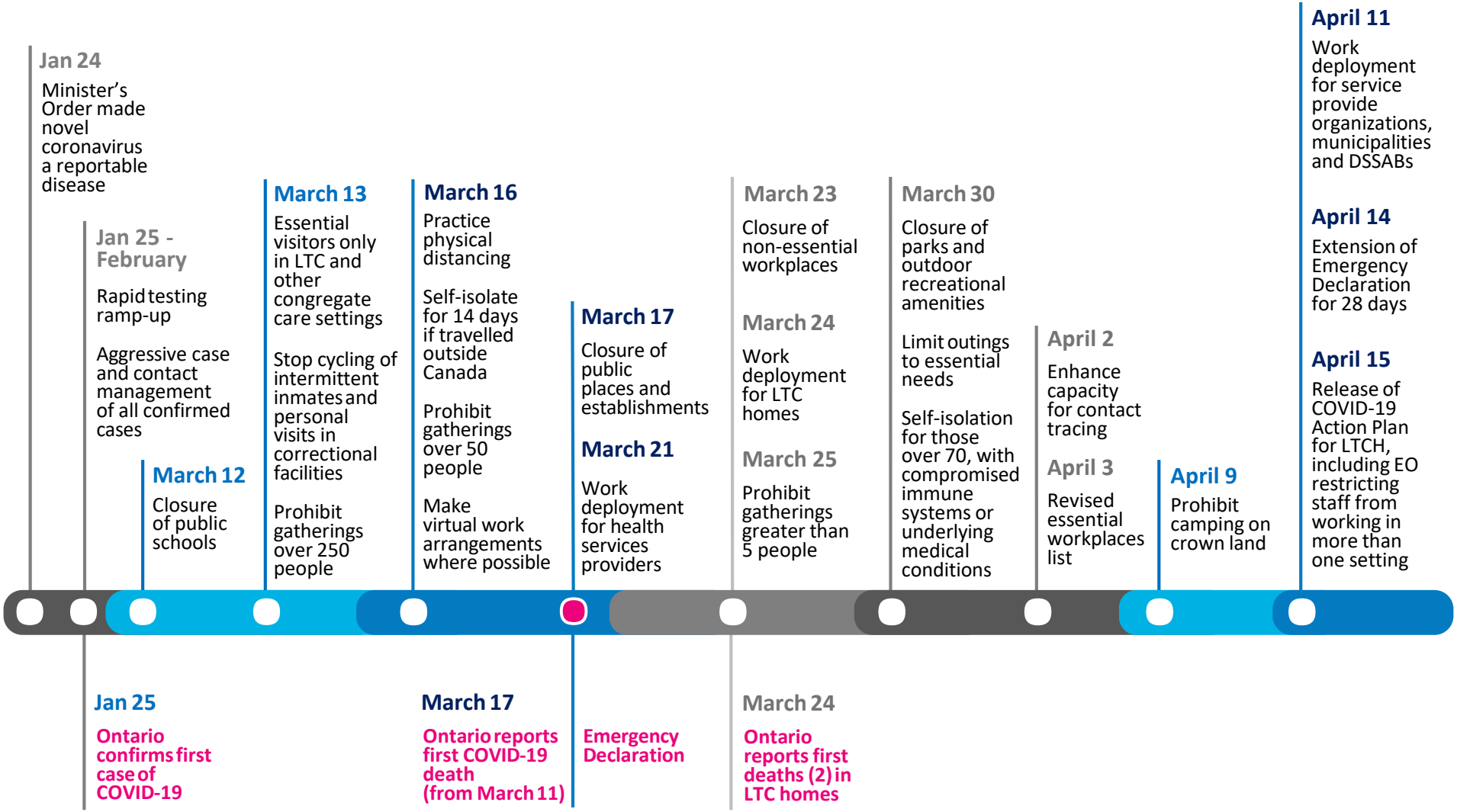
- Providing this information is key to ensuring continued transparency with the public about the current challenges that Ontario faces in dealing with COVID-19 and where there has been progress in flattening the curve.

Ontario

500

Current Situation in Ontario

COVID-19: Key Public Health Measures Timeline



Ontario

Current Status

- The wave of new community spread cases of COVID-19 in Ontario appears to have peaked.

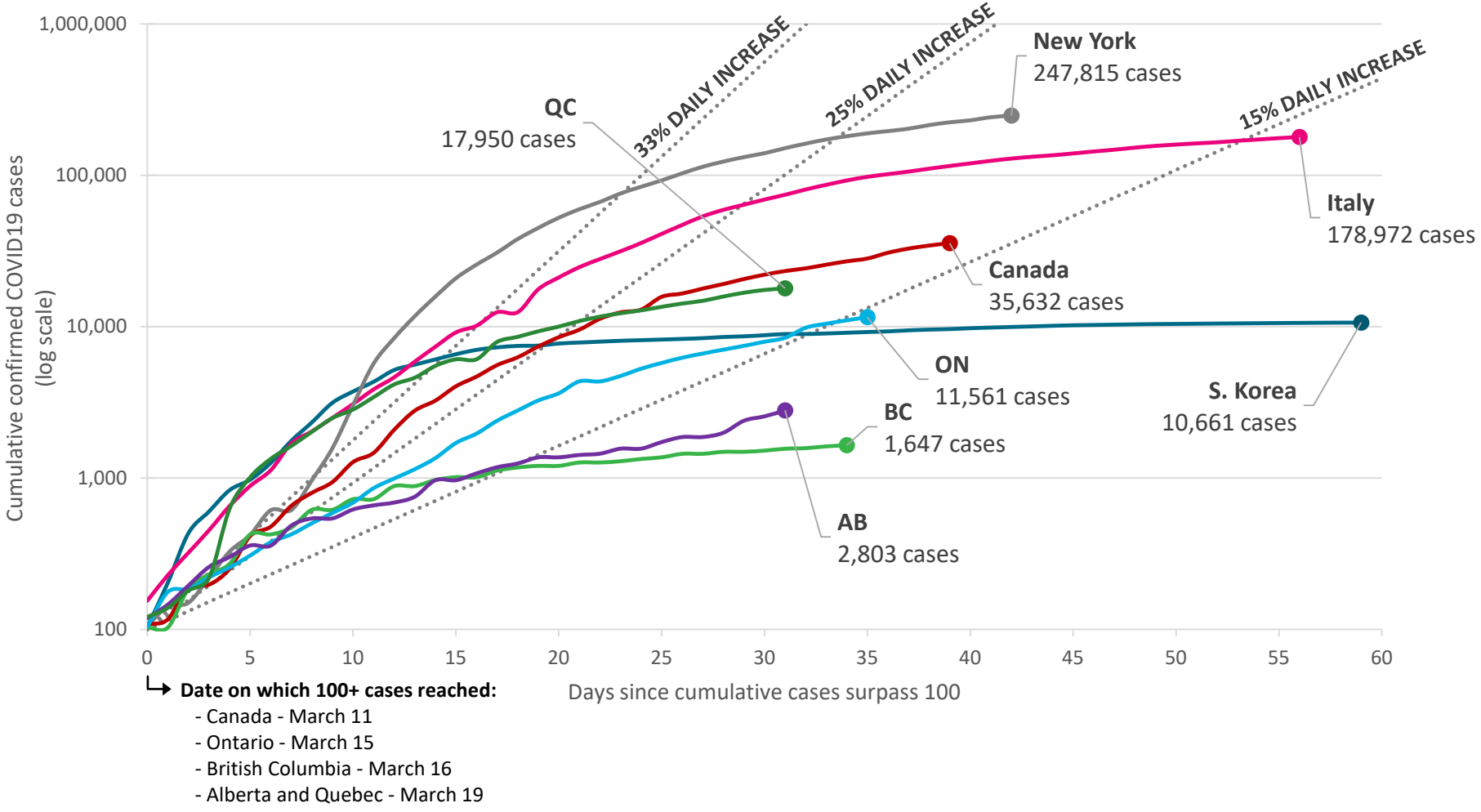
- While earlier models predicted a peak in cases in May, public health interventions, including widespread adherence to physical distancing, have accelerated the peak to now. The sacrifices people are making to stay home and wash their hands are making a difference.
    - Peak is important because epidemics follow what is called Farr's Law, where epidemics have a symmetrical shape.
    - Total cumulative cases for span of the outbreak now likely less than 20,000, substantially lower than worst case (300,000) or even expected case (80,000) projected by previous models.
    - Projections now show Ontario's COVID-19 outbreak behaving more like best case.

- However, data shows that province is facing two different disease processes.
    - Community spread of COVID-19 seems to have peaked and is coming under control.
    - Spread in long-term care and other congregate settings seems to be growing.

Ontario

Epidemic Curve: Cumulative confirmed COVID-19 cases, number of days since the 100th case

By country, including the Canadian provinces of Ontario, Alberta, British Columbia and Quebec



Date on which 100+ cases reached:

- Canada - March 11
- Ontario - March 15
- British Columbia - March 16
- Alberta and Quebec - March 19

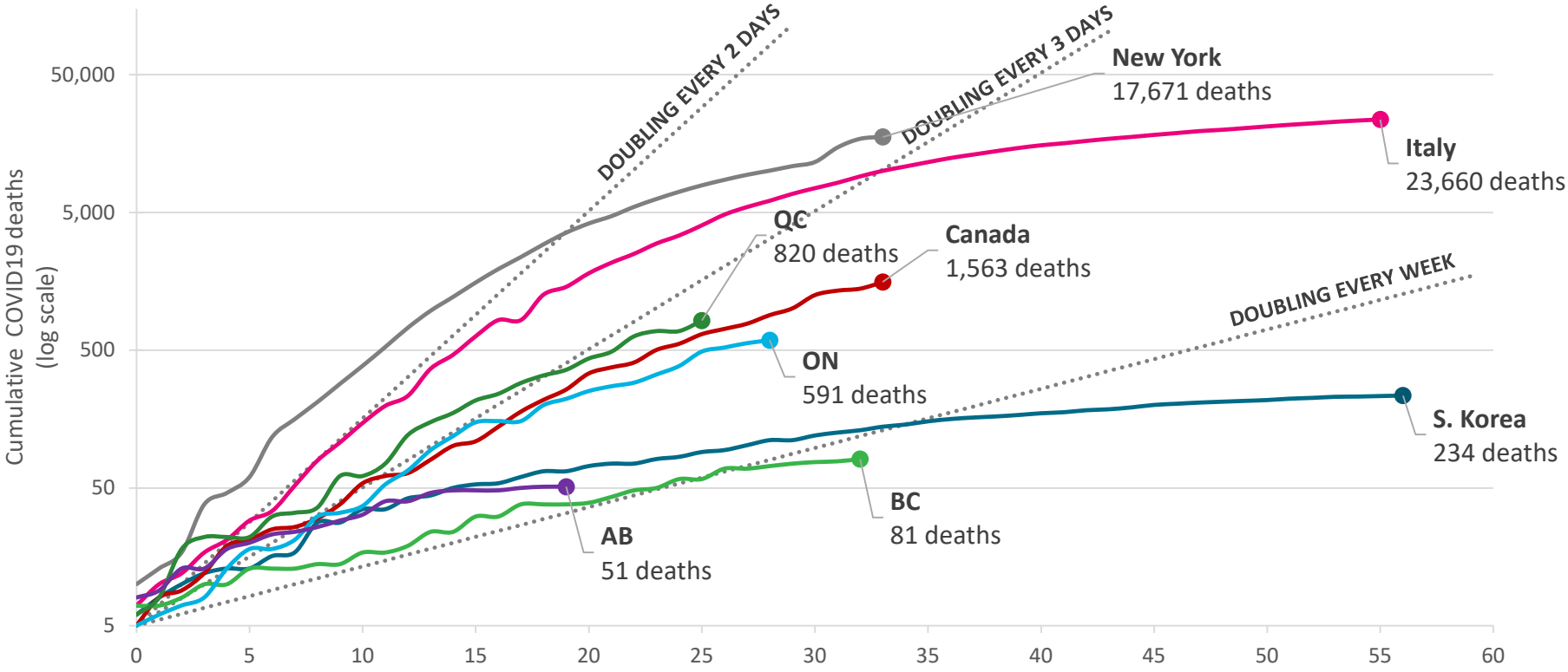
Data from: Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. *The Lancet Infectious Diseases*, as of **April 19, 2020**.

Data compiled by Johns Hopkins University from the following sources: WHO, CDC, ECDC, NHC, DXY, 1point3acres, Worldometers.info, BNO, state and national government health department, and local media reports.

Ontario

Epidemic Curve: Cumulative COVID-19 deaths, number of days since the 5th death

By country, including the Canadian provinces of Ontario, Alberta, British Columbia and Quebec



Date on which 5th death was reported:

- Canada - March 17
- Ontario - March 22
- British Columbia - March 18
- Quebec - March 25
- Alberta - March 31

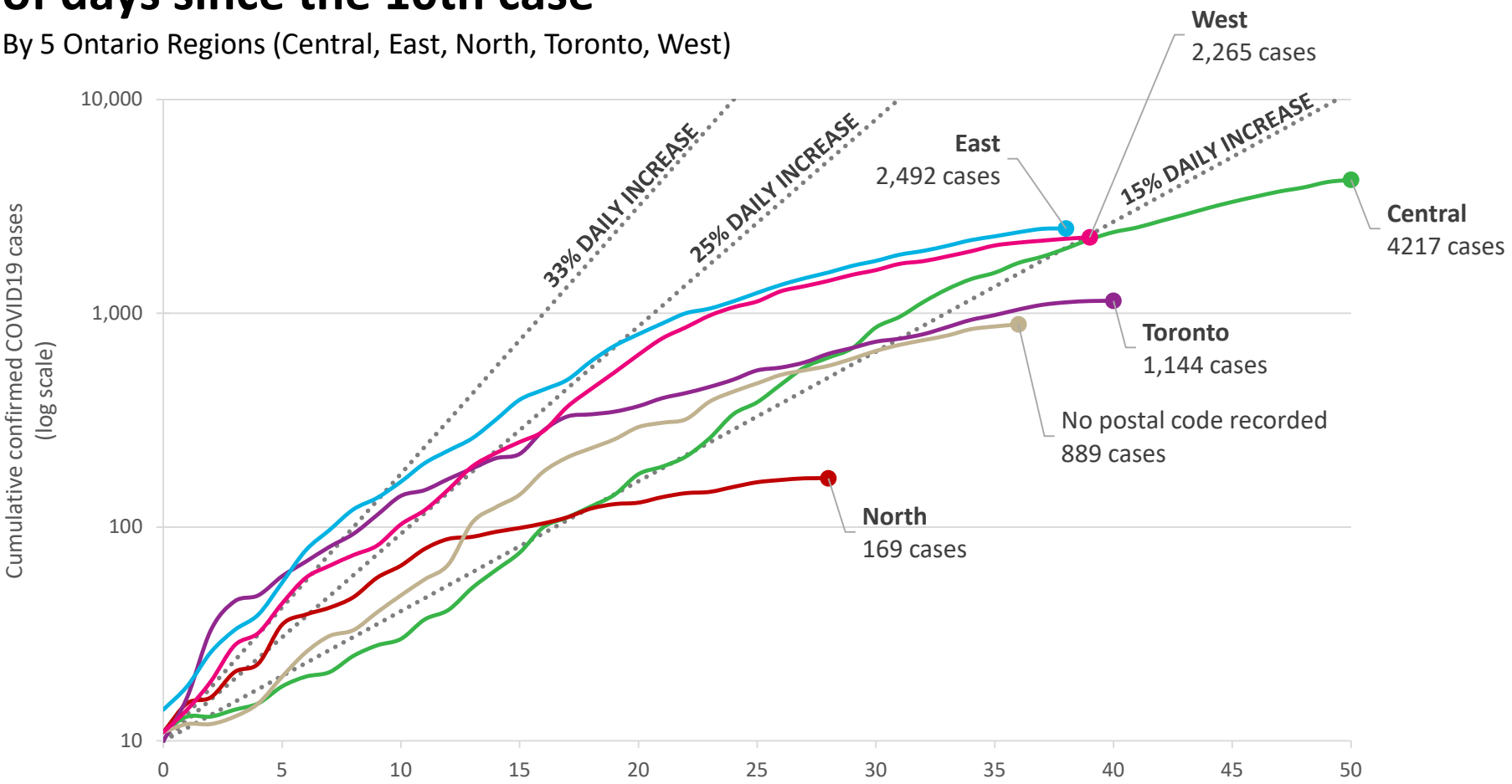
Data from: Dong, E., Du, H., & Gardner, L. (2020). An interactive web-based dashboard to track COVID-19 in real time. *The Lancet Infectious Diseases*, as of **April 19, 2020**.

Data compiled by Johns Hopkins University from the following sources: WHO, CDC, ECDC, NHC, DXY, 1point3acres, Worldometers.info, BNO, state and national government health department, and local media reports.

Ontario

Epidemic Curve: Cumulative confirmed cases, number of days since the 10th case

By 5 Ontario Regions (Central, East, North, Toronto, West)



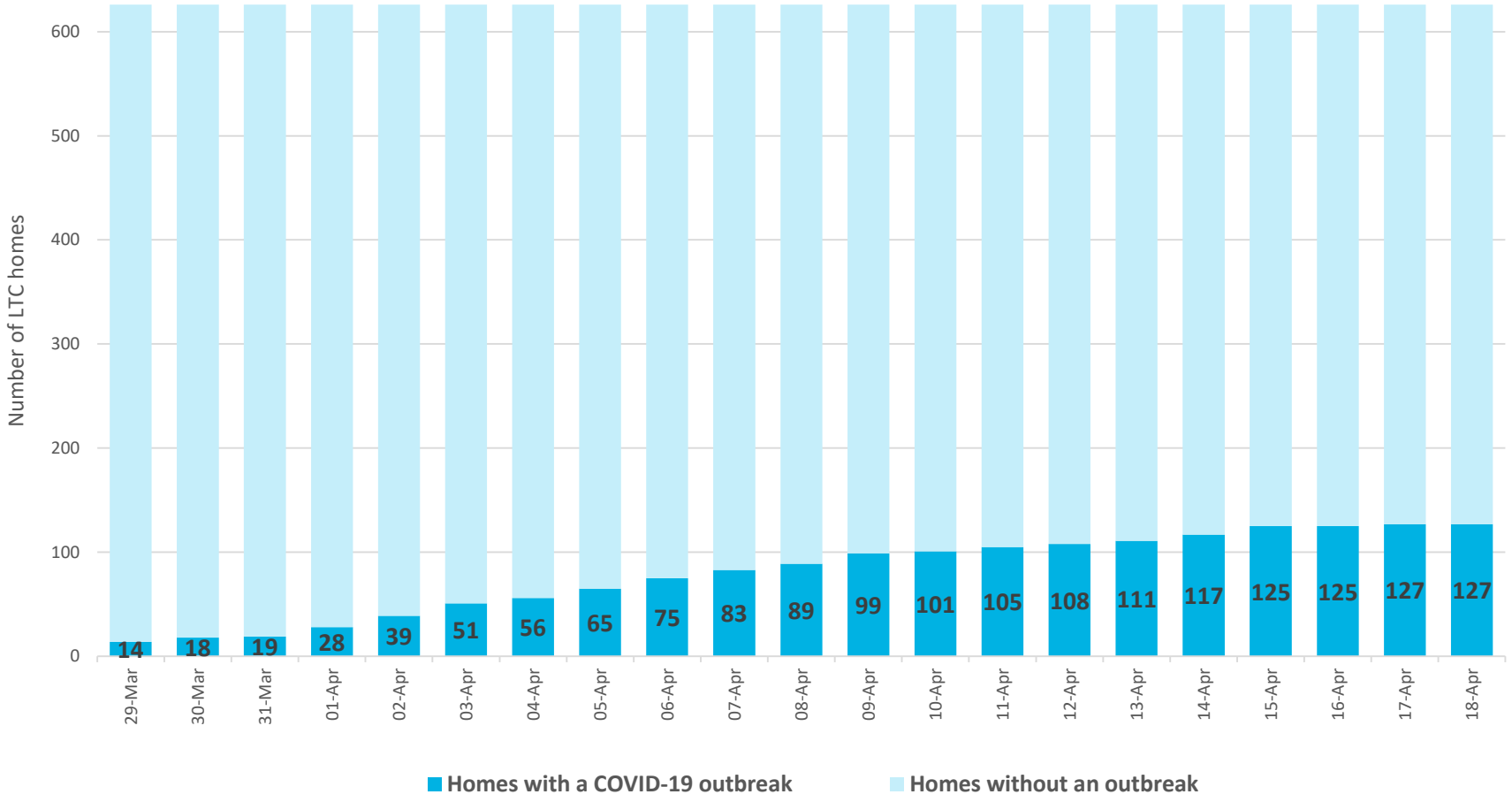
↳ **Date on which 10+ cases reached:**

- Central - February 29
- East - March 12
- North - March 23
- Toronto - March 11
- West - March 11
- Ontario - February 28

Data source: Integrated Public Health Information System, as of **April 19 (8pm)**

Ontario

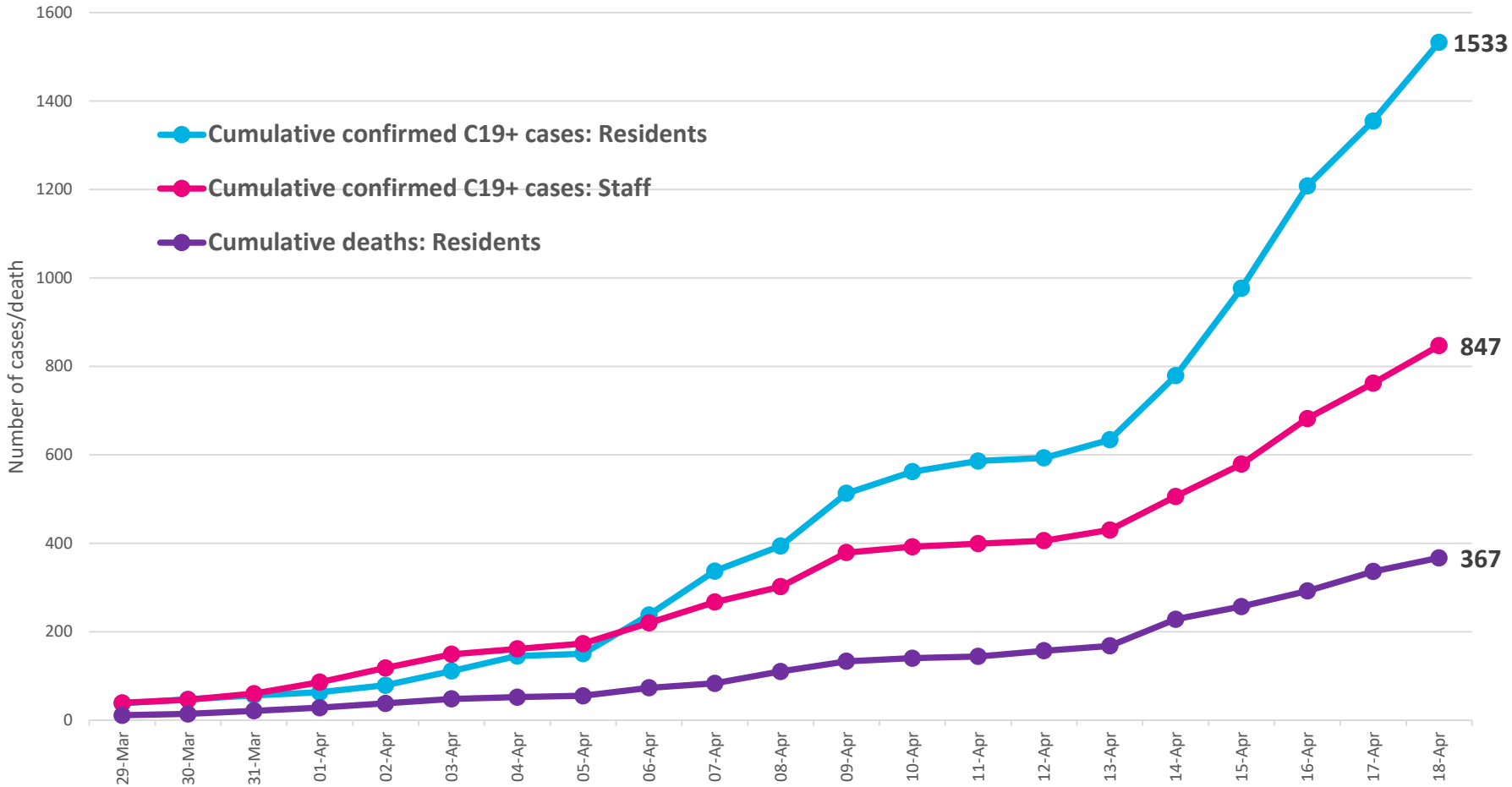
LTC Snapshot:
Cumulative long-term care homes with a COVID-19 outbreak



Data source: LTC COVID-19 daily report via COVID-19 dashboard. All data current as of April 19.

Ontario

LTC Snapshot:
Cumulative resident COVID-19 cases, staff COVID-19 cases and resident deaths



Data source: LTC COVID-19 daily report via COVID-19 dashboard. All data current as of April 19.

Ontario

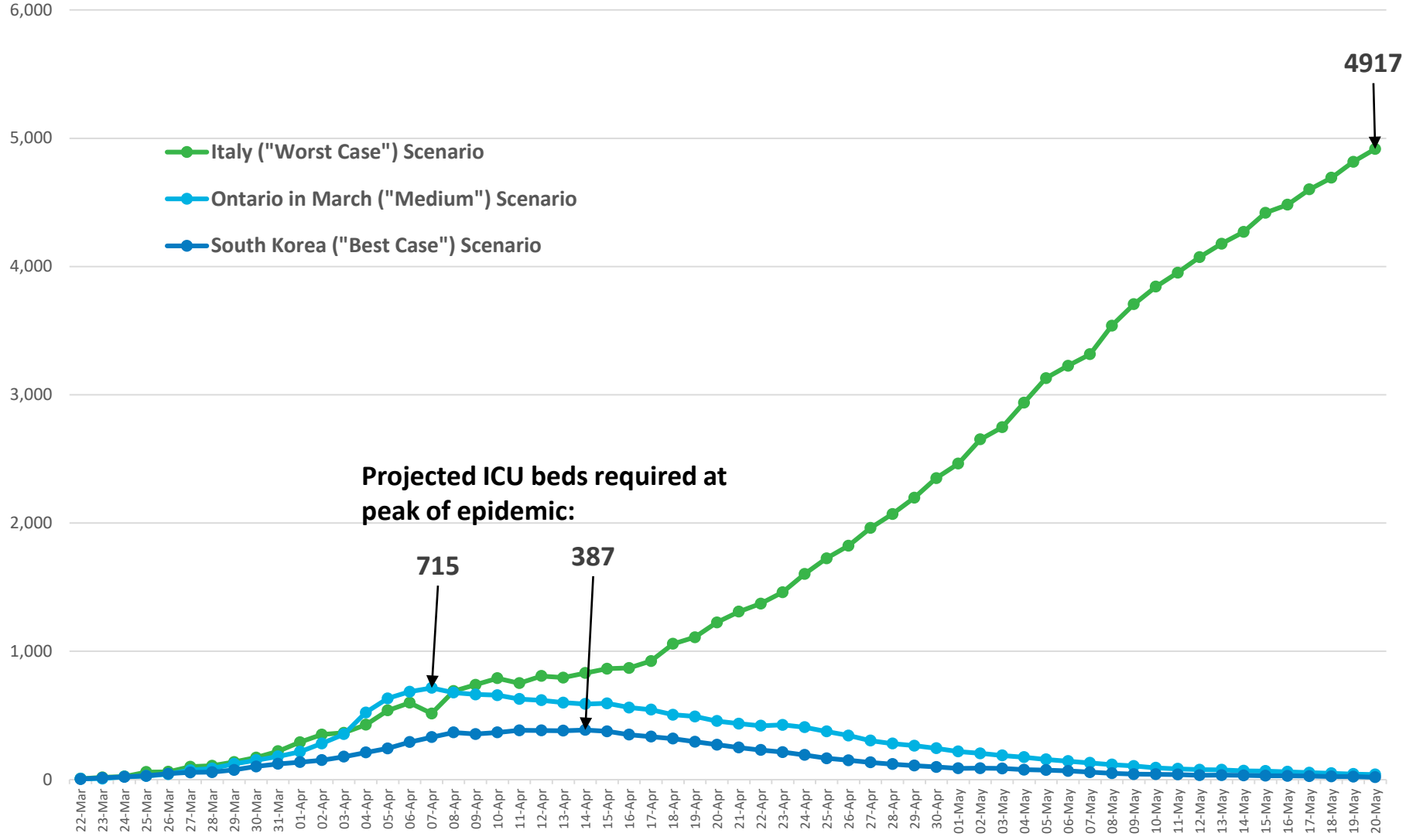
Modelling: Continuing to Inform Ontario's Planning

Hospital Demand Modeling Scenarios

- The projections presented here draw from COVID-19 health system impact models developed by a multidisciplinary collaborative of researchers and clinician scientists.
- Three scenarios were modeled:
    - **South Korea ("Best Case")**: Restrained growth in infected cases slowed early through impact of public health measures.
    - **Ontario in March ("Medium Case")**: Moderate growth in infected cases slowed later on through impact of public health measures.
    - **Italy ("Worst Case")**: Moderate then rapid growth in COVID-19 cases that continue to climb at an exponential rate without public health measures.
- Based on recent data, if current measures restricting spread of the disease remain in place, **Ontario appears to be tracking toward the South Korea ("best case") scenario**.
- The rate of growth in COVID-19 hospitalizations has slowed, while the number of COVID-19 patients in intensive care units has remained relatively constant over the past week.
- These models focus on predicting COVID-19 requirements for hospital intensive care unit and ward beds. They are not designed to predict impacts on community services such as long-term care and retirement homes.
- The recent experience in long-term care demonstrates that the disease multiplies rapidly in congregate settings, emphasizing the need for redoubled efforts to restrict spread of COVID-19.

Projecting COVID-19 Demand for Health Care Resources in Ontario: 510

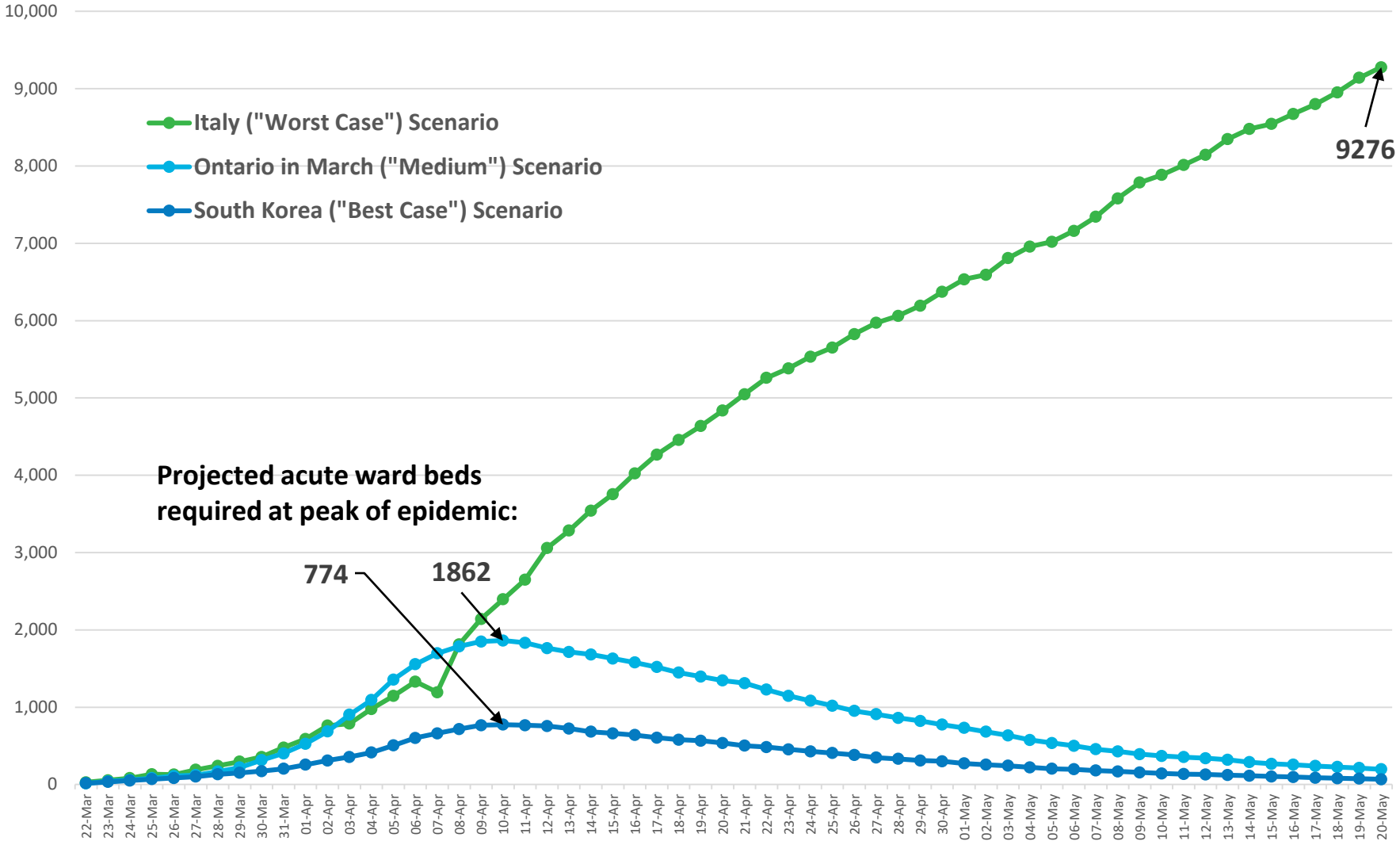
ICU Beds Required



Ontario

Projecting COVID-19 Demand for Health Care Resources in Ontario: [511]

Acute Ward Beds Required

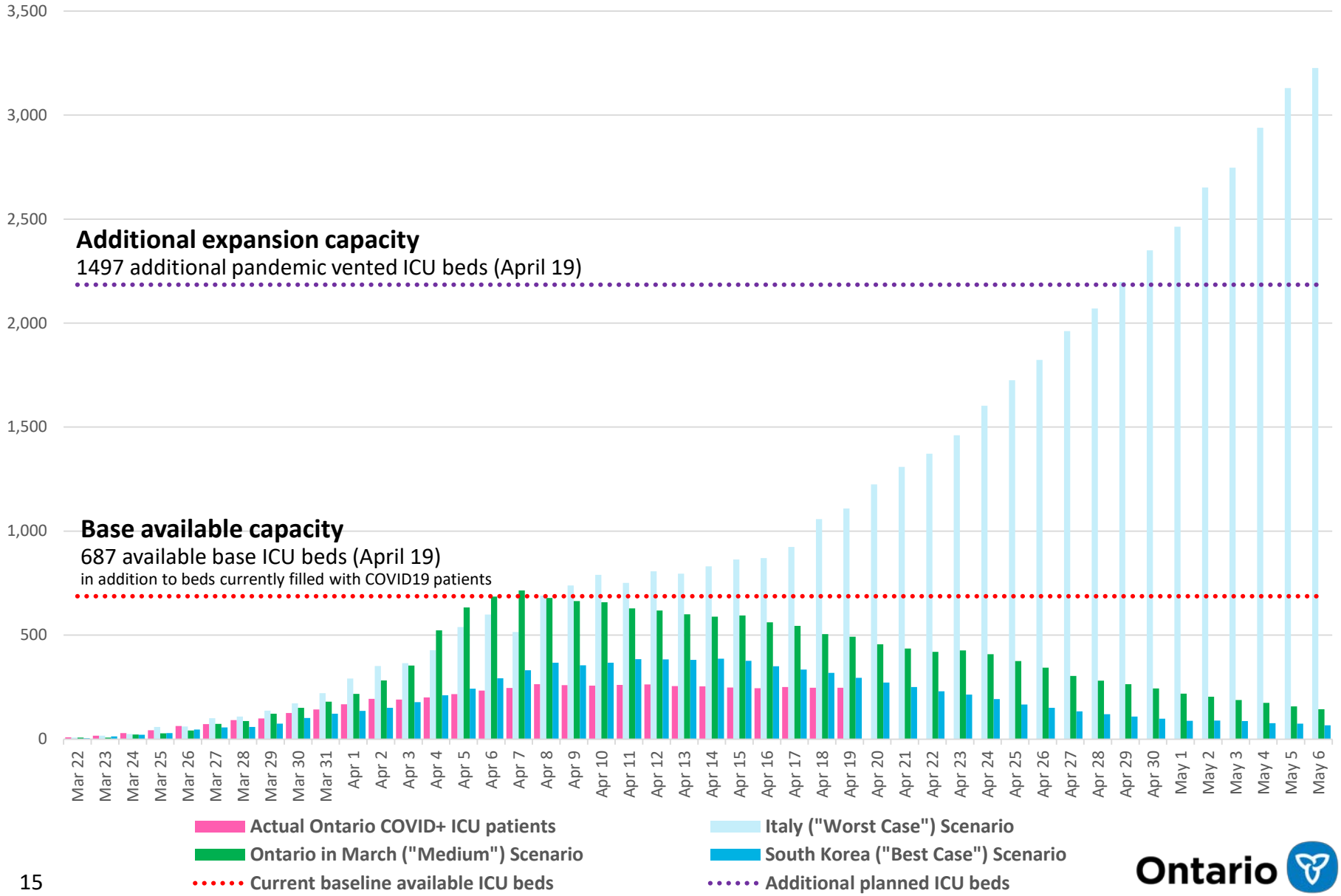


Ontario

How are we doing so far?

512

COVID-19 patients in Ontario ICU beds each day vs. predicted ICU bed demands in 3 model scenarios



Ontario

Looking Ahead

Prevention and Disease Management in Long-Term Care Homes

- Ontario is urgently implementing the COVID-19 Action Plan for Protecting Long-Term Care Homes:
  - **Aggressive Testing, Screening, and Surveillance:** Enhancing testing for symptomatic residents and staff and those who have been in contact with persons confirmed to have COVID-19; expanding screening to include more asymptomatic contacts of confirmed cases; and leveraging surveillance tools to enable care providers to move proactively against the disease.
  - **Managing Outbreaks and Spread of the Disease:** Supporting long-term care homes with public health and infection control expertise to contain and prevent outbreaks; providing additional training and support for current staff working in outbreak conditions.
  - **Growing our Heroic Long-Term Care Workforce:** Redeploying staff from hospitals and home and community care to support the long-term care home workforce and respond to outbreaks, alongside intensive on-going recruitment initiatives.

- Issued an emergency order directing long-term care employers to ensure their employees, including registered nurses, registered practical nurses, personal support workers, kitchen and cleaning staff only work in one long-term care home.

- Enhanced guidance on personal protective equipment requiring staff to always wear appropriate protection, supporting by priority distribution to homes.

Ontario

Continued Adherence to Public Health Measures

- Continued implementation of enhanced public health measures to stop the spread of COVID-19 and flatten the curve:
    - Extended the declaration of emergency to at least May 12 to support existing public health measures in place, including restricting social gatherings to five people and the closure of all non-essential workplaces, outdoor recreational amenities, public places and bars and restaurants, expect those that provide takeout and delivery.
    - Implementing the next phase of the testing strategy to expand testing to include several priority groups to identify and contain new cases, especially among vulnerable populations.
    - Extending actions taken in long-term care homes to retirement homes and other congregate settings, including group homes and homeless shelters, to further protect vulnerable populations.

- Public should continue to stay home and maintain physical distancing to ensure the province continues to stop the spread of COVID-19 and flatten the curve. These actions are making a difference and people need to stay the course and stay strong in order to save lives.

Ontario

THIS IS **EXHIBIT "D"** TO THE

AFFIDAVIT OF DR. AARON ORKIN

AFFIRMED BEFORE ME by videoconference

THIS 8th DAY OF JUNE , 2020.

A Commissioner for Taking Oaths

VANORA SIMPSON

Public Health Ontario | Santé publique Ontario

Epidemiologic Summary

COVID-19 in Ontario: January 15, 2020 to June 6, 2020

This report includes the most current information available from the integrated Public Health Information System (iPHIS) as of **4:30 p.m. June 6, 2020,** from the Toronto Public Health Coronavirus Rapid Entry System (CORES) and the Ottawa Public Health COVID-19 Ottawa Database (The COD), and Middlesex-London COVID-19 Case and Contact Management tool (CCMtool) as of **2 p.m. June 6, 2020.**

Please visit the interactive Ontario COVID-19 Data Tool to explore recent COVID-19 data by public health unit, age group, sex, and view trends over time.

Additionally, PHO produces Enhanced Epidemiologic Summaries on COVID-19, including: *COVID-19 in Ontario – A Focus on Diversity*, *Evolution of COVID-19 Case Growth in Ontario*, *COVID-19 Infection in Children and COVID-19* and *Severe Outcomes in Ontario.*

Purpose

- This daily report provides an epidemiologic summary of COVID-19 activity in Ontario to date.

Highlights

- There are 30,617 confirmed cases of COVID-19 in Ontario reported to date. This represents an increase of 415 confirmed cases from the previous report.
    - Of the 415 increase 223 cases were impacted by a laboratory-to-public health reporting delay.
    - 44.6% of cases are male, 54.5% are female.
    - 38.1% of cases are 60 years of age and older.
    - Greater Toronto Area public health units account for 67.2% of cases.
    - 12.1% of cases were hospitalized.
- 2,426 deaths have been reported (please note there may be a reporting delay for deaths). This is an increase of 19 deaths from the previous report.
- 311 outbreaks have been reported in long-term care homes. This is an increase of 0 outbreaks from the previous report.

Case Characteristics

Table 1. Summary of cases of COVID-19: Ontario, January 15, 2020 to June 6, 2020

	Number	Percentage
Number of cases[1]	30,617	N/A
Change from previous report	415	1.4% increase
Gender: Male	13,662	44.6
Gender: Female	16,700	54.5
Ages: 19 and under	1,226	4.0
Ages: 20-39	8,331	27.2
Ages: 40-59	9,398	30.7
Ages: 60-79	6,048	19.8
Ages: 80 and over	5,599	18.3
Number of cases in health care workers	5,065	16.5

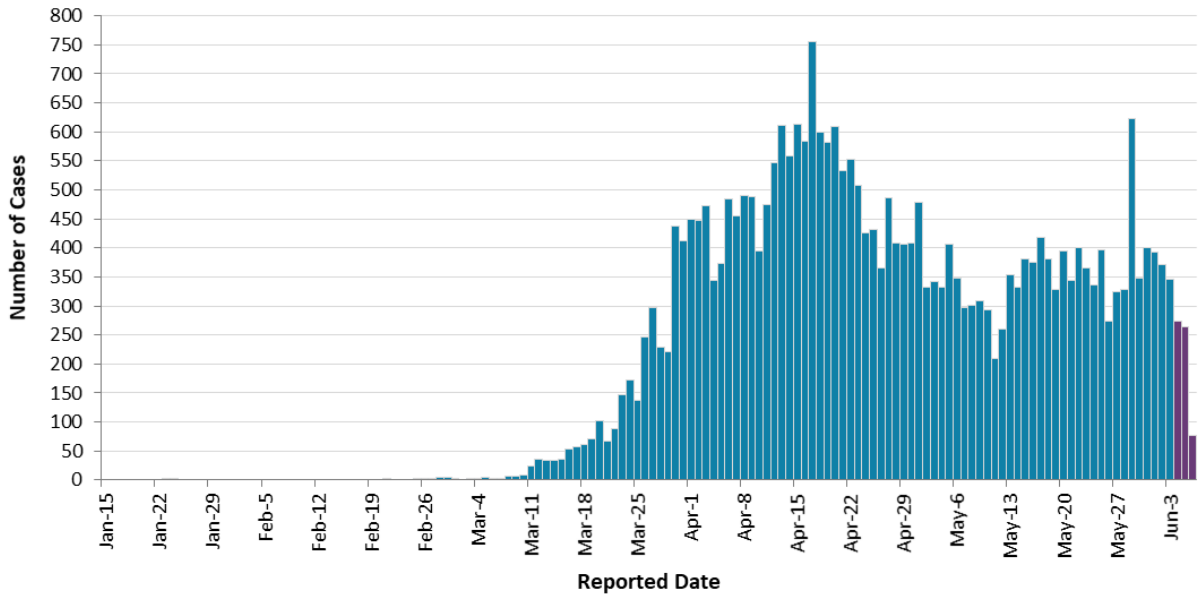
[1] Cases and rates by public health units are provided in Appendix A.

Note: 255 cases did not specify male or female. 15 cases had an unknown age.

Data Source: integrated Public Health Information System (iPHIS) database, Coronavirus Rapid Entry System (CORES) database, The COVID-19 Ottawa Database (The COD), COVID-19 Case and Contact Management tool (CCMtool).

Time

Figure 1. Confirmed cases (n=30,617) of COVID-19 by reported date: Ontario, January 15, 2020 to June 6, 2020[1]

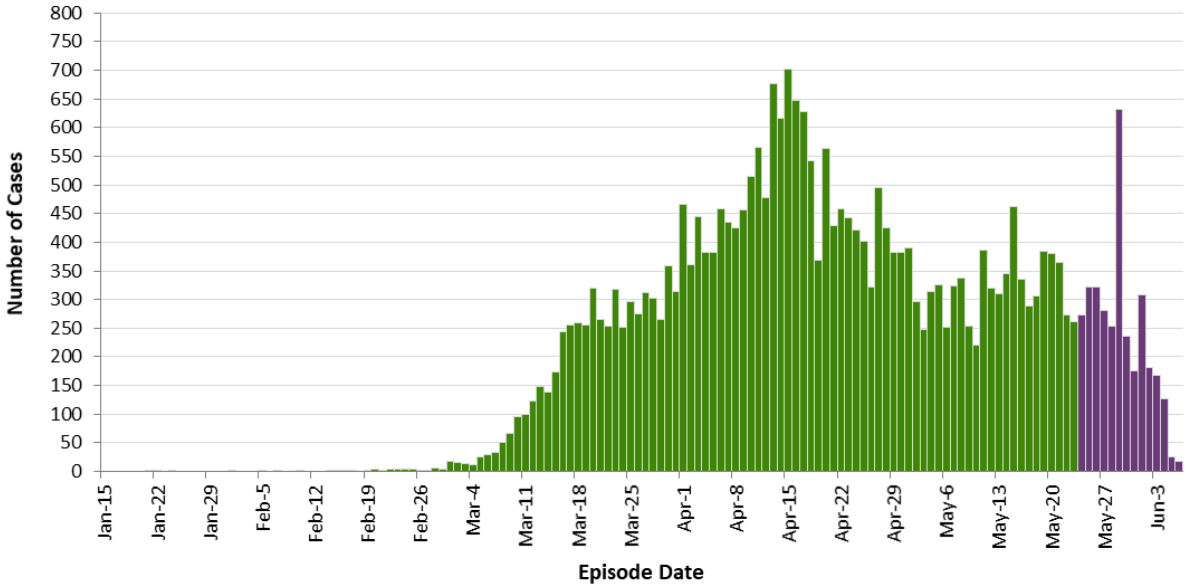


[1] Interpret case counts for the most recent days (approximately 3 days, as shown in purple) with caution due to reporting lags.

Interpretation note: Case counts from May 25 forward are most impacted by a laboratory-to-public health reporting delay that is being rectified during this period.

Data Source: integrated Public Health Information System (iPHIS) database, Coronavirus Rapid Entry System (CORES) database, The COVID-19 Ottawa Database (The COD), COVID-19 Case and Contact Management tool (CCMtool).

Figure 2. Confirmed cases (n=30,613[1]) of COVID-19 by an approximation of symptom onset date[2]: Ontario, January 15, 2020 to June 6, 2020[3]



[1] This count excludes 4 cases that did not have an episode date.

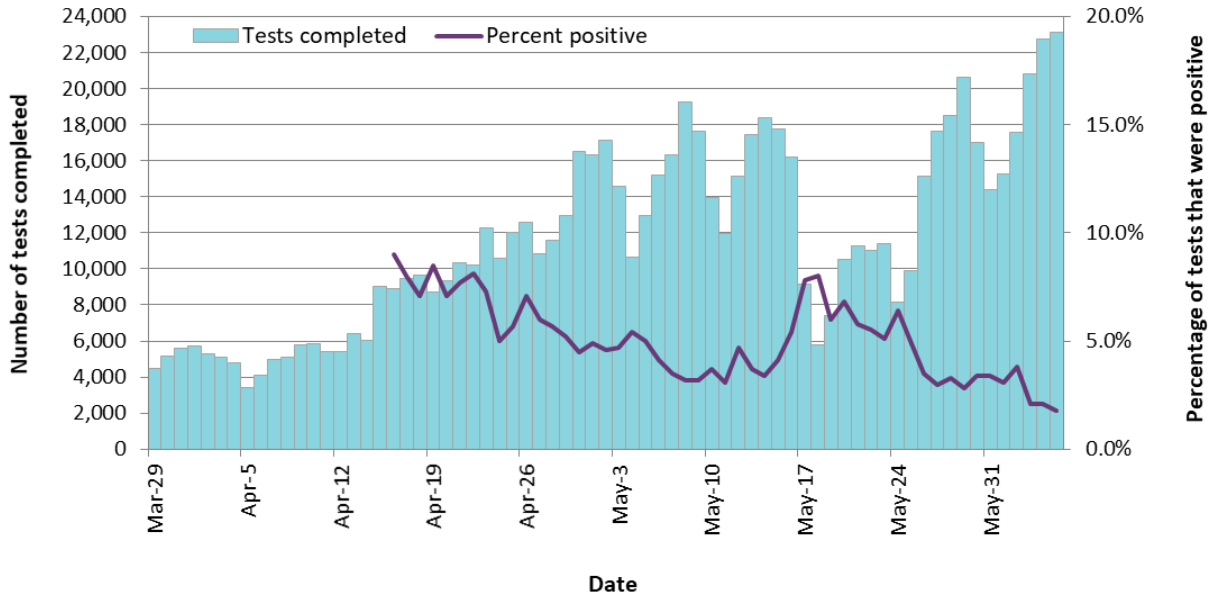
[2] This date, referred to as episode date, is intended to approximate symptom onset date. It is calculated based on either the date of symptom onset, specimen collection/test date, or the date reported to public health.

[3] Interpret case counts for the most recent days (approximately 14 days, as shown in purple) with caution due to reporting lags.

Interpretation note: Case counts from May 25 forward are most impacted by a laboratory-to-public health reporting delay that is being rectified during this period.

Data Source: integrated Public Health Information System (iPHIS) database, Coronavirus Rapid Entry System (CORES) database, The COVID-19 Ottawa Database (The COD), COVID-19 Case and Contact Management tool (CCMtool).

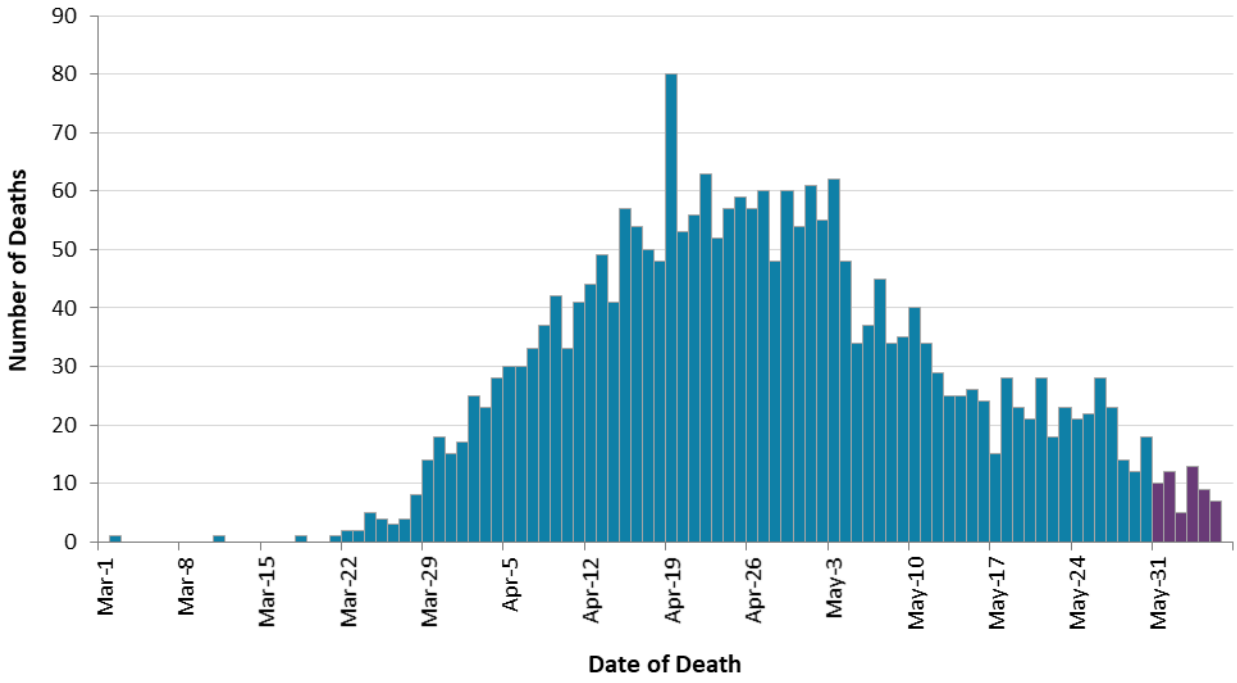
Figure 3. Number of COVID-19 tests completed[1] and percent positivity: Ontario, March 29, 2020 to June 5, 2020



[1] The number of tests performed does not reflect the number of specimens or persons tested. More than one test may be performed per specimen or per person. As such, the percentage of tests that were positive does not necessarily translate to the number of specimens or persons testing positive.

Data Source: The Provincial COVID-19 Diagnostics Network, data reported by member microbiology laboratories.

Figure 4. Confirmed deaths (n=2,424[1]) among COVID-19 cases by date of death: Ontario, March 1, 2020 to June 6, 2020[2]



[1] This count excludes 2 cases that did not have a date of death reported.

[2] Interpret case counts for the most recent days (approximately 7 days, as shown in purple) with caution due to reporting lags.

Interpretation note: Death counts will change as death information is reconciled with Coroner data

Data Source: integrated Public Health Information System (iPHIS) database, Coronavirus Rapid Entry System (CORES) database, The COVID-19 Ottawa Database (The COD), COVID-19 Case and Contact Management tool (CCMtool).

Exposure

Table 2. Confirmed cases (n=30,617) of COVID-19 by likely source of acquisition: Ontario, January 15, 2020 to June 6, 2020

	Number	Percentage
Travel[1]	1,575	5.1
Outbreak-associated[2] or close contact of a confirmed case	18,976	62.0
No known epidemiological link[3]	6,511	21.3
Information missing or unknown[4]	3,555	11.6

[1] Travel outside of Ontario during the incubation period, where close contact with a confirmed case or link to an outbreak was not reported.

[2] Includes cases indicating a link to a local outbreak.

[3] Includes cases that could not be classified as travel, outbreak-associated or close contact. Sporadic community transmission was re-labelled to no known epidemiological link on May 27. This name change does not represent a change in the way cases are categorized.

[4] Includes cases that only identified unknown exposure or risk factor data, as well as cases with no information.

Data Source: integrated Public Health Information System (iPHIS) database, Coronavirus Rapid Entry System (CORES) database, The COVID-19 Ottawa Database (The COD), COVID-19 Case and Contact Management tool (CCMtool).

Severity

Table 3. Confirmed cases (n=30,617) of COVID-19 by severity: Ontario, January 15, 2020 to June 6, 2020

	Number	Percentage
Cumulative deaths reported (please note there may be a reporting delay for deaths in iPHIS)	2,426	7.9
Change from previous report	19	0.8% increase
Deaths reported in ages: 19 and under	0	0
Deaths reported in ages: 20-39	10	0.1
Deaths reported in ages: 40-59	94	1.0
Deaths reported in ages: 60-79	634	10.5
Deaths reported in ages: 80 and over	1,688	30.1
Cumulative intensive care[1]	801	2.6
Cumulative hospitalized[1]	3,709	12.1
Number of resolved[2] cases	24,252	79.2

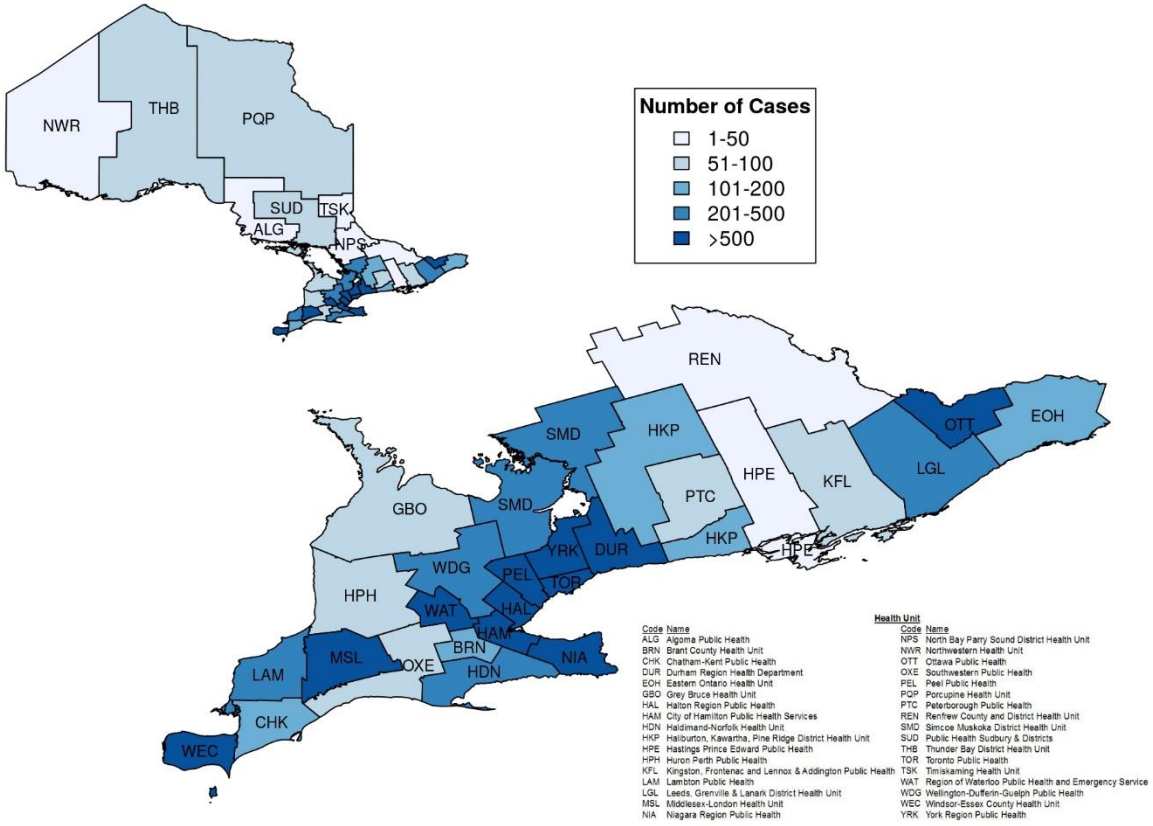
[1] These refer to all hospitalized or ICU admitted cases, not cases that are currently hospitalized or in ICU.

[2] Cases that are 14 days past symptom onset (if available) or 14 days past the episode date are classified as resolved for non-fatal cases that are not currently listed as hospitalized. Cases are also classified as resolved if the case is reported as “recovered” in iPHIS.

Data Source: integrated Public Health Information System (iPHIS) database, Coronavirus Rapid Entry System (CORES) database, The COVID-19 Ottawa Database (The COD), COVID-19 Case and Contact Management tool (CCMtool).

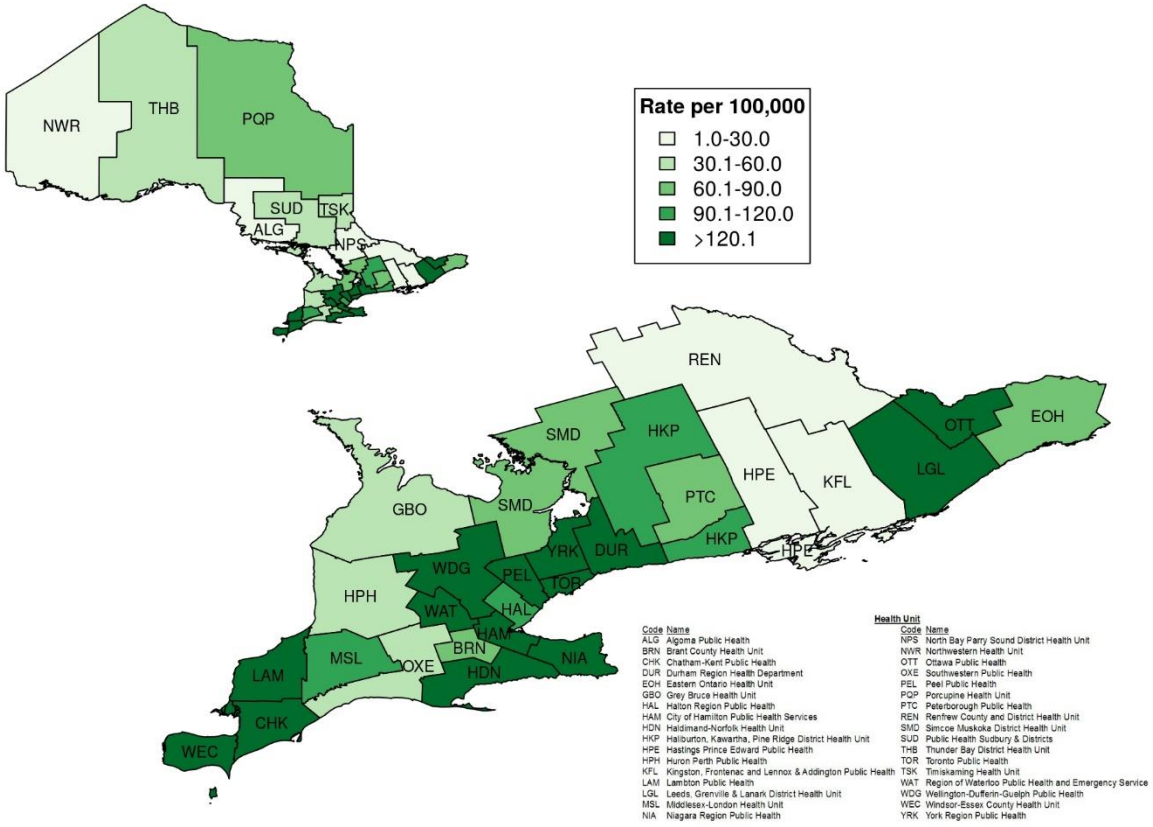
Geography

Figure 5. Confirmed cases (n=30,617) of COVID-19 by public health unit: Ontario, January 15, 2020 to June 6, 2020



Data Source: integrated Public Health Information System (iPHIS) database, Coronavirus Rapid Entry System (CORES) database, The COVID-19 Ottawa Database (The COD), COVID-19 Case and Contact Management tool (CCMtool).

Figure 6. Rate of confirmed cases of COVID-19 by public health unit: Ontario, January 15, 2020 to June 6, 2020



Data Source: integrated Public Health Information System (iPHIS) database, Coronavirus Rapid Entry System (CORES) database, The COVID-19 Ottawa Database (The COD), COVID-19 Case and Contact Management tool (CCMtool).

Outbreaks in Institutions and Public Hospitals

Table 4a. Confirmed COVID-19 outbreaks reported in long-term care homes, retirement homes and hospitals by status: Ontario, January 15, 2020 to June 6, 2020

Institution type	Number of ongoing outbreaks[1]	Cumulative number of outbreaks reported
Long-term care homes	85	311
Retirement homes	37	149
Hospitals	8	86

[1] Includes all outbreaks that are 'Open' in iPHIS without a 'Declared Over Date' recorded.

Data Source: integrated Public Health Information System (iPHIS) database.

Table 4b. Confirmed cases of COVID-19 in long-term care homes[6]: Ontario, January 15, 2020 to June 6, 2020

Indicator	Number	Percentage
Cases among long-term care home residents[1,2,3]	5,254	17.2% of all cases
Cases among health care workers[2,3,4,] associated with long-term care outbreaks	1,921	6.3% of all cases
Deaths[5] reported for residents in long-term care homes[1,2,3]	1,557	64.2% of all deaths
Deaths[5] reported for health care workers[2,3,4,] in long-term care homes	5	0.2% of all deaths

[1] Includes cases that reported 'Yes' to the risk factor 'Resident of nursing home or other chronic care facility' and reported to be part of an outbreak assigned as a long-term care home (via the Outbreak number or case comments field); or were reported to be part of an outbreak assigned as a long-term care home (via the outbreak number or case comments field) with an age over 70 years and did not report 'No' to the risk factor 'Resident of nursing home or other chronic care facility'.

[2] Excludes cases that reported 'Yes' to the risk factor 'Resident of nursing home or other chronic care facility' and the 'health care workers' variable.

[3] There is a lag between when cases are reported and when risk factors are updated.

[4] 'Health care workers' includes cases that reported 'Yes' to any of the occupations health care worker, doctor, nurse, dentist, dental hygienist, midwife, other medical technicians, personal support worker, respiratory therapist, first responder; and reported to be part of an outbreak assigned as a long-term care home (via the outbreak number or case comments field).

[5]Deaths are determined by using the outcome field. Any case marked 'Fatal' is included in the deaths data. Deaths are included whether or not COVID-19 was determined to be a contributing or underlying cause of death as indicated in iPHIS or local case management systems.

[6] Counts of cases and deaths for long term care home residents and staff are now being calculated using individual level data as opposed to aggregate data. As a result, they are being reported separately from the aggregate counts in table 4c.

Data Source: integrated Public Health Information System (iPHIS) database, Coronavirus Rapid Entry System (CORES) database, The COVID-19 Ottawa Database (The COD), COVID-19 Case Contact Management tool (CCMtool).

Table 4c. Aggregate case counts (confirmed and epidemiologically linked) reported for COVID-19 outbreaks in retirement homes and hospitals:[1] Ontario, January 15, 2020 to June 6, 2020

Indicator	Retirement Homes	Hospitals
Total number of cases[2,3,4] reported as part of the confirmed COVID-19 outbreaks	1,242	820
Cases reported among residents/patients	819	395
Cases reported among staff	423	413
Total number of deaths[2,3,4] reported as part of the confirmed COVID-19 outbreaks	170	80
Deaths reported among residents/patients	170	80
Deaths reported among staff	0	0

[1] Counts of cases and deaths for long term care home residents and staff are now being calculated using individual level data as opposed to aggregate data. These are available in table 4b.

[2] Includes all outbreak-related cases and deaths reported in aggregate outbreak summary counts, regardless of whether the case was laboratory confirmed (deaths among non-laboratory confirmed cases reported here are not included in Table 3).

[3] May include cases and deaths other than residents/patients or staff, such as volunteers. As a result, the total number of cases and deaths may be greater than the number of cases and deaths reported in residents or staff.

[4] Counts may fluctuate from previous reports due to updates made by health units as additional information about the outbreak is reported.

Data Source: integrated Public Health Information System (iPHIS) database.

Technical Notes

Data Sources

- The data for this report were based on:
    - Information extracted from the Ontario Ministry of Health (MOH) integrated Public Health Information System (iPHIS) database, as of **June 6, 2020 at 4:30 p.m.**
    - Information successfully uploaded to the Ministry from Local Systems: Toronto Public Health (Coronavirus Rapid Entry System) CORES, The Ottawa Public Health COVID-19 Ottawa Database (The COD) and Middlesex-London COVID-19 Case and Contact Management Tool (CCMtool) as of **June 6, 2020 at 2 p.m.**
- iPHIS, CORES, The COD and COVID-19 CCMtool are dynamic disease reporting systems, which allows ongoing updates to data previously entered. As a result, data extracted from iPHIS and the Local Systems represent a snapshot at the time of extraction and may differ from previous or subsequent reports.
- Ontario population projection data for 2020 were sourced from Ontario Ministry of Health, IntelliHEALTH Ontario. Data were extracted on November 26, 2019.
- COVID-19 test data were based on information from The Provincial COVID-19 Diagnostics Network, reported by member microbiology laboratories.

Data Caveats:

- The data only represent cases reported to public health and recorded in iPHIS and the Local Systems (e.g., CORES, The COD, COVID-19 CCMtool). As a result, all counts will be subject to varying degrees of underreporting due to a variety of factors, such as disease awareness and medical care seeking behaviours, which may depend on severity of illness, clinical practice, changes in laboratory testing, and reporting behaviours.
- Lags in iPHIS and Local Systems data entry due to reduced holiday and weekend staffing may result in lower case counts than would otherwise be recorded.
- Only cases meeting the confirmed case classification as listed in the MOH COVID-19 case definition are included in the report counts from iPHIS the Local Systems.
- Case episode date is based on an estimate of the best date of disease onset. This date is calculated based on either the date of symptom onset, specimen collection/test date, or the date reported to public health.
- Orientation of case counts by geography is based on the diagnosing health unit (DHU). DHU refers to the case's public health unit of residence at the time of illness onset and not necessarily the location of exposure. Cases for which the DHU was reported as MOH (to signify a case that is not a resident of Ontario) have been excluded from the analyses.
    - GTA health units include: Durham Region Health Department, Peel Public Health, Toronto Public Health and York Region Public Health

- Likely source of acquisition is determined by examining the exposure and risk factor fields from iPHIS and local systems to determine whether a case travelled, was associated with an outbreak, was a contact of a case, had no known epidemiological link (sporadic community transmission) or was reported to have an unknown source/no information was reported. Cases with multiple exposures or risk factors were assigned to a single likely acquisition source group which was determined hierarchically in the following order:
    - For cases with an episode date *on or after* April 1, 2020: Outbreak-associated > close contact of a confirmed case > travel > sporadic community transmission > information missing or unknown
    - For cases with an episode date *before* April 1, 2020: Travel > outbreak-associated > close contact of a confirmed case > sporadic community transmission > information missing or unknown
- Deaths are determined by using the outcome field in iPHIS or Local Systems. Any case marked 'Fatal' is included in the deaths data. Deaths are included whether or not COVID-19 was determined to be a contributing or underlying cause of death as indicated in the iPHIS field Type of Death.
    - The date of death is determined using the outcome date field for cases marked as 'Fatal' in the outcome field.
- iPHIS cases for which the Disposition Status was reported as ENTERED IN ERROR, DOES NOT MEET DEFINITION, DUPLICATE-DO NOT USE, or any variation on these values have been excluded.
- To provide a measure of the impact of COVID-19 on long-term care homes and hospitals, the number of outbreaks and the associated cases are reported. To obtain the case and deaths data for these outbreaks, the aggregate counts recorded by public health units in the outbreak's summary counts section of iPHIS is used. This information is presented in Table 4.
    - Previously only a select number of persons in institutional outbreaks would be tested for COVID-19, and there could still be circumstances where not all individuals end up being tested (e.g., the person dies before they can be tested).
    - These counts may not be updated as frequently as the information for laboratory-confirmed cases.
    - The information in the aggregate counts can not necessarily be reconciled with the laboratory-confirmed case data.

Appendix A

Table 1. Confirmed cases (n=30,617) of COVID-19 by public health unit: Ontario, January 15, 2020 to June 6, 2020

Public Health Unit Name	Cases	Rate per 100,000 population
Northwestern Health Unit	23	26.2
Thunder Bay District Health Unit	83	55.3
TOTAL NORTH WEST	106	44.6
Algoma Public Health	21	18.4
North Bay Parry Sound District Health Unit	27	20.8
Porcupine Health Unit	65	77.9
Public Health Sudbury & Districts	64	32.2
Timiskaming Health Unit	18	55.1
TOTAL NORTH EAST	195	34.9
Ottawa Public Health	1,999	189.5
Eastern Ontario Health Unit	151	72.3
Hastings Prince Edward Public Health	44	26.1
Kingston, Frontenac and Lennox & Addington Public Health	62	29.1
Leeds, Grenville & Lanark District Health Unit	351	202.7
Renfrew County and District Health Unit	28	25.8
TOTAL EASTERN	2,635	136.8
Durham Region Health Department	1,567	220.0
Haliburton, Kawartha, Pine Ridge District Health Unit	182	96.3
Peel Public Health	4,964	309.1

Public Health Unit Name	Cases	Rate per 100,000 population
Peterborough Public Health	90	60.8
Simcoe Muskoka District Health Unit	490	81.7
York Region Public Health	2,607	212.7
TOTAL CENTRAL EAST	9,900	220.9
Toronto Public Health	11,431	366.3
TOTAL TORONTO	11,431	366.3
Chatham-Kent Public Health	148	139.2
Grey Bruce Health Unit	93	54.7
Huron Perth Public Health	55	39.4
Lambton Public Health	268	204.6
Middlesex-London Health Unit	555	109.4
Southwestern Public Health	74	35.0
Windsor-Essex County Health Unit	1,004	236.3
TOTAL SOUTH WEST	2,197	129.9
Brant County Health Unit	120	77.3
City of Hamilton Public Health Services	726	122.6
Haldimand-Norfolk Health Unit	380	333.1
Halton Region Public Health	670	108.2
Niagara Region Public Health	713	150.9
Region of Waterloo Public Health and Emergency Services	1,146	196.1
Wellington-Dufferin-Guelph Public Health	398	127.6
TOTAL CENTRAL WEST	4,153	145.8
TOTAL ONTARIO	**30,617**	**206.0**

Disclaimer

This document was developed by Public Health Ontario (PHO). PHO provides scientific and technical advice to Ontario's government, public health organizations and health care providers. PHO's work is guided by the current best available evidence at the time of publication.

The application and use of this document is the responsibility of the user. PHO assumes no liability resulting from any such application or use.

Citation

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Epidemiologic summary: COVID-19 in Ontario – January 15, 2020 to June 6, 2020. Toronto, ON: Queen's Printer for Ontario; 2020.

For Further Information

For more information, email cd@oahpp.ca.

Public Health Ontario

Public Health Ontario is an agency of the Government of Ontario dedicated to protecting and promoting the health of all Ontarians and reducing inequities in health. Public Health Ontario links public health practitioners, front-line health workers and researchers to the best scientific intelligence and knowledge from around the world.

For more information about PHO, visit publichealthontario.ca.

Ontario

Court File No. T-539-20

FEDERAL COURT

BETWEEN:

**CANADIAN CIVIL LIBERTIES ASSOCIATION,
CANADIAN PRISON LAW ASSOCIATION
HIV & AIDS LEGAL CLINIC ONTARIO,
HIV LEGAL NETWORK,
& SEAN JOHNSTON**

Applicants

– and –

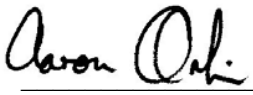
THE ATTORNEY GENERAL OF CANADA

Respondent

CERTIFICATE CONCERNING CODE OF CONDUCT FOR EXPERT WITNESSES

I, **Aaron Orkin**, having been named as an expert witness by the Applicants, certify that I have read the Code of Conduct for Expert Witnesses set out in the schedule to the *Federal Courts Rules* and agree to be bound by it.

July 13, 2020



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Court File No. T-539-20

FEDERAL COURT

BETWEEN:

**CANADIAN CIVIL LIBERTIES ASSOCIATION,
CANADIAN PRISON LAW ASSOCIATION
HIV & AIDS LEGAL CLINIC ONTARIO,
HIV LEGAL NETWORK,
& SEAN JOHNSTON**

Applicants

– and –

THE ATTORNEY GENERAL OF CANADA

Respondent

AFFIDAVIT OF DAVID FISMAN

I, DAVID FISMAN, of the City of Toronto, in the Province of Ontario, AFFIRM as follows:

1. I have been asked to provide an affidavit on the following issues:

    - The current state of the severe acute respiratory syndrome coronavirus 2 ("SARS-CoV-2" or "novel coronavirus") pandemic in Canada;
    - Anticipated outlook for the pandemic in fall 2020;
    - Mortality rates associated with COVID-19, the disease caused by the novel coronavirus.

My Qualifications

2. I am an infectious disease physician and a Professor of Epidemiology, and former Chair of the Epidemiology Division, at the Dalla Lana School of Public Health, University of Toronto.

My research focuses on emerging infectious disease and disease dynamics, including predictive modelling. A copy of my *curriculum vitae* is attached as **Exhibit "A"** to my affidavit.

3. One of my particular and long-standing research interests is the seasonality of infectious disease. I have spent approximately 20 years studying seasonal and climatic effects on the reproduction rates of infections disease. My publications in this area include:

- **Fisman, David N.**, et al. (2005) It's Not the Heat, It's the Humidity: Wet Weather Increases Legionellosis Risk in the Greater Philadelphia Metropolitan Area. *The Journal of Infectious Diseases*, 192(12), 2066-2073.
- **Fisman, David N**. (2007) Seasonality of Infectious Disease. *Annual Review of Public Health* 28, 127-143.
- Greer, A., Ng, V., & **Fisman, D.** (2008). Climate change and infectious diseases in North America: the road ahead. *Canadian Medical Association Journal*, 178(6), 715-722.
- Soverow, J. E., Wellenius, G. A., **Fisman, D. N.**, & Mittleman, M. A. (2009). Infectious disease in a warming world: how weather influenced West Nile virus in the United States (2001-2005). Environmental health perspectives, 117(7), 1049–1052,
- Free, Amy L., Drews, Steven J., and **Fisman, David N.** (2009) Why "Winter" Vomiting Disease? Seasonality, Hydrology, and Norovirus Epidemiology in Toronto, Canada. *Ecohealth* 6(2), 192-199.
- White, Alexander N.J., Ng, Victoria, Spain, C. Victor, Johnson, Caroline C., Kinlin, Laura M. & **Fisman, David N.** (2009) Let the sun shine in: effects of ultraviolet radiation on invasive pneumococcal disease risk in Philadelphia, Pennsylvania. *BMC Infectious Diseases* vol 9.
- Kuster, S. P., Tuite, A. R., Kwong, J. C., McGeer, A., & **Fisman, D. N.** (2011). Evaluation of coseasonality of influenza and invasive pneumococcal disease: results from prospective surveillance. PLoS Medicine, 8(6), 1+.
- Tien, J. H., Poinar, H. N., **Fisman, D. N.**, & Earn, D. J. (2011). Herald waves of cholera in nineteenth century London. Journal of the Royal Society, Interface, 8(58), 756–760.
- Eisenberg, Marisa C., Kujibida, Gregory, Tuite, Ashleigh R., **Fisman, David N.** & Tien, Joseph H. (2013) Examining rainfall and cholera dynamics in Haiti using statistical and dynamic modelling approaches. *Epidemics* 5(4), 197-207.
- Brown, Kevin A., Daneman, Nick, Arora, Paul, Moineddin, Rahim, & **Fisman, David N.** (2013) The Co-Seasonality of Pneumonia and Influenza With Clostridium difficile Infection in the United States, 1993-2008. *American Journal of Epidemiology* 178(1), 118-125.

- **Fisman, D. N.**, Tuite, A. R., & Brown, K. A. (2016). Impact of El Niño Southern Oscillation on infectious disease hospitalization risk in the United States. *Proceedings of the National Academy of Sciences of the United States of America*, 113(51), 14589–14594.
- Brunn, A., **Fisman, D.N**., Sargeant, J.M. et al. (2019) The Influence of Climate and Livestock Reservoirs on Human Cases of Giardiasis. *EcoHealth* 16, 116–127 (2019).

4. Over the past number of months, I have been actively involved in treating Canadians diagnosed with COVID-19, the disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), more commonly known as the "novel coronavirus". I have also been actively involved in research and modelling regarding the risks associated with the novel coronavirus / COVID-19, as well as strategies to mitigate those risks.

5. I am one of ten members of the Government of Canada's Expert Group on Modelling Approaches, which is co-chaired by Chief Science Advisor of Canada, Mona Nemer, and the Deputy Minister of Health Canada, Stephen Lucas. The Expert Group reviews modelling approaches to predict and manage disease spread, identify hot spots and recovery strategies, and identify hot spots in provinces and territories as well as recovery strategies, data accessibility and data gaps. I also provide daily reports to senior public health officials and political leaders in Canada on the current status of COVID-19 each morning.

6. On May 20, 2020, I gave evidence to the House of Commons Standing Committee on Health concerning the government's response to the COVID-19 pandemic. A copy of my remarks is attached hereto as **Exhibit "B"**.

7. I am also a member of the provincial modelling table for Ontario, which uses primary data from the province to predict virus transmission under different scenarios as well as mortality rates among various groups.

8. I have co-authored a number of articles on modelling of transmission rates and mortality risk associated with COVID-19, including:

- Tuite, A.R. & **Fisman, D.N.** (2020). Reporting, Epidemic Growth, and Reproduction Numbers for the 2019 Novel Coronavirus (2019-nCoV) Epidemic. *Annals of Internal Medicine* 172(8):567-568. (A copy is attached hereto as **Exhibit "C"**.)

- Berry I, Soucy JR, Tuite A, **Fisman D**; COVID-19 Canada Open Data Working Group. (2020). Open access epidemiological data and an interactive dashboard to monitor the COVID-19 outbreak in Canada. *Canadian Medical Association Journal* 192(15): E420. (A copy is attached hereto as **Exhibit "D"**.)
- Jüni P, Rothenbühler M, Bobos P, Thorpe KE, da Costa BR, **Fisman DN**, Slutsky AS, Gesink D. (2020). Impact of climate and public health interventions on the COVID-19 pandemic: a prospective cohort study. *Canadian Medical Association Journal* 192(21): E566-E573. (A copy is attached hereto as **Exhibit "E"**.)
- Tuite AR, Fisman DN, Greer AL. (2020). Mathematical modelling of COVID-19 transmission and mitigation strategies in the population of Ontario, Canada. *Canadian Medical Association Journal* 192(19): E497-E505. (A copy is attached hereto as **Exhibit "F"**.)
- Tuite AR, Ng V, Rees E, **Fisman D.** (2020). Estimation of COVID-19 outbreak size in Italy. *The Lancet Infectious Diseases* 20(5): 537. (A copy is attached hereto as **Exhibit "G"**.)
- Tuite AR, Bogoch II, Sherbo R, Watts A, **Fisman D**, Khan K. (2020). Estimation of Coronavirus Disease 2019 (COVID-19) Burden and Potential for International Dissemination of Infection from Iran. *Annals of Internal Medicine* 172(10):699-701. (A copy is attached hereto as **Exhibit "H"**.)
- Tuite, AR, Bogoch II, **Fisman D**. (2020). Estimation of Coronavirus Disease 2019 Burden and Potential for International Dissemination of Infection from Iran. *Annals of Internal Medicine* 173(1):74-75 [response to correspondence]. (A copy is attached hereto as **Exhibit "I"**.)

9. I also have several COVID-related articles in preprint, meaning that they have not yet been peer-reviewed. These include:

- **David Fisman**, Amy L. Greer, Ashleigh Tuite. 2020. Derivation and Validation of Clinical Prediction Rule for COVID-19 Mortality in Ontario, Canada. (A copy is attached hereto as **Exhibit "J"**.)

10. I have conducted research and published articles on the epidemiology of other infectious diseases, including coronaviruses and influenza viruses, in addition to COVID-19. Relevant publications include:

- **Fisman, David N.** & Tuite, Ashleigh R. (2014). The epidemiology of MERS-CoV. *The Lancet Infectious Diseases* 14(1), 6-7.
- Hsieh, Ying-Hen, **Fisman, David N.** & Wu, Jianhong (2010) On epidemic modeling in real time: An application to the 2009 Novel A (H1N1) influenza outbreak in Canada. *BMC Research Notes* 3(1)

- **Fisman, D. N.**, & Laupland, K. B. (2009). Influenza mixes its pitches: Lessons learned to date from the influenza A (H1N1) pandemic. *The Canadian journal of infectious diseases & medical microbiology*, 20(3), 89–91.
- Tuite, A. R., Greer, A. L., Whelan, M., Winter, A. L., Lee, B., Yan, P., Wu, J., Moghadas, S., Buckeridge, D., Pourbohloul, B., & **Fisman, D. N.** (2010). Estimated epidemiologic parameters and morbidity associated with pandemic H1N1 influenza. *Canadian Medical Association Journal*, 182(2), 131–136.
- **Fisman, David N**., Leung, Gabriel M. & Lipsitch, Marc. (2014). Nuanced risk assessment for emerging infectious diseases. *The Lancet* 383(9913), 189-190.
- Seyed M Moghadas, Christopher S Bowman, Gergely Röst, **David N Fisman** & Jianhong Wu (2009). Post-exposure prophylaxis during pandemic outbreaks. *BMC Medicine* 7.
- Venkata R Duvvuri, Jane M Heffernan, Seyed M Moghadas, Bhargavi Duvvuri, Hongbin Guo, **David N Fisman**, Jianhong Wu & Gillian E Wu (2012). The role of cellular immunity in Influenza H1N1 population dynamics. *BMC Infectious Diseases*, 12.
- **Fisman, David N**. et al. (2009). Modelling an influenza pandemic: a guide for the perplexed. *Canadian Medical Association Journal*, 181(3-4), 171+
- Mostaço-Guidolin, L. C., Bowman, C. S., Greer, A. L., **Fisman, D. N.,** & Moghadas, S. M. (2012). Transmissibility of the 2009 H1N1 pandemic in remote and isolated Canadian communities: a modelling study. *British Medical Journal*, 2(5).

Current Status of COVID-19 in Canada

11. The emergency measures implemented across the country have been highly successful in controlling the spread of COVID-19, effectively “flattening the curve” of new infections. By flattening the curve, however, we have also extended it, prolonging the period of time during which the vast majority of Canadians remain susceptible to infection. As of June 30, 2020, the total number of confirmed cases of COVID-19 in Canada was 104,204. According to Statistics Canada, the total population of the country for the second quarter of 2020 (that is, the period ending June 30, 2020) was 37,971,020. This means that only approximately 0.27 percent of the total Canadian population has been diagnosed with COVID-19.

12. We know, however, that many of those who contract COVID-19 will experience only mild symptoms, and some percentage will not develop any symptoms. In addition, during the early stages of the pandemic in Canada, diagnostic testing capacity was severely limited and diagnostic tests were only provided to those who not only were experiencing symptoms

consistent with COVID-19 but also had identified risk factors such as recent travel or close contact with an identified case. As a result, the true number of COVID-19 cases across Canada is almost certainly much higher than the number of cases that have been confirmed.

13. Testing for antibodies to the novel coronavirus can assist in identifying the total number of persons who have previously contracted COVID-19, and thus provides a more reliable indicator of the actual rate of infection. We do not yet have Canadian seroprevalence data, but serological studies from elsewhere suggest that the true number of COVID-19 cases is 10 to 20 times higher than the number of confirmed cases. For Canada, this would mean that somewhere between 2.7 percent and 5.2 percent of the population has been contracted COVID-19 – leaving upwards of 94.8 percent of the population still susceptible to infection.

14. One of the key metrics in assessing the risks associated with any infectious disease is its reproduction number – that is, the number of other people a single infected person will infect on average. This is commonly abbreviated as R. The basic reproduction number, abbreviated R_0 ("R-nought" or "R-zero"), measures the fundamental infectiousness of a new disease, when there is zero immunity in the population. If the average R_0 in a population is greater than 1, infection will spread exponentially. If it is less than 1, the disease will spread slowly and eventually die out.

15. Using data from China and South Korea, where the novel coronavirus first emerged, researchers from the Centre for Evidence-Based Medicine of Oxford have found that the R_0 for COVID-19 averages around 2.6 to 2.7. In other words, in the absence of interventions, the average infected person infected between two and three people. This makes COVID-19 about twice as contagious as the flu (R_0 of 1.8) and more contagious than Ebola (R_0 of 1.2 to 2).

16. The basic reproduction number tells us whether a novel infectious disease has epidemic potential (R_0 of >1), and if so, how widespread it is likely to be and how sharply we can anticipate infection rates will increase without intervention. It is important to note, however, that the basic reproduction number is a measurement of the *average* number of new cases resulting from one old case. COVID-19 is challenging in that it has what is known as an overdistributed reproduction number, where many cases do not result in any new transmission while others

result in dozens of secondary cases. In other words, even when R_0 is less than 1 (less than one new case per old case on average), there can still be significant outbreaks.

17. The basic reproduction number also tells us the approximate percentage of the population that needs to be immune in order to achieve "herd immunity", where even those who are not themselves immune are indirectly protected from infection by the rate of immunity in the general population. For COVID-19, if R_0 is 2.6, approximately 62 percent of the population will have to be immune in order to achieve herd immunity.

18. Another key metric is the *effective* reproduction number, or R_e. This is the number of people in a population who can be infected by an individual at any specific *time* (and for that reason is sometimes abbreviated R_t). The effective reproduction number falls as the population becomes increasingly immunized, either following infection or by vaccination; as people recover or die; and as interventions such as physical distancing and contact tracing and isolation are adopted.

19. In mid-March 2020, the estimated R_e for Canada was greater than 2. At present, there are continuing outbreaks in various congregate living and working environments, and R_e generally remains higher in urban areas with greater population density. On average across the country, however, R_e has been trending close to 1 since approximately May 9 – and we continue to estimate this daily. For Ontario alone, according to Public Health Ontario, the estimated R_e was almost 4 in mid-March, but by the week ending June 23, 2020, had fallen to 1.0 on average across the province, with the median R_e ranging from 0.8 for Toronto to 2.1 for the Northern Region.[1]

20. This reduction in R_e was achieved through the emergency measures implemented by governments across Canada, and public health interventions such as limiting contacts, physical distancing, and the use of masks when physical distancing is not possible. As set out above, even assuming a true infection rate 20 times higher than the number of confirmed cases, and also assuming that infection confers full and lasting immunity from reinfection, we are nowhere near

[1] Ontario Agency for Health Protection and Promotion (Public Health Ontario). Evolution of COVID-19 case growth in Ontario. Toronto, ON: Queen's Printer for Ontario; 2020.

achieving herd immunity. Herd immunity will only be achieved once an effective vaccine has been developed and widely implemented, or if a large fraction of the Canadian population is infected.

21. Provinces across Canada are now engaged in a process of gradual reopening, while paying close attention to any change in R_e. It is important to note, however, that R_e does not actually measure current rates of transmission. Because of the incubation period of COVID-19, reported cases lag up to 14 days behind transmission. The effective reproduction rate is therefore a measure of rates of infection up to two weeks in the past.

22. Other jurisdictions that eased restrictions sooner and more fully have seen a surge in R_e of COVID-19. For example, a number of American states that had achieved R_e of 1 or less through lockdown are now once again experiencing exponential growth in infections. According to rt.live, a website that aggregates public health data on COVID-19 infections across the United States, as of July 1, 2020, only 13 states had maintained R_e of 1 or less – and as set out above, these data reflect transmission rates from up to two weeks ago. In the wake of soaring numbers of new COVID-19 cases, several states, including Florida, Texas, and California, have moved to reimplement various public health measures to control the spread of the disease.

23. These experiences underscore the importance of avoiding the four Cs (crowding, continuous contact, closed spaces, and close contact), maintaining physical distancing, and wearing masks when physical distancing is not possible. They also demonstrate how tenuous our control of the pandemic is. At the moment, and with the exception of hotspots in congregate living and working environments, the pandemic is at a simmer – still spreading, but not at exponential rates. However, it could very easily and very rapidly return to the boiling point over the weeks and months ahead.

24. Increased testing and contact tracing will assist in efforts to control the spread of the novel coronavirus. Notably, however, one of the particular challenges associated with the novel coronavirus – and one that I and others had initially underestimated based on the limited data available at the time – is the significance of pre-symptomatic and asymptomatic transmission. We now know that individuals are infective, and potentially most infective, prior to the onset of symptoms. We also know that many individuals will be pauci-symptomatic, experiencing only

few and mild symptoms that they may not even identify as COVID-19, and that some proportion of those who are infected – currently estimated at 18 percent, although the true percentage may be higher – will be truly asymptomatic. Both pauci-symptomatic and asymptomatic individuals can nevertheless infect others.

25. While the evidence continues to evolve, it is clear that transmission by persons who are asymptomatic or presymptomatic is a significant factor in the spread of the novel coronavirus, and can in fact cause local outbreaks. Many of known "super spreader" events – including in jurisdictions that were previously believed to have controlled the pandemic – involved transmission from individuals who were not symptomatic at the time they infected others.

26. Diagnostic testing capacity is now far greater than it was a few months ago, and no longer limited to those who are symptomatic and/or have known risk factors or exposure. We do not and will not, however, have the capacity to test every Canadian every day on a continuous basis until a vaccine is found. There will therefore inevitably still be individuals who are infected but not identified through testing because they are not experiencing symptoms and are not aware that they have been exposed.

27. Attached hereto as **Exhibit "K"** are slides I prepared for Respirology Rounds on May 29, 2020, which contain a number of graphs that show much of what I have described above. Although the data on which these are based are now somewhat dated, they provide a useful visual aid to understanding some of the disease dynamics associated with COVID-19.

Outlook for Fall 2020

28. In my opinion, even if we manage to maintain control of the epidemic over the summer months, there is a very high likelihood that Canada will experience a second and far more serious wave of COVID-19 infections in the fall of 2020. My opinion is based on a review of the data available both within Canada and from other countries, and a consideration of the factors set out below.

29. Because SARS-CoV-2 is so new, we do not yet know for certain whether it is seasonal in nature. We do know, however, that other coronaviruses and the influenza virus are strongly influenced by climate conditions such as heat, humidity and ultraviolet light, and infection rates

of those viruses are much higher in the fall and winter than during the warmer months of the year. While there are important differences between the novel coronavirus and these other viruses, there is equally no reason to expect that the novel coronavirus will behave differently.

30. Further, and even if the novel coronavirus itself is less subject to climate conditions, we can still expect transmission rates to increase as temperatures drop due to seasonal changes in behaviour (e.g., indoor crowding).

31. In assessing infection risk we often talk about the “three Cs” – closed spaces; crowded places; and close contact. Increasingly, we are also talking about a “fourth C”, namely continuous exposure. All of those factors significantly increase the risk and rate of disease transmission. As is by now well known, the novel coronavirus is spread primarily from person to person through small droplets from the nose or mouth, which are expelled when a person who is infected with the virus speaks, coughs or sneezes. In closed spaces with poor ventilation, those droplets are more likely to linger and accumulate. In crowded places, there will be a greater number of droplets in the air. Close contact, such as face-to-face conversation, increases exposure to others’ droplets. All three of those “Cs” increase the intensity of exposure, while the fourth “C” speaks to the duration of exposure. The risk of infection increases is a product of the intensity of exposure multiplied by time.

32. Japan’s success in controlling the spread of SARS-CoV-2 without resorting to the intensive lockdown measures implemented elsewhere demonstrates the significance of the four Cs to rates of transmission. Japan’s public health response has stressed avoiding closed and crowded environments and close contact. While there are undoubtedly multiple factors in play, it appears that widespread adherence to those guidelines, coupled with the use of masks, has contributed to Japan’s relatively low death rate.

33. The significance of the four Cs is also evident in the number and size of outbreaks in congregate living and work environments. These are typically closed and crowded environments where persons are in close and continual contact with one another – and so it is unsurprising that they have also been the settings in which the spread of the novel coronavirus has been so difficult to contain.

34. Over the spring and summer months, when people can gather and socialize outdoors, they are more likely to be able to maintain physical distance. Even when physical distance is not maintained, air circulation disperses droplets. The presence of UV light may also destroy at least some of the virus in any remaining droplets. As temperatures drop and people move back indoors, the risk of transmission increases again.

35. As difficult as our experience with COVID-19 has been to date, we have so far benefitted from a substantial "seasonal assist". The novel coronavirus emerged and began spreading relatively late in the normal coronavirus season, which typically begins in the fall or early winter, depending on the specific virus in question. Temperatures were rising by the time the global pandemic was declared, and conditions in the spring and summer months have made it easier to control the spread of the disease.

36. In previous epidemics we have often seen what is known as a "herald wave" – an initial emergence and wave of infections outside of the normal season for that form of disease. For example, as set out in **Exhibit "L"**, deaths from cholera in London, UK during the 19th century were strongly seasonal, with peak mortality almost always occurring in the summer months. The only non-summer outbreaks occurred in the spring of 1832, the autumn of 1848, and the winter of 1853. There were extraordinarily severe summer outbreaks in 1832, 1849, 1854, and 1866 – the four "great" cholera years. The non-summer outbreaks that preceded three of those years appear to have been herald waves of newly invading strains of cholera. The initial outbreaks were tempered by the season, and were followed by more severe outbreaks in the summer when environmental conditions more strongly promote cholera transmission. (The major epidemic of 1866 may have simply reflected the arrival of a new strain coincidental with the start of the normal cholera season.)

37. Herald waves have also been identified for influenza epidemics. Perhaps most famously, in the great Spanish flu pandemic of 1918, a herald wave emerged in the spring approximately six months before the far more significant wave in the fall. Similarly, the 2009 outbreak of a novel strain of the H1N1 influenza virus ("swine flu") in fact consisted of an initial wave in

March and April, which then subsided over the summer only to re-emerge in September and peak in November.[2]

COVID-19 Mortality Rates

38. As previously noted, we do not yet have seroprevalence studies that would enable us to better determine the true rate of infection in Canada. In order to estimate true *infection* mortality as opposed to *case* mortality – that is, the death rate for all those who are infected with the virus rather than the death rate just for confirmed cases – we have to look to data from other jurisdictions. At present, the best estimate is based on data from Spain and suggests a 1 percent infection mortality rate – in other words, 1 of 100 individuals who becomes infected will die as a result of COVID-19. While this may at first blush appear low, it is useful to compare it to the infection mortality rate for H1N1, which is estimated to be between 1 in 10,000 and 1 in 100,000 (again, a more accurate measure of the infection mortality rate is somewhat confounded by the number of cases that are not identified). In other words, the novel coronavirus is between 100 and 1000 times more lethal that H1N1.

39. While we do not yet have the data to determine infection mortality in Canada, the information that is being gathered by public health authorities does allow us to examine and estimate the risk of mortality for various groups. For example, in Ontario, as of June 11, 2020, more than 30,000 virologically confirmed cases of COVID-19 had been identified, with epidemiological, clinical and outcome data for each entered into the province's Integrated Public Health Information System. Using these data, my colleague Ashleigh Tuitte and I have sought to develop prediction rules for infection-related deaths in individuals with COVID-19 in Ontario. What we have found – as reported at **Exhibit "J**" and generally consistent with research elsewhere – is that the mortality risk is not evenly distributed across the population.

40. Age is the strongest predictor of death from COVID-19. The risk of death increases sharply at age 50, and approximately doubles with each decade thereafter. After age 70, we see a death rate comparable to that of Ebola.

[2] See *e.g.* David J.D. Earn et al. (2012). Effects of School Closure on Incidence of Pandemic Influenza in Alberta, Canada. *Annals of Internal Medicine* 156(3): 173-181.

41. The presence of comorbidities (which also increases statistically with age) is also a significant predictor of mortality risk. The conditions most strongly associated with increased risk are lung disease, cardiac disease, diabetes, kidney disease, and immune suppression. Some of these were initially surprising, when we first understood COVID-19 to be primarily a respiratory disease. It now appears that COVID-19 may be better understood as a disease of the endothelium – that is, the lining of blood vessels. COVID-19 causes endothelial dysfunction, which results in stroke, deep vein thrombosis, and dysregulation of the ability to maintain blood pressure, among other things.

42. The increase in mortality risk associated with various comorbidities is substantial. For example, diabetes "ages" you a decade, and immune compromise by a decade and a third. In other words, a 50-year-old with diabetes has a risk of death from COVID-19 equivalent to that of a 60-year-old, while a 50-year-old with compromised immunity is effectively a 63.3-year-old for purposes of COVID-19 mortality risk.

43. As we age, we experience what is known as immune senescence – in other words, our immune response weakens. This is generally mitigated to some degree by gains in immune experience – that is, the exposure to different diseases, and different strains of disease, over time – but that does not protect against novel viruses.

44. One of the significant differences between the COVID-19 pandemic and the 2009 H1N1 "swine flu" epidemic, is that those born prior to 1957 had some immunity to H1N1 as a result of early life experience. 1957 saw the emergence of an H2N2 virus, which caused the "Asian flu" pandemic and completely displaced the H1N1 viruses that had been circulating in humans since 1918. Those born prior to 1957 thus had early exposure to H1N1 viruses, while those born later did not. This is especially significant because individuals tend to mount the most effective immune response to the first kind of flu virus they experience. (This phenomenon is known as "antigenic original sin". My colleagues and I posited that this phenomenon influenced H1N1 mortality in correspondence published in the *New England Journal of Medicine* in November 2009, attached as **Exhibit "M"**, and it has since been widely accepted.)

45. When the H1N1 "swine flu" global pandemic occurred in 2009, those over 50 therefore had greater immunity than younger individuals, which resulted in lower mortality rates than we

would otherwise have expected in that age group. With the novel coronavirus, in contrast, there is no pre-existing immunity and so those who are older are at higher risk.

Conclusion

46. SARS-CoV-2 has only been with us since approximately December 2019, and while global efforts to research the virus and its spread have been unprecedented, there is much we still do not know. New data continue to be gathered and analyzed every day, and our understanding of the dynamics of this disease is rapidly evolving.

47. I would be delighted to be proven wrong, but based on the best available evidence with respect to the novel coronavirus as well as our existing knowledge of other epidemic events, there is in my opinion a high likelihood of a significant resurgence in infection in the fall of 2020.

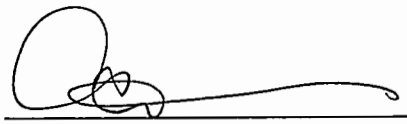
48. Further, given what we know about the risk of infection and the "four Cs", it is my opinion that congregate living and work environments will again be especially susceptible to outbreaks.

49. Finally, while some percentage of those infected will remain asymptomatic or develop only relatively mild symptoms from which they recover without incident, others will experience much more severe health outcomes, up to and including death. The risk of death is significantly increased for those 50 and over, and/or those who have underlying comorbidities.

50. I make this affidavit in good faith and for no improper purpose.

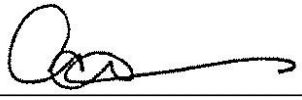
AFFIRMED before me by videoconference)
in the City of Toronto,)
in the Province of Ontario)
this 21st day of July, 2020)

David Fisman



A Commissioner, etc

This is **Exhibit "A"** to the
Affidavit of David Fisman,
affirmed before me by videoconference
July 21, 2020



A Commissioner, etc.

Curriculum Vitae

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A. DATE CURRICULUM VITAE REVISED:

August 19, 2019

B. BIOGRAPHICAL INFORMATION

1. Academic Background

Education:

2000	MPH, Harvard School of Public Health (Clinical Effectiveness), Boston, MA. USA
1994	MD, University of Western Ontario, London, Ontario, Canada

Postdoctoral Training:

Internships and Residencies

1996 - 1997	Senior Assistant Resident, Rhode Island Hospital, Providence
1995 - 1996	Junior Assistant Resident, Royal Victoria Hospital, Montreal
1994 - 1995	Intern in Medicine, Royal Victoria Hospital, Montreal

Clinical and Research Fellowships

1998	Fellow in Clinical Effectiveness, Harvard School of Public Health, Boston, MA
1999 – 2001	Agency for Healthcare Policy and Research Postdoctoral Fellow, Center for Risk Analysis, Harvard School of Public Health, Boston, MA
1997 - 1999	Clinical Fellow in Medicine, Infectious Diseases, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA

Licensure and Certification:

2000	Subspecialty Certification in Infectious Diseases, American Board of Internal Medicine
1998	Fellow of the Royal College of Physicians of Canada #514086 (active)
1997	Specialty Certification in Internal Medicine, American Board of Internal Medicine
1995	Licentiate of the Medical Council of Canada #79306

2. Academic Employment

Current principal appointment

2017-present	Division Head, Epidemiology, Dalla Lana School of Public Health, University of Toronto
2013-present	Professor, Tenured (July 1, 2012), Dalla Lana School of Public Health, University of Toronto

Current academic appointments

2016-present	Adjunct Professor, Department of Population Medicine, University of Guelph
2010-present	Full member of School of Graduate Studies, University of Toronto
2013-present	Professor, Department of Health Policy, Management and Evaluation, University of Toronto
2013-present	Professor of Medicine, Department of Medicine, Faculty of Medicine, University of Toronto

Current hospital/public health agency appointments

2012-present	Attending Physician, Toronto Western Hospital, Toronto, Ontario, Canada
2010-present	Assistant Physician, Department of Medicine, University Health Network, Toronto, Ontario, Canada

Previous academic appointments

2007-2010	Associate Member of School of Graduate Studies, University of Toronto
2008-2013	Associate Professor, Tenured (July 1, 2012), Dalla Lana School of Public Health, University of Toronto
2007-2013	Associate Professor, Department of Health Policy, Management and Evaluation, University of Toronto
2009-2013	Adjunct Associate Professor of Medicine, Department of Medicine, Faculty of Medicine, University of Toronto

2005-2006	Visiting Research Scholar and Visiting Assistant Professor of Public Affairs, Center for Health and Wellbeing, Woodrow Wilson School, Princeton University
2004-2006	Assistant Professor, Department of Medicine, Division of Infectious Diseases, Drexel University College of Medicine
2004-2006	Associate Scholar, Center for Clinical Epidemiology and Biostatistics, University of Pennsylvania
2003 - 2006	Assistant Professor, Department of Epidemiology and Biostatistics, Drexel University School of Public Health
2002 - 2003	Associate Member, Clinical Health Sciences (Health Research Methodology) Graduate Programme, McMaster University, Hamilton, Ontario
2001 – 2004	Assistant Professor (Part Time), Department of Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, Ontario

Previous hospital/public health agency appointments

2010-2013	Attending Physician, Department of Medicine, North York General Hospital, Toronto, Ontario, Canada
2009-2010	Adjunct Scientist, Ontario Agency for Health Protection and Promotion, Toronto, Ontario, Canada
2008-2009	Medical Epidemiologist, Ontario Agency for Health Protection and Promotion, Toronto, Ontario, Canada
2006-2009	Scientist, Child Health Evaluative Sciences, Research Institute of the Hospital for Sick Children, Toronto, Ontario, Canada
2006-2008	Medical Epidemiologist, Ontario Central Public Health Laboratory, Toronto, Ontario, Canada
2004-2006	Attending Physician, Department of Medicine, Hahnemann Hospital, Philadelphia, PA
2002 - 2003	Attending Physician, St. Joseph's Healthcare, TB Clinic, Hamilton, Ontario, Canada
2002 - 2003	Medical Advisor, Phoenix Association (Herpes Support Group), Toronto, Ontario, Canada
2001 - 2003	Associate Medical Officer of Health, City of Hamilton Department of Social and Public Health Services, Hamilton, Ontario, Canada
2001 - 2003	Medical Director for Sexually Transmitted Diseases and Information and Sexual Health Services, City of Hamilton Department of Social and Public Health Services, Hamilton, Ontario, Canada
2001 - 2003	Associate Staff Physician and Director, Hamilton General Hospital Sexually Transmitted Diseases Clinic, Hamilton Health Sciences, Hamilton, Ontario, Canada
2000 - 2001	Staff Physician, Department of Medicine, Division of Infectious Diseases, Beth Israel Deaconess Medical Center, Boston, MA
1998 - 2000	Assistant in Medicine, McLean Hospital, Belmont, MA

1997 - 2000	Fellow, Division of Infectious Diseases, Beth Israel Deaconess Medical Center, Boston, MA

3. Awards and honours

2019	John Hastings Award for Excellence in Service to the University and the Community. Dalla Lana School of Public Health, June 2019.
2009	Schwartz-Reisman Hospital for Sick Children Canada-Israel Scholars Program ($8000) [declined].
2005	Drexel University School of Public Health Class of 2005 “Golden Apple” Award for Excellence in Teaching
2003	International Herpes Management Forum Elion Young Investigator Award
2003	Outstanding Teacher, McMaster University International Medical Graduate Program
2001	Distinguished Reviewer, Journal of General Internal Medicine
1997	Winner, Associates Vignette Poster Competition, American College of Physicians 78th Annual Session, Philadelphia
1996	Merck-Frosst Resident Research Award, Royal Victoria Hospital
1994	Medical Honor Society, University of Western Ontario
1993	First Prize, Alpha Omega Alpha Medical Student Essay Competition
1992	Alexander Hotson Memorial Scholarship, University of Western Ontario
1988	CFPL-TV Scholarship, University of Western Ontario

4. Professional Affiliations and Activities

Professional Associations

2008-present	International Society for Infectious Diseases
2002- present	Canadian Infectious Disease Society—Association of Medical Microbiology and Infectious Disease (AMMI) Canada
1997-2006	Infectious Disease Society of America
2005-present	Fellow of the College of Physicians of Philadelphia
2005-2007	Society for Epidemiologic Research
2006-2009	American Society for Microbiology
2002-2011	Society for Hospital Epidemiology of America
2004-2006	Pennsylvania Public Health Association
2001-2013	Society for Medical Decision Making
2001-2003	Association of Local Public Health Agencies (alPHa)
1998-2003	Massachusetts Medical Society

1997 - 1998	Society of General Internal Medicine
1994 - 1997	Associate, American College of Physicians
1994 - present	Member, Canadian Medical Association

Journal Peer Review

2018-	Statistical Consultant, Annals of Internal Medicine
2017-	Editorial Board Member, Infectious Disease Epidemiology
2015-2017	Editorial Board Member, Nature Scientific Reports
2016-	Lancet Public Health (Elsevier)
2014-	New England Journal of Medicine, Massachusetts Medical Society
2011	PLoS ONE, Public Library of Science
2010	American Society for Microbiology mBIO
2009-	American Journal of Epidemiology, (Oxford University Press)
2009-2012	Section Co-editor (with Dr. Kevin Laupland), Adult Infectious Disease Notes, Canadian Journal of Medical Microbiology and Infectious Diseases.
2008-	PLoS Medicine, Public Library of Science
2008-	Canadian Journal of Infectious Diseases and Medical Microbiology, Association of Medical Microbiology and Infectious Diseases Canada
2008-	Epidemiology and Infection, Cambridge University Press
2008-	JAMA, American Medical Association
2007-	Journal of Infection, Elsevier
2007-	Archives of Internal Medicine, American Medical Association
2007-	International Journal of Public Health, Birkhäuser Basel
2006-	Canadian Medical Association Journal, Canadian Medical Association
2006	Environment and Development Economics, Beijer Institute of Ecological Economics, Royal Swedish Academy of Sciences/Cambridge University Press.
2006-	BMC Infectious Diseases. BioMed Central.
2006-	The Lancet, Elsevier Ltd.
2005-	Infection Control and Hospital Epidemiology, Society for Hospital Epidemiology of America.
2005	Occupational and Environmental Medicine, Faculty of Occupational Medicine of the Royal College of Physicians of London (BMJ).
2005	Lancet Infectious Diseases, Elsevier, Inc.
2005-	British Medical Journal (BMJ), British Medical Association
2005-	Archives of Pediatrics and Adolescent Medicine, American Medical Association
2005-	Tropical Medicine and International Health, Belgian Society of Tropical Medicine

2004-	Sexually Transmitted Diseases, American Sexually Transmitted Diseases Association.
2004-	Pharmacoepidemiology and Drug Safety, Wiley Interscience
2004-	Sexually Transmitted Infections, British Association of Sexual Health and HIV
2003-	Annals of Internal Medicine, American College of Physicians
2003-	Vaccine, Elsevier Science
2002 -	American Journal of Epidemiology, Society for Epidemiologic Research
2002 -	American Journal of Infection Control, Association for Professionals in Infection Control and Epidemiology, Inc.
2002 -	Society for Medical Decision Making Journal for the Society of Medical Decision Making
2001 -	Clinical Infectious Diseases, Infectious Diseases Society of America
2001 -	Emerging Infectious Diseases, U.S. Centers for Disease Control and Prevention
2001 -	Medical Care, American Public Health Association
2001	Haematologica, Ferrata Storti Foundation, Pisa, Italy
2000	Journal of General Internal Medicine, Society of General Internal Medicine

External Peer Review

2019	Canada Research Chairs Program
2017-	Canadian Institutes of Health Research College of Reviewers and Member, PH1 Study Section
2015-	Reviewer, CIHR Foundation Grants Competition
2015-	Reviewer, Canadian Immunization Research Network Grants Competition
2011-	Member, Institute of Population and Public Health Study Section (PH1), Canadian Institutes of Health Research
2011	External Reviewer, Fonds de Recherches en Sante de Quebec (FRSQ) Program on Cancer and the Environment (GRPeC)
2011	External Reviewer, Canada Research Chairs Program
2011	Scientific Review Committee, Association for Medical Microbiology and Infectious Disease—Canada (AMMI-Canada) Annual Meeting
2011	Scientific Review Committee, International Society for Sexually Transmitted Disease Research Biannual Meeting
2010-	External Reviewer, Public Health Agency of Canada Field Epidemiology Training Program
2010	Reviewer, Cancer Care Ontario Position Paper on Epidemiology of Cancer and Infectious Diseases

2009	National Science and Engineering Research Council of Canada, Discovery Grants Program. Reviewer
2008	Physician's Services Incorporated Foundation Grant Program
2007-2008	Review Committee for Operating Grant: Pandemic Influenza Diagnostics, Canadian Institutes for Health Research
2007	2008 U.S. National STD Prevention Meeting (Centers for Disease Control and Prevention)
2007	External Reviewer, Washington University (St. Louis) Diabetes Research Training Center Pilot and Feasibility grants program
2007-	Canadian Institutes for Health Research
2006-	Bulletin of Mathematical Biology, Society for Mathematical Biology
2004	2004 Canadian National Sexually Transmitted Disease Guidelines, Health Canada
2004-	Proceedings of the National Academy of Sciences, National Academy of Sciences
2003	MITACS (Canadian Applied Mathematics Consortium)
2002 & 2006	Scientific Review Committee, Annual Meetings of the Society for Medical Decision Making.
2001 -	Value in Health, International Society for Pharmacoeconomics and Outcomes Research
2001	Mayo Clinic Proceedings for Mayo Clinic Rochester, Rochester, MI

Professional Service

2019-	Member, Clinical Research Network, AMMI Canada
2018-	Member, Canadian Immunization Research Network, Training and Education Committee
2018-2021	Planning Committee, European Society for Clinical Microbiology and Infectious Diseases Annual Meeting
2016	World Health Organization Guideline Working Group on Use of Mathematical Models, Geneva, Switzerland, April 27-29, 2016.
2016, 2018	Scientific Committee, International Meeting on Emerging Diseases, Vienna, Austria, November 4-7, 2016.
2015	Member, Toronto Public Health Advisory Group on Climate Change
2013-2016	Member, Ontario Chief Medical Officer's Annual Report Advisory Group. (Provided input and editorial assistance on annual reports tabled in the Ontario provincial legislature).
2015	Organizing Committee, 3rd Digital Disease Detection Conference, Florence, Italy, May 21-22, 2015.

2013-	Editorial Board, ID Cases, Elsevier
2011-2017	Editorial Board, Nature Scientific Reports
2011	Organizer and Chair, Plenary Session on Climate Change and Infectious Diseases, International Meeting on Emerging Diseases, Vienna, Austria, February 4-7, 2011.
2011	International Society for Pharmacoeconomics and Outcomes Research—Society for Medical Decision Making. Expert Panel on Health Economic Evaluation of Communicable Disease Control Programs. Chair: Richard Pitman, Oxford Outcomes.
2010-	Honorary Advisory Board, One Health Initiative (http://www.onehealthinitiative.com)
2010	Organizing Committee (Chair Susan Lett), Canadian Pandemic Influenza Planning Meeting: Assumptions. Public Health Agency of Canada, Winnipeg, Manitoba, February 2-3, 2011.
2010	Organizing Committee (with Drs. Jan Sargeant, Zvonimir Poljak, Amy Greer, Javier Sanchez, and Bruce McNab), "One Health One Model: Modeling at the Animal-Human Interface". 4 day meeting on applying mathematical modeling to the "One Health" paradigm. University of Guelph, November 1-4, 2010.
2010	Organizing Committee, International Society for Infectious Diseases International Meeting on Emerging Diseases (IMED, Vienna, Austria, February 2011)
2010	Co-organizer (with Profs. Jianhong Wu and Troy Day), Fields Institute Thematic Program in the Mathematics of Antimicrobial Resistance, Toronto, Ontario, Canada, July-August 2011
2010	Co-organizer (with Profs. David Earn and Jonathan Dushoff), Banff International Research Station Meeting on Persistent Infectious Diseases (Banff, AB, February 2011)
2009	Co-organizer (with Dr. Emery Leger, Canadian Food Inspection Agency; Dr. Javier Sanchez, University of Prince Edward Island; and Dr. Babak Pourbohloul, British Columbia Centre for Disease Control), Canadian Food Inspection Agency Meeting on Animal-Human Modeling of Influenza. Montreal, Quebec, Canada, November 18-19, 2009.
2009-2011	Member, Society for Hospital Epidemiology of America External Affairs Committee (Ms. Barbara Soule, Chair).
2009	Organizer, Signal Detection 2009: An International Conference on Modeling and Surveillance. Ontario Agency for Health Protection and Promotion, Toronto, Ontario, Canada. October 8-9, 2009.
2009	Organizing Committee, Mitigating the spread of influenza A (H1N1) (Part II): An International Mathematical Modelling Meeting. British Columbia Centre for Disease Control (BCCDC), Vancouver, BC, Canada, September 14 – 16, 2009.
2009	Ontario Agency for Health Protection and Promotion Medical Officers of Health "Scientific Webinar" on Mathematical Modeling and Influenza, May 6, 2009.
2009	Organizer and Co-host (with Ontario Emergency Management Unit): Mathematical Modeling and Pandemic Influenza Control. Sutton Place Hotel, January 30-31, 2009.

2008	Organizer and Host, Ontario Agency for Health Protection and Promotion --- University of Guelph Center for Public Health and Zoonosis meeting on collaborative efforts in human-veterinary health research, Ontario Central Public Health Laboratory, November 26, 2008.
2007-2009	Ontario Vaccine Evaluation Center Planning Committee (Dr. Craig Laferriere, Chair)
2007	Co-organizer, Public Health Agency of Canada—MITACS Joint Symposium on Modeling Sexually Transmitted and Blood-Borne Infections (with Dr. Jianhong Wu, York University and Dr. Tom Wong, PHAC). Banff International Research Station for Mathematical Innovation and Discovery, Banff, Alberta, Canada, August 10-12, 2007.
2007	Introduction to Decision Analysis, Cost-Effectiveness Analysis, and Dynamic Transmission Modeling. Merck Frosst Health Sciences Associates Mentorship Program. Montreal, PQ, September 26, 2007.
2007-2008	Program Committee, U.S. Centers for Disease Control National STD Prevention Meeting (Chicago, IL, May 10-13 2008).
2006-2007	CDC Expert Panel on Chlamydia Screening in Males (Chair, Dr. Tom Gift, CDC).
2006	Ontario Ministry of Health and Long-term Care Research Paper Editorial Board (Healthy and Responsible Consumers). (document available via the Internet at http://www.ourplanforhealth.ca/moh/research/Healthy_and_Responsible_Consumers.pdf).
2006-2009	Ontario Public Health Laboratory Research Ethics Board Member (Dr. Steve Drews, Chair)
2006-2008	Clinician-Scientist Training Program Committee, Hospital for Sick Children Research Institute (Dr. Neil Sweezy, Chair)
2005	New Jersey State Department of Public Health Task Force on Antimicrobial Resistance (New Jersey CAUSE) (Dr. Corey Robertson, Chair)
2005	Society for Hospital Epidemiology of America (SHEA), Working Group on Management of Invasive Group A Streptococcal Infections in Long-Term Care (Chair, Dr. Andrew Simor, University of Toronto).
2003-2004	Adjunct Member, Hahnemann Hospital SARS Planning Committee
2004	Society for Hospital Epidemiology of America, Working Group on Economic Evaluation in Infection Control (Chair, Dr. Eli Perencevich, University of Maryland).
2003	Ontario SARS Science Committee, March 30-April 16, 2003.
2002-2004	Canadian Infectious Disease Society, STD/HIV Committee
2002	McMaster University Community Medicine Residency Training Committee
2002 - 2003	Hamilton Regional Microbiology Committee
2002 - 2003	Emergency Preparedness Group, City of Hamilton, Hamilton, Ontario
2002	Ontario Ministry of Health, Health Canada Advisory Group on Smallpox Vaccine, Toronto, October 11, 2002.
2001 - 2003	Hamilton Regional Infection Control Committee, Hamilton, Ontario (Dr. Maureen Cividino, Chair)

2001 - 2003	Hamilton City Nuclear/Biological/Chemical Planning Committee, Hamilton, Ontario
2001 - 2003	Hamilton Health Sciences Center Nuclear/Biological/Chemical Planning Committee, Hamilton, Ontario
2001 - 2003	Consultant, Ontario Public Health Research, Education, Development (PHRED) Program, City of Hamilton Department of Social and Public Health Services, Hamilton, Ontario
1994 - 1996	Residency Training Committee, Royal Victoria Hospital, Montreal, Quebec (Dr. Sam Benaroya, Chair)

C. ACADEMIC HISTORY

Research Endeavours

I have broad training and experience as an infectious disease specialist physician, mathematical modeller, and epidemiologist, and have practical experience that extends from patient care settings (hospital inpatient and outpatient settings), public health practice, and medical epidemiology, to policy spheres, as well as extensive expertise and experience as a teacher and researcher in the field of infectious disease epidemiology. This unusual breadth of expertise has provided me with a unique niche within the Canadian communicable disease control community as a translator of epidemiological and mathematical methods into tools for the study of communicable diseases at both the clinical and population levels. I have developed a particular specialized expertise in the study of environmental impacts on infectious disease occurrence, and in the economic evaluation of the indirect benefits of communicable disease control programs. These endeavours, which are ongoing and supported by a variety of grants and contracts described elsewhere in this document, are ongoing.

1. Translational Research in Infectious Disease Epidemiology and Control

I am a recognized national and international expert on the translation of cutting-edge epidemiological and modeling efforts for the quantification and control of infectious diseases from the research sphere into public health practice. Over the past decade I have used this skill set to help provide understanding and guide policy related to persistent and emerging infectious diseases in Ontario and in Pennsylvania.

1.1. The Microbiology Laboratory as an Epidemiological Resource

The epidemiology of infectious diseases is distinctive in that infectious disease epidemiology concerns itself with at least two interdependent populations: human (or animal) hosts who experience disease, and the pathogens themselves, which constitute distinct, ecologically dynamic populations in their own right. From 2006 to 2008, I served as consultant Medical Epidemiologist to the Ontario Public Health Laboratory (now the Public Health Laboratory—Toronto (PHLT) of Public Health Ontario), and have continued to work with laboratory-derived epidemiological data since that time. I have learned that large service-oriented microbiology laboratories constitute a unique and underutilized epidemiological resource, in that such laboratories serve as repositories for data on cases, data on infecting microbes, the microbes themselves, and data on such health services indicators as specimen volumes received. Using data derived from PHL-T, I have helped document changes in the epidemiology of such diseases as pertussis (whooping cough) and legionellosis in the province of Ontario, and also to evaluate the impact of changing test technologies on apparent rates of disease.

For four diseases of public health importance, I (and my collaborators) have used econometric time series (e.g., Granger methods) to evaluate the bidirectional interactions between laboratory-reported rates of pertussis, legionellosis, syphilis and chlamydia. For each of these infections, we identify evidence of positive feedback loops, such that surges in positivity predict subsequent surges in test submission by

clinicians (independent of the level of disease activity). An example of this type of analysis is presented in our recently published manuscript entitled *Pertussis resurgence in Toronto, Canada: A population-based study including test-incidence feedback modeling* (Fisman DN et a l., BMC Public Health 2011). This finding has important implications for the design and interpretation of public health surveillance systems and data. Another unique facet of laboratory-based epidemiology is the ability to control for both volume and type of testing; the explosion in nucleic acid amplification testing technology has created a "tarnished gold standard" problem for diagnostic microbiology, in that traditional gold standard tests (e.g., culture testing) are now less sensitive than emerging culture-free technologies. Using such analytical methods as latent class analysis, I have collaborated with microbiologists to develop efficient and effective testing strategies for such common outbreak-associated pathogens as norovirus (a major cause of diarrhoea outbreaks in institutional settings). An example of such work is presented in a manuscript entitled *Of gastro and the gold standard: evaluation and policy implications of norovirus test performance for outbreak detection* (Fisman DN et al., Journal of Translational Medicine 2009), described in further detail below.

1.2. The Use of Mathematical Epidemiology for Control Policy during Public Health Crises

Because communicable diseases represent "non-independent" events (i.e., one case causes another), dynamic systems models and simulations are commonly used in infectious disease epidemiology research. However, these tools have historically not been widely applied in public health practice, particularly in Canada. My trans-disciplinary skills in infectious disease epidemiology, mathematical modeling and infectious disease epidemiology have allowed me to contribute valuable modeling work during three major public health crises (SARS, the 2009 influenza pandemic, and the recent cholera epidemic in Haiti) and in support of responses to Ontario's current large outbreaks of both chlamydia and syphilis.

My translational research activities in mathematical modeling of infectious diseases have received recognition from my mathematician colleagues. Although not a mathematician, I was asked to deliver the 10th Anniversary Public Lecture for the Canadian National Centre of Excellence for applied mathematics (MITACS) in 2009; I have co-organized an international thematic program on mathematics of antimicrobial resistance at the Fields Institute, and an international workshop on disease persistence at the Banff International Research Station, and I continue to coordinate a monthly seminar series (the "IDEA Seminars" at the Fields Institute); this series receives support from Fields.

1.2.a. SARS and Pandemic Influenza A (H1N1)—2009

In 2003, I was employed as a Medical Officer of Health at the City of Hamilton, and was seconded to Ontario's SARS Science Committee to assist in the public health response to the SARS crisis. In April 2003, the question of whether SARS could be controlled was unanswered. I advocated the use of mathematical modeling to explore this question, but the use of modeling was (at that time) not acceptable to Ontario public health officials. I consequently linked with a mentor (Prof. Marc Lipsitch) at Harvard School of Public Health, and we initiated a process that culminated in a mathematical model of SARS in Singapore, which was published in Science in June 2003. The "Lipsitch model" provided projections that suggested that SARS was indeed controllable using aggressive quarantine and isolation, projections borne out by subsequent events. In 2009, when influenza A (H1N1)-2009 emerged in Ontario, I held an appointment at Public Health Ontario (PHO), a new agency created as a result of the Naylor Report on SARS, which was, unlike its predecessor, notably friendly to the use of modeling and mathematical epidemiology, and collaborations between PHO and the Ontario Ministry of Health and Long-term Care allowed the evaluation of key epidemiological properties of influenza A (H1N1)-2009. These properties are described in the paper, on which I was senior responsible author (the first author, Ashleigh R. Tuite, being a Dalla Lana School of Public Health practicum student with me at the time) (Tuite AR et al., *Estimated epidemiological parameters and morbidity associated with pandemic H1N1 influenza*, CMAJ

2010). A companion brief report on age effects in the 2009 pandemic (Fisman DN et al., *Older age and reduced likelihood of 2009 H1N1 virus infection*, New England Journal of Medicine 2009) was published in the New England Journal of Medicine. Taken together, these two papers provided the parameter values necessary to create valid models of H1N1 dynamics in Ontario and Canada, which were used to provide policy guidance to provincial and national public health leaders in the following months, including to build a mathematical model of vaccine policy that helped develop the national strategy around prioritization of risk groups for immunization (Tuite AR et al., *Optimal pandemic influenza vaccine allocation strategies for the Canadian population*, PLoS ONE 2010).

1.2.b. Cholera in Haiti, 2010-11

I have subsequently collaborated in a similar manner with the United States Centres for Disease Control in creating a model that correctly projected the path of cholera epidemics in Haiti in 2009 and 2010 (see Tuite A.R., *Cholera epidemic in Haiti, 2010: using a transmission model to explain spatial spread of disease and identify optimal control interventions.* Annals of Internal Medicine 2011). In October 2010, cholera emerged in Haiti, a country which had never previously experienced epidemic cholera and which had been cholera-free for at least 50 years. At that time, Dr. Nathaniel Hupert (Director of Disaster Modeling for the United States CDC), contacted me regarding the possibility of model-based guidance on the likely future contours and timing of the Haitian cholera epidemic.

Future program of research: In addition to our model (published as mentioned above), this effort included provision of guidance and education via teleconferences and webinars to CDC personnel. Our cholera collaborative group incudes Dr. Joe Tien, at Ohio State University; while our work for CDC was *pro bono*, follow-on activities have been the subject of a successful grant submission by Dr. Tien, myself, and Dr. Marissa Eisenberg, which will allow us to continue our work on the impact of water quality on cholera risk in Haiti. This effort will also include Master's of Public Health students from the Dalla Lana School of Public Health.

1.2.c. Sexually Transmitted Infections in Philadelphia and Ontario

Sexually transmitted infections are the most common notifiable infectious diseases in Canada and the United States. Surging rates of chlamydia and syphilis, and the emergence of multi-drug resistant gonorrhoea, represent a major crisis in the control of these infections.

Future program of research: I am currently engaged in work, supported by the Canadian Institutes for Health Research, the Public Health Agency of Canada, the Ontario AIDS Bureau, and the National Collaborative Centre for Infectious Diseases, that uses such techniques to develop strategies for management of chlamydia and syphilis outbreaks currently active in Ontario. These models will help public health agencies to devise smarter and more efficient strategies for the control of sexually transmitted infections.

2. Dynamic Modeling of Infectious Diseases for Health Policy and Economic Evaluation

Much of my current work focuses on optimal means of evaluating the benefits and cost- effectiveness of communicable disease control interventions. As I learned as a post-doctoral research fellow at the Harvard Centre for Risk Analysis, methodologies developed for assessment of cost-effectiveness of health technologies and interventions often assume that the risk of disease in a population is stable over time; this is not the case with communicable diseases. This has important health economic implications: prevention of a case of communicable disease may also prevent the entire future stream of additional cases that would have resulted from transmission by that one individual. Furthermore, preventive interventions, such as vaccination, depend on broad community uptake in order for individuals to benefit from their application. I use my skills in cost-effectiveness analysis and epidemic modeling to simulate infectious disease processes and their costs and consequences. The effects of interventions can then be evaluated by comparing models with interventions to models without interventions; in other words, models present an efficient and compact platform for the exploration of the *epidemiological*

counterfactual. I have authored or coauthored several publications that have applied this framework to infectious diseases including SARS, vancomycin-resistant Enterococcus, and herpes simplex viruses. I developed a method for utility-based assessment of health related quality of life in genital herpes (Fisman DN, *Sexually Transmitted Infections* 2005) which can be used to compare the health-economic attractiveness of herpes-control interventions to other commonly accepted health interventions.

My team contributed some of the first health economic evaluations of pandemic influenza immunization, and I collaborated with other investigators from University of Toronto, University of Guelph, Georgia Technological Institute, and Emory University in performing parallel investigations for Canadian and U.S. populations. More recent health economic work has focussed on cost-effective approaches to the control of sexually transmitted diseases and whooping cough (pertussis). Importantly, these evaluations have shown that policy optima often change when the transmissible nature of communicable diseases is taken into account. For example, in work performed in collaboration with the Philadelphia Department of Public Health's STD screening program, we showed that for a given prevalence of chlamydia in females, cost-effectiveness of screening in males is *inversely* related to prevalence, as infected individuals in low-prevalence male populations present "high-value targets" for screening programs (Fisman DN, *Sexually Transmitted Diseases* 2008). This finding helped overturn existing dogma on screening of males for chlamydia. More recent work on pertussis transmission in the neonatal intensive care unit, performed in collaboration with Dr. Amy Greer, shows that low levels of pertussis boosting in healthcare workers are likely to be adequate for the prevention of outbreaks when patient care networks are considered; high levels of coverage become cost-effective only in the face of community-based outbreaks. This finding provides an intuitive and manageable strategy for healthcare institutions seeking to protect vulnerable patients in the face of limited resources (Greer AL and Fisman DN, *Pediatrics* 2011).

My expertise in the economic evaluation of communicable disease control methodologies is recognized by my international peers. I have taught numerous workshops on dynamic modeling methods for health economic evaluation at the Annual Meeting of the Society for Medical Decision Making (SMDM) and at the International Society for Pharmacoepidemiology and Outcomes Research (ISPOR). In 2010, I was asked to join the joint international expert working group of ISPOR and SMDM on best practices for mathematical modeling of communicable diseases for economic evaluation. These guidelines are forthcoming in the journals Medical Decision Making and Value in Health. I was also a member of the international expert working group on economic evaluation of the Society for Healthcare Epidemiology of America (2007).

3. Pathogen-Environment Interactions, Seasonality, and Climate Change: Impacts on Infectious Diseases

Seasonality is a well-described attribute of communicable diseases but remains poorly understood. Seasonal environmental influences might enhance infectious disease risk in two general ways: first, average background seasonal climatic effects may provide the necessary environmental "backdrop" for increased disease incidence due to enhanced pathogen survival, transmission or invasion or host susceptibility. Second, acute, intermittent, seasonally specific weather events (e.g., cold snaps or heavy rains) could acutely increase disease risk due to enhanced pathogen transmissibility or virulence, or host susceptibility. I have created a body of work that has contributed in important ways to the understanding of seasonality of infectious diseases in ongoing work on the application of both case-crossover methods and time series methods to a variety of bacterial and protozoan infectious diseases, including legionellosis, pneumococcal disease, invasive meningococcal disease, campylobacteriosis, and giardiasis.

While my interest in this area emerged when I was a Medical Officer of Health in Hamilton in 2001-2003, my first important publication on seasonality related to an exploration of environmental drivers of legionellosis (a.k.a., Legionnaire's disease) in Philadelphia, Pennsylvania in 2005-06. Philadelphia had

had a remarkable surge in legionellosis burden during a year with unusually large amounts of rainfall. I was approached by the Philadelphia Department of Public Health regarding an evaluation of this phenomenon. I used case-crossover methodology to explore acute environmental impacts on case occurrence; this methodology implicitly controls for between individual variability in risk (due to self-matching) and also controls for the underlying seasonal periodicity of infectious diseases like legionellosis. We found temperature surges and humidity to independently explain the surge in legionellosis risk, a finding that has subsequently been validated in the United States, Spain and the Netherlands. The approach taken in this study formed the basis for a subsequent grant submission, which was funded by the National Institute of Allergy and Infectious Diseases, and which permitted similar analyses of the epidemiology of other seasonal pathogens (campylobacteriosis, pneumococcal disease, invasive meningococcal disease, and giardiasis) in Philadelphia. I was also invited to write a review of the topic of disease seasonality for the Annual Review of Public Health (*Fisman DN* 2007), which has itself been widely cited (38 citations, per Science Citations Index). My work on seasonality of infectious diseases has had tremendous relevance to the growing concern around climate change and infectious disease patterns. In 2008 I was senior responsible author on a scoping review of climate change and infectious diseases, published in the Canadian Medical Association Journal, which drew attention to this issue. My expertise in this regard has resulted in my being an invited speaker on this issue in Canada, the United States, and the United Kingdom, and in 2010 I was asked to serve as an expert on climate change and disease transmission for a taskforce of the Institute of Medicine, which recently (June 2011) published producing a report entitled Climate Change, the Indoor Environment, and Health. My work on legionellosis (noted above) is cited in this report. I have also worked hard to engage the public on this issue, for example by taking part in a Café Scientifique in Toronto on climate change and infectious diseases in 2009.

Upon my relocation to Toronto in 2006, I continued this work on legionellosis, norovirus, and invasive pneumococcal and meningococcal disease in the Greater Toronto Area. The work on legionellosis and norovirus re-emphasized the importance of the physical environment (and local watersheds in particular) in the occurrence of these diseases. Further work evaluated the disparate contributions of the physical environment and influenza to invasive pneumococcal disease and invasive meningococcal disease incidence in central Ontario (see Tuite AR et al., *PLoS ONE*, 2010; and Kuster SP et al., *PLoS Medicine*, 2011). This work validated earlier observations from Philadelphia on the importance of ambient ultraviolet radiation as a driver of the seasonality of invasive pneumococcal disease, but also demonstrated the key role influenza plays in driving the wintertime burden of invasive bacterial diseases in Ontario.

Future program of research: This finding has important implications for influenza control policy in Ontario and Canada. This work formed the basis for a grant, awarded by the Canadian Institutes for Health Research (Institute of Population and Public Health) on coseasonality of influenza and invasive bacterial disease across diverse geographical regions (including 4 Canadian provinces, 3 U.S. states, 4 regions of France, and 6 Australian cities). We are currently collaborating with international colleagues to complete these analyses.

4. Clinical Epidemiology of Infectious Diseases in the Healthcare Setting

In addition to my experiences and contributions to public health practice in Canada and the United States, I am trained as a specialist physician in clinical infectious diseases, and have a body of work that focuses on the use of epidemiology as a tool to improve the clinical practice of infectious diseases. Key areas of research related to clinical infectious disease practice have included a large case-crossover study of needlestick injuries in healthcare workers, extensive work on infection-related outcomes using a clinical quality improvement database, and application of decision analysis and cost-effectiveness analysis to clinical infectious disease issues.

4.1. Needlesticks and other Sharps-Related Injuries

Needlesticks and other sharps-related injuries constitute a major source of costs and healthcare worker concern for healthcare institutions; it has been estimated that such injuries are a source of $1 billion in excess costs in the United States each year. The diversity of healthcare worker job types, expertise, and experience in performing procedures makes case-control studies of these injuries challenging. I collaborated with Dr. Murray Mittleman of Harvard University and Dr. Anthony Harris of University of Maryland on an innovative case-crossover study of needlesticks from 2001-2006. The study, which was funded by the National Institute of Occupational Safety and Health, included 683 subjects from six hospitals, recruited after injury. Using a usual-frequency case-crossover approach, we were able to document the association between needlesticks and common workplace exposures. Of particular importance, we were able to demonstrate the impact of fatigue on injury risk in interns and residents, a finding that following publication (Fisman DN et al., *Infection Control and Hospital Epidemiology*, 2007) was incorporated into the Institute of Medicine's report on resident duty hours and fatigue (Resident Duty Hours: Enhancing Sleep, Supervision, and Safety), which was in turn a key document used for the restructuring of resident duty hours by the Accreditation Counsel on Graduate Medical Education in the United States.

4.2. Evaluation of Infectious Outcomes using a Clinical Quality Database

From 2003 to 2006, I was on faculty at the Drexel University School of Public Health. Links between Drexel-affiliated teaching hospitals and the Tenet Healthcare System created opportunities to contribute to Tenet's clinical quality improvement efforts using a multi-hospital database (with information on infectious disease outcomes in > 100 hospitals throughout the United States). This collaboration resulted in publications on health benefits associated with vaccination against influenza and pneumococcus in older adults, and also produced a robust clinical prediction rule that can be used to accurately forecast which patients will develop pneumonia after coronary bypass surgery (Kinlin L, et al., *Clinical Infectious Diseases* 2010). I also used this dataset to perform (with Caitlin McCabe, a summer student) an analysis documented the survival benefit conferred upon patients when their physicians follow clinical practice guidelines for community-acquired pneumonia (McCabe CJ et al., Archives of Internal Medicine, 2009). Taken together these efforts enhance the credibility of clinical practice guidelines for individuals with infectious diseases, and should help reduce the risk of infectious outcomes in hospitalized patients.

4.3. Application of Decision Science to Clinical Infectious Diseases

My skill set in clinical decision analysis, meta-analysis and health economic analysis has allowed me to contribute to the literature guiding patient care for individuals with infectious diseases. Important papers have been published in the area of orthopaedic infection; antibiotic choice for individuals with pneumonia; optimal use of serological testing for the prevention of herpes virus infections in newborns; best practices for the management of HIV infection in pregnancy; and optimal management of empyema in children. My work in this area facilitates the evidence-based, cost-efficient practice of medicine by infectious disease clinicians.

5. Evolution of Research Interests and Future Research Directions (5-Year Time Horizon)

The challenge of infectious diseases rests in their diversity and changeability. What I bring to their study is command of a broad array of methodological tools, as well as a substantial body of real-world experience in the clinical and public health realms. However, this diversity and changeability makes me reluctant to tie myself firmly to any single pathogen or clinical entity: as SARS, pandemic influenza, and cholera show, some of my best work has been performed in the face of *unexpected crises in public health*. As such, the evolution of my work requires that I maintain and build ties with local, national and international public health partners, which I continue to do. As evinced by records of recent contract work, my skills are currently in heavy demand by Public Health Agency of Canada as it strives to meet emerging public health challenges. However, maintenance of such ties, and relevance in times of crisis,

requires ongoing educational efforts (for students and trainees, such that they have relevant skill sets when called upon) and knowledge translation activities for public health and clinician stakeholders, such that they are aware of the ways in which quantitative methods can benefit outbreak control efforts.

A second key challenge I have identified as my research has evolved involves translation of research results to policy. In particular, I have learned how difficult it is to integrate quantitative data on risk and uncertainty into the political decision-making process. I have recently been invited to become involved in a series of roundtables on emerging and persistent infectious diseases (surveillance, mitigation, and prevention) sponsored by the US-based Institute on Science for Global Policy (http://www.scienceforglobalpolicy.org/), which identifies leading scientists and political decision makers, and invites them to participate in debates regarding scientific policy. I hope to take the insights I have gained from ISGP workshops and apply them to help make my group's work increasingly policy-relevant.

Three specific areas where I see my research growing in the next five years are as follows:

1. Disease dynamics and health economics: As noted above, I am held in high regard by my international peers for my expertise in applying mathematical modeling and disease dynamics to health policy (as evinced by my invitation to help write the ISPOR-SMDM best-practices guidelines referred to elsewhere in this document). I see abundant opportunities to continue to expand our work that captures the economic benefits of immunization, while considering the positive and negative externalities (indirect effects) of immunization. In particular, current discussions with such industry partners as GlaxoSmithKline and Sanofi Pasteur focus on funding for work related to optimal strategies for pertussis immunization and on the economic attractiveness of vaccine stockpiling in Canada (such stockpiles are extant in the United States but not here). Other work in progress on disease dynamics includes a rapid "epidemic forecaster" that provides information on turning-points, outbreak durations, and rate of change in reproductive numbers; this work, which has been completed in collaboration with Dr. Amy Greer, Ashleigh Tuite, and a University of Toronto medical student (Tanya Hauck) will be presented in November 2011 at the Epidemics 3.0 conference in Boston.

2. From local to global: vaccines and counterfactuals: As noted above, my disease modeling activities to date have largely focussed on the present day North American context. However, recent discussions with colleagues both at Toronto Public Health (TPH) and in the vaccine industry have reinforced the degree to which modeling can be used as a tool to help decision-makers understand the silent "public good" that has been created by immunization. Recent vaccine-related health scares (e.g., the now discredited suggestion that MMR vaccine is linked to autism) have resulted in falling vaccine uptake in North America and Europe, with resultant resurgence in disease. However, in areas where outbreaks have not occurred, the impetus for keeping vaccine coverage high may be absent. Models can be used to demonstrate explicitly the good that is created via maintenance of high levels of immunization coverage.

In addition to demonstrating the value of immunization programs at current levels (or enhanced levels of coverage) in wealthy countries, we can also use the existing models our group has created (on influenza, pertussis, and norovirus dynamics) in the context of developing countries, in order to demonstrate the health economic benefits that would accrue if these countries were to invest heavily in improving immunization coverage. An emerging partnership with Dr. Prabhat Jha and the Centre for Global Health Research promises to provide abundant opportunities to evaluate novel and efficient approaches to improved immunization coverage in India.

2. The physical environment, infectious diseases, and public health:

As noted above, my interests in disease seasonality have resulted in my having significant input into current debates on climate change and infectious diseases in the North American context. They have also resulted in my playing roles in both the Canadian Community of Practice on EcoHealth (COPEH-Canada) and the One Health Initiative. Moving forward, I anticipate that our work on seasonality and

environment will continue to inform these debates in important ways, particularly via work on waterborne disease and respiratory infection. Our current CIHR-funded grant on disease seasonality has created a wide web of collaborators, and this network can be leveraged for future within- and across-region analyses that evaluate the degree to which infectious disease risk is being enhanced or mitigated by environmental change.

D. RESEARCH GRANTS AND CONTRACTS

(Principal investigator(s) underlined)

Principal investigator

2018-2020 **Fisman DN (PI),** Greer AL, Ellen M, Lofmark S, Hulth A, Daneman N. An Online Platform for Expanding Antibiotic Stewardship: OPEN Stewardship. Joint International Program on Antimicrobial Resistance/CIHR. 460,564 to Canadian site. $800,000 total.

2015-2018 **Fisman DN (PI),** Greer AL (co-PI)**.** One Health In Action: Linking Human and Animal Data Sources to Understand and Prevent Enteric Disease in Ontario (#343143). CIHR Operating Grant ($100,000)

2015-2019 **Fisman DN (PI)**, Tuite AR, Hatchette T, Drews S, Gubbay J**.** Seasonal Influenza Forecasting in Real Time using the IDEA Model. Canadian Immunization Research Network. ($37,076).

Fisman DN (PI). Cost Effectiveness of Decennial Booster Dosing of Acellular Pertussis Vaccine: A Dynamic Modeling Approach. Canadian Immunization Research Network. ($38,021).

2013 **Fisman DN (PI).** FitzGerald Seminar Series in Communicable Disease Epidemiology (unrestricted educational grant). Novartis Pharma Canada Inc., Merck Canada Inc. and GlaxoSmith Kline Inc. ($40,000)**.**

2012 **Fisman DN (PI).** FitzGerald Seminar Series in Communicable Disease Epidemiology (unrestricted educational grant). Novartis Pharma Canada Inc. ($31,000)**.**

2011 **Fisman DN (PI).** FitzGerald Seminar Series in Communicable Disease Epidemiology (unrestricted educational grant). Novartis Pharma Canada Inc. ($38,400)**.**

2011-2014 **Fisman DN,** Allen VG, Gesink D, Garay JR, Greer A. *Untangling the web: understanding the abrupt increase in chlamydia risk in Ontario through applied epidemiology and mathematical modeling.* Canadian Institutes of Health Research Operating Grant. ($247, 423).

2010-2012 **Fisman DN**, Kwong J, McGeer A, Drews S, Pourbohloul B, Buckeridge D. *Wintertime Seasonality of Influenza and Invasive Bacterial Disease: Influence of Environment, Pathogen Interactions, Time Scales, and Geography.* Canadian Institutes for Health Research Institute of Infection and Immunity and Population and Public Health. ($227,612).

2009 **Fisman DN**, Wu J, Crowcroft N, Moore K. *Signal Detection 2009* (conference at OAHPP on linkage between public health surveillance and mathematical modeling). Mathematics of Information Technology and Complex Systems (MITACS) grant. ($7,500).

2007-2010 **Fisman DN**. *Keeping Vulnerable Children Safe from Pertussis: Cost-Effective Strategies for Ontario Hospitals as Whooping Cough Returns.*Ontario Ministry of Innovation Early Researcher Award. ($150,000).

2006-2008 **Fisman DN**, Johnson C. *Seasonality, environment, and infectious disease occurrence.* National Institute of Allergy and Infectious Diseases (R21AI065826-01A1). ($200,000).

2002-2003 **Fisman DN**, Cividino M, Harris AD, Mittleman MA. *Case-crossover study of sharps related injuries.* City of Hamilton, Social and Public Health Services Department, Public Health Research, Education and Development Program, Hamilton, Ontario. ($11,400).

2002 **Fisman DN**, Sheehan D. *Assessment of health-related quality of life in individuals with symptomatic and asymptomatic genital herpes infection.* City of Hamilton, Social and Public Health Services Department, Public Health Research, Education and Development Program, Hamilton, Ontario. ($6,000).

1999-2001 **Fisman DN**. Agency for Healthcare Research and Quality. National Research Service Award #5-T32-HS00020-15. ($50,000).

1995 **Fisman DN**, Tamblyn R. *Survival after percutaneous endoscopic gastrostomy in the elderly.* Department of Medicine, Royal Victoria Hospital, Montreal, Quebec. ($500).

1992 **Fisman DN**. *Medicine, Fraud, and Puritanism in 17th century England*. Osler Studentship in the History of Medicine. McGill University, Montreal, Quebec.($5,000).

1990 **Fisman DN**, LaChance M. *Taxonomic evaluation of yeasts through protein gel-electrophoresis.* Natural Science and Engineering Research Council Scholarship. Western University, London, Ontario. ($5,000).

Co-investigator

2013-2017 Burchell A, Allen V, Tan D, Cooper C, Fisman D, Gardner S, Gough K, MacPherson P, Raboud J, Rachlis A, Remis RS, Rourke SB, Walmsley S. Enhanced syphilis screening among HIV-positive men who have sex with men: Evaluation of a clinic-based intervention. Canadian Institutes for Health Research (#300246). ($411,244).

2011-2014 Tien J, **Fisman DN**, Eisenberg M. Modeling the effects of heterogeneity in water quality on cholera disease dynamics. National Science Foundation (US) ($978,123).

2010-2013 Wu J, **Fisman DN**, Moghadas S, Sahai B, Dean C, Brauer F, Webb G, Zhu H, Belair J, Watmmough J, Heffernan J, Khan K, Arino J, Wang L, Rioux M, Gardam M, Li M, Madras N, Yan P, van den Driessche P, Ruan S, Day T, Jacobson Z. York-MITACS Centre for Disease Modeling. *Transmission Dynamics and Spatial Spread of Infectious Diseases: Modelling, Prediction and Control.* Mathematics, Information Technology and Complex Systems Nation al Centre of Excellence. ($198,000).

2010-2012 Mishra S, **Fisman DN**. *Assessing the Impact of Undiagnosed Syphilis on the Transmission of Syphilis and HIV in Ontario: Epidemiological evaluation of co-infection and development of a disease transmission model.* Canadian Institutes for Health Research Public Health Fellowship. ($100,000), (deferred).

2009-2010 Pourbohloul B, **Fisman DN**, Buckeridge D, Arino J, Dushoff J, Earn DJD, Moghadas S, Wu J. *Pan-Canadian Decision-Making Support Network for Pandemic Preparedness. ("CanPan").* Emergency Supplementary Funding, Canadian Institutes for Health Research Catalyst Grant (Pandemic Preparedness). ($700,000).

2009 Wu J, **Fisman D**, Moghadas S. MITACS *Accelerate Internship in Mathematical Modeling of Infectious Diseases* ($45,000 with $45,000 match from Ontario Agency for Health Protection and Promotion). ($90,000).

2008-2009 Pourbohloul B, Bauch C, Beauchemin C, Brauer F, Buckeridge D, Dean CB, Dushoff J, Earn DJD, **Fisman DN**, Khan K, McGeer AJ, Tellier R, Moghadas S, Wu J. *Pan-Canadian Decision-Making Support Network for Pandemic Preparedness ("CanPan").* Canadian Institutes for Health Research Catalyst Grant (Pandemic Preparedness). ($100,000).

2008-2009 Moghadas S, Wu J, Pizzi N, **Fisman DN**, Yan P, Driedger M, Roos L, Alexander M. *Evaluation of Mitigation Strategies for Pandemic Preparedness in Canada.* Canadian Institutes for Health Research Catalyst Grant (Pandemic Preparedness). ($94,750).

2007-2009 To T, Stanbrooke M, Crichton E, Guttman A, **Fisman DN**, Wang C. *Respiratory population-based outcomes network: Studies and evaluations (RESPONSE).* Canadian Institutes of Health Research (CIHR) Partnerships for Health System Improvement (PHSI). ($87,715).

2003-2004 Abrutyn E, Kirchner C, **Fisman DN**, Kim Y, Dhond AJ. *Center for study of hospital acquired infections.* Tenet Healthcare Foundation, Dallas TX (GFW 11595). ($1,004,000 US).

2002-2006 Mittleman MA, **Fisman DN**, Harris AD, Sorock G. *A case-crossover study of sharps-related injuries.* Centers for Disease Control and Prevention (CDC). National Institute for Occupational Safety and Health, Atlanta, GA. ($1,076,531 US).

2002 Redwood-Campbell L, Kaczorowski J, **Fisman DN**. *Improving pap smear screening in immigrant women.* City of Hamilton, Social and Public Health Services Department, Public Health Research, Education and Development Program. ($14,000).

2002 Gardam M, Tsang L, Petrich A, Jamieson F, **Fisman DN**. *Molecular epidemiology of tuberculosis in the Greater Toronto Area 1999-2001*. National Sanatorium Foundation. 2002.

2000-2001 Mittleman MA, **Fisman DN**, Sorock G, Harris AD. *Case-crossover study of sharps-related injuries in healthcare workers.* Harvard-Liberty Department of Occupational and Environmental Health. Harvard School of Public Health. ($100,000 US)

Supervisor

2015-2016 Tahmina Nasserie, Canadian Immunization Research Network Studentship ($10,000). Using IDEA to forecast seasonal influenza.

2015-2016 Ashleigh McGirr, Canadian Immunization Research Network Studentship ($25,000). Agent based model of pertussis transmission in Ontario.

2014-2016 Dr. Derek MacFadden, CIHR Doctoral Award ($275,000). ResistanceOpen: Developing a Global Map of Regional Antimicrobial Resistance.

2012-2015 Ashleigh McGirr, CIHR Doctoral Award (Banting and Best), ($105,000). Evaluating vaccination strategies to contain the spread of pertussis in Canada.

2012-2015 Ashleigh Tuite, CIHR Doctoral Award (Banting and Best), ($70,000). Evaluating vaccination strategies to contain the spread of pertussis in Canada.

2010-2013 Kevin A. Brown, CIHR Doctoral Award (Banting and Best), ($105,000). Developing a clinical prediction rule for hospital-acquired Clostridium difficile infection to enable inter-institution comparisons of incidence rates and promote quality improvement.

Research Contracts

2012-2013 **Fisman DN**, Tuite AR. Toronto Unvaccinated: Estimating the Impact of Vaccination on Toronto's Health. Toronto Public Health, ($25,000).

2011-2012 **Fisman DN**, Tuite AR. *Mathematical modeling of novel partner notification strategies for communicable disease control.* National Collaborating Centre for Communicable Diseases, ($25,000).

2011-2012 **Fisman DN**, Mishra S, Tuite AR. *Mathematical modeling of syphilis/HIV testing strategies in Ontario*. Ontario AIDS Bureau/Public Health Agency of Canada/Hassle Free Clinic (Toronto), ($25,000).

2011 **Fisman DN**, Tuite AR. *Estimation of the health and economic burden of Chlamydia trachomatis infection in Canada.* Public Health Agency of Canada, ($10,000).

2011 **Fisman DN**. *Health economic evaluation of rotavirus vaccine in Canada*. Public Health Agency of Canada, ($6,000).

2010-2011 **Fisman DN,** Tuite AR. *Mathematical modeling of the impact of an adjuvanted influenza vaccine*. Novartis Vaccines Canada. ($35,000).

2010 **Fisman DN**, Tuite AR. *Mathematical modeling of pertussis under-reporting in Ontario.* GlaxoSmithKline Canada. ($50,000).

2009-2010 **Fisman DN**, Greer A. *Mathematical modeling of optimal control strategies for Chlamydia trachomatis in Canada*. Public Health Agency of Canada. ($25,000).

Career summary of research funding

SUMMARY OF RESEARCH FUNDING (PEER-REVIEWED GRANTS AND CONTRACTS)

	Past	Current	Career Total
Total Grants as Principal Investigator	$732,412	$287,423	$1,019,835
Total Grants as Co-Investigator	$3,366,996	$1,281,123	$4,648,119
Total Grants	$3,840,796	$1,787,158	$5,667,954

Total Contracts	$176,000	$25,000	$201,000
Total Grants and Contracts	**$4,016,796**	**$1,812,158**	**$5,868,954**

ALL GRANTS – PRINCIPAL INVESTIGATOR

Funder	Years	Role	Team	Amount	Title
Novartis Pharma Canada Inc.	01.2013-12.2013	Nominated PI	Vasilevska, M	$40,000	*FitzGerald Seminar Series in Communicable Disease Epidemiology (Knowledge Translation Activity)*
Novartis Pharma Canada Inc.	01.2012-12.2012	Nominated PI	Vasilevska, M	$31,000	*FitzGerald Seminar Series in Communicable Disease Epidemiology (Knowledge Translation Activity)*
Novartis Pharma Canada Inc.	07. 2011-12. 2011	Nominated PI	Vasilevska, M	$38,400	*FitzGerald Seminar Series in Communicable Disease Epidemiology (Knowledge Translation Activity)*
CIHR, Operating Grant	10.2011-09.2014	Nominated PI	Allen AG, Gesink D, Garay JR, Greer A.	$247, 423	*Untangling the web: understanding the abrupt increase in chlamydia risk in Ontario through applied epidemiology and mathematical modeling.*
CIHR, Operating Grant	10.2010-09.2012	Nominated PI	Kwong J, McGeer A, Drews S,	$227,612	*Wintertime Seasonality of Influenza and*

Funder	Years	Role	Team	Amount	Title
			Pourbohloul B, Buckeridge D.		*Invasive Bacterial Disease: Influence of Environment, Pathogen Interactions, Time Scales, and Geography*
MITACS – Mathematics of Information Technology and Complex Systems	2009	Nominated PI	Wu J, Crowcroft N, Moore K.	$7,500	*Signal Detection 2009* (conference at OAHPP on linkage between public health surveillance and mathematical modeling).
Ontario Ministry of Innovation Early Researcher Award.	10.2008-09.2010	Nominated PI	N/A	$150,000	*Keeping Vulnerable Children Safe from Pertussis: Cost-Effective Strategies for Ontario Hospitals as Whooping Cough Returns.*
National Institute for Allergy and Infectious Diseases (R21AI065826-01A1).	09.2006-08.2008	PI	Johnson C.	$200,000	*Seasonality, environment, and infectious disease occurrence*
City of Hamilton, Social and Public Health Services Department, Public Health Research, Education and Development Program, Hamilton, Ontario	2002-2003	Nominated PI	Cividino M, Harris AD, Mittleman MA.	$11,400	*Case-crossover study of sharps related injuries*
City of Hamilton, Social and	2002	Nominated PI	Sheehan D.	$6,000	*Assessment of health-related quality of life in*

Funder	Years	Role	Team	Amount	Title
Public Health Services Department, Public Health Research, Education and Development Program, Hamilton, Ontario					*individuals with symptomatic and asymptomatic genital herpes infection*
Agency for Healthcare Research and Quality	1999-2001	Nominated PI	N/A	$50,000	National Research Service Award #5-T32-HS00020-15
Department of Medicine, Royal Victoria Hospital, Montreal, Quebec	1995	Nominated PI	Tamblyn R	$500	*Survival after percutaneous endoscopic gastrostomy in the elderly*
Osler Studentship in the History of Medicine. McGill University, Montreal, Quebec	1992	Nominated PI	N/A	$5,000	*Medicine, Fraud, and Puritanism in 17th century England*
Natural Science and Engineering Research Council Scholarship. Western University, London, Ontario	1990	Nominated PI	LaChance M.	$5,000	*Taxonomic evaluation of yeasts through protein gel-electrophoresis*
				$1,019,835 AWARDED	

ALL GRANTS – CO-INVESTIGATOR

Funder	Years	Role	Team	Amount	Title
National Science Foundation (US)	08.2011-07-2014	CI	Tien J (PI), Fisman DN, Eisenberg M.	$978,123	*Modeling the Effects of Heterogeneity in Water Quality on Cholera Disease Dynamics*
MITACS Centre for Disease Modeling	04.2010-03.2013	CI	Wu J (PI), Moghadas S, Sahai B, Dean C, Brauer F, Webb G, Zhu H, Belair J, Watmmough J, Heffernan J, Khan K, Arino J, Wang L, Rioux M, Gardam M, Li M, Madras N, Yan P, van den Driessche P, Ruan S, Day T, Jacobson Z.	$198,000	*Transmission Dynamics and Spatial Spread of Infectious Diseases: Modelling, Prediction and Control*
CIHR Doctoral Award—Banting and Best	09.2010-08-2013	Supervisor	Daneman, N Brown, K	$105,000	*Epidemiology of Clostridium difficile in Canada*
CIHR Fellowship-Health Professionals	06.2010-06.2012	Supervisor	Mishra S.	$100,000	*Assessing the Impact of Undiagnosed Syphilis on the Transmission of Syphilis and HIV in Ontario: Epidemiological evaluation of co-infection and development of a disease transmission model.*

Funder	Years	Role	Team	Amount	Title
CIHR Catalyst Grant Emergency Supplementary Funding, Pandemic Preparedness	10.2009-09.2010	CI	Pourbohloul B, (PI) Buckeridge D, Arino J, Dushoff J, Earn DJD, Moghadas S, Wu J.	$700,000	*Pan-Canadian Decision-Making Support Network for Pandemic Preparedness.* *"CanPan"*
MITACS ($45,000 with $45,000 match from Ontario Agency for Health Protection and Promotion).	2009	CI	Wu J, Moghadas S.	$90,000	*Accelerate Internship in Mathematical Modeling of Infectious Diseases*
CIHR Catalyst Grant Emergency Supplementary Funding, Pandemic Preparedness	10.2008-09.2009	CI	Pourbohloul B (PI), Bauch C, Beauchemin C, Brauer F, Buckeridge D, Dean CB, Dushoff J, Earn DJD, Khan K, McGeer AJ, Tellier R, Moghadas S, Wu J.	$100,000	*Pan-Canadian Decision-Making Support Network for Pandemic Preparedness "CanPan"*
CIHR Catalyst Grant Pandemic Preparedness	10.2008-09.2009	CI	Moghadas S (PI), Wu J, Pizzi N, Yan P, Driedger M, Roos L, Alexander M.	$94,750	*Evaluation of Mitigation Strategies for Pandemic Preparedness in Canada*

Funder	Years	Role	Team	Amount	Title
CIHR Partnerships for Health System Improvement (PHSI)	08.2007-07.2009	CI	To T (PI), Stanbrooke M, Crichton E, Guttman A, Wang C.	$87,715	*Respiratory population-based outcomes network: Studies and evaluations (RESPONSE)*
Tenet Healthcare Foundation, Dallas TX (GFW 11595).	2003-2004	CI	Abrutyn E, Kirchner C, Kim Y, Dhond AJ.	$1,004,000 ($US)	*Center for study of hospital acquired infections.*
Centers for Disease Control and Prevention (CDC). National Institute for Occupational Safety and Health, Atlanta, GA.	2002-2006	CI	Mittleman MA, Harris AD, Sorock G.	$1, 076,531 ($US)	*A case-crossover study of sharps-related injuries.*
City of Hamilton, Social and Public Health Services Department, Public Health Research, Education and Development Program	2002	CI	Redwood-Campbell L, Kaczorowski J	$14,000	*Improving pap smear screening in immigrant women*
National Sanatorium Foundation	2002	CI	Gardam M, Tsang L, Petrich A, Jamieson F	---	*Molecular epidemiology of tuberculosis in the Greater Toronto Area 1999-2001*
Harvard-Liberty Department of Occupational and Environmental Health. Harvard School of Public Health	2000-2001	CI	Mittleman MA, Sorock G, Harris AD	$100,000 ($US)	*Case-crossover study of sharps-related injuries in healthcare workers.*
				$4,648,119 AWARDED	

ALL CONTRACTS

Funder	Years	Role	Team	Amount	Title
Toronto Public Health	2012-2013	Nominated PI (for Decision Centre for Infectious Disease Epidemiology (DeCIDE)	Tuite AR, McGirr A, Hum R	$25,000	*Toronto Unvaccinated: Estimating the Impact of Vaccination on Toronto's Health*
National Collaborating Centre on Infectious Diseases (NCCID)	2011-12	Nominated PI	Tuite AR	$25,000	*Mathematical modeling of novel partner notification strategies for communicable disease control.*
Ontario AIDS Bureau and Hassle-Free Clinic (Toronto)	2011-12	Nominated PI	Tuite AR, Mishra S	$25,000	*Mathematical modeling of syphilis/HIV testing.*
Public Health Agency of Canada	2011	Nominated PI	---	$6,000	*Health economic evaluation of rotavirus vaccine in Canada.*
Public Health Agency of Canada	2011	Nominated PI	Tuite AR	$10,000	*Estimation of the health and economic burden of Chlamydia trachomatis infection in Canada.*
Novartis Vaccines Canada	2010-2011	Nominated PI	Tuite AR	$35,000	*Mathematical modeling of the impact of an adjuvanted influenza vaccine*
GlaxoSmithKline Canada	2010	Nominated PI	Tuite AR	$50,000	*Mathematical modeling of pertussis under-reporting in Ontario*
Public Health Agency of Canada	2009-2010	Nominated PI	Greer A	$25,000	*Mathematical modeling of optimal control strategies for Chlamydia trachomatis in Canada*

Funder	Years	Role	Team	Amount	Title
				$201,000 AWARDED	

Legend

CIHR: Canadian Institutes for Health Research

MITACS: Mathematics of Information Technology and Complex Systems

E. PUBLICATIONS

Notes regarding authorship and contributions

I believe strongly that the experience of preparing and submitting research for publication is an invaluable component of scientific training, and is a core component of my mentorship strategy. As such, I frequently encourage students, trainees, and junior research officers, where appropriate, to serve as lead authors on publications. As such, in many of the papers below, on which I am listed as senior responsible author, I have contributed in a manner that would also have made first authorship reasonable.

Peer reviewed publications (* student/trainee)

Journal articles

Peer reviewed publications

129. Logar-Henderson C*, Ling R*, Tuite A, **Fisman DN**. Effects of Large-Scale Oceanic Phenomena on Non-Cholera Vibriosis Incidence in the United States: Implications for Climate Change. *Epidemiology and Infection* 2019; in press.

128. Nasserie T*, Tuite AR, Whitmore L, Hatchette T, Drews SJ, Peci A, Kwong JC, Friedman D, Garber G, Gubbay J, **Fisman DN**. Seasonal Influenza Forecasting in Real Time Using the Incidence Decay With Exponential Adjustment Model. Open Forum Infect Dis. 2017 Sep 27;4(3):ofx166. doi: 10.1093/ofid/ofx166. eCollection 2017 Summer.

127. Tuite AR, Shaw S, Reimer JN, Ross CP, **Fisman DN**, Mishra S. Can enhanced screening of men with a history of prior syphilis infection stem the epidemic in men who have sex with men? A mathematical modelling study. Sex Transm Infect. 2018 Mar;94(2):105-110. doi: 10.1136/sextrans-2017-053201. Epub 2017 Jul 13.

126. Guthrie JL*, **Fisman D**, Gardy JL. Self-rated health and reasons for non-vaccination against seasonal influenza in Canadian adults with asthma. PLoS One. 2017 Feb 16;12(2):e0172117. doi: 10.1371/journal.pone.0172117. eCollection 2017.

125. Derek MacFadden*, Sarah McGough, **David Fisman**, Mauricio Santillana, and John Brownstein. Antibiotic Resistance Increases with Local Temperature. Nature Climate Change, accepted for publication. [Paper #NCLIM-17050804C]

124. Santillana M, Tuite AR, Nasserie T*, Fine P, Champredon D, Chindelevich L, Dushoff J, **Fisman DN**. Relatedness of the incidence decay with exponential adjustment (IDEA) model, "Farr's law" and SIR compartmental difference equation models. Infectious Disease Modelling. Volume 3, 2018, Pages 1-12. url: https://www.sciencedirect.com/science/article/pii/S2468042718300101?via%3Dihub

123. Brankston G*, Boughen C, Ng V, **Fisman DN,** Sargeant J, Greer AL. Assessing the Impact of Environmental Exposures and Cryptosporidium Infection in Cattle on Human Incidence of Cryptosporidiosis in Southwestern Ontario, Canada. PLoS ONE, accepted for publication [PONE-D-17-14499R1]

122. MacFadden DR*, Bogoch II, Brownstein JS, Daneman N, **Fisman D**, German M, Khan K. A passage from India: Association between air traffic and reported cases of New Delhi Metallo-beta-lactamase 1 from 2007 to 2012. Travel Med Infect Dis. 2015 Jul-Aug;13(4):295-9. doi: 10.1016/j.tmaid.2015.06.003.

121. Tuite AR*, **Fisman DN**. Go big or go home: impact of screening coverage on syphilis infection dynamics. Sexually Transmitted Infections. Sex Transm Infect. 2015 May 7. pii: sextrans-2014-052001. doi: 10.1136/sextrans-2014-052001. [Epub ahead of print]

120. Brown K*, Valenta K, **Fisman D**, Simor A, Daneman N. Hospital Ward Antibiotic Prescribing and the Risks of Clostridium difficile Infection. JAMA Intern Med. 2015 Feb 23. doi: 10.1001/jamainternmed.2014.8273.

119. Majumder MS*, Rivers C*, Lofgren E*, **Fisman D**. Estimation of MERS-Coronavirus Reproductive Number and Case Fatality Rate for the Spring 2014 Saudi Arabia Outbreak: Insights from Publicly Available Data. PLoS Curr. 2014 Dec 18;6. pii: ecurrents.outbreaks.98d2f8f3382d84f390736cd5f5fe133c. doi: 10.1371/currents.outbreaks.98d2f8f3382d84f390736cd5f5fe133c.

118. **Fisman D**, Tuite A*. Projected impact of vaccination timing and dose availability on the course of the 2014 west african ebola epidemic. PLoS Curr. 2014 Nov 21;6. pii: ecurrents.outbreaks.06e00d0546ad426fed83ff24a1d4c4cc. doi: 10.1371/currents.outbreaks.06e00d0546ad426fed83ff24a1d4c4cc.

117. **Fisman D**, Khoo E*, Tuite A*. Early epidemic dynamics of the west african 2014 ebola outbreak: estimates derived with a simple two-parameter model.PLoS Curr. 2014 Sep 8;6. pii: ecurrents.outbreaks.89c0d3783f36958d96ebbae97348d571. doi: 10.1371/currents.outbreaks.89c0d3783f36958d96ebbae97348d571.

116. McGirr A*, **Fisman DN**. Duration of Pertussis Immunity After DTaP Immunization: A Meta-analysis. Pediatrics. 2015 Feb;135(2):331-343.

115. Kleiner-Fisman G, Khoo E*, Moncrieffe N, Forbell T, Gryfe P, **Fisman D**. A randomized, placebo controlled pilot trial of botulinum toxin for paratonic rigidity in people with advanced cognitive impairment. PLoS One. 2014 Dec 23;9(12):e114733. doi: 10.1371/journal.pone.0114733. eCollection 2014.

114. **Fisman D**, Patrozou E, Carmeli Y, Perencevich E, Tuite AR, Mermel LA; Geographical Variability of Bacteremia Study Group. Geographical variability in the likelihood of bloodstream infections due to gram-negative bacteria: correlation with proximity to the equator and health care expenditure. PLoS One. 2014 Dec 18;9(12):e114548. doi: 10.1371/journal.pone.0114548. eCollection 2014.

113. Brown KA*, **Fisman DN**, Moineddin R, Daneman N. The magnitude and duration of Clostridium difficile infection risk associated with antibiotic therapy: a hospital cohort study. PLoS One. 2014

Aug 26;9(8):e105454. doi: 10.1371/journal.pone.0105454. eCollection 2014.

112. Poling J*, Kelly L, Chan C, **Fisman D**, Ulanova M. Hospital admission for community-acquired pneumonia in a First Nations population. Can J Rural Med. 2014 Fall;19(4):135-41.

111. Tuite A, Burchell A, **Fisman DN**. Cost-effectiveness of enhanced syphilis screening among HIV-positive men who have sex with men: a microsimulation model. PLOS One, in press.

110. Brown KA*, **Fisman DN**, Moineddin R, Daneman N. The Magnitude and Duration of Clostridium difficile Infection Risk after Antibiotic Therapy: a Hospital Cohort Study. PLOS One, in press.

109. Vasilevska M, Ku J*, **Fisman DN**. Factors Associated with Healthcare Worker Acceptance of Vaccination: A Systematic Review and Meta-analysis. Infect Control Hosp Epidemiol. 2014 Jun;35(6):699-708. doi: 10.1086/676427. Epub 2014 Apr 17. PMID:24799647.

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Book Chapters

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Commentaries and Selected Letters

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1. **Fisman D**. Syphilis Resurgent in China. Lancet 2007 Jan 13;369(9556):84-5.

F. PRESENTATIONS AT MEETINGS

Invited presentations

International:

52. **Fisman DN**. Climate Change and Infectious Diseases. Pediatric Academic Societies Annual Meeting. Toronto, Canada, May 8, 2018.

51. **Fisman DN**. Impact of Herd Immunity from Influenza Vaccination of Children and Adolescents. European Conference on Clinical Microbiology and Infectious Diseases. Madrid, Spain, April 21-24, 2018.

50 **Fisman DN.** Weather, Climate and Antimicrobial Resistance. European Conference on Clinical Microbiology and Infectious Diseases. Vienna, Austria, April 21-25, 2017.

49. **Fisman DN**. Climate change and infectious diseases dynamics. European Conference on Clinical Microbiology and Infectious Diseases. Amsterdam, The Netherlands, April 11, 2016.

48. **Fisman DN.** Single equation approaches to modeling emerging infectious diseases. Harvard School of Public Health Centre for Infectious Disease Dynamics Seminar Series. Boston, MA, February 26, 2015.

47. **Fisman DN**. Forecast Model 1: Incidence Decay and Exponential Adjustment Model. Forecasting Plenary. World Health Organization--London School of Hygiene and Tropical Medicine Meeting on Ebola Modeling. London, UK, February 16-17, 2015.

48. **Fisman DN** (Moderator). With Amy Greer, Keith Klugman, Xavier Rodo. Things Are Heating Up: Emerging Infectious Diseases and Climate Change. International Meeting on Emerging Infectious Diseases. Vienna, Austria, October 31-November 3, 2014.

47. **Fisman DN.** Indirect effects of climate on disease emergence: Population stress and migration, and emerging infectious diseases. International Meeting on Emerging Diseases, Vienna, Austria, October 31-November 3, 2014.

46. **Fisman DN.** The Incidence Decay and Exponential Adjustment (IDEA) model: a new single equation model to describe epidemics and their simultaneous control. Yale University School of Public Health Epidemiology of Microbial Disease Seminar Series. New Haven CT, October 9, 2014.

45. **Fisman DN.** Climate Change and Infectious Diseases: Knowns and Unknowns. Northeast Branch—American Society of Microbiology and American Society for Clinical Chemistry Waltham, MA March 13, 2014

44. **Fisman DN**, Cattuto C, Horvitz E, Bharti N, Buckeridge, D. Big data and predictive analytics. Moving beyond nowcasting (panel). 2nd Conference on Digital Disease Detection. San Francisco CA, September 18-20, 2013.

43. **Fisman DN.** Climate change and changing patterns of infectious diseases. Council of State and Territorial Epidemiologists Annual Meeting. Omaha, Nebraska, June 6, 2012.

42. **Fisman DN.** Is it cost-effective? Best practices on evaluating the bang-for-the-buck in communicable disease control. International Meeting on Emerging Diseases and Surveillance (IMED). Vienna, Austria, February 15-18, 2013.

41. **Fisman DN.** Economic issues in the control of herpesvirus infections. Fondation Merieux Conference on Herpes and Immunity. Annecy, France, June 18-20, 2012.

40. **Fisman DN**. Catch the wave: seasonality of infectious diseases and why clinicians should care. Brown University Medical Grand Rounds. Providence, RI November 29, 2011.

39. **Fisman DN**. Bugs and bucks: infectious disease persistence is a matter of economics. Institute on Science for Global Policy, Emerging and Persistent Infectious Diseases: Focus on Prevention. La Jolla, California, June 5-8, 2011.

38. **Fisman DN**. Odd Couples: The Complex Relationship Between Influenza and Invasive Bacterial Diseases. Institut National de Veille Sanitaire (National Institute for Public Health Surveillance). Paris (Sainte-Maurice), France, March 26, 2011.

37. **Fisman DN**. The need for improved influenza vaccines in older adults. Novartis Vaccines Scientific Roundtable Meeting. Frankfurt, Germany, March 24, 2011.

36. **Fisman DN**. Odd Couples: The Complex Relationship Between Influenza and Invasive Bacterial Diseases. Centre Hopitalier Universitaire Seminar in Infectious Diseases Epidemiology. Lyon, France, February 9, 2011.

35. **Fisman DN**. Odd Couples: The Complex Relationship Between Influenza and Invasive Bacterial Diseases. Harvard School of Public Health, Lunchtime Seminars in Infectious Disease Epidemiology. Boston, MA, January 22, 2010.

34. **Fisman DN**. Climate change and disease transmission. Institute of Medicine Workshop on Indoor Air Quality and Climate Change. Institute of Medicine, Washington, DC, June 19, 2009.

33. **Fisman DN**. Residency training and fatigue: are we killing our house staff? Society for Hospital Epidemiology of America Annual Meeting; Plenary on Occupational Health and Safety, San Diego, California, March 21, 2009.

32. **Fisman DN**. Climate Change and Infectious Diseases in North America: The Road Ahead. Imperial College London Division of Infectious Disease Epidemiology Seminar Series, February 17, 2009.

31. **Fisman DN**. "'Sneezonality': What we know (and don't) about the seasonality of respiratory infections". AstraZeneca Epidemiology Seminar, Wilmington, Delaware, May 17, 2006.

30. **Fisman DN**. "'Sneezonality': What we know (and don't) about the seasonality of respiratory infections". University of Pennsylvania Infectious Disease Grand Rounds, Philadelphia, PA. March 23, 2006.

29. **Fisman DN**. A vaccine that works even when it fails: effect of prior pneumococcal vaccination on survival and morbidity in community acquired pneumonia. Harvard School of Public Health, 5th Annual Jonathan Freeman Seminar in Infectious Diseases Epidemiology, Boston, MA, February 10, 2006.

28. **Fisman DN**. "Bugs and Bucks: The Economics of STD Control". University of Pennsylvania, Center for Clinical Epidemiology and Biostatistics Seminar Series, Philadelphia, January 12, 2006.

27. **Fisman DN**. Economic costs of antibiotic resistance: identification, measurement, and valuation. New Jersey State Department of Health and Senior Services Antimicrobial Resistance Symposium. West Windsor, NJ, October 31, 2005.

26. **Fisman DN**. "Sharps related injuries and their prickly precipitants". Association of Professionals in Infection Control Philadelphia Chapter Meeting, Philadelphia, December 10, 2004.

25. **Fisman DN**. "Seasonality, weather, and acute infectious disease occurrence" University of Pennsylvania, Center for Clinical Epidemiology and Biostatistics Seminar Series, Philadelphia, October 21, 2004.

24. **Fisman DN**. "Seasonality, weather, and acute infectious disease occurrence" Emory University, Rollins School of Public Health Epidemiology Seminar Series, Atlanta GA, October 14, 2004.

23. **Fisman DN**. "Genital Herpes: Epidemiology and Cost-Effectiveness of Emerging Vaccines". Fox Chase Cancer Center Population Sciences Seminar. Philadelphia, PA, September 14, 2004.

22. **Fisman DN**. "The response to SARS". SARS and Emerging Infectious Diseases: Lessons Learned. New Jersey Hospital Association. Princeton, NJ. June 15, 2004.

21. **Fisman DN**. “Syndromic surveillance: rationale and implementation”. Capitol Hill Steering Committee on Telehealth and Healthcare Informatics, “Advances in Biosurveillance, Early Warning, and Effective Response Toward Protecting Providers and the Public”. Washington, DC. June 9, 2004.

20. **Fisman DN**. "Genital herpes: what's new?". Infectious Disease Grand Rounds, University of Pennsylvania. April 8, 2004.

19. **Fisman DN**. "Seasonality and infection: meningococcus runs hot and cold." Harvard School of Public Health Freeman Seminar in Infectious Disease Epidemiology. Boston, April 29, 2004.

18. **Fisman DN**. “Modeling genital herpes: Biological and economic considerations” (Elion IHMF Junior Investigator Award Lecture). 11th Annual Meeting of the International Herpes Management Forum. Amsterdam, The Netherlands, February 26-29, 2004.

17. **Fisman DN**. “SARS in Toronto: Lessons Learned (and Already Forgotten?)”. Preparing Your Hospital for SARS. Florida Hospital Association, Orlando, FL, March 5 2004.

16. **Fisman DN**. How good is good enough? Modeling approaches to the effectiveness and cost-effectiveness of vaccines for herpes simplex virus type 2. Sexually Transmitted Diseases in Philadelphia: Linking Clinicians and Researchers. University of Pennsylvania and Centers for Disease Control and Prevention. Philadelphia, PA, January 28, 2004.

15. **Fisman DN**. Dynamic projection of cost-effectiveness of HSV-2 vaccines for young women. University of Tampere/Finnish National Public Health Institute International Symposium in Medicine. Lääkäripäivat 2004 (2004 Finnish Medical Association Annual Meeting). Helsinki, Finland, January 8, 2004.

14. **Fisman DN**. Prickly precipitants: epidemiology of needlesticks, and cost-effectivness of prevention. Johns Hopkins Bloomberg School of Public Health, Center for Injury Research and Policy, Graduate Seminar in Injury Research and Policy. Baltimore, MD, December 1, 2003.

13. **Fisman DN**. SARS in Toronto: the good, the bad, and the ugly. Southeastern Pennsylvania Regional Bioterrorism Preparedness Working Group. Philadelphia PA, August 6, 2003.

12. **Fisman DN**. Cold and rainy, with scattered relative risks: seasonality, weather, and invasive group A streptococcal disease. 3rd Annual Jonathan Freeman Memorial Seminar in Infectious Diseases Epidemiology, Harvard School of Public Health, Boston, MA, May 15, 2003.

11. **Fisman DN**. Novel tools for prevention of HSV-2 transmission: implications for HSV-2 testing. International Herpes Management Forum “Strategies for Interrupting the Transmission of HSV” Workshop, Seattle, WA, May 5, 2003.

10. **Fisman DN**. Prickly precipitants: epidemiology of needlesticks, and cost-effectivness of prevention. Drexel University School of Public Health. Philadelphia PA, January 11, 2003.

9. **Fisman DN**. Prickly precipitants: epidemiology of needlesticks, and cost-effectivness of prevention. Division of General Internal Medicine Rounds, University of Pennsylvania. Philadelphia PA, January 10, 2003.

8. **Fisman DN**. Control of herpes simplex virus type 2: using modeling to inform policy. Special Rounds, Department of Epidmiology and Preventive Medicine, University of Maryland. Baltimore MD, January 8, 2003.

7. **Fisman DN**. Precipitants of needlestick injuries in health care workers: a case-crossover study. Infectious Disease Grand Rounds, Washington University, St. Louis, MO. June 25, 2002.

6. **Fisman DN**, Mandl L. Medical management of osteoarthritis of the knee: cost-effectiveness of American College of Rheumatology guidelines. Partners Healthcare Arthritis Research Centre, Brigham and Women's Hospital. Boston, MA. May 1, 2002.

5. **Fisman DN**. Cost-effectiveness of directly observed therapy for the prevention of maternal-fetal HIV transmission. Lifespan/Tufts/Brown Center for AIDS Research Forum on Directly Observed Therapy for Treatment of HIV. Providence, Rhode Island. April 30, 2002.

4. **Fisman DN**. Virulent outbreak of severe group A streptococcal disease in a long-term care facility: control with mass antibiotic prophylaxis. 2nd Annual Jonathan Freeman Memorial Symposium in Infectious Disease Epidemiology. Harvard School of Public Health, Boston, MA. April 26, 2002.

3. **Fisman DN**. Control of herpes simplex virus type 2: using modeling to inform policy Sexually Transmitted Diseases Seminar Series, Johns Hopkins School of Medicine, Baltimore, Maryland. June 2001.

2. **Fisman DN**. A case-crossover study of sharps-related injuries in healthcare workers. Institute for Healthcare Improvement, Boston, MA. June 2001.

1. **Fisman DN**. Modeling genital herpes. 1st Annual Jonathan Freeman Memorial Symposium in Infectious Disease Epidemiology. May 2001.

National:

34. **Fisman DN**. Climate change and infectious diseases. Canadian Infectious Diseases and Microbiology Annual Retreat. Toronto, Ontario, Canada, August 11, 2014.

33. **Fisman DN.** Economic issues in vaccine decision making. Vaccine Decision Making—Beyond the Science. Policy Panel 1. Canadian Immunization Conference. Ottawa, Canada. December 2-4, 2014.

32. **Fisman DN.** The Incidence Decay and Exponential Adjustment (IDEA) model: a new single equation model to describe epidemics and their simultaneous control. University of Montreal School of Veterinary Medicine. McGill University Department of Epidemiology, Biostatistics and Occupational Health, 50th Anniversary Seminar Series, October 27, 2014.

31. **Fisman DN.** The Incidence Decay and Exponential Adjustment (IDEA) model: a new single equation model to describe epidemics and their simultaneous control. University of Montreal School of Veterinary Medicine. Ste. Hyacinthe, Quebec. June 17, 2014.

30. **Fisman DN**. A whirlwind introduction to health economic analysis. Canadian Public Health Association. Economic Evaluation of New Influenza Vaccine Options (Plenary). Canadian Public Health Association Annual Meeting, Toronto, Canada, May 28, 2014.

29. **Fisman DN.** The impact of climate and environmental change on infectious diseases. Keynote Address. AMMI-CACMID Annual Meeting, Victoria, BC, April 3, 2014.

28. **Fisman DN.** Pharmacoeconomic Evaluation of Vaccines: How They're Different. Vaccine Industry of Canada Pharmacoeconomic Workshop. Toronto, Ontario, Canada, November 25, 2013.

27. **Fisman DN.** Severity of influenza in remote and isolated First Nations communities. Possible mechanisms and implications for control. Banff International Research Station Workshop on Mathematical Modeling of Indigenous Populations Health, Banff, AB, Canada, Sep 27-29, 2013.

26. **Fisman DN**. Economic evaluation of vaccines. Canadian Immunization Conference. Vancouver, British Columbia, December 3-5, 2012.

25. **Fisman DN**. One Health for Clinicians. Canadian Family Medicine Forum, Toronto, November 15, 2012.

24. **Fisman DN**. Influenza immunization in older adults: an epidemiological perspective. University of Ottawa "IDeology" Seminar, Ottawa, Ontario, Canada. October 12, 2011.

23. **Fisman DN**. Mathematical modeling: a useful tool for guidance of partner notification strategies. National Collaborating Centre on Infectious Diseases, national consultation on partner notification. Toronto, Ontario, Canada, October 4, 2011.

22. **Fisman DN** and Tuite AR. Estimation of the burden and economic costs of *Chlamydia trachomatis* infection in Canada. Public Health Agency of Canada, Ottawa, Ontario, Canada, June 30, 2011.

21. **Fisman DN** and Sargeant J. Prioritization of zoonotic diseases. Canadian Conference on Medical Education, plenary session on "One Health". Toronto, Ontario, Canada, May 10, 2011.

20. **Fisman DN.** The economics of disease persistence. Banff International Research Station Workshop on Persistent Infectious Diseases. Banff, Alberta, Canada, March 2, 2011.

19. Tuite AR, **Fisman DN**. Modeling in the real world: contribution of modeling to management of influenza pandemics. Public Health Agency of Canada—Canadian Pandemic Influenza Planning Meeting, Winnipeg, MB, February 1-2 2011.

18. **Fisman DN**, Greer A. Modeling disease spread in populations—overview and pts. One Health—One Model Zoonotic Disease Modeling Meeting. University of Guelph, November 1-4, 2010.

17. **Fisman DN**. What a Difference a Year Makes: PanINFORM, the 2009 pH1N1 Pandemic, and Mathematical Modeling in Canada. PanINFORM National Influenza Modeling Meeting (The First Influenza Pandemic of the 21st Century: Canada's Response, Lessons Learned, and Challenges Ahead). Winnipeg, MB. April 19-20, 2010.

16. **Fisman DN**. One Health: getting human health experts to think "trans-species". (Plenary address). Canadian Association of Veterinary Epidemiology and Preventive Medicine, Guelph, Ontario, Canada, May 29-30, 2010.

15. **Fisman DN**. The Flu Formula: How Math is Helping Canada Respond to H1N1. University of Western Ontario Applied Mathematics Seminar Series. London, Ontario, Canada, December 9, 2009.

14. **Fisman DN**. The Flu Formula: How Math is Helping Canada Respond to H1N1. MITACS 10th Anniversary Public Lecture. Vancouver, BC, November 6, 2009.

13. **Fisman DN.** Plenary: The Great Divide: Can Models Inform Disease-Control Policy in Real Time? Mitigating the spread of influenza A (H1N1) (Part II): An International Mathematical

Modelling Meeting. British Columbia Centre for Disease Control (BCCDC), Vancouver, BC, Canada, September 14 – 16, 2009.

12. **Fisman DN.** Age and Epidemiology of Novel Influenza A (H1N1) in Ontario. Mitigating the spread of influenza A (H1N1) (Part II): An International Mathematical Modelling Meeting. British Columbia Centre for Disease Control (BCCDC), Vancouver, BC, Canada, September 14 – 16, 2009.

11. **Fisman DN**. Invasive bacterial disease, seasonality, and climate change. 26th International Conference on Chemotherapy and Infection/2009 Annual Meeting of the Association of Medical Microbiology and Infection of Canada. Plenary session "the changing climate of infectious diseases". Toronto, Ontario, June 18, 2009.

10. **Fisman DN**, Deonandan R. An Expert Panel Discussion on Health Effects of Climate Change. University of Ottawa Health Science Students Environmental & Public Health Advocacy Group and the Student Federation of the University of Ottawa; Ottawa, Ontario, December 5, 2008.

9. **Fisman DN.** But the bugs bounce back: simple transmission models and "failure" of bacterial STD control programs. Canadian Applied and Industrial Mathematics Mini-symposium on Communicable Diseases, 2nd Canada-France Congress on Mathematics. Universite de Quebec a Montreal, Montreal, PQ, June 1, 2008

8. **Fisman DN.** There's a Bug in My Model: Using Mathematical Modeling to Inform Communicable Disease Control Policy and Practice. University of Calgary Division of Infectious Diseases Rounds, Calgary, Alberta, Canada, January 8, 2008.

7. **Fisman, DN**. Environment, Climate Change, and Infectious Diseases. Infectious Diseases Seminar, Queens University, Kingston, Ontario, Canada. November 27, 2007.

6. **Fisman DN.** High School-Based Chlamydia Screening: Projected Health and Economic Impact in Philadelphia. Public Health Agency of Canada—MITACS Joint Symposium on Modeling Sexually Transmitted and Blood-Borne Infections. Banff International Research Station for Mathematical Innovation and Discovery, Banff, Alberta, Canada, August 10-12, 2007.

5. **Fisman DN.** "Seasonality, Environment, and Infectious Disease Occurrence: A Novel Application for Case-Crossover Study Design". University of Alberta Public Health Sciences Grand Rounds. Edmonton, Alberta, Canada, October 5, 2005.

4. **Fisman DN.** "Environmental Factors and Acute Communicable Disease Occurrence: A Rediscovery". University of Western Ontario Homecoming 2004 Seminar: Political and Ecological Influences on Health. London, Ontario, Canada, October 2, 2004.

3. **Fisman DN**. Control of herpes simplex virus type 2: using modeling to inform policy. British Columbia Center for Disease Control. November 8, 2003.

2. **Fisman DN**. Prophylaxis and immunization in the emergency room. Canadian Association of Emergency Physicians. Annual Scientific Assembly. Hamilton, Ontario. April 19, 2002.

1. **Fisman DN**. Sexually transmitted diseases: an overview for the mental health professional. Department of Psychiatry, University of Western Ontario, London, Ontario, Canada. April 2001.

Local:

43. **Fisman DN**, Birn AE, Orbinski J, Upshur R, Lavery J. Ebola In Context Symposium, Panel Discussion. University of Toronto Student Ebola Working Group, Toronto, Ontario, April 22, 2014.

42. **Fisman DN**, Bean S, Fong G, Caulford P. Opening the medicine cabinet: Economic limitations on public health provision. Ill With Illness. Munk School Graduate Conference, University of Toronto, March 27, 2015.

41. **Fisman DN**. How epidemics grow and stop: Ebola 2014 as a case study. Ebola: Stories and Perspectives from the Frontlines. Ryerson University, Toronto, ON March 4, 2014.

40. **Fisman DN,** Upshur R, Orbinski J. Ebola in context: a conversation. University of Toronto, January 16, 2015.

39. **Fisman DN**. Moderator. Ebola: a global response. University of Toronto Faculty of Medicine Student Global Health Conference. Toronto, Ontario, February 11, 2015.

38. **Fisman DN.** Clinical case rounds: typhoid. University of Toronto Infectious Disease Conference, December 17, 2014.

37. **Fisman DN.** Ebola 2014: How did we get here? What can we expect? Public lecture, University of Toronto in Your Neighborhood. Toronto, Canada, November 13, 2014.

36. **Fisman DN**, Kamanye AM and Bogoch I. Ebola and vulnerable health systems. Amref Health Coffee House Speaker Series. Toronto, Canada, November 22, 2014. (http://www.amrefcanada.org/media-centre/stories/is-the-ebola-outbreak-a-symptom-of-poor-health-systems/)

35. **Fisman DN**. Sexy models: what math can tell us about STI in Ontario. Public Health Ontario Grand Rounds. Toronto, Canada. October 24, 2013.

34. **Fisman DN**. Is it cost-effective? Why communicable diseases are different (and why clinicians should care). University of Toronto City-Wide Infectious Diseases Conference. Sunnybrook Health Sciences Centre, Toronto, Canada. January 8, 2013.

33. Tuite AR, Mishra S, **Fisman DN**. Mathematical modeling and resurgence of sexually transmitted infections in Canada. Canadian National Infectious Disease Fellows' Retreat. University of Toronto, Canada. August 16, 2012.

32. **Fisman DN.** John Snow: Insights into Emerging Infections from the Pre-Microbiologic Era. John Snow 200th Birthday Bash. Dalla Lana School of Public Health, University of Toronto, March 15, 2013.

31. **Fisman DN**. It's Gettin' Hot in Here: Climate Change and Implications for Infectious Disease Control. University of Toronto School of the Environment Environmental Health Seminar Series. January 24, 2013

30. Tuite AR, **Fisman DN.** Understanding the Increase in Chlamydia Risk in Ontario through Applied Epidemiology and Mathematical Modeling. York Region Community and Health Services. September 26, 2012

29. Agard E, Rutty C, **Fisman DN**. Vaccines: is controversy overshadowing science? Ontario Science Centre Café Scientifique. May 26, 2012.

28. **Fisman DN**. Using mathematical models to inform syphilis prevention strategies in Ontario. Ontario Syphilis Working Group. Toronto, April 30, 2012.

27. Bell J, **Fisman DN.** Can Viruses Cure Cancer? Ontario Institute for Cancer Research Café Scientifique. February 9, 2012.

26. **Fisman DN.** Influenza immunization in older adults: an epidemiological perspective. FitzGerald Seminar Series in Communicable Disease Epidemiology, Dalla Lana School of Public Health, University of Toronto. October 13, 2011.

25. **Fisman DN.** Climate change and infectious diseases. York Region Infection Prevention and Control Education Day. Kettleby, Ontario, October 5, 2011.

24. **Fisman DN** and Tuite AR. Mathematical epidemiology of pertussis in the Greater Toronto Area: Implications for vaccine policy. GlaxoSmithKline Canada, Mississauga, Ontario, March 16, 2011.

23. **Fisman DN.** Cholera Model in Haiti, 2010—Using a Gravity Model to Explain Initial Spatial Dynamics. Toronto Public Health Epi Lunch Bunch; Toronto, Ontario, Canada, March 11, 2011.

22. Tuite AR, **Fisman DN**. Plagues past: what history teaches us about epidemics. Woodsworth College Alumni Lecture Series, University of Toronto. January 18, 2011.

21. **Fisman DN**, Greer AL, Jones N, Derry B. It's Getting' Hot in Here: Climate Change and Infectious Diseases. Canadian Institutes for Health Research Café Scientifique presented by the Research Institute of the Hospital for Sick Children. Toronto, Ontario, Canada, October 5, 2009.

20. **Fisman DN**. Flu on the Fly: Emerging Diseases, Public Policy, and the Influenza Pandemic. Woodsworth College (University of Toronto) Alumni Café. October 13, 2009.

19. **Fisman DN.** The Ontario Mathematical Epidemiology Hub ("ONTology"). Public Health Agency of Canada National Mathematical Modeling Meeting, Toronto, Ontario, Canada, July 9, 2009.

18. **Fisman DN**. Bright Ideas? Ultraviolet Radiation, Weather, and the Seasonality of Invasive Bacterial Disease in North America. Toronto Invasive Bacterial Disease Network (TIBDN) Research Day, Mt. Sinai Hospital, Toronto. November 27, 2008.

17. **Fisman DN**. Overview of Modelling as it relates to Public Health and Emergency Preparedness. Ontario Agency for Health Protection and Promotion Session on Disaster Preparedness, Canadian Critical Care Conference. Toronto, Ontario, November 11, 2008.

16. **Fisman DN**. By the numbers: math, vaccines, and the secrets of disease control. St. Michael's Hospital Center for Global Health Research, Toronto, Ontario, Canada, August 1, 2008

15. **Fisman DN**. Modeling Genital Herpes and Related Conditions: Exercises, Approaches, and Evaluation of Cost-Effectiveness. Public Health Agency of Canada-MITACS Conference on Mathematical Modeling of Herpes Simplex Viruses and Human Papillomavirus. York University, Toronto, Ontario, Canada, May 29-30, 2008.

14. **Fisman DN**. By the numbers: math, vaccines, and the secrets of disease control. University of Toronto Infectious Diseases/Microbiology Academic Day, Toronto, Ontario, Canada, May 27, 2008.

13. **Fisman DN**. "Making Best Bets: Mathematical Modeling as a Tool for Vaccine Policy". St. Michael's Hospital Clinical and Population Research Rounds, February 7, 2008.

12. **Fisman DN.** "Old Timey Diseases" in the Here and Now. Fields Institute Center for Mathematical Medicine Seminar Series, Toronto, Ontario, Canada. January 25, 2008.

11. **Fisman DN**. A high-school Chlamydia screening program. Toronto Public Health "Epi Lunch Bunch". Toronto, Ontario, Canada, January 22, 2008.

10. **Fisman DN.** "Pertussis: the disease that won`t go away". York Region Health Services Lunch and Learn. Newmarket, Ontario, June 25, 2007.

9. **Fisman DN.** "Seasonality, Environment, and Infectious Diseases". Sunnybrook and Women's Hospital Infectious Disease/Microbiology Rounds, June 19, 2007.

8. **Fisman DN.** "There's a Bug in this Model: Transmission Modeling in Epidemiology and Health Policy". York University MITACS Seminar, Toronto, Ontario, February 13, 2007.

7. **Fisman DN.** "Enhanced Screening for *Chlamydia* Control: Recent Experience and Projected Health and Economic Impact in Philadelphia". Plenary Session on Sexually Transmitted Disease Control (Chairs Edward W. Hook III and Jonathan Zenilman). 44th Annual Meeting Infectious Disease Society of America, Toronto, Ontario, Canada, October 14, 2006.

6. **Fisman DN**. "Bugs and bucks: cost-effectiveness of Philadelphia's high-school *Chlamydia* screening program." Population Health Sciences Seminar, Hospital for Sick Children Research Institute, Toronto, Ontario, Canada. March 20, 2006.

5. **Fisman DN**. Invasive group A streptococcal disease in long-term care. Toronto Public Health Infection Control Education Day. Toronto, Ontario, November 5, 2002.

4. **Fisman DN**. Needlestick injuries: identifying precipitants and evaluating the cost-effectiveness of prevention. Institute for Clinical Evaluative Sciences, Sunnybrook Hospital, Toronto, Ontario. October 9, 2002.

3. **Fisman DN**. Update on genital herpes. Phoenix Association (Herpes Support Group). Toronto, Ontario. March 20, 2002.

2. **Fisman DN**. Report of an invasive group A streptococcal outbreak investigation in a nursing home. Toronto Invasive Bacterial Disease Network Research Day. Mt. Sinai Hospital, Toronto, February 7, 2002.

1. **Fisman DN**. Bioterrorism: Simulation, Preparation, Motivation. Ontario Hospital Association Roundtable on Bioterrorism. Toronto, Ontario. December 20, 2001.

Contributed presentations, peer reviewed

43. Brown KA, Daneman N, **Fisman DN**. Above and Beyond Individual Exposure: Ward-level Antibiotic Prescribing Is the Principal Predictor of Increased *Clostridium difficile* Infection (CDI) Risk. ID Week, Philadelphia PA, October 11, 2014.

42. McGirr AA and **Fisman DN**. "Duration of Pertussis Immunity Following Childhood Immunization with DTaP: A Systematic Review and Meta-Analysis". The Canadian Society for Epidemiology and Biostatistics National Student Conference, May 2014.

41. Tuite AR, **Fisman DN.** Estimation of the burden of disease and costs of genital *Chlamydia trachomatis infection in Canada.* International Society for Sexually Transmitted Diseases Research Biannual Meeting, Quebec City, Quebec. July 10-13, 2011.

40. Chan CH, McCabe CJ, **Fisman DN.** Core Groups, Antimicrobial Resistance and Rebound in Gonorrhea. International Society for Sexually Transmitted Diseases Research Biannual Meeting, Quebec City, Quebec. July 10-13, 2011.

39. Tuite AR, **Fisman DN**. Pertussis in Ontario, Canada: a transmission dynamic model. North American Congress of Epidemiology, Montreal, Quebec. June 21-24, 2011.

38. Tuite AR, **Fisman DN**. Seasonality of influenza-attributable meningococcal disease in central Ontario, Canada: implications for targeting of influenza vaccination programs. AMMI Canada – CACMID Annual Conference 2011, Montreal, Quebec, April 7-9, 2011.

37. Brown K, **Fisman DN.** A mathematical model of nosocomial clostridium difficile infection (CDI) transmission in an acute care hospital system with seasonal variations in transmission rate. AMMI Canada – CACMID Annual Conference 2011, Montreal, Quebec, April 7-9, 2011.

36. Devault A, Poinar H, Tien J, Earn D, **Fisman DN,** Dhody A. Ancient DNA analysis of 19th century cholera. Society for American Archeology, Sacramento, CA, March 30-April 2, 2011.

35. Tuite AR, Tien J, Earn DJD, Eisenberg M, Ma J, **Fisman DN.** Use of a gravity model to reproduce spatial patterns of cholera spread in Haiti, 2010. International Meeting on Emerging Diseases, Vienna, Austria, February 4-7, 2011.

34. Tuite AR, **Fisman DN**. Cholera, commerce and contagion: rediscovering Dr. Beck's report. Pennsylvania Medical Humanities Consortium Annual Meeting. Philadelphia, PA May 19-20, 2010.

33. **Fisman DN**. Gonorrhea Ain't Gone: Dissemination of Antibiotic Resistance via Core Groups. Canadian Mathematics Society Winter Meeting 2008. Ottawa, Ontario, December 6, 2008.

32. Soverow J, Wellenius G, **Fisman D**, Mittleman MS. Infectious Disease in a Warming World: How Weather Influenced West Nile Virus in the United States (2001-2005). 20th Annual Conference of the International Society for Environmental Epidemiology, October 12-16, 2008 Pasadena, CA.

31. **Fisman DN**, Greer A, Broukhanski G, Drews S. Of Gastro and the Gold Standard: Use of Latent Class Modeling to Estimate Test Performance for a Novel PCR and EIA for Norovirus G1 and G2. AMMI Canada—CACMID Annual Conference. Vancouver, British Columbia, February 27 - March 1, 2008.

30. Kinlin L, Spain CV, Ng V, White A, Johnson C, **Fisman DN**. Seasonal Variation and Environmental Effects in Invasive Meningococcal Disease in Philadelphia, Pennsylvania. AMMI Canada—CACMID Annual Conference. Vancouver, British Columbia, February 27 - March 1, 2008.

29. **Fisman DN**, Tang P, Richardson S, Drews S, Jamieson F. Pertussis Resurgence in Toronto, 2007. The View from the Lab. Late Breaker Sessions II: 2007 Annual Meeting of the Pediatric Academic Societies. Toronto, Ontario, Canada, May 5-8, 2007.

28. Cohen E, Weinstein M, **Fisman DN**. What Is the Most Cost Effective Treatment for Pediatric Empyema? 2007 Pediatric Academic Societies Annual Meeting, Toronto, Ontario, Canada. May 5-8, 2007.

27. Drews S, **Fisman D**, Brouhanski G, Chedore P, Jamieson F. Association of histopathology and biopsy specimen type with direct detection of Mycobacterium tuberculosis by PCR. AMMI-Canada CACMID 2007 Annual Conference, Halifax, Nova Scotia, Canada, March 14-18 2007.

26. Chedore P, **Fisman D**, Jamieson F. Current trends in extremely drug resistant (XDR) tuberculosis in Ontario. International Union against Tuberculosis and Lung Disease (IUATLD) 11th North American Regional Conference. Vancouver, British Columbia, Canada. February 22-24, 2007.

25. **Fisman DN**, Spaude KA, Kirchner C, Kim A, Abrutyn EA, Daley J. Recent influenza vaccination reduces adverse health outcomes in adults with community-acquired pneumonia. 16th Annual Meeting of the Society for Hospital Epidemiology of America (SHEA), Chicago, IL, March 18-21, 2006.

24. Johnson-Masotti, AP, **Fisman DN**, Lynd L, Sheehan D. Anonymous HIV testing in Canada: a cost-effective health intervention. Health Services Restructuring: New Evidence and New Directions. John Deutch Institute for the Study of Economic Policy. Queens University, Kingston, Ontario, Canada. November 17-18, 2005.

23. **Fisman DN**, Spain V, Asbel L, Goldberg M, Lawrence D, Newbern EC. High-school-based screening for Chlamydia in Philadelphia: identification of cost-savings using a dynamic transmission model. 27th Annual Meeting of the Society for Medical Decision Making. San Francisco, CA, October 21-24, 2005.

22. **Fisman DN**, Edmunds J. The importance of transmissibility in estimating cost-effectiveness of STI prevention: lessons from simulation studies. 16th Biennial Meeting of the International Society for Sexually Transmitted Disease Research. Amsterdam, The Netherlands. July 10-13, 2005.

21. Sorock GS, Lombardi DA, **Fisman DN**, Harris AD, Courtney TK, Evanoff B, Smith GS, Mittleman MA. Future directions for case-crossover research in injury epidemiology. 132nd Annual Meeting of the American Public Health Association. Washington, DC. November 6-10, 2004.

20. **Fisman DN**, Johnson-Masotti A, Lynd L, Sheehan D. Anonymous HIV Testing in Canada: A Cost-Effective Health Intervention. 132nd Annual Meeting of the American Public Health Association. Washington, DC. November 6-10, 2004.

19. **Fisman DN**, Spaude K, Kirchner C, Kim A, Daley J, Alexander J, Zhang J, Abrutyn E. Prior Pneumococcal Vaccination Reduces Death and Respiratory Failure Among Adults Admitted to Hospital with Community-Acquired Pneumonia. 44th Interscience Congress on Antimicrobial Agents and Chemotherapy. Washington, DC. October 30-November 2, 2004.

18. **Fisman DN**, Goldie SJ, Hook EW, Lipsitch M. Dynamic projection of ness and cost-effectiveness of HSV-2 vaccine for young women: how good is good enough? CDC STD Prevention Meeting, Philadelphia PA, March 8-11, 2004.

17. **Fisman DN**, Goldie SJ, Hook EW, Lipsitch M. Dynamic projection of the effectiveness and cost-effectiveness of HSV-2 vaccine for young women: how good is good enough? 11th Annual Meeting of the International Herpes Management Forum, Amsterdam, The Netherlands, February 26-29, 2004.

16. **Fisman DN**, Harris AD, Sorock GS, Mittleman MA. Cost-effectiveness of safer sharp medical devices for prevention of HIV and hepatitis C infection in healthcare workers. NIOSH/CDC National Occupational Injury Symposium, Pittsburgh PA, October 29 2003.

15. **Fisman DN**. The season's the reason: invasive group A streptococcal disease and weather patterns in a Canadian city. Pennsylvania Public Health Association Conference, Harrisburg, PA, October 17, 2003.

14. **Fisman DN**, Goldie SJ, Hook EW, Lipsitch M. Dynamic projection of the effectiveness and cost-effectiveness of HSV-2 vaccine for young women. Pennsylvania Public Health Association Conference, Harrisburg, PA, October 16, 2003.

13. Weir E, Taha M, Knowles L, Hart R, Haley A, **Fisman DN**, Tsang L, Li A, Sheehan D. Devil take the hindmost: A large community verotoxigenic E. Coli outbreak associated with

haggis consumption. Society for Hospital Epidemiology of America 13th Annual Meeting, Arlington, VA. April 5-8, 2003.

12. **Fisman DN**. Cost-effectiveness of directly observed highly active antiretroviral therapy in pregnant HIV-infected women. Ontario HIV Treatment Network Research Day. Toronto, Ontario, November 28-29, 2002.

11. Kleiner-Fisman G, **Fisman D**, Sime E, St. Cyr J, Lozano A, Lang A. Long-term outcome of subthalamic nucleus deep brain stimulation in patients with advanced Parkinson's disease. 7th Annual International Congress on Parkinson's Disease and Other Movement Disorders, Miami, FL, November 10-14, 2002.

10. Kleiner-Fisman G, **Fisman D**, Khan F, Sime E, Lozano A, Land A. Motor cortical stimulation in patients with multi-system atrophy. 7th Annual International Congress on Parkinson's Disease and Other Movement Disorders, Miami, FL, November 10-14, 2002.

9. Mandl LA, Liang M, **Fisman DN**. Cost-effectiveness of competing strategies for management of knee osteoarthritis. American College of Rheumatology 66th Annual Scientific Meeting, New Orleans, LA, October 25-29, 2002.

8. **Fisman DN**. Cost-effectiveness of competing strategies for management of osteoarthritis of the knee. 24th Annual Meeting of the Society for Medical Decision Making Annual Meeting, Baltimore, MD, October 20–23, 2002

7. **Fisman DN**. Cost-effectiveness of post-exposure antibiotic prophylaxis in household contacts of individuals with severe invasive group A streptococcal disease. 24th Annual Meeting of the Society for Medical Decision Making Annual Meeting, Baltimore, MD, October 20–23, 2002

6. Perencevich EN, **Fisman DN**, Harris AD, Morris JG, Smith DL. Point prevalence and clinical culture positivity may be inadequate measures of an infection control intervention's effectiveness. 24th Annual Meeting of the Society for Medical Decision Making Annual Meeting, Baltimore, MD. October 20–23, 2002

5. **Fisman DN**, Smith A. Virulent outbreak of severe group A streptococcal disease in a long-term care facility: control with mass antibiotic prophylaxis. 12th Annual Meeting, Society for Hospital Epidemiology of America, Salt Lake City, UT April 6-9, 2002.

4. **Fisman DN**, Harris AD, Lipsitch M, Perencevich EN, Smith DL. Benefits of active surveillance for vancomycin-resistant enterococcus on ICU Admission assessed with a stochastic model. 41st International Congress on Antimicrobial Agents and Chemotherapy, Chicago, IL, December 16-19, 2001.

3. **Fisman DN**, Perencevich EN, Cosgrove SE, Levy DB, Goldie SJ. Cost-effectiveness of directly observed highly active antiretroviral therapy in pregnant women with asymptomatic HIV infection. Infectious Disease Society of America 39th Annual Meeting, San Francisco, CA, 2001, and Society for Medical Decision Making Annual Meeting, San Diego, CA October 25 –28, 2001.

2. Perencevich EN, Lipsitch M, Harris AD, **Fisman DN**. Estimating the costs and benefits of active surveillance for vancomycin resistant enterococcus on ICU admission. Society for Healthcare Epidemiology of America Annual Meeting, Toronto, Ontario April 1 – 3, 2001.

1. **Fisman DN**, Goldie SJ. Estimating the costs and benefits of screening monogamous, heterosexual couples for asymptomatic infection with herpes simplex virus type 2. Society for Medical Decision Making 22nd Annual Meeting, Cincinnati, OH October 2000.

Contributed poster presentations, peer reviewed

58. Tuite AR and **Fisman DN**. Go big or go home: impact of screening coverage on syphilis infection dynamics. International Meeting on Emerging Infectious Diseases and Surveillance, Vienna Austria. October 31-November 3, 2014.

57. Tuite AR and **Fisman DN**. Are screening blitzes contributing to the observed trends in syphilis outbreaks in urban men who have sex with men? ID Week, Philadelphia, PA October 8-12, 2014.

56. McGirr AA and **Fisman DN**. "Duration of Pertussis Immunity Following Childhood Immunization with DTaP: A Systematic Review and Meta-Analysis" Poster presented at the Canadian Immunization Conference. Ottawa, ON. Dec 1-4, 2014.

55. McGirr AA and Fisman DN. "Duration of Pertussis Immunity Following Childhood Immunization with DTaP: A Systematic Review and Meta-Analysis". Poster presented at The Society for Epidemiologic Research Annual Meeting. Seattle, WA. June 24-27, 2014.

54. Brown KA, Daneman N, Moinedden R, Fisman DN. The duration of effects of antibiotic exposures on the risk of Clostridium difficile infection (CDI): a cohort study. International Meeting on Emerging Diseases and Surveillance (IMED). Vienna, Austria, February 15-18, 2013.

53. Tuite AR, **Fisman DN,** Alexander D, Guthrie J, Marchand-Austin A, Lam K, Ma J, Whelan M, Lee B, Jamieson F. Epidemiological evaluation of spatio-temporal and genotypic clustering of Mycobacterium tuberculosis in Ontario, Canada. International Meeting on Emerging Diseases and Surveillance (IMED). Vienna, Austria, February 15-18, 2013.

52. Vasilevska M, Major M, McGeer A, Brown V, Greer A, Tuite A, Ulanova M, Morris S, FitzGerald J, DeAngelis F, **Fisman DN.** The FitzGerald Seminar Series - Creation of an Open Access Infectious Disease Control and Prevention Seminar Series in Ontario. 10th Canadian Immunization Conference, Vancouver, Canada, December 3-5, 2012.

51. Tuite AR, **Fisman DN.** Estimation of the health impact and cost-effectiveness of an adjuvanted influenza vaccine with enhanced effectiveness and durability of effect. Poster presented at: 3rd North American Congress of Epidemiology, June 2011.

50. Devault, Alison, Hendrik N. Poinar, Joseph H. Tien, David J.D. Earn and **David N. Fisman.** *Ancient DNA analysis of 19th century North American cholera* Multiple pandemics. Society for American Archeology 76th Annual Meeting, Sacramento, California, March 30-April 3, 2011.

49. Tuite AR, **Fisman DN.** Cost-effectiveness of an adjuvanted vaccine for prevention of influenza in Ontario, Canada. International Meeting on Emerging Diseases, Vienna, Austria, February 4-7, 2011.

48. Xiao Y, **Fisman DN**. Impact of antiviral drug use on epidemic dynamics in an isolated First Nations reserve in Ontario, 2009. International Meeting on Emerging Diseases, Vienna, Austria, February 4-7, 2011.

47. Kuster S, Tuite AR, McGeer A, Kwong J, **Fisman DN**. Influenza drives risk of invasive pneumococcal disease but not pneumococcal transmission dynamics in Toronto, Canada. International Society for Prevention of Pneumococcal Disease, Tel Aviv, Israel, March 14-18, 2010.

46. Tuite AR, Kinlin LM, **Fisman DN**. Influenza A activity and increased risk of invasive meningococcal disease in central Ontario, Canada: a case-crossover analysis. European Society for Pediatric Infectious Diseases, Nice, France, May 4-8, 2010.

45. Kinlin L, Kirchner C, Zhang H, Daley J, **Fisman DN**. Derivation and validation of a clinical prediction rule for nosocomial pneumonia following coronary artery bypass grafting surgery. Annual Meeting of the Society for Hospital Epidemiology of America. San Diego, California, March 20-22, 2009.

44. Kinlin LM, Ng V, Crowcroft N, Granerod J, Fraser G, Spain CV, Johnson CC, Jamieson F, Brown EM, **Fisman DN**. Seasonal Patterns and Environmental Predictors of Invasive Meningococcal Disease in London, England; Philadelphia, United States; Sydney, Australia; and Toronto, Canada. International Society of Infectious Diseases—International Meeting on Emerging Diseases. Vienna, Austria, February 13-16, 2009.

43. **Fisman DN.** Rate of change of Lyme disease incidence in the United States exhibits a north-south gradient consistent with climate change effect. International Society for Infectious Diseases—International Meeting on Emerging Diseases. Vienna, Austria, February 13-16, 2009.

42. Greer A, **Fisman DN**. Keeping vulnerable children safe from pertussis: preventing nosocomial pertussis transmission in the neonatal intensive care unit (NICU). *Epidemics* First Annual Conference, Asilomar, California. December 1-3, 2008.

41. Greer A, **Fisman DN**. Keeping vulnerable children safe from pertussis: preventing nosocomial pertussis transmission in the neonatal intensive care unit (NICU). 120th Anniversary Conference of the Pasteur Institute, Paris, France. November 11-13, 2008.

40. Ng V, Tang P, Jamieson F, Guyard C, **Fisman DN**. Laboratory-Based Evaluation of the Epidemiology of Legionellosis in Ontario, Canada, 1978 to 2006. 46th Annual Conference of the Infectious Disease Society of America, Washington, DC, October 25-28, 2008.

39. Kinlin L, Jamieson F, Brown E, Rawte P, Brown S, Dolman S, **Fisman DN**. Impact of Conjugate Group C Meningococcal Vaccine on Invasive Meningococcal Disease in Vaccinated and Unvaccinated Groups in Ontario, Canada, 2000 to 2006. 46th Annual Conference of the Infectious Disease Society of America, Washington, DC, October 25-28, 2008

38. Greer AL, Drews S, **Fisman DN**. Why Does the "Winter Vomiting Disease" Happen in Winter? Unravelling the Seasonality of Norovirus Outbreaks in Toronto, Canada. 46th Annual Conference of the Infectious Disease Society of America, Washington, DC, October 25-28, 2008.

37. White ANJ, Kinlin L, Johnson C, Ng V, **Fisman DN**. Let the Sun Shine In: Temperature and UV Radiation Affect the Incidence of Pneumococcal Infection in Philadelphia. 46th Annual Conference of the Infectious Disease Society of America, Washington, DC, October 25-28, 2008.

36. White ANJ, Johnson C, Ng V, **Fisman DN**. Environmental Effects on the Incidence of *Campylobacter* Infection in Philadelphia. 2008 Canadian *Campylobacter* Conference. Montreal, Quebec, September 25-26, 2008.

35. Ota K, **Fisman DN**, Jones K, Tamari I, Jamieson F, Wong T, DePrima A, Richardson, S. Prevalence and characteristics of *Neisseria gonorrhoeae* isolates in Ontario. AMMI Canada—CACMID Annual Conference. Vancouver, British Columbia, February 27 - March 1, 2008.

34. Brown E, **Fisman DN**, Brown S, Rawte P, Jamieson F. Epidemiology of invasive meningococcal disease with decreased penicillin susceptibility in Ontario, 2000 to 2006. AMMI Canada—CACMID Annual Conference. Vancouver, British Columbia, February 27 - March 1, 2008.

33. Ng-Brett V, **Fisman DN**, Moineddin R. Cute, Cuddly, Contagious: Kangaroo Density Drives Human Ross River Virus Infections. Late breaker, American Society of Tropical Medicine and Hygeine 56th Annual Meeting, Philadelphia PA, November 4-8, 2007.

32. Ng-Brett V, Tang P, Jamieson F, Drews S, Johnson C, **Fisman DN**. Hydrological factors associated with increase legionellosis risk in the Greater Toronto Area, Ontario, Canada. 47th Annual Interscience Conference on Antimicrobial Agents and Chemotherapy (ICAAC), Chicago, Illinois, United States of America, September 17- 20, 2007.

31. **Fisman DN,** Tang P, Richardson S, Ng-Brett V, Drews S, Low DE, Jamieson F. Laboratory Factors in an Apparent Pertussis Resurgence, Toronto, Canada, 2005-2007. 47th Annual Interscience Conference on Antimicrobial Agents and Chemotherapy (ICAAC), Chicago, Illinois, United States of America, September 17- 20, 2007.

30. **Fisman DN,** Spain V, Ng-Brett V, Johnson C. Weather, Water and Giardia in Philadelphia. 47th Annual Interscience Conference on Antimicrobial Agents and Chemotherapy (ICAAC), Chicago, Illinois, United States of America, September 17- 20, 2007.

29**.** **Fisman DN**, Harris AD, Rubin M, Daley K, Mittleman, MA. Alcohol consumption and sharps-related injuries among healthcare workers: results from a case-crossover study. 16th Annual Meeting of the Society for Hospital Epidemiology of America (SHEA), Chicago, IL, March 18-21, 2006.

28. **Fisman DN**. Cost-effectiveness of the SuturTek 360° Fascia Closure Device for prevention of operative sharps-related injuries. 16th Annual Meeting of the Society for Hospital Epidemiology of America (SHEA), Chicago, IL, March 18-21, 2006.

27. **Fisman DN**, Harris AD, Sorock GS, Rubin M, Daley K, Mittleman MA. Gloves reduce the risk of sharps related injuries in healthcare workers. Results from a case-crossover study. Annual Meeting of the Society for Epidemiological Research. Toronto, Ontario, Canada. June 27-30, 2005.

26. **Fisman DN**, Harris AD, Sorock GS, Rubin M, Mittleman MA. Fatigue Increases Sharps-Injury Risk in Medical Trainees: Results from a Case-Crossover Study. 132nd Annual Meeting of the American Public Health Association. Washington, DC. November 6-10, 2004.

25. **Fisman DN**, Bamberg W, Kirchner C, Kim A, Daley J, Alexander J, Zhang J, Abrutyn E. Female Gender Increases Risk of Graft Harvest Site Infection, but not Sternal Wound Infection, After Cardiac Bypass Grafting. 44th Interscience Congress on Antimicrobial Agents and Chemotherapy. Washington, DC. October 30-November 2, 2004.

24. Perencevich EN, Kaye KS, Strasbaugh LJ, Bradham DD, **Fisman DN**, Harris AD. Acceptable failure rates for antibiotic therapy of central venous catheter associated bacteremia. 26th Annual Meeting of the Society for Medical Decision Making. Atlanta, GA, October 17-20, 2004.

23. **Fisman DN**, Kirchner C, Daley J, Ambrose JF, Kim A, Alexander J, Zhang H, Abrutyn E. Risk Factor Analysis for Deep Sternal Wound Infections after Coronary Artery Bypass Grafting in Community Hospitals. 42nd Annual Meeting of the Infectious Disease Society of America Meeting, Boston MA, Sept 30-Oct 3, 2004.

22. **Fisman DN**, Kirchner C, Daley J, Ambrose JF, Kim A, Alexander J, Zhang H, Abrutyn E Risk Factors for Saphenous Vein Graft Harvest Site Infections after Cardiac Surgery and Impact of Infection on Outcome. 42nd Annual Meeting of the Infectious Disease Society of America Meeting, Boston MA, Sept 30-Oct 3, 2004.

21. **Fisman DN**, Lim S, Wellenius G, Britz P, Gaskins M, Newbern C. Rainfall Acutely Increases the Risk of Legionellosis in Philadelphia. 42nd Annual Meeting of the Infectious Disease Society of America Meeting, Boston MA, Sept 30-Oct 3, 2004.

20. **Fisman DN**, Kirchner C, Daley J, Kim A, Zhang H, Paris M, Alexander J, Abrutyn E. Deep sternal wound infection after coronary artery bypass grafting markedly increases hospital length of stay: Estimates from community hospitals. Association of Professionals in Infection Control 31st Annual Educational Conference and National Meeting. Phoenix, AZ, June 6-10, 2004.

19. Kirchner C, Abrutyn A, Jones I, **Fisman D**, Dhond A, Kim Y, Alexander J, Daley J, Zhang H, Kim A. Using a multi-center, computer-based surveillance system: Overcoming data collection challenges with the use of technology and creative teamwork. Association of Professionals in Infection Control 31st Annual Educational Conference and National Meeting. Phoenix, AZ, June 6-10, 2004.

18. **Fisman DN**, Wellenius G, Tsang L, Mittleman MA. Meteorological factors associated with occurrence of meningococcal disease: a novel use of case-crossover study design. Society for Healthcare Epidemiology of America Annual Meeting, Philadelphia, PA, April 17-20, 2004.

17. Bamberg W, **Fisman DN**, Kirchner C, Kim Y, Kim A, Daley J, Alexander J, Zhang H, Paris M, Abrutyn E. Risk factors for nosocomial pneumonia after coronary artery bypass grafting in community hospitals. Society for Healthcare Epidemiology of America Annual Meeting, Philadelphia, PA, April 17-20, 2004.

16. **Fisman DN,** Harris AD, Sorock GS, Mittleman MA. Characteristics of past unreported sharps-related injuries in healthcare workers. Society for Healthcare Epidemiology of America Annual Meeting, Philadelphia, PA, April 17-20, 2004.

15. **Fisman DN,** Harris AD, Sorock GS, Mittleman MA. Fatigue increases needlestick risk in medical trainees: results from a case-crossover study. Society for Healthcare Epidemiology of America Annual Meeting, Philadelphia, PA, April 17-20, 2004.

14. **Fisman DN**. Health-related quality of life and symptomatic genital herpes: Comparison of measures. CDC STD Prevention Meeting, Philadelphia PA, March 8-11, 2004.

13. Lynd L, Johnson-Masotti A, Sheehan D, **Fisman DN**. Anonymous HIV testing in Canada: A cost-effective health intervention. CDC STD Prevention Meeting, Philadelphia PA, March 8-11, 2004.

12. Lynd L, Johnson-Masotti A, Sheehan D, **Fisman DN.** Anonymous HIV testing in Canada: A cost-effective health intervention. CDC STD Prevention Meeting, Philadelphia PA, March 8-11, 2004.

11. **Fisman DN**, Goldie SJ, Hook EW, Lipsitch M. Dynamic projection of the effectiveness and cost-effectiveness of an HSV-2 vaccine for young women. International Society for STD Research 2003 Congress. Ottawa, Ontario, Canada. July 27-30, 2003.

10. Jang D, Chong S, Howard M, Smeija M, **Fisman D**, Chernesky M. Diagnosis of Chlamydia trachomatis (CT) infections in men and women by a new VIDAS Probe CT amplification

assay performed on swabs and urines. International Society for STD Research 2003 Congress. Ottawa, Ontario, Canada. July 27-30, 2003.

9. **Fisman DN**, Lowry L. Cost-effectiveness of safer sharp medical devices for prevention of HIV infection in healthcare workers. 40th Annual Meeting of Infectious Diseases Society of America, Chicago, Ill October 24-27, 2002.

8. **Fisman DN**. Cost-effectiveness of post-exposure antibiotic prophylaxis in household contacts of individuals with severe invasive group A streptococcal disease. 40th Annual Meeting of Infectious Diseases Society of America, Chicago, Ill October 24-27, 2002.

7. **Fisman, DN**. Cost-effectiveness of safer sharp medical devices for prevention of bloodborne infection in healthcare workers. 24th Annual Meeting of the Society for Medical Decision Making Annual Meeting, Baltimore, MD, October 20–23, 2002

6. **Fisman DN**, Leder K. Age and efficacy of recombinant hepatitis B vaccination: a meta-analysis. 12th Annual Meeting, Society for Hospital Epidemiology of America, Salt Lake City, UT April 6-9, 2002.

5. **Fisman DN**, Harris AD, Sorock GS, Mittleman MA. Transient risk-factors for sharps-related injuries in healthcare workers. Society for Hospital Epidemiology of America Annual Meeting, Toronto, Ontario April 2001.

4. **Fisman DN**, Harris AD, Sorock GS, Mittleman MA. A pilot case-crossover study of sharps-related injuries in healthcare workers. National Occupational Injury Research Symposium, Pittsburgh, PA October 17 – 19, 2000.

3. **Fisman DN**, Freeman J, Lipsitch M, Goldie SJ. The future economic costs of the herpes simplex virus type 2 epidemic in the United States. Infectious Disease Society of America 38th Annual Meeting, New Orleans, LA September 7 – 10, 2000.

2. **Fisman DN**, Goldie SJ. Estimating the costs and benefits of screening monogamous, heterosexual couples for asymptomatic infection with herpes simplex virus type 2. Infectious Disease Society of America 38th Annual Meeting, New Orleans, LA September 7 – 10, 2000.

1. **Fisman DN**, Barlam TF, Dorman S, Holland S, O'Donnell MA. Risk factors for BCGosis in bladder cancer patients. Infectious Disease Society of America 37th Annual Meeting, Philadelphia, PA Fall, 1999.

G. TEACHING AND STUDENT SUPERVISION

Full graduate courses developed, in development, or substantially revised

University of Toronto

2017- **<u>Decision Making in Communicable Disease Control (course code pending, course in development)</u>**. This course, in development, is an advanced companion course to CHL5425, below. Students integrate skills in construction and parameterization of communicable disease models with principles of medical decision making and cost-effectiveness analysis through a series of case-based lectures and exercises. By the end of the course students should be capable of using dynamic infectious disease models as a platform for evaluating cost-effectiveness of communicable disease control strategies, in a manner that allows them to account for both direct costs of programs (e.g., vaccination costs, negative costs of cases averted directly through vaccination) and indirect costs

(e.g., those associated with development of herd immunity, strain replacement, and changing average age at infection).

2016- **Epidemiologic Methods for Communicable Disease Control (course code pending, course in development)**. With Prof. Paul Arora now teaching CHL5412, I have had the opportunity to focus on a skills-based course for intermediate level learners in communicable disease epidemiology. The course is built around cases that refer to specific infectious disease entities and challenges, including outbreaks of emerging infectious diseases. Topics covered include statistical methods for communicable diseases (Poisson regression, case-control methods and logistic regression, distributed lag models), social network analysis for sexually transmitted infections, an introduction to forecasting using both statistical and mathematical models, and parameterization and construction of epidemic models, ranging from single equation descriptive models to compartmental ODE models. Integration of molecular epidemiology and phylogenetics with standard epidemiological methods is also discussed.

2011-2015 **Epidemiology of Communicable Diseases (CHL5412H)**. This course represents an amalgam of two courses in communicable diseases previously taught at the Dalla Lana School of Public Health. Course co-director Dr. Amy Greer and I have totally reorganized and restructured the course, which now focuses on building quantitative and data management and analysis skills needed by frontline public health professionals and infectious disease epidemiologists. In the current year (2013) the course was co-taught with Effie Gournis of Toronto Public Health.

2010 -2015 **Epidemiology I: Introduction to Epidemiology (CHL5401H)**. Although an introductory epidemiology course with this number had been in existence previously, when I inherited this course in 2010 I revised and reorganized the course in its entirety. The course now puts a major emphasis on the development of quantitative skills necessary for front-line public health practice. It is a core course for the MPH with Epidemiology concentration at Dalla Lana School of Public Health.

2010- **Mathematical Epidemiology of Infectious Diseases (CHL5425H)**. This is an intermediate level course on dynamic modeling of infectious diseases. I developed this new course in its entirety and am the sole instructor. This 36 hour course provides students with extensive instruction and hands-on experience with mathematical modeling as a tool for the study and control of communicable diseases.

2009 **Spatial Epidemiology and Infectious Disease Modeling (CHL 7001)**: Introduction to mathematical modeling and geospatial analysis in infectious diseases. This was a 10-week seminar course on the use of mathematical modeling, GIS, and spatial analysis for evaluation of disease epidemiology and disease control programs. This course was developed and taught by Dr. Gesink and myself.

Princeton University

2006 **Epidemiology (Public Affairs 598)**. This was a 12 week introductory course on epidemiologic measures and principles for students in the Wilson School Master of Public Affairs program. While PA598 had been taught previously, I completely redeveloped the course at Princeton during my year as a Visiting Assistant Professor at Princeton University. The course was very successful and the course version developed by myself is still in use at Princeton.

Drexel University

2004 **Infectious Diseases Epidemiology** (9 hour lecture/workshop block), Drexel University School of Public Health Epidemiology Concentration Seminar. I developed a series of lectures and exercises that introduced MPH students to core concepts in infectious disease epidemiology and public health communicable disease control.

2004 **Introduction to Epidemiology (Block III)**. This was an entirely new introductory epidemiology curriculum, developed by myself at Drexel University. The course included a series of lectures, graded and ungraded problem sets, computer exercises, and "journal clubs" for critical appraisal of the public health literature. The course also included an "evidence-based public health project" that introduced students to the concept of evidence-based clinical practice in public health.

Graduate courses taught*

**University of Toronto unless otherwise stated.*

2015 University of Guelph, Infectious Disease Modeling (POPM 6950-02). 15 hours.

2015 McGill University, Infectious Disease Epidemiology (EPIB-615), 10 hours.

2013 Lecturer and Course Co-director, Communicable Disease Epidemiology, Prevention and Control (CHL5412H). 36 lecture/lab hours.

2012 Lecturer, Introduction to Public Health (CHL5004). 3 lecture/lab hours. Introduction to infectious disease epidemiology and outbreak investigation.

Lecturer and Course Director, Introduction to Epidemiology and Public Health (CHL5401H). 36 lecture/lab hours.

Lecturer and Course Co-director, Communicable Disease Epidemiology, Prevention and Control (CHL5412H). 36 lecture/lab hours.

2011 Lecturer, Introduction to Public Health (CHL5004). 3 lecture/lab hours. Introduction to infectious disease epidemiology and outbreak investigation.

Lecturer and Course Co-director (with Dr. Amy Greer), Introduction to Communicable Disease Epidemiology (CHL5412H). 36 lecture/lab hours.

Lecturer and Course Director, Introduction to Epidemiology/Epidemiology I (CHL5401H). 39 lecture/lab hours.

Guest Lecturer, "Communicable disease surveillance and outbreak investigation". Health Trends and Surveillance (CHL5405H) (Profs. Lilian Yuan and Eric Holowaty, 3 lecture hours).

2010 Lecturer and Course Director, Mathematical Epidemiology of Infectious Diseases (CHL5425H). 36 lecture/lab hours.

Lecturer and Course Director, Introduction to Epidemiology/Epidemiology I (CHL5401H). 36 lecture/lab hours.

Lecturer, CHL 5415F (Practice of Communicable Disease Epidemiology, Prevention and Control, Prof. Elizabeth Rea). Taught 3 two hour blocks (Vaccines I, Vaccines II, and Zoonotic Disease).

Lecturer, CHL5416H (Environmental Epidemiology, Prof. Don Cole). 1 hour lecture (Global Climate Change and Infectious Diseases). November 30, 2009.

Guest Lecturer, CHL5412H (Communicable Disease Epidemiology, Prevention and Control: Principles, Prof. Robert Remis). 3 hour lecture (Introduction to Mathematical Modeling). November 16, 2009.

Co-instructor (with Dr. Reshma Amin): "Introduction to decision analysis", lecture/seminar (3 hours) , HAD 5301H. Department of Health Policy, Evaluation and Management. August 6, 2010.

2009 Co-instructor (with Dr. Andreas Laupacis): "Introduction to decision analysis", lecture/seminar (3 hours) , HAD 5301H. Department of Health Policy, Evaluation and Management. August 5, 2009.

Co-instructor (with Dr. Matthew Stanbrook): "Introduction to test theory: diagnostic tests", lecture/seminar (3 hours), HAD 5301H. Department of Health Policy, Evaluation and Management. July 23, 2009.

Lecturer, Public Health Sciences CHL 5415F (Practice of Communicable Disease Epidemiology, Prevention and Control). Taught 3 two hour blocks (Vaccines I, Vaccines II, and Zoonotic Disease).

Tutor, HAD 5304H (Clinical Decision-Making and Cost-Effectiveness), Prof. Ahmed Bayoumi. Students: Drs. Kaede Ota and Darrell Tan, Pre-exposure antiretroviral prophylaxis for individuals at high risk of HIV infection.

Co-instructor (with Dr. Lawrence Paszat): "Non-experimental methods in epidemiology", lecture/seminar (3 hours), HAD 5301H. Department of Health Policy, Evaluation, and Management. July 28, 2008.

Co-instructor (with Dr. Gary Naglie): "Introduction to decision analysis", lecture/seminar (3 hours) , HAD 5301H. Department of Health Policy, Evaluation and Management. August 1, 2008.

Tutor, HAD 5304H (Clinical Decision-Making and Cost-Effectiveness), Prof. Ahmed Bayoumi. Student: Dr. Henry Ahn, Operative vs. conservative management of scoliosis in adolescent girls.

Lecturer, Public Health Sciences CHL 5415F (Practice of Communicable Disease Epidemiology, Prevention and Control). Taught 3 two hour blocks (Vaccines I, Vaccines II, and Zoonotic Disease).

2007 Lecturer, Health Policy, Management and Evaluation HAD 5301 H (Introduction to Clinical Epidemiology and Health Care Research). Taught two 3-hour blocks (Bias and Confounding, and Disease Frequency).

2006 Tutor, HAD 5304H (Clinical Decision-Making and Cost-Effectiveness), Prof. Ahmed Bayoumi. Student: Dr. Eyal Cohen, Cost-effectiveness of Strategies for the Management of Pediatric Empyema.

"Introduction to Test Theory and Screening". MI580 Principles of Epidemiology. January 26, 2006. Thomas Jefferson University, Philadelphia.

2005 "Introduction to Test Theory and Screening". MI580 Principles of Epidemiology. March 10 and May 25, 2005. Thomas Jefferson University, Philadelphia, PA.

Needlestick injuries and case-crossover study design". Infectious Disease Epidemiology Seminar (EP656), Center for Clinical Epidemiology and Biostatistics. March 15, 2005. University of Pennsylvania, Philadelphia, PA.

"Case-crossover study design". Advanced Epidemiology Methods Seminar (EP640), Center for Clinical Epidemiology and Biostatistics. March 2, 2005. University of Pennsylvania, Philadelphia, PA.

"Seroepidemiology". Infectious Disease Epidemiology Seminar (EP656), Center for Clinical Epidemiology and Biostatistics. March 2, 2005. University of Pennsylvania, Philadelphia, PA.

"Tick-Borne Infectious Diseases: A Review", Drexel University Infectious Disease Fellows Lecture. Hahnemann Hospital, Philadelphia, May 26, 2005.

Panelist, "Typhoid Mary: Villain or Victim?" (with Drs. Janet Fleetwood, Ed Mormon, and Steven Peitzman). Drexel University College of Medicine Medical Humanities Grand Rounds, May 24, 2005.

2004 Introduction to Infectious Diseases Epidemiology (Block I). Drexel University School of Public Health MD/MPH Program.

Facilitator, Lab Instructor and Lecturer, Epidemiology and Biostatistics I (6 week introductory epidemiology and biostatistics course: 8-10 teaching hours/week), Drexel University School of Public Health.

Facilitator, Lab Instructor/Leader and Lecturer, Epidemiology and Biostatistics II (7 week introductory epidemiology and biostatistics course: 8-10 teaching hours/week), Drexel University School of Public Health.

2003 Guest Lecturer, Clinical Health Sciences-Health Research Methods 789 (Health Economics for Health Care Managers), March 26, 2003. McMaster University, Hamilton, Ontario, Canada.

Unit 6 Undergraduate Medicine (Obstetrics & Gynecology Clinical Clerkship)"Inroduction to Sexually Transmitted Diseases", McMaster University Faculty of Health Sciences, Hamilton, Ontario, Canada. Lecture given every 6 weeks.

2002 Department of Clinical Epidemiology and Biostatistics, Continuing Education Sessions. "The Burden of Genital Herpes in the United States: Estimation and Projection Using a Difference-Equation Model." McMaster University, Hamilton, Ontario, Canada. March 21, 2002.

Tutor: Clinical Health Sciences-Health Research Methods 721 Period: October – November. McMaster University, Hamilton, Ontario, Canada.

Preceptor: Unit 1 Undergraduate Medicine, Microbiology and Infectious Diseases. Period: September – October. McMaster University, Hamilton, Ontario, Canada.

Tutor: Clinical Health Sciences-Health Research Methods 721. Period: July – August. McMaster University, Hamilton, Ontario, Canada.

Unit 6 Undergraduate Medicine (Obstetrics & Gynecology Clinical Clerkship)"Inroduction to Sexually Transmitted Diseases", McMaster University Faculty of Health Sciences, Hamilton, Ontario, Canada. Lecture given every 6 weeks.

2001 Unit 6 Undergraduate Medicine (Obstetrics & Gynecology Clinical Clerkship)"Inroduction to Sexually Transmitted Diseases", McMaster University Faculty of Health Sciences, Hamilton, Ontario, Canada. Lecture given every 6 weeks.

2000 Teaching Assistant, "Mathematical Modeling of Infectious Diseases (EPI 260d)" Professor Marc Lipsitch, Harvard School of Public Health, Boston, MA.

Teaching Assistant, "Decision Analysis in Clinical Research", Professor M.C. Weinstein, Summer Clinical Effectiveness Course, Harvard School of Public Health, Boston, MA.

1999 Teaching Assistant, "Decision Analysis for Health and Medical Practices" Professor S.J. Goldie, Harvard School of Public Health, Boston, MA.

Teaching Assistant, "Decision Analysis in Clinical Research". Professor M.C. Weinstein, Summer Clinical Effectiveness Course. Harvard School of Public Health, Boston, MA

Professional, continuing education and faculty development training and workshops

[see also invited presentations]

2012 Infectious disease modeling course for public health epidemiologists. With Ashleigh Tuite. DLSPH, Toronto, Ontario, Canada, May 28 and June 4, 2012; Hamilton, Ontario, Canada, August 23, 2012; and Ottawa, Ontario, Canada, October 18, 2012; and Hamilton, Ontario, Canada,

2011 Invited participant and facilitator, Institute on Science for Global Policy, Emerging and Persistent Infectious Diseases: Focus on Mitigation. Edinburgh, Scotland, October 22-26, 2011.

Invited participant, Institute on Science for Global Policy, Emerging and Persistent Infectious Diseases: Focus on Prevention. La Jolla, California, June 5-8, 2011.

Infectious Disease Modeling: Beyond the Basics (Short Course). With Dr. Amy Greer and Ashleigh Tuite. North American Congress of Epidemiology, Montreal, Quebec. June 21-24, 2011.

2010 Introduction to Infectious Disease Modeling (with Dr. Amy Greer), DLSPH Summer Institute in Biostatistics, Toronto, Ontario, Canada June 9-11, 2010.

Health Policy, Management and Evaluation. 2010 Clinical Epidemiology Institute, planning committee member and faculty (5 x 1.5 hour critical appraisal sessions and 1 hour lecture on "Practical Prognostication: Introduction to Clinical Prediction Rules".)

Introduction to Infectious Disease Modeling (Short Course). With Dr. Amy Greer, Vicky Ng, and Ashleigh Tuite. 31st Annual Meeting of the Society for Medical Decision Making, Toronto, Ontario, Canada, October 24, 2010.

2009 "Epidemiology on the Fly: Infectious Disease Epidemiology and the Public Health Response to Novel Influenza A (H1N1)". Dalla Lana School of Public Health Research Seminar Series. July 3, 2009

"Climate Change and Infectious Diseases in North America: Bugs to Watch." Public Health Research Seminar Series, March 5, 2009.

"A wake up call? Links between fatigue, healthcare worker injury, and medical errors." Toronto General Hospital Clinical Epidemiology Rounds, March 30, 2009.

"Climate change and infectious diseases in North America: Bugs to watch." Faculty of Medicine Public Health Interest Group, March 10, 2009.

University of Toronto Division of Infectious Diseases: "Demoting the 'Captain of the Men of Death': Recent work on optimizing outcomes in community-acquired pneumonia". Departmental Rounds, March 3, 2009.

Health Policy, Management and Evaluation. 2009 Clinical Epidemiology Institute, planning committee member and faculty (5 x 1.5 hour critical appraisal sessions and 1 hour lecture on "Practical Prognostication: Introduction to Clinical Prediction Rules".)

"Systematic Review and Meta-Analysis" (2 hour lecture), December 1, 2009. Respiratory GREAT Network Training Program. This program, created by Dr. Teresa To, provides training in clinical epidemiology and biostatistics to international pediatric respirology trainees.

Introduction to Conjoint Analysis in Health Care (Short Course). With Vicky Ng. 31st Annual Meeting of the Society for Medical Decision Making, Hollywood, CA. October 18, 2009.

Advanced Topics in Infectious Diseases Modeling (Short Course). With Amy L. Greer. 31st Annual Meeting of the Society for Medical Decision Making, Hollywood, CA. October 18, 2009.

Organizer and Co-instructor (with Ms. Victoria Ng and Ms. Melanie Zahab): "Putting Public Health on the Map", an interactive workshop for public health epidemiologists. Canadian Society for Epidemiology and Biostatistics Annual Meeting, Ottawa, Ontario, Canada, May 25, 2009.

2008 "Climate Change and Infectious Diseases in Canada: A Challenge to Public Health and Healthcare" University of Toronto Environment and Health Seminar, November 20, 2008.

University of Toronto Community Medicine Program: "Introduction to Mathematical Modeling of Infectious Diseases", Biostatistical Methodology Unit short course on infectious diseases modeling. Presented basic elements of communicable disease models (including herd immunity and critical fraction, seasonality, model fitting, and modeling of antibiotic resistance) to 15 community medicine residents from University of Toronto and McMaster University. Two 3-hour sessions, October 10 and October 17, Hamilton and Toronto, Ontario.

Health Policy, Management and Evaluation. 2008 Clinical Epidemiology Institute, planning committee member and faculty (5 x 1.5 hour critical appraisal sessions and 1 hour lecture on "Practical Prognostication: Introduction to Clinical Prediction Rules".)

"Herd Immunity". Ontario Public Health Laboratory "Lab Rounds". March 6, 2008.

"Systematic Review and Meta-Analysis" (2 hour lecture), November 18, 2008. Respiratory GREAT Network Training Program. This program, created by Dr. Teresa To, provides training in clinical epidemiology and biostatistics to international pediatric respirology trainees.

"Introduction to Mathematical Modeling of Infectious Diseases", Biostatistical Methodology Unit short course on infectious diseases modeling. Presented basic elements of communicable disease models (including herd immunity and critical fraction, seasonality, model fitting, and modeling of antibiotic resistance) to 25 students from

research and clinical infectious disease backgrounds. Two 3-hour sessions, July 7 and July 21, 2008.

"Making Best Bets: Mathematical Modeling as a Tool for Vaccine Policy". Pediatric Medicine Grand Rounds, January 16, 2008.

Judge, SickKids Student Summer Research Experience Research Day, July 24, 2008.

Speaker, Kids Science "Science Extravaganza" Program (science outreach to high-school students from high-risk backgrounds), Dr. Lisa Robinson, Director, May 8, 2008.

2007 Health Policy, Management and Evaluation. 2007 Clinical Epidemiology Institute, planning committee member and faculty (5 x 1.5 hour critical appraisal sessions).

University of Toronto Division of Infectious Diseases: Haygarth and Snow: Insights into "Emerging Infections" from the Pre-Microbiologic Era. Infectious Disease Fellows Retreat, August 23, 2007.

Judge, Health Policy, Management and Evaluation Student Research Day, May 2, 2007.

Judge, Department of Pediatrics Research Day, May 23 2007.

University of Toronto Division of Infectious Diseases: "Seasonality, Environment and Infectious Diseases". Departmental Rounds, April 3, 2007.

Introduction to Public Health Surveillance and Microbiology, in partnership with the Ontario Science School (tour and lab session for gifted 12th grade science students). Ontario Public Health Laboratory, May 30, 2007.

"Practical prognostication: a hands-on guide to clinical prediction rules". Pediatric Outcomes Research Team Rounds, December 13, 2007.

"Climate Change, Environment, and Infectious Diseases". (with Dr. Amy Greer, Vicky Ng-Brett, and Laura Kinlin). Child Health Evaluative Sciences Seminar Series, October 29, 2007

"Whooping it Up: The Apparent Resurgence of Pertussis in the Greater Toronto Area". Child Health Evaluative Sciences Seminar Series, September 10, 2007.

Coordinator, Biostatistical Methodology Unit Journal Club.

Judge, SickKids Student Summer Research Experience Research Day, July 18, 2007.

"Under Surveillance: How I Got Into Infectious Disease Epidemiology". Child Health Evaluative Sciences Outcomes Pillar meeting, May 15, 2007.

Sticky Situations: Needlesticks and their Implications for Patient Safety". SickKids Patient Safety Rounds, February 28, 2007.

Introduction to Infectious Disease Modeling (Short Course). With John Edmunds and Beate Sander, 29th Annual Meeting of the Society for Medical Decision Making, Pittsburgh, PA. October 20, 2007.

2006 "Seasonality of Infectious Diseases." Ontario Public Health Laboratory Seminar Series. December 14, 2006.

"There's a Bug in this Model: Transmission Modeling as a Tool for Epidemiology and Health Policy", Child Health Evaluative Sciences Seminar Series, Research Institute of the Hospital for Sick Children, December 4, 2006.

"There's a Bug in this Model: Transmission Modeling as a Tool for Epidemiology and Health Policy", Infectious Disease Division Research Rounds, November 22, 2006.

"Sneezonality: What we know (and don't) about seasonality of respiratory infections." Child Health Evaluative Sciences Seminar Series, Research Institute of the Hospital for Sick Children, October 23, 2006.

"Weather, Seasonality, and Communicable Disease Occurrence". Woodrow Wilson School (Princeton University) Science, Technology and the Environment Program (STEP) Seminar, February 20, 2006.

"SARS, Emerging Infectious Diseases, and the Basic Reproductive Number". Epidemiology of Infectious Diseases. February 13, 2006. Univ. Medicine and Dentistry of New Jersey School of Public Health, Piscataway, New Jersey.

2005 "The Economics of STD Control: Why Transmissibility Matters". Center for Health and Wellbeing Seminar Series, November 28, 2005.

Public Health Law and Infectious Diseases" (with Drs. John Culhane and Andy Newman). Current Concepts in Law and Medicine. Widener University Law School, Wilmington, Delaware

"SARS, Emerging Infectious Diseases, and the Basic Reproductive Number". Epidemiology of Infectious Diseases. April 25, 2005. Univ. Medicine and Dentistry of New Jersey School of Public Health, Piscataway, New Jersey.

2003 "SARS: Lessons learned (and already forgotten?)". Hahnemann Hospital SARS Planning Committee, Philadelphia, PA, December 17, 2003.

2004 Drexel University Math/Computer Science Seminar, April 12, 2004.
"Dynamic Projection of Effectiveness and Cost-Effectiveness of HSV-2 Vaccines for Young Women: How Good is Good Enough?"

"One in Five: Adventures in Genital Herpes". Drexel University School of Public Health Grand Rounds. February 19, 2004.

"SARS" Drexel University College of Medicine, Department of Medicine Hospital Infections Seminar. Hahnemann Hospital, Philadelphia, April 21, 2004.

"Directly Observed Therapy for HIV: A Useful Paradigm?" Infectious Disease Fellows Lecture Series. Hahnemann Hospital, Philadelphia, March 17, 2004.

Introduction to Infectious Disease Modeling (Short Course). With John Edmund 26th Annual Meeting of the Society for Medical Decision Making, Atlanta, GA. October 17, 2004.

2003 "Bring an umbrella and some penicillin: weather and invasive bacterial disease." Drexel University School of Public Health Research Friday Lunch Forum. October 31, 2003.

Hamilton Emergency Services Network. "Smallpox preparedness". Shalom Village, Hamilton, Ontario, Canada, March 28, 2003.

"Dynamic projection of the effectiveness and cost-effectiveness of an HSV-2 vaccine for young women". Hamilton Public Health Research, Education and Development (PHRED) "Share Symposium", Hamilton, Ontario, Canada, March 25, 2003.

McMaster University Regional Infectious Diseases Rounds, Division of Infectious Diseases. "Smallpox vaccination: risk vs. risk". March 13, 2003.

Hamilton Regional Emergency Medicine Rounds. "Smallpox vaccination: risk vs. risk". March 12, 2003.

Hamilton Regional Microbiology Research Day. "Dynamic projection of the effectiveness and cost-effectiveness of an HSV-2 vaccine for young women", St. Joseph's Healthcare Centre, February 27, 2003.

Department of Family Medicine, St. Joseph's Healthcare Centre, Hamilton, Ontario, Canada. "Public Health Update". March 14, 2003.

Center for Evaluation of Medicines Rounds. St. Joseph's Healthcare Centre, Hamilton, Ontario, Canada. "Invasive group A streptococcal infection: applying pharmacoeconomics to the 'flesh-eating disease'". February 11, 2003.

International Herpes Management Forum, "Strategies for Interrupting the Transmission of HSV" Workshop Participant, Seattle, Washington, May 4-6, 2003.

2002 "SARS in Toronto: the good, the bad, and the ugly." Drexel University College of Medicine Division of Infectious Diseases. Hahnemann Hospital, Philadelphia, November 6, 2003.

1-Day Workshop in Communicable Diseases for Emergency Service Workers. Hamilton,Ontario. November 19, 2002.

"Bloodborne Infectious Diseases: An Overview". City of Hamilton Police, Fire and Ambulance Designated Medical Officers, Hamilton, Ontario. February 19, 2002.

Department of Clinical Epidemiology and Biostatistics, Departmental Rounds, McMaster University, Hamilton, Ontario, Canada. "Case-crossover study of needlestick injury". March 14, 2002.

Regional Infectious Diseases Rounds, Division of Infectious Diseases. "Sharps-related injuries: identifying precipitants and measuring the costs of prevention". September 12, 2002.

Department of Family Medicine Rounds, McMaster University, Hamilton, Ontario, Canada. "Update in Sexually Transmitted Diseases, Part I". November 27, 2002

2001 "Bioterrorism". City of Hamilton Police, Fire and Ambulance Designated Medical Officers, Hamilton, Ontario. November 27, 2001.

"Bioterrorism". City of Hamilton Department of Social and Public Health Services, Hamilton, Ontario. November 9, 2001.

"Update in STDs". Infectious Diseases Fellows Academic ½ Day, Faculty of Health Sciences, McMaster University, Hamilton, Ontario. November 21, 2001.

"Bioterrorism". Infectious Diseases Fellows Academic ½ Day, Faculty of Health Sciences, McMaster University, Hamilton, Ontario. November 7, 2001.

Regional Infectious Diseases Rounds, McMaster University Division of Infectious Diseases. "Bioterrorism", October, 2001.

Clinical Preceptor, Hamilton Sexually Transmitted Diseases Clinic.

Economic Issues in Infectious Diseases Seminar, Harvard Center for Risk Analysis. "Prickly precipitants: a case-crossover study of sharps-related injuries in healthcare workers". Spring 2001, Harvard School of Public Health, Boston, MA.

Department of Medicine Special Rounds, St. Joseph's Healthcare Centre, Hamilton, Ontario, Canada.. "Bioterrorism: thinking about the unthinkable". November 13, 2001.

Seminar in Clinical Effectiveness. "Clinical and cost-effectiveness of 2 Clinical and cost-effectiveness of 2 management strategies for infected total hip arthroplasty in the elderly." Spring 2000. Harvard School of Public Health, Boston, MA.

Coordinator, Economic Issues in Infectious Diseases Seminar, Harvard Center for Risk Analysis

Seminar in Clinical Effectiveness. "Survival after percutaneous endoscopic gastrostomy". Spring 1999.

2000 Economic Issues in Infectious Diseases Seminar, Harvard Center for Risk Analysis. Estimating the costs and benefits of screening monogamous, heterosexual couples for asymptomatic infection with herpes simplex virus type 2. April 2000.

Centre for Outcomes and Policy Research Seminar. "Prickly precipitants: a case-crossover study of sharps-related injuries in healthcare workers." Dana-Farber Cancer Center, Boston, MA, USA.

Harvard Medical School Division of Infectious Diseases, City-wide Conference. "Clinical and cost-effectiveness of 2 Clinical and cost-effectiveness of 2 management strategies for infected total hip arthroplasty in the elderly.

Centre for Outcomes and Policy Research Seminar. The demise of genital herpes vaccines: using modeling to define 'Plan B'. Fall 2000. Dana-Farber Cancer Center, Boston, MA, USA.

1999 Visiting Physician ("Teaching Attending"), Department of Medicine, Beth Israel Deaconess Medical Centre, Boston, MA, April 1999.

Caregroup Center for Quality and Value, Beth Israel Deaconess Medical Centre, Boston, MA. "Management of the infected hip prosthesis".

Department of Orthopedics Departmental Conference, Beth Israel Deaconess Medical Centre, Boston, MA. Management of the infected hip prosthesis".

Department of Medicine, Beth Israel Deaconess Medical Centre, Boston, MA, Resident Lecture Series. "Fever of unknown origin"

Department of Obstetrics and Gynecology, Beth Israel Deaconess Medical Centre, Boston, MA, Resident Lecture Series. "Sexually transmitted diseases: an overview"

Department of Medicine, Beth Israel Deaconess Medical Centre, Boston, MA, Resident Journal Club. "An introduction to decision analysis".

Harvard Medical School Division of Infectious Diseases, City-wide Conference. "Infectious disease and hemophagocytosis."

1998 Harvard Medical School Division of Infectious Diseases, City-wide Conference. "Epiglottitis in the immunocompromised host".

1996 Department of Medicine Research Day, Royal Victoria Hospital, Montreal, Quebec. "Intrapleural placement of a nasogastric tube." Spring 1996.

Journal Clubs and Seminar Series

2011- Founder and Coordinator, FitzGerald Seminar Series in Communicable Disease Epidemiology, Dalla Lana School of Public Health. This series provides continuing

education to public health and medical professionals on a variety of topics in communicable disease control and vaccinology. The seminar is webcast to participants across Canada. Past seminars are archived at: . http://www.dlsph.utoronto.ca/page/fitzgerald-seminars.

2008- Founder and Coordinator, Infectious Disease Epidemiology Afficionados (IDEA) Seminar Series, Fields Institute for Mathematics and Dalla Lana School of Public Health

2008-2010 Founder and Coordinator, Infectious Disease Epidemiology Afficionados (IDEA) Journal Club, Hospital for Sick Children.

2007-2008 Founder and Coordinator, Hospital for Sick Children Biostatistics Methodology Unit Journal Club.

2000-2001 Founder and Coordinator, Economic Issues in Infectious Diseases Seminar Series, Harvard Centre for Risk Analysis

Supervision of Trainees

1. Supervisor /Co-Supervisor

Post-doctoral Fellows

2010-2012 Amy Hurford, PhD. Fields Institute for Research in Mathematical Sciences, University of Toronto. *Mathematical modeling of antimicrobial resistance in healthcare settings.* Co-supervisor with Dr. Jianhong Wu (York University).

2009-2011 Sharmistha Mishra, University of Toronto. Research mentor/co-supervisor (with Dr. M.C. Boily, Imperial College London)*, Division of Infectious Diseases, University of Toronto. Dr. Mishra obtained both a Commonwealth Scholarship and a Canadian Institutes for Health Research Fellowship in Public Health Sciences (2009-2011) ($60,000 per year).

2007-2009 Amy L. Greer, PhD. Hospital for Sick Children. Dr. Greer is a disease ecologist by training, and has joined our group to expand her expertise and understanding of *infectious diseases of humans*. Dr. Greer is a recipient of a SickKids Research Training Centre Travel Award (2008) ($960) and an Ontario Ministry of Innovation Post-doctoral Fellowship Award (2009) ($26,000).

Post-graduate Medical Trainees

2005 Wendy Bamberg, Drexel University School of Public Health, Philadelphia PA. *Risk factors for infection after cardiac surgery.* Infectious Disease Fellowship Research Supervisor.

2002-2003 Cheryl Main, McMaster University Faculty of Health Sciences, Hamilton, Ontario, Canada. *Community MRSA outbreak in a Canadian city jail.* Infectious Disease/Microbiology Fellowship Research Supervisor

Doctoral Students

2015-present Derek MacFadden, PhD Student (co-Supervisor), Harvard University School of Public Health. Cosupervisor with Dr. Bill Hannage. *Bioinformatic and geographic models for antimicrobial resistance.*

2014-present Eva Wong, PhD Student (Supervisor), Dalla Lana School of Public Health, University of Toronto. *Climate change and infectious disease risk in Canada.*

2012-present Ashleigh Tuite, PhD Student (Supervisor), Institute of Medical Sciences, University of Toronto. *Mathematical modeling of syphilis control and "rebound"*.

2012-present Ashleigh McGirr, PhD Student (Supervisor), Dalla Lana School of Public Health, University of Toronto. *Mathematical modeling of pertussis control strategies.*

2010-2014 Kevin Brown, PhD Student (Supervisor), Dalla Lana School of Public Health, University of Toronto. *Spatial and temporal patterns in Clostridium difficile outbreaks.* Committee: Allison McGeer, Nick Daneman, Rahim Moineddin. Kevin Brown received a CIHR Banting and Best Doctoral Award in 2010 ($105,000).

Medical Students

2010 Tanya Hauck, Faculty of Medicine, University of Toronto. *Pertussis epidemiology in Ontario*. Comprehensive Research Experience for Medical Students (CREMS) Supervisor.

Master's Students

2015 Tahmina Nasserie, MPH student, Dalla Lana Public Health Sciences, Epidemiology. *Growth characteristics of Western Hemisphere Chikungunya Epidemic.* Practicum Supervisor.

2013 Sandy Bae, MPH student, Dalla Lana Public Health Sciences, Epidemiology. *Impact of El Nino Southern Oscillation on Infectious Disease Hospitalization Risk in the United States, and Implications for Climate Change.* Practicum Supervisor.

2011-2012 Gregory Kujbida, MPH student, Dalla Lana Public Health Sciences, Epidemiology. *Incorporating fine scale water quality and case data for modeling cholera in Haiti.* Practicum Supervisor.

2010-2011 Ruth Campbell, MSc (Supervisor), Health Policy, Management and Evaluation. *The experiences of immigrants seeking healthcare in Toronto*. Committee: Brian Hodges, Angela Robertson.

2010-2011 Christina Chan, MPH student, Dalla Lana Public Health Sciences, Epidemiology.

Latent class analysis for STD test methods. Practicum Supervisor.

2009 Laura Kinlin, MPH, University of Toronto. *Sharps injuries in healthcare workers; Prediction of pneumonia after cardiac surgery*. SickKids Summer Student Research Experience.

2009 Ashleigh Tuite, MSc. University of Toronto. *Influenza modeling*. SickKids Summer Student Research Experience.

2008-2009 Laura Kinlin, MPH, University of Toronto. *Epidemiology of invasive meningococcal disease in Ontario, Sydney, Australia, and London, England.* Public Health Sciences Master's Student Practicum Supervisor

2008-2009 Ashleigh Tuite, MSc, University of Toronto. *Biases in discordant couples study designs.* Public Health Sciences Master's Student Practicum Supervisor

2005 Rory Gagan, Drexel University School of Public Health, Philadelphia PA. *Hospital-acquired pneumonia after coronary artery bypass grafting: attributable mortality and length of stay*. MPH Thesis Supervisor

2005 Kimberly Spaude, Drexel University School of Public Health, Philadelphia PA. *Prior influenza vaccination and mortality among individuals hospitalized with community-acquired pneumonia.* MPH Thesis Supervisor

2005 Oumar H. Gaye, Drexel University School of Public Health, Philadelphia PA. *Epidemiology of Lyme disease in Philadelphia.* MPH Thesis Supervisor

2005 Joseph Noorigian, Drexel University School of Public Health, Philadelphia PA. *Risk factors for falling in Parkinson's disease*. MPH Thesis Supervisor

2004 John F. Ambrose, Drexel University School of Public Health, Philadelphia PA. *Risk factors for sternal wound infection after coronary artery bypass grafting.* MPH Thesis Supervisor

Undergraduate Students

2009 Caitlin McCabe, BSc. University of Toronto. *Directly observed therapy in women with HIV infection.* SickKids Summer Student Research Experience.

2007 Laura Kinlin, MPH. University of Toronto. *Environmental influences on invasive meningococcal disease in Philadelphia.* SickKids Summer Student Research Experience.

2008 Alexander White. *Environmental influences on campylobacteriosis in Philadelphia.* SickKids Summer Student Research Experience

2008 Caitlin McCabe, BSc. University of Toronto. *Compliance with antibiotic treatment guidelines and mortality in community acquired pneumonia.* SickKids Summer Student Research Experience.

2008 Stephanie Ross, BSc, University of Toronto. *Systematic review and meta-analysis of relative risk of cervical cancer in Indigenous women in Australia, Canada, New Zealand and the United states.* SickKids Summer Student Research Experience.

2008 Jennifer Ku, Applied Health Sciences Co-op Program, University of Waterloo. *Systematic review of factors influencing vaccine acceptance by healthcare workers*. Co-op Placement Supervisor.

2007 Alexander White. *Environmental influences on invasive pneumococcal disease in Philadelphia*. SickKids Summer Student Research Experience.

2001 Louisa Lowry, McMaster University Faculty of Health Sciences, Hamilton, Ontario, Canada . *Cost-effectiveness of safer sharps devices*. Supervisor: Student Research, Health Sciences 4L02 (Research Practicum).

Other Supervisory Activities

2009-2010 Ashleigh Tuite, MHSc. University of Toronto. *Modeling of vaccination strategies for pandemic H1N1 influenza*. MITACS Accelerate program (in conjunction with Ontario Agency for Health Protection and Promotion).

2009-2010 Beate Sander, University of Toronto. *Health economic aspects of pandemic mitigation.* Strategic Training Initiative in Health Research—Health Policy, Dalla Lana School of Public Health and MITACS Accelerate program (in conjunction with Ontario Agency for Health Protection and Promotion).

Note: The MITACS Accelerate program is an internship experience that fosters the integration of students in applied mathematics and other quantitative backgrounds into the corporate or public sector workplace.

2009-2010 Yanyu Xiao, University of Western Ontario. Mathematical modeling of H1N1 influenza in remote First Nations. CIHR Pan-Canadian Decision-Making Support Network for Pandemic Preparedness (CanPan) internship program.

2009-2010 Venkata Duvvuri, York Unversity. Conserved epitopes and cellular immunity as determinants of the epidemiology of the 2009 influenza pandemic. CIHR Pan-Canadian Decision-Making Support Network for Pandemic Preparedness (CanPan) internship program.

Note: The CanPan program was a national training effort aimed at fostering mathematical modeling expertise as part of Canada's response to the 2009 influenza pandemic. It was supported by the Canadian Institutes for Health Research. Additional information is available at https://canpan.ca/.

2. Committee member

PhD students

2008-2011 David Vickers, PhD candidate in interdisciplinary studies, University of Saskatchewan. *Epidemiology and immunology of Chlamydia trachomatis*. (Chair Dr. Nathaniel Osgood). Doctoral Thesis Committee.

2008- Paul Arora, PhD candidate in Epidemiology, University of Toronto. *Sexually transmitted disease risk in India.* (Chair Dr. Prabhat Jha). Doctoral Thesis Committee.

2008- Andrea Stachon MD, PhD candidate, University of Toronto Institute of Medical Sciences, Department of Psychiatry. *Gene expression and psychosis risk in 22q11 microdeletion syndrome*. (Chair Dr. Kathy Siminovich). Doctoral Thesis Committee Member

Master's students

2007-2010 Kaede Ota, MD, Health Policy, Management and Evaluation, University of Toronto. *Epidemiology of Antimicrobial Resistant Gonorrhea in Greater Toronto*. (Chair Dr. Sharon Walmsley). Master's Thesis Committee Member.

2008-2010 Elizabeth Brown, Laboratory Medicine and Pathobiology, University of Toronto. *Characterization of the epidemiology and microbiology of blastomycosis in Ontario.* (Chair Dr. Susan Richardson). Master's Thesis Committee Member.

H. UNIVERSITY SERVICE

Faculty Responsibilities

2016- Promotion and Tenure Committee, Dalla Lana School of Public Health

2013-2016 School of Public Health Faculty Representative
Clinician-Scientist Training Program Review
Faculty of Medicine, University of Toronto

2012- Faculty Council
Dalla Lana School of Public Health
University of Toronto

2011 Strategic Planning Steering Committee
Dalla Lana School of Public Health
University of Toronto

2011 Directorial Search Committee
Dalla Lana School of Public Health
University of Toronto

2004-2005 Continuing Medical Education Committee
Drexel University School of Public Health (Dr. Arthur Frank, Chair)

2002 - 2003 Local Planning Committee
Regional Training Centre in Health Services Research
McMaster University

1994 - 1996 Sciences Library Committee
McGill University

Departmental Responsibilities

2017- Head, Divison of Epidemiology, Dalla Lana School of Public Health, University of Toronto

2017- Member, Senior Administration Committee, Dalla Lana School of Public Health, University of Toronto

2017- Member, Dalla Lana School of Public Health Curriculum Committee

2014-15 Faculty Advisor (with Prof. Ross Upshur), Student Ebola Working Group

2011- Chair, Scientific Advisory Group for the FitzGerald Seminar Series on Communicable Diseases Control and Prevention

2011-2012 Member, Curriculum Review Committee

	Epidemiology Division, Dalla Lana School of Public Health University of Toronto
2010-present	Chair, Curriculum Review Committee Epidemiology Division, Dalla Lana School of Public Health University of Toronto
2009-	Admissions Committee Dalla Lana School of Public Health University of Toronto
2007-2012	Clinical Epidemiology Institute Planning Committee Department of Health Policy, Management and Evaluation University of Toronto
2004-5	Department of Epidemiology and Biostatistics Chair Search Committee Drexel University School of Public Health (Dr. Arthur Frank, Chair)
2003-2005	Admissions Committee Drexel University School of Public Health (Dr. Todi Villanueva, Chair)
2001	Pre-Medical Committee Member and Non-resident Tutor, Cabot House, Harvard College

This is **Exhibit "B"** to the
Affidavit of David Fisman,
affirmed before me by videoconference
July 21, 2020

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A Commissioner, etc.

HOUSE OF COMMONS
CHAMBRE DES COMMUNES
CANADA

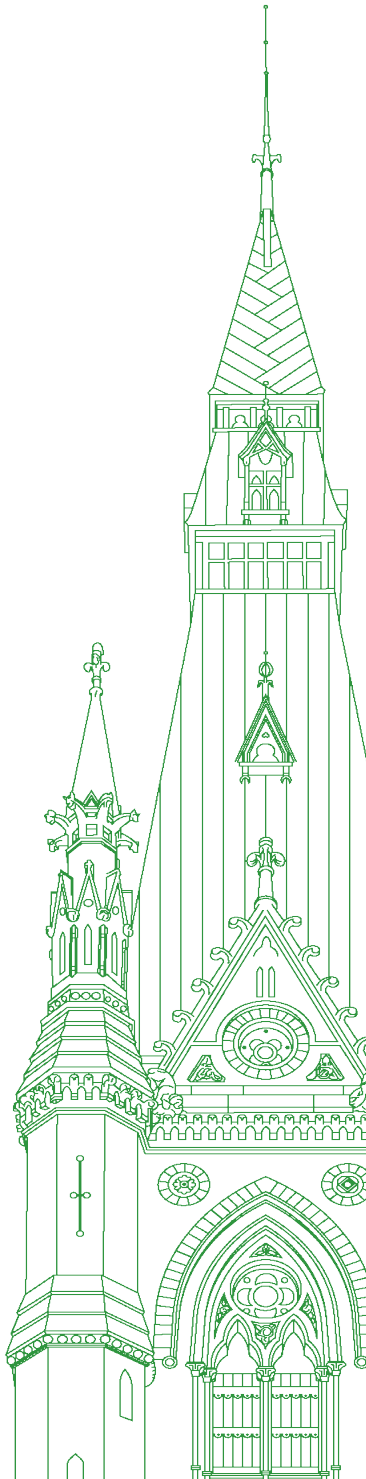
43rd PARLIAMENT, 1st SESSION

Standing Committee on Health

EVIDENCE

NUMBER 022

Wednesday, May 20, 2020



Chair: Mr. Ron McKinnon

Standing Committee on Health

Wednesday, May 20, 2020

● (1615)

[*English*]

The Chair (Mr. Ron McKinnon (Coquitlam—Port Coquitlam, Lib.)): I now call this meeting to order.

I'd like to welcome everyone to meeting number 22 of the House of Commons Standing Committee on Health. Pursuant to the orders of reference of April 11 and April 20, 2020, the committee is meeting for the purpose of receiving evidence concerning matters related to the government's response to the COVID-19 pandemic.

In order to facilitate the work of our interpreters and ensure an orderly meeting, I would like to outline a few rules to follow.

First, interpretation in this video conference will work very much like in a regular committee meeting. You have the choice at the bottom of your screen of floor, English or French. Please speak slowly and clearly and hold your microphone in front of your mouth.

If you will be speaking in both official languages, please ensure that the interpretation is listed as the language you will speak in before you start. For example, if you're going to speak in English, please switch to the English feed and then speak. This allows for better sound quality for interpretation.

Before speaking, please wait until I recognize you by name. For witnesses, the questioner will basically identify who they would like to respond to the questions. When you're ready to speak, click on the microphone icon to activate your mike. Should members need to request the floor outside of their designated time for questions, they should activate their mike and state that they have a point of order.

As a reminder, all comments by members and witnesses should be addressed through the chair. Should any technical challenges arise, please advise the chair or the clerk immediately and the technical team will work to resolve them. It may be necessary to suspend the meeting in such cases in order to sort things out.

Before we get started, could everyone check on the upper right-hand corner of their screen if they're using a personal computer. In the top right-hand corner there's a choice between speaker view and gallery view. Gallery view will ensure that all video participants can see each other.

I'd now like to welcome our witnesses. Each witness will have 10 minutes for an opening statement, followed by the usual rounds of questions from members. First, as an individual, we have Dr. Amir Attaran, professor, faculty of law, University of Ottawa. As an individual, we have Dr. David Fisman, professor of epidemiology, University of Toronto; and as an individual, Dr. Richard Schabas, former chief medical officer of health for Ontario. From BlueDot we have Dr. Kamran Khan, chief executive officer and founder; and from Dynacare we have Vito Ciciretto, president and chief executive officer.

Welcome everyone. Thank you for joining us today.

We will begin with Dr. Attaran. Welcome back. You have 10 minutes. Please go ahead.

Professor Amir Attaran (Professor, Faculty of Law, University of Ottawa, As an Individual): Thank you.

Good afternoon, ladies and gentlemen. Thank you for having me back at the health committee. I hope you've been well.

Mr. Tony Van Bynen (Newmarket—Aurora, Lib.): Mr. Chair, I'm sorry. The interpretation is overriding the English language.

The Chair: Dr. Attaran, are you on the appropriate translation channel? You should be on the channel for the language you're speaking.

Prof. Amir Attaran: I'm sorry, I forgot that. Let's start over.

The Chair: Thank you.

Prof. Amir Attaran: Good afternoon, ladies and gentlemen.

Thank you for having me back at the health committee. I hope you've been well and that your families have been keeping safe.

When we last met, Canada was in a full lockdown, and I strove to explain how we might get out of it. I offered a road map for exiting the lockdown gradually. That road map remains valid. First, a nationwide lockdown to bring disease transmission to virtually nil, and simultaneously a massive push to increase testing and contact tracing by a factor of ten or more, followed by a sequence of gradual reopenings and infection wavelets that are well calibrated by disease forecasts and monitored by testing to minimize deaths. No competent expert disagrees with this basic strategy.

I said that following this road map would be long and difficult, and I reassured you that there is light at the end of the tunnel. Sadly, some weeks on, today I am here to tell you that the light seems dimmer than I imagined, not for scientific reasons, but for political reasons, which you can fix.

As you know, countries like Australia, Denmark, New Zealand and Norway are executing successful reopenings. Meanwhile, Canada is flying somewhat blind because provincial and federal governments have still not solved their massive failure to co-operate in sharing and analyzing epidemiological data. Without data and analysis, many experts think reopening is arriving too early in some places like Toronto, which will kill people needlessly, and arriving too late in others, like Kingston or the Maritimes, after crippling the economy and ballooning the deficit. This isn't good.

My goal today is to offer a frank reality check, franker than Dr. Tam and Dr. Nemer delivered. I was saddened and frustrated that yesterday many of you asked excellent questions, but got evasive and, at times, mealy-mouthed answers. Please feel free to ask me those same questions. If I can help, I promise I will.

First, let's start with some data and the big question. Is Canada really bending the curve? The answer is sort of.

Many Canadians think we have done well because we are better than the United States, a country that has no public health care, vocal COVID-19 deniers and a president who recommends injecting bleach. The Americans are obviously not the right comparison for us. It's better to compare Canada with other wealthy countries, especially confederations, because they have federal-provincial complications like our own.

Please turn to the line graph I've provided to the committee. It's one of two graphs that were provided.

This graph shows confirmed COVID-19 cases, adjusted for population, starting on the day that a country exceeded the threshold of one case per million population. Canada was the last country to face COVID-19. That's luck, and it gave us extra time to prepare and the benefit of learning from others who went before us. With those advantages we achieved a lower infection peak. However, we come to the question of bending the curve down, we're doing poorly. Instead of the successful nosedive the graph shows for France, Germany, Spain or Switzerland, which they achieved despite a faster and higher peak than ours, our curve looks more like an undulating plateau that gradually drops off like a bunny ski hill. By May 18, our daily confirmed cases were tied with those on April 4. Between those dates are weeks of squandered time, lives and money, the latter being around $12 billion a week to the macro economy.

● (1620)

I find the comparison with Australia the most interesting. It proves that Canada could have done better. It is a large confederation of states, much like our own provinces, and it crossed the threshold of one case per million just one day before we did. In other words, we started off tied, but instead of dithering, Australia smacked down its curve hard and fast. Its results are almost as impressive as South Korea’s, which many reckon to be the world’s most successful country. Now Australia is opening thoroughly, and we are not, so the costs of this failure are just massive. The next time you hear the Prime Minister and Dr. Tam say that Canada is bending the curve, be skeptical. Be much more skeptical than you have been.

Let’s now talk about testing. You heard from nearly everyone that Canada is doing a poor job and that without more and faster testing it is impossible to reopen without unnecessarily risking and losing Canadian lives. The scientific goal is not simply testing the sick, but over-testing the vulnerable and anyone else who might have come been contact with the sick so as to isolate them for 14 days and nip outbreaks in the bud, yet Canada’s testing remains awful, especially in Ontario and Quebec.

The bar graph I furnished to the committee shows over-testing as the ratio of total COVID-19 tests per positive test. The higher that ratio, the better the chance of spotting infections and avoiding outbreaks. If one chooses not to worry about the price of testing—and one shouldn’t, because testing costs peanuts compared to hospitalizations or lockdowns—then it is far better to test too much than too little.

On this measure of testing, Canada lags behind not just top performers like Australia and South Korea, but also behind Ethiopia, Rwanda, Kenya, Cuba and Ghana. We are such testing tightwads that low-income countries in Africa surpass us. Africans also outclass Canada on contact tracing. Addis Ababa’s extensive testing and contact tracing puts Montreal and Toronto to shame.

For Canada to be beaten by the world's poorest countries has got to puncture the myth of competence and success. It cannot be that Canada lacks Africa's scientists, laboratories, equipment or chemicals, any of that. No. The reason we have failed is the cupidity and stupidity of certain governments, and this is where I put my constitutional lawyer hat on to talk about federalism. American lawyers have a great saying. They say that the Constitution is not a suicide pact, but I'm afraid, ladies and gentlemen, that during a killer pandemic our usually accepted federal-provincial relations can turn into a suicide pact.

I believe that our most fundamental failing right now is that pandemic responses are handicapped by a mythological, schismatic view of federalism. Thus, when provinces withhold epidemiological data or do a poor job of testing, collectively we grumble, we shrug and we mutter that health is provincial, but this is wrong. Speaking as a constitutional lawyer, health is actually a shared federal/provincial jurisdiction. The Supreme Court is dead clear about that. It says, "Health is a jurisdiction shared by both the provinces and the federal government." That's our Supreme Court, and it's perfectly accurate.

I think it is good for the federal government to let provinces run their show, and that's normally how it should work, but I'll suggest that a pandemic is not normal. There comes a point when the federal government must step in, the point where provincial actions are killing Canadians. If our country cannot show that once-in-a-century flexibility, then, yes, we are turning the Canadian Constitution into a suicide pact.

I know that what I've just said will be outrageously controversial. I'm sorry, but as a person who loves this country, I cannot let obvious mistakes pass and kill my neighbours.

● (1625)

Let me close with three recommendations.

First, Parliament must pressure cabinet into taking legal steps to force provinces to share epidemiological data. These are the data that scientists like Dr. Fisman and Dr. Khan absolutely need to keep me, you and your loved ones alive as this lockdown lifts. Parliament gave cabinet the power to demand data in section 15 of the Public Health Agency of Canada Act, but the Prime Minister has not used that power. It's frankly pathetic.

Second, demand that the Public Health Agency of Canada set minimum standards for things like testing. We cannot remain stuck behind Africa. Come on. It was only last week that the Prime Minister proposed a national testing strategy. That is much too late. We need it now.

The Chair: Dr. Attaran, you're at 11 minutes. Could you wrap up, please?

Prof. Amir Attaran: Sure.

Third, sign an accord with the provinces on co-operating throughout this pandemic. In Australia, the prime minister and the premiers signed a COVID accord on March 13, and the Vikings have killed this thing. Those Australian Vikings have put it down.

It's unbelievable that two months later, Canadian governments still have no COVID accord.

I'll close there. I hope you take these suggestions in the spirit they are intended, not to gore anyone's sacred cow, but to save the lives of the Canadians we love.

Thank you for hearing me.

● (1630)

The Chair: Thank you, Dr. Attaran.

We go now to Dr. Fisman.

Dr. Fisman, please go ahead. You have 10 minutes.

Dr. David Fisman (Professor of Epidemiology, University of Toronto, As an Individual): Honourable committee members, thank you for the privilege of appearing before you.

The last several months have offered us as a country extraordinary challenges. As an epidemiologist, internist and parent, these challenges have subsumed every part of my work life and my personal life. I haven't hugged my kids since mid-March. I have watched patients admitted to hospital with mild breathing difficulties and have seen these same patients wheeled into the intensive care unit 72 hours later. My colleagues have cared for married couples, and have had to tell the surviving spouse of the death of their partner while on clinical rounds. I've had the gratifying experience of watching our modelling work influence policy. I've also experienced the annoyance of watching epidemiological data abused, misused and distorted in support of various political, economic and social agendas.

The challenges I have faced pale next to those faced by many Canadians, those who have lost their jobs or lost their loved ones, often without the chance to hold hands or say goodbye. They pale next to the challenges faced by those who have worked at essential jobs under pressure from employers but without access to adequate personal protective equipment. We've watched extraordinary leadership from senior public health officials across the country. Here I'd like to single out the clear, compassionate messaging from Drs. Henry, Hinshaw and Tam for special praise.

We have also struggled with more limited leadership in other provinces. Here I would note in particular the failure of provincial public health officials in Ontario to act swiftly and courageously to stop the spread of COVID-19 in long-term care facilities, the failure to clearly articulate that COVID-19 was spreading in our communities in early March, and the failure to keep up with the best epidemiological evidence on important issues like transmission of disease by individuals with few or no symptoms.

So yes, we have seen many challenges, some of which we have met and some of which we have not. My group prepares forecasts for several federal and provincial colleagues each morning. We have documented a reproduction number for the epidemic in Canada of below one since around May 9, 2020. That's a hopeful sign. The reproduction number of an epidemic, the number of new cases created by an old case, is an index of epidemic growth and decline. A sustained reproduction number of below one suggests that this first wave of the COVID-19 pandemic is approaching an end in Canada.

I have been concerned by how this encouraging turn of events has been interpreted by some to mean that this wave is ending in spite of, rather than because of, the patient and selfless actions of many Canadians who've experienced hardship, isolation and deprivation in order to distance themselves from workplaces, friends and family. In Canada we have seen health care systems stretched and challenged, but we have not witnessed the tragic overflow of intensive care units as has occurred in Wuhan, Lombardy, New York and Madrid.

Make no mistake, our failure to experience these tragedies does not mean that models were wrong. Cities around the world that failed to react to approaching epidemics as promptly as Canadian cities did have experienced astounding surges in mortality—a 300% increase in deaths in New York, 75% in Stockholm, 460% in Bergamo, and a 100% increase in mortality in London. We reacted to approaching disaster in time to avert the worst of this first wave, but in our two largest cities, Montreal and Toronto, we still have several hundred individuals in intensive care units.

Now we face what I'll refer to as the “paradox of prevention”. By preventing widespread infection in the country, we've maintained susceptibility in the population, which leaves us vulnerable to future epidemic waves. This is the defining paradox of public health. Our fundamental deliverable is the non-occurrence of events. Those of us who work in the field are accustomed to having our outputs taken for granted. To note one familiar example, vaccination programs are criticized because their very success means we don't experience outbreaks. Perhaps a silver lining to this episode, moving forward, will be a greater appreciation of what public health provides us in normal times.

To go back to our successful avoidance of even greater tragedy in Canada in March and April, having achieved this important success, we need to move forward with economic revitalization. I think the presentation of our choice as economic revitalization versus prevention of disease transmission is a Hobson's choice or false dichotomy. We can't ignore our economy, but we won't have robust revitalization without strong surveillance systems and health protection measures. A frightened and grieving population will not drive a strong economy. In the United States, data assembled by JP-Morgan Chase show clearly that declines in spending are strongly linked to levels of disease activity.

● (1635)

The bedrock on which revitalization rests will be public health surveillance and laboratory testing. We can't see this epidemic without testing, and we can't fight an epidemic that we cannot see.

The virus is a slippery foe, and it's a study in contradictions. I call it Schrödinger's coronavirus. It's dangerous and it's lethal, but it causes mild illness and even infection without symptoms. It kills over 7% of the Canadians with recognized infection, but it gives most children a free pass.

Asymptomatic and presymptomatic infections are a Trojan horse that gives entry to congregate settings like long-term care and retirement homes, health care facilities, prisons and food processing plants. Once it's spreading in these institutions, it can take a terrible toll, as we have seen in long-term care facilities.

We can look around the world for successful responses to this epidemic and emulate best practices, but we can also emulate best practices here in our own country. Colleagues in Newfoundland have controlled COVID-19 rapidly; they tell us to hunt the virus and be proactive. Colleagues in British Columbia teach us how important clear strategy and communication are in this fight. Alberta can show us how to scale up testing, and our northern territories can show us how to protect isolated remote communities. Saskatchewan has shown us how to deal swiftly with growing outbreaks to prevent geographic spread of infection.

But I do believe that our most potent weapon in the fight is testing. Work by my colleague, Dr. Ashleigh Tuite, shows that without aggressive testing, control measures like contact tracing are likely to be fruitless, as we will only perform contact tracing on tested cases. If we fail to test at scale, we will miss too many additional cases for contact tracing to change the dynamics of the epidemic. It will simply be a waste of resources. If we test at scale, we can keep the epidemic in our sight and move toward economic revitalization while keeping Canadians safe.

Testing will be our eyes and ears as we move forward to open our economy, but the laboratory is a tool that needs to be used differently in different settings. We need to establish regular testing regimens for those who work in congregate settings with vulnerable individuals, especially in long-term care and in hospitals. Testing in a stable and consistent way allows us to estimate the reproduction number of the epidemic and know when we're headed back into exponential growth. We want to find all the cases we can. That's how we prevent sparks from turning into forest fires.

Hospitalizations and deaths are easy to see, but they're lagging indicators. Instituting control policies once those are surging means that we've already missed the boat. We can use non-traditional surveillance tools, too, like web-based syndromic surveillance, and even surveillance of sewage for coronavirus levels, as is already being done in other countries. Situational awareness will keep us safe as our economy comes back to life.

We can also demand more of our country. This epidemic shows us that having laboratories with 21st century diagnostic technology, but public health information systems that depend on fax machines from 1995, will hold us back. We can demand more transparency from our leaders. As action by the public is central to disease control, it's important that the public be kept in the loop and made to feel like they're on the team. Indeed, they are the team.

We need clear, transparent benchmarks across the country on testing, on turnaround times for case reporting and contact tracing and for the reproduction numbers that will be used to determine when we need to strengthen distancing and when we can loosen it. We will have more setbacks; the countries with the strongest response programs in the world have all suffered them. We will too. I'd ask you not to throw your hands up and let the virus win.

Don't let uncertainty distract you from the mission. Uncertainty is to be expected for a disease that's been in humans for 24 weeks. Don't let smug professors bully you about the absence of randomized controlled trial evidence for control of a disease that has only existed for half a year. We can acknowledge uncertainty and be humble about this disease, but always put the lives and livelihoods of Canadians at the forefront when we make our decisions.

Thank you for the opportunity to answer your questions today.

● (1640)

The Chair: Thank you, Dr. Fisman.

We go now to Dr. Schabas.

Please go ahead. You have 10 minutes.

Dr. Richard Schabas (Former Chief Medical Officer of Health for Ontario, As an Individual): Mr. Chair and members of the committee, it's a privilege to speak with you today.

I'm a retired physician. I practised medicine for 40 years in two specialties: public health and internal medicine. I worked in local public health for 15 years. I was Ontario's chief medical officer of health for 10 years. I was directly involved in the 2003 SARS outbreak as the chief of staff of York Central Hospital. I have published academic and popular articles on relevant subjects, such as SARS, quarantine and bird flu.

Canadians on the whole enjoy a wonderful standard of health, resting on the foundation of the social determinants of health: education, employment and our social fabric. Anything that threatens these foundations threatens our public health.

Canada is now faced with both a tragedy and a crisis. The tragedy is caused by COVID, a respiratory virus. It has the potential to cause the deaths of tens of thousands of Canadians, overwhelmingly old and infirm.

The crisis is caused by our attempts to control that virus. The crisis has the potential to cause severe and lasting damage to the fabric of our country's economy, education, social and cultural institutions, and mental health that will have repercussions for our public health for decades.

The tragedy is a natural disaster that saddens me and saddens us all. The crisis is a self-inflicted wound that frankly terrifies me. It offends social justice, because the burden of the crisis falls disproportionately on children, young families and blue-collar workers. The more we focus exclusively on COVID, the greater the danger to our public health.

The best analogy to the COVID outbreak is the H2N2 Asian flu pandemic that swept around the world in the fall of 1957. Asian flu caused more disease and a much higher death rate, especially in younger people, than COVID. Asian flu killed between one million and two million people in a matter of a few months in a world population one-third the size of today's. That's the equivalent of three million to six million deaths today, many more than from COVID. Asian flu was a tragedy, but it wasn't a crisis, because 60 years ago people responded differently. Some modest control measures were taken, but they were very temporary. The world moved on.

Perspective isn't very popular with COVID, but I think it's important. We get spooked by COVID deaths because every day we see the numbers for COVID, but not for anything else. Death is a common phenomenon in our world. Almost 300,000 Canadians will die this year, like every year, from cancer, heart disease, stroke, motor vehicle crashes, suicide and a myriad of other causes. Since mid-March, for every Canadian outside long-term care who has died of COVID, 50 Canadians have died of something else.

We have frightened people. Predictably, the media has led the way. But public health has also frightened people, I think, to promote better compliance with social distancing. This was wrong for two reasons: first, it's cynical; and second, it now will make it that much harder to step down.

My wife and I live in Toronto. When we walk our dog, we see two kinds of people— those like us who have done the math and aren't really frightened by COVID, and those who think walking the streets is dangerous. But there's a third group, the people in our building whom we haven't seen for two months who are too terrified to even go outside. Getting them to re-enter the world will be a tremendous challenge.

The only reliable defence against a respiratory virus is immunity. You can get immunity from being infected or you can get it from a vaccine. A safe and effective vaccine would be wonderful, but it would be foolish to build public policy around expectations of a vaccine any time soon. Any strategy that doesn't take us towards immunity ultimately leads us nowhere. So long as the disease is circulating elsewhere, it's coming back here too. Provincial or national elimination is a false promise.

● (1645)

Population immunity leading to herd immunity is a natural phenomenon not an intervention, not an experiment. Herd immunity is what has controlled every other respiratory virus. We will get there sooner or later with COVID. The policy challenge is to mitigate the worst effects of the disease while protecting the real determinants of our health: education, employment and our social fabric.

We have better information about COVID than we did two months ago. We know that COVID is very serious, certainly much more serious than I, for one, expected. However, it's also not the apocalypse that some of the models had predicted, not even remotely close. The comparison should be with 1957, not 1918.

We know that our health care system can cope. A combination of expanded capacity, better treatment strategies, and triage mean that the apparent capacity crisis in Italy has not been repeated here or really anywhere else. We know that the great majority of people in Canada are at very little personal risk of death from COVID. For virtually everyone under the age of 60 and for people without serious comorbidities to a much older age, the risk of death from COVID infection is not materially different from the risk of dying from influenza. We are two populations: the frail elderly for whom COVID is a deadly disease and the great majority for whom it is not.

Canada's experience in the last two months has been problematic. We seem to have been reasonably effective at reducing infection in the community, but we have not been effective in protecting the institutionalized, frail elderly because of a massive failure of infection control in some facilities. As a consequence, we have had many deaths, but we have relatively little population immunity.

The COVID outbreak in the northern hemisphere has been on the wane since late March—for almost two months. The policy tide worldwide is now towards reopening. Canada will be swept along.

My real concern is that the virus will return, probably in September, and that our attempts to control it with widespread testing and contact tracing will probably fail. I've worked long enough in public health to understand the limitations of contact tracing as a disease control strategy, particularly for a disease like COVID.

However, when this strategy fails, will we panic and lockdown again, this time indefinitely, or will we respond in a more measured and rational way? We have some time to prepare. If plan A is based on testing and contact tracing, we need a plan B. What should we do now?

First, we need to identify those things that are fundamentally non-negotiable. Education, which requires the reopening of schools, and employment, which requires that many people return physically to work, should be top of the list, along with access to medical and dental care.

Second, we need to be clear that we are pursuing the policy of mitigation not elimination. With mitigation, we can tolerate an increase in cases when we open up now, and again when the disease resurges in the fall. We will regard community spread as inevitable and as a step towards population immunity.

Third, we need to do serious policy work to identify those aspects of social distancing that are effective, acceptable and sustainable. Canada's latest fad is for non-medical masks, based on the thinnest of evidence. Let's think carefully before we change ourselves into a society that hides its face in public.

Fourth, we must develop better strategies to protect the vulnerable, particularly better infection control in long-term care institutions. This alone will go a long way towards reducing mortality.

Fifth, we need to change our messaging to the public to better reflect their real risk of serious illness and death so that people will be willing to come out of isolation and resume normal life.

Sixth, we need to look for ways to develop public health policy nationally. We need a national, not a federal, public health agency that engages the provinces with the federal government as equal partners.

Thank you.

● (1650)

The Chair: Thank you, Dr. Schabas.

We'll go now to Dr. Khan from BlueDot. You have 10 minutes.

Dr. Kamran Khan (Professor of Medicine and Public Health, University of Toronto, Chief Executive Officer and Founder, BlueDot): Good afternoon, ladies and gentlemen, and thank you for inviting me to be a part of this important discussion today.

First let me introduce myself and tell you a bit about my background and its relevance to today's meeting. My name is Kamran Khan, and I'm a physician trained in internal medicine, infectious diseases, and preventive medicine and public health. I practise medicine and am an epidemiologist who has been studying outbreaks and emerging infectious diseases at St. Michael's Hospital in Toronto for the past 17 years. I'm a professor of medicine and public health at the University of Toronto and am the founder and CEO of a digital health company called BlueDot.

What has motivated me to dedicate my professional life as a clinician, an academic and an entrepreneur to the field of emerging infectious diseases? Twenty years ago, I began my training in infectious diseases and public health in New York when West Nile virus arrived in the city and began its westward march across the continent. Two years later, shortly after the terrorist attacks of September 11, 2001, anthrax was weaponized and dispersed through the U.S. postal system, reminding us that deadly outbreaks can arise from deliberate acts. After returning to my home in Toronto two years later, a coronavirus known as SARS spread from mainland China to dozens of cities and countries around the world, including Toronto, where it triggered a deadly outbreak that lasted four very long months. While the world had never seen an outbreak quite like SARS before, it was clear that this wouldn't be the last time.

The world is changing in ways that are driving the emergence and spread of dangerous diseases, but it's also changing in other ways that can play to our advantage. The rise of big data, the advent of artificial intelligence and emerging digital technologies offer us the raw materials needed to literally spread knowledge around the world faster than any outbreak. This was the inspiration for BlueDot's founding six and a half years ago, to build a digital global early warning system for infectious diseases that can transform how the world prepares for and responds to tomorrow's inevitable infectious disease threats, whether they arise from Mother Nature, accidents or deliberate acts.

The early warning system we have developed at BlueDot serves three key objectives: first, to detect infectious disease threats as early as possible to buy ourselves valuable time; second, to assess their potential for global spread and impact so that we can channel our finite resources to the right place at the right moment; third, to empower a wider array of decision-makers, from government to health care to the private sector, with timely insights so that together we can mobilize highly effective, efficient and coordinated responses.

To detect threats at their earliest stages, our early warning system processes vast amounts of online data in 65 languages, searching for early signals of outbreaks involving over 150 different diseases and syndromes, 24 hours a day, 365 days a year. The surveillance engine does not rely solely on official news of outbreaks reported by government agencies, but also analyzes unofficial information generated through digital media, health blogs and other online sources.

This engine picked up an article in Chinese on the morning of December 31, 2019, reporting on an outbreak of pneumonia of an unknown cause in Wuhan, China. This event certainly captured my attention, given the number of parallels to the emergence of SARS in 2003. Within a few seconds of detecting the outbreak in Wuhan, our system analyzed the flight schedules and anonymous itineraries of hundreds of thousands of travellers departing Wuhan on commercial flights for destinations around the world. Given our early concerns about this outbreak, my team submitted results of this analysis for publication in an open access, peer-reviewed scientific journal on January 8, 2020, in order to make this data freely available for anyone to access. This analysis accurately identified many of the cities outside of mainland China that were among the first to confirm cases of COVID-19.

As cases of COVID-19 arrived in North America, our team began generating insights to support public health efforts to mitigate domestic transmission of this virus within our communities. These analyses made use of anonymous location data generated from mobile apps to understand the movements of populations—critical insights for public health officials to optimize and strategically make use of their finite human resources across the country and over time.

It's worth noting that BlueDot only makes use of third party data that is anonymized, adheres to all legal and regulatory requirements, and is aggregated up to the level of populations. These location data have been used for years in sectors from urban planning to transportation to retail, among others. Here, we're making use of them for the sole purpose of safeguarding communities and protecting lives during the midst of a pandemic.

● (1655)

At BlueDot, our diverse team, comprising physicians, veterinarians, epidemiologists, geographers, ecologists, data scientists and engineers, has been diligently working for the past six and a half years leveraging data, advanced analytics and emerging digital technologies to develop innovative solutions that are capable of generating insights to mitigate risks from infectious disease threats in our rapidly changing world. But insights are only meaningful if they are translated into action, and that translation can only happen through partnerships.

In this regard, BlueDot has a long-standing partnership with Global Affairs Canada, going back to 2014, in which we have been building and implementing digital systems to manage infectious disease risks across the Association of Southeast Asian Nations. In 2019 we began a partnership with the Public Health Agency of Canada, channelling our efforts to mitigate domestic risks from global infectious diseases. Now, as the COVID-19 pandemic evolves into new phases, we continue to work together to mitigate its impacts across the country.

I'd like to conclude by saying that Mother Nature is sending us a message. A confluence of forces in our rapidly changing world—population growth, urbanization, the industrialization of agriculture, the disruption of wildlife ecosystems, climate change and increases in global population mobility—is accelerating the emergence and global spread of infectious diseases with unprecedented consequences. As global citizens, this is a reality we have to confront, or we risk finding ourselves in the same precarious position we are in today a few years down the road.

We have also learned that outbreaks move incredibly fast in our hyper-connected world. If we want to remain a step ahead, we are going to have to move even faster. Thankfully, we have what is needed to generate powerful insights: access to diverse and novel data, and human intelligence coupled with artificial intelligence to derive meaning from these complex data.

We need to translate insights into actions that reach across the whole of society. Governments empowered with timely insights will be better able to protect their citizens and economies from dangerous global infectious diseases. Hospitals and health care providers will be better able to protect themselves and the rest of us from these very same diseases. Businesses will be better able to protect the lives and livelihoods of their employees and customers. Creating an ecosystem to manage these risks together is not only possible, but, in my opinion, necessary.

A final thought to leave with you is that our most valuable resource is time, and it is a non-renewable resource. When we get through COVID-19—and we will—the question for all of us will be whether we will use every day of peacetime to prepare for the next inevitable threat with the same sense of urgency with which we are responding to COVID-19 today.

Thank you for the opportunity to share my thoughts with this committee.

The Chair: Thank you, Dr. Khan.

We go now to Mr. Ciciretto, president and chief executive officer of Dynacare.

Go ahead, please. You have 10 minutes.

Mr. Vito Ciciretto (President and Chief Executive Officer, Dynacare): Good afternoon. Thank you, Mr. Chair and members of the House of Commons Standing Committee on Health, for your invitation to this very important meeting. I hope that each of you and your families are healthy and well. It is a privilege to be with you today on behalf of Dynacare to discuss the Canadian response to the COVID-19 pandemic.

At Dynacare, we believe that life is precious. Our mission is to support the health of Canadians with commitment and care. That is why we do what we do. Our 2,900 Dynacare employees deliver the highest level of clinical and scientific testing to provide the necessary information that supports the diagnosis, treatment and well-being of Canadians. Each and every day we provide testing and medical laboratory services to over 32,000 Canadians across the country, amounting to over 11 million tests annually. We operate 200 convenient and accessible specimen collection centres in Ontario, Manitoba and Quebec. We operate seven state-of-the-art laboratories in four Canadian provinces. We report over 500 critical results requiring immediate action by physicians.

Our goal is to inspire confidence in Canadians when it comes to managing their health and well-being. To achieve this, we have elevated the patient experience at our specimen collection centres. We continuously innovate by introducing new and improved test methodologies such as genetic testing; liquid-based cytology; non-invasive prenatal testing; and the piloting of Pixel, a self-collection test methodology utilized in remote rural communities. We have introduced patient-friendly diagnostic testing reports and digital apps that help Canadians better manage their health journeys.

This unprecedented pandemic has highlighted that the work we do at Dynacare matters now more than ever. We are very proud to play a critically important role in supporting the provincial public health authorities of Ontario, Manitoba and Quebec in their efforts to control this pandemic. Since March 25, our talented scientific and laboratory professionals at Dynacare have conducted over 40,000 COVID-19 molecular tests across these provinces, including COVID-19 testing for members of vulnerable and priority populations, such as those in emergency shelter systems, residents of long-term care facilities, EMS first responders and health care workers.

Even throughout this pandemic, Dynacare has continued to operate its laboratories and accept patients at our collection sites for urgent non-COVID-19 testing. In addition to the provision of COVID-19 testing, our community laboratory infrastructure has helped to alleviate pressure on provincial public health systems and hospitals. In particular, our medical couriers have quickly and safely transported COVID-19 test specimens from screening and assessment centres to Dynacare, public health and hospital laboratories. On behalf of the provincial public health labs, we have delivered negative COVID-19 test results to over 25,000 patients. We have supported vulnerable populations by establishing designated Dynacare specimen collection sites for immunocompromised patients and for COVID-19 positive patients. We have engaged in non-COVID-19 sample collection at long-term care facilities.

Our employees have rallied behind Dynacare's response to this pandemic and, as such, we celebrate the many acts of compassion through our Dynacare health care heroes social media campaigns. Our people are the ones who have truly stepped up.

The COVID-19 testing system has generally been working well with strong collaboration among public health agencies, community laboratories and hospitals. But, as with any unprecedented and rapidly evolving environment, there are challenges and opportunities for improvement.

The technical nature of the nasopharyngeal collection process, along with the required swabs that are employed in the collection of a COVID-19 sample, have been rate-limiters in terms of testing and have increased the demand for PPE. At over 200 collections centres, Dynacare has over 850 phlebotomists who are not authorized to collect samples using the current collection devices.

● (1700)

By employing alternative specimen collection procedures used in other countries, our team can support provincial screening. To this end, Dynacare is embarking on a study with Sunnybrook Occupational Health to validate alternative sample collection methods using saliva and front-of-nose collected specimens. The results of this study are expected within a few weeks.

Second, shortages of testing reagents and collection kits were common early in this pandemic. Due to increased vendor production and the proactive response of our supply chain team, we appear to have sufficient supply for our current volume of testing. However, in order to support expanded testing needs, our intention is to increase testing capacity, both through new collection techniques and through supply chain preparedness. Global demand has made it very difficult to secure additional testing capacity and reagent supply on a timely basis. Vendor allocation practices drive more test capacity and reagent to jurisdictions that have been more severely impacted by the COVID-19 virus than Canada has.

It's important to everyone at Dynacare that at the end of every laboratory test we perform there is a person—a mom, a dad, a daughter, a friend. It is not uncommon for our dedicated teams of employees to go above and beyond the call of duty by helping to secure a replacement test requisition for a patient, by leading a drive-by convoy to acknowledge the efforts of front-line health care workers at hospitals, or by making extended efforts to contact a patient with a critical result.

We treasure the value that our dedicated employees bring to the health care system, and we go to great lengths to take care of them. Notwithstanding the significant drop in non-COVID-19 test volumes during this pandemic, we have not thus far implemented furloughs, layoffs or reductions in base pay, due to our long-term philosophy and government wage programs. We are very proud of this and believe that it positions us well for the future. As doctors' offices and clinics reopen, as elective surgeries start again, as insurers and employers resume regular activities, Dynacare will be in a position to meet the laboratory testing needs of our patients and clients and support our health systems across Canada.

Unquestionably, our workplace will be defined by a new normal, with new social distancing and PPE protocols that will protect our patients and our people. As the number of patients requiring service continues to increase, these new protocols will demand the need to adapt, and we will.

Across Canada, some provinces are slowly beginning to open back up in ways that we would not characterize as business as usual. In the absence of a vaccine and lack of scientific consensus on the potential for immunity to the COVID-19 virus, some employers are expressing concern that their workplaces could be prone to COVID-19 outbreaks. Employers across a number of sectors, including food and beverage production, natural resources, manufacturing and many more have expressed an interest in the provision of COVID-19 testing at their own cost. Dynacare's priority will always be supporting health systems in responding to the emergency presented by COVID-19. As the economy opens up, we see a need to work with industry to avoid workplace outbreaks as a means to limiting the community spread of COVID-19.

Key to restarting the Canadian economy is high-quality antibody testing, which can determine whether an individual has been exposed to the COVID-19 virus. Public health authorities, in conjunction with medical and scientific experts, are working to determine how COVID-19 antibody testing could be applied.

This past week, two COVID-19 antibody tests were approved by Health Canada. Dynacare is currently working with two additional vendors who will be seeking Health Canada approval for an antibody test. A community laboratory like Dynacare is very well positioned to support large-scale provincial COVID-19 antibody testing surveillance programs through its extensive specimen collection network of 200 centres, our well-equipped laboratory facilities and our extensive logistics network. We do this every day—efficiently, effectively and with compassion.

In public health emergencies, those in poor health or with underlying chronic conditions are often the most vulnerable.

● (1705)

For many, the COVID-19 pandemic has emphasized the importance of keeping Canadians healthy and decreasing the prevalence of chronic conditions such as cardiovascular disease, lung disease, metabolic syndrome and diabetes.

At Dynacare, we believe that life is precious, and we look forward to continuing to improve the health of Canadians by providing ongoing support to provincial health care systems and through health and well-being programs at Canadian workplaces both through the COVID-19 pandemic and beyond.

Thank you again for the opportunity to address this committee.

Take care and be well.

The Chair: Thank you, Mr. Ciciretto.

We'll start our rounds of questioning now. We will do three rounds. We will start the first round with Ms. Jansen.

Ms. Jansen, please go ahead. You have six minutes.

Mrs. Tamara Jansen (Cloverdale—Langley City, CPC): Thank you to everybody for all your presentations. That was very wholesome. It was great.

I'd like to start with Professor Attaran. I found your written submission very interesting, and I had to chuckle when you pointed out the fact that some hospitals are still faxing in their data. My first foray into state-of-the-art technology on the farm was when we bought a fax machine back in 1992, 28 years ago.

However, in order to stay in business, we obviously had to invest in better and better data collecting technology. I have to say that I was completely shocked to find out from previous witness testimony at this committee that our health care system doesn't have a real-time data collection system in place, especially considering the different recommendations that have been made following previous pandemics.

We have had several witnesses come to this committee and beg us to find a way to move forward with a pan-Canadian data collection system that works in real time. A system like this could help us on so many different levels, not just during a pandemic, but it seems there is this fear that sharing information in this way will compromise the autonomy of provincial and local health authorities.

In your opinion, is there not a way to ensure that each provincial and regional jurisdiction can continue to make decisions that make sense for them while still sharing their data and helping the country with a more informed pandemic response?

● (1710)

Prof. Amir Attaran: What a great question, thank you.

On the question of sharing epidemiological data, it's like this: If you had a number of people who had pieces of a map of a minefield, would you tolerate them not sharing that data? I think you'd probably want to have a map of the entire minefield, not just your little patch of it, if you were setting out on a journey.

The current situation is as foolish as that. Each province has a certain amount of data about the outbreak within its borders, and it can either contribute that piece to modelling exercises or not, and depending on whether it does so or not, we have a better or worse view of the epidemic.

The answer to your question lies in a legal part as well as an administrative part. Legally it's very simple. Cabinet just needs to use section 15 of the Public Health Agency of Canada Act and issue an order in council that data must be provided, period.

Parliament gave it that power. It simply leaves me speechless that the current cabinet hasn't used it. That is something I hope you follow up.

Mrs. Tamara Jansen: Okay, I have a really short amount of time, sorry.

Prof. Amir Attaran: I'm sorry.

Mrs. Tamara Jansen: Okay, I appreciate that.

You mentioned in your submission the dysfunction that we have in sharing data, and, again, being from a business background.... I worked in the retail sector for many years, and our spring season was always very short. We had an eight-week period across multiple provinces, so that meant timely data was absolutely critical to make these decisions on where to send what product and when. We were able to take into consideration those regional differences to ensure the right assets were sent to the right place at just the right time, and we know the technology is available for a pan-Canadian data system.

Yesterday Dr. Tam mentioned that PHAC has no choice, and now you are mentioning they actually do under section 15, so it strikes me that, if Statistics Canada is able to aggregate information about Canadians without violating privacy rights, surely the health care system can do the same.

Prof. Amir Attaran: Statistics Canada can do the same, too. They could build the system inside of about a couple of weeks, I'm told, but they need the mandate from cabinet. That is what's missing. There you go.

Mrs. Tamara Jansen: Okay.

Prof. Amir Attaran: I will just add one last thing to this. There was a time in this country when the federal government did provide a contract to somebody to develop such an epidemic data reporting system. It was given to IBM Canada. The system did not function, and they are the same ones who are behind Phoenix, so there is not a good history here.

Mrs. Tamara Jansen: Okay. Thank you.

I've asked numerous witnesses if they would give PHAC a grade on their pandemic response. So far no one has been willing to give me a straight answer. I've been hearing of some backlash by PHAC to those who are vocally critical in their response to the pandemic.

Are you willing to give me a grade, or could that disadvantage you in your work in some way?

Prof. Amir Attaran: My grade is a C-minus or a D. And there is retaliation, yes. Since the last time I appeared in front of this committee, and was negative about some of those efforts, I was asked to join a grant application with people from PHAC. I understand they said they wouldn't participate unless I stood off it, which I did willingly because I didn't want to cause trouble for my colleagues. But I don't feel there should be retaliation against witnesses simply for providing our democratic government what we think is the truth.

Mrs. Tamara Jansen: Okay. Thank you for that direct answer. I appreciate that.

Yesterday, Dr. Nemer talked about the task forces she set up to tackle the Canadian pandemic response. She mentioned that, although she could share the agendas, she couldn't share the deliberations or findings because they are secret. I believe other countries around the world that have set up similar task forces are sharing their research papers publicly, which helps us all.

Do you think the findings of these task forces should also be public so we can have that timely data sharing for a better pandemic response?

● (1715)

Prof. Amir Attaran: I can't even believe that's a question. Of course, it has to be public. Science is always conducted in public. If you look at a country like Switzerland, they too have a task force on COVID, a scientific task force. If you go to the website over two dozen public reports by that task force are published. If Switzerland, little Switzerland, can get two dozen reports out of their task force by now, why does Canada have zero? It's shameful.

The Chair: Thank you.

Mr. Fisher, please, go ahead. You have six minutes.

Mr. Darren Fisher (Dartmouth—Cole Harbour, Lib.): Thank you, Mr. Chair.

Dr. Fisman, you have a wealth of experience in the battle against infectious diseases, yet you've publicly explained that predictions you made earlier this year on the virus were wrong. I think we can both agree that hindsight is 20/20. There's been a lot of discussion at this committee about why certain decisions were made in the early days of this virus.

I wonder if you could explain to this committee, and to Canadians, about the difficulties of making predictions around a novel virus, and why what's considered the best advice one day can change and evolve so quickly the next?

Dr. David Fisman: I think part of the difficulty relates to the fact that viruses are the troublemakers, and Dr. Khan alluded to this. The troublemakers tend to be RNA viruses, that's their genetic material that comes from animals. RNA viruses are very good at mutating. What we see with this virus, which is a cousin of SARS 1, and bears a lot of similarity to SARS 1, is that it behaves differently in important ways. Being 80% similar can still translate into some very important differences, but some very important similarities.

What we tend to see, what we almost always see with infectious diseases as they emerge, is we find out about hot spots first. Typically we have this sense of the virus being more virulent than it ultimately turns out to be. That's certainly been the case with some outbreaks. What we saw with this virus, also initially, was it looked a lot like SARS based on the information we knew from China. I've acknowledged publicly I think my biggest mistake was thinking it really was looking like SARS in China. We did some forecasting on how the Chinese seemed to be doing in controlling it, and we accurately forecasted that it would be done in Wuhan by early March. That was right, but the difficulty was we didn't see Iran coming. Once you saw this in Iran, you knew the game was over, and this was going to disseminate around the world.

They're all the same, but they're all different. When you look at some of the key parameters, as we talk about, with these diseases, which let you sort of predict how things are going to play out, some important numbers include the reproduction number of the disease, the number of new cases per old case. This virus turns out to be a real trickster, in that it's got what's called an overdistributed reproduction number, where many cases are dead ends but some individual cases make 40 secondary cases. You see that play out again and again, whether it's in nursing homes, on cruise ships or in restaurants. As you know, there's the single individual in Korea who infected 40 secondary cases and sparked a massive outbreak in the city of Daegu.

That makes it difficult. It also provides a potential vulnerability for the virus in terms of control, because once you get rid of those large gatherings that make super-spreading events difficult, the virus becomes much less transmissible. The initial case fatality that we saw coming out of China—that's deaths per case—was listed as 2.4%. Of course, deaths go up slowly with this thing, because people die in the ICU. The China case fatality I think at this point is 5% or 6%. We're at 7% in Canada.

As for what we know now, we've been helped a lot in this regard by data from Spain from last week, from a national seroprevalence study, where they were able to find both the recognized and the unrecognized infections. About 5% of the country of Spain has had this, with 27,000 deaths. Now we're able to go from a case fatality in Spain, which is deaths per recognized case, down to an infection fatality rate, which in Spain we now are pretty sure is about 1.2%, based on seroprevalence data.

The fact that Spain is at 5% prevalence 30,000 deaths in, with an infection fatality rate of 1%, makes me very concerned about some of Dr. Schabas's remarks in terms of moving towards herd immunity. We think that we'd hit herd immunity at 60% to 70% of Canadians infected. Seventy per cent of Canadians infected is 28 million people, and 1% of that is 280,000 Canadians dead. I would note that the failure to have mass mortality in Canada to date relates to the public health response.

I would also note that we can do this because we've shown around the country that we can control this disease without just letting it rip and pushing for herd immunity, as they're doing in Sweden. We've seen competence in British Columbia. We've seen tremendous competence in Atlantic Canada and on the Prairies. We can do this. We just need to get the job done.

Throwing your hands up and saying that we're going to follow Stockholm, Sweden, which is currently leading Europe in per capita mortality, is not the way to go, in my opinion.

● (1720)

Mr. Darren Fisher: Thank you. I had other questions for you, and I think we've run out the clock—

Dr. David Fisman: I'm sorry.

Mr. Darren Fisher: —but I do want to say that this is excellent and very thoughtful testimony, and I want to thank you for that, Doctor.

Dr. David Fisman: Thank you.

Mr. Don Davies (Vancouver Kingsway, NDP): Mr. Chair, I have a point of order.

I'm still somewhat shocked at the evidence I heard from Dr. Attaran about him potentially being discriminated against or having retribution threatened against him as a result of this testimony before the health committee. All of us, as members of this committee, have an interest in upholding the integrity of this committee and ensuring that all witnesses who come before us can give us the sincere, unvarnished benefit of their opinion, particularly when we're talking about science.

I would like to ask that this committee formally request that Dr. Attaran indicate to us full details of what has occurred by PHAC or Stats Canada, or whoever it was, to ensure that the integrity of this committee is upheld at all times.

The Chair: Thank you, Mr. Davies.

Under our current operating mandate, we don't have the authority to do that. We can certainly invite him to submit all of the evidence, all of the allegations he has, to us or to the Speaker of the House. We would be unable to deal with a matter of this kind in our current operating situation.

Mr. Don Davies: Mr. Chair, if I might—

Mr. Robert Kitchen (Souris—Moose Mountain, CPC): Mr. Chair—

Mr. Don Davies: —I would vehemently dispute that. This committee is mandated to receive evidence. It's clearly in the consent order of the House of Commons. If we have evidence before us that witnesses are being pressured or intimidated against not giving evidence, that is a direct interference with the precise mandate of this committee.

On the record, I'm happy to ask Dr. Attaran to provide those details, but for the record, I want to state in the strongest terms possible that it is absolutely the prerogative and mandate of this committee to ensure that we uphold the integrity of our process. Any time we hear that a witness may have been intimidated, or harmed in any way, for simply accepting the invitation from us to come and give us the benefit of their testimony, it's absolutely part of the pith and substance of this committee, and I will pursue this matter fully once we get that information from Dr. Attaran.

The Chair: Thank you, Mr. Davies. Your point is well taken. I will take the matter under advisement and—

Mr. Robert Kitchen: Mr. Chair, I have a point of order.

The Chair: Dr. Kitchen, go ahead.

Mr. Robert Kitchen: Mr. Chair, I'm 100% behind what Mr. Davies said, but my point of order extends further than that. We as committee members are here to present and ask questions, to protect our witnesses as well as ourselves, and to make certain that we have that protection. If we do not have that as a committee, the questions and points that we may bring up can be held against us, and that's just not acceptable. How can we function as a committee if that's not the place?

● (1725)

Mr. Matt Jeneroux (Edmonton Riverbend, CPC): Mr. Chair, just to add on to that, if you could point us in some direction as to why you don't think we have these powers to be able to do that in this committee....

I disagree with you. I agree with Mr. Davies that it's within the mandate of this committee to ask for that testimony.

If you can point us in that direction, please do. If you can't, then I suggest we allow Mr. Davies to proceed with his point of order.

The Chair: Your points are well taken. It should be pointed out that all testimony before this committee, when it's operating in official capacity, is privileged. We have parliamentary privilege. Any repercussions that follow from that would be a serious matter, but our mandate is solely to receive evidence.

We are explicitly allowed to move motions relating to the invitation and scheduling of witnesses. We do not have the authority at this time to undertake a motion to demand information about matters such as this, but I certainly would welcome Dr. Attaran's information if he should provide it.

I wonder if our clerk would like to give an opinion on this.

[*Translation*]

Mr. Luc Thériault (Montcalm, BQ): Mr. Chair, I would like to raise a point of order.

Professor Attaran seems to want to add a comment. Perhaps he could clarify what it is, which could help you deliberate further. I would be prepared to let him speak quickly, since I thought I saw him raise his hand. So I would like us to hear what he has to say. Then you could deliberate on that.

[*English*]

The Chair: Witnesses aren't able to participate in the committee on points of order, but as I said, I will welcome his information. I invite him to bring it to the committee, to send it to the committee.

The clerk will be looking into this matter and will come back to us at a later time with an opinion. In the interim, I will reserve judgment and suggest that we carry on with the testimony.

Mr. Thériault, please go ahead. You have six minutes.

[*Translation*]

Mr. Luc Thériault: Thank you, Mr. Chair.

I am going to address Professor Attaran first. These days, we can say that science is being tossed around a lot. All decisions are supposedly made in the name of science. One might even think that it is being used more to justify some political dithering.

Mr. Attaran, on page 3 of your brief, you say the following:

...the Prime Minister hesitated, perhaps because of the scientifically inaccurate advice from his Minister of Health, that closing the borders to slow the disease down is “very ineffective.”

Some people argue that border closures have no significant effect in stopping the spread of the disease. I understand you disagree. Should the borders—especially the U.S. border—have been closed much sooner?

Did we have all the information we needed to make that decision? If not, what would have been required to make that decision as quickly as possible? What is the reason for the conflicting scientific advice?

Prof. Amir Attaran: You are right that scientific issues are often politicized, and that was the case with the border closure.

In my view, the purpose of closing the border is to protect us, especially in the case of the U.S. border. However, as you already know, the WHO says that it is almost useless, and the minister said that it is useless, but I disagree.

I know that, after the disaster we are now experiencing, we will rethink these issues. In Africa, for example, the borders between countries were quickly closed. They learned that lesson from the Ebola crisis. Now we see that nations are more protected. The infection rate in Kenya and Rwanda, for example, is lower than it would normally be. So it works.

● (1730)

Mr. Luc Thériault: Some witnesses have told us that we cannot fall behind in the case of this virus. The fact that the incubation period is often 14 days means that, since the beginning of the pandemic, we have constantly been feeling that we are playing catch-up. So I imagine that things should have been done differently and that decisions should have been made much more quickly.

You were talking about structural and systemic difficulties related to the Confederation and the inability of the scientific community and public health authorities to work in a coordinated manner and in real time with respect to sharing data.

What is the point of not working together? What justifies it? You gave the example of Ontario during the SARS episode. What is the point of those provinces or Quebec not working together? I have trouble understanding that.

Prof. Amir Attaran: I don't understand it either. It's almost dangerous to think of our Confederation as 10 provinces that are not connected through their biomedical resources, especially considering the virus that's connecting us right now. You are right.

Mr. Luc Thériault: How could legislating or establishing regulations be more effective? I'm trying to understand the motivation behind this inefficiency.

Prof. Amir Attaran: To answer more effectively, I have to speak in English. May I?

Mr. Luc Thériault: Yes, of course.

[*English*]

Prof. Amir Attaran: I'm sorry, but some of the legal words I don't know in French. I try.

The order in council that would be necessary to make data exchange mandatory between the federal government and the provinces is not a controversial thing. It is something that Parliament put into the law in, I believe, 2004 or 2005. Simply put, it should be used. We should not let our preconceptions about the appropriateness of what the province may do, or what the federal government may do, stand in the way of the clear reading of the law. You, as parliamentarians, created that law on sharing, and I'm grateful to you for doing so. It's a very useful tool, but it does need to be used.

I think Dr. Fisman would probably be able to add something to this.

Dr. David Fisman: I'm not sure, though I could add my perspective as a researcher based in Toronto since 2006.

What I've always found astounding is the failure to make accessible data that are paid for, assembled and cleaned on the public dime available to Canadians in a manner that doesn't threaten anyone's privacy or well-being. I've found that astounding for a long time.

A lot of my work, since I've come to Toronto, uses the national hospital discharge survey from the United States, which is pretty similar to the stuff you get from CIHI, except that if you ask for the data online from the CDC, they will FedEx it to you and pay for the FedEx, whereas if you ask for the same stuff from CIHI, you pay them. I don't understand it.

There's a much deeper issue here than COVID, and I thank my colleague for flagging it. We have a culture of what I call data hugging in Canada, and it does need to change. It harms us all.

● (1735)

The Chair: Thank you, Mr. Thériault.

We will now go to Mr. Davies.

Mr. Davies, please go ahead for six minutes.

Mr. Don Davies: Thank you.

Dr. Fisman, last week you were interviewed on TVO and you said, “I think there are a lot of folks who are itching to declare victory and open things up again, which is a bit of a problem because the reason that infections are subsiding is because we have distancing in place.” Are you concerned that some provinces and territories may be moving too rapidly to open?

Dr. David Fisman: I think my own province is, and I appreciate tremendously the pressure our premier is under. I think he's done a marvellous job given the cards he's been dealt, but I'm also aware there are a lot of folks who want to get back to business.

I'm not sure whether doing a screen share on Zoom is part of parliamentary committees, but we are looking at reproduction numbers here in Ontario. That is the number of new cases per old case. What we see is that the disease has clearly surged over the last week in Toronto, particularly in Peel. Part of that is from the liberalized use of testing, which drives the numbers up. Part of that is probably from the anticipation of greater economic opening. I think we may get a couple of rude bumps along the way, but ultimately distancing will be our parachute. If things start to look too grim, they'll be able to close things back down again, but, yes, I'm concerned that there's tremendous momentum to get folks back to business.

There's a lot of economic activity that could resume safely in the province of Ontario. Ontario is a big place. It's bigger than France, and we have regions.... Dr. Attaran referred to the city of Kingston. It has had one or two cases over the last 10 days but is subject to the same blanket lockdown as Toronto and Peel, which have had a couple of hundred cases a day. I think more—

Mr. Don Davies: I'd like to direct you to some of the things we should be doing.

You also said in the interview, “Predictably, as we reopen, we’ll see a resurgence of disease.”

Dr. David Fisman: Right.

Mr. Don Davies: That's exactly what we've seen in Korea and in Germany this week, two places that controlled their initial epidemic faster than we did and are moving toward revitalization. They've seen resurgences, just as Singapore did before them and just as Wuhan did last week.

What do you recommend we do, given that you see resurgences? What steps should we be taking to get in front of that, if there are any?

Dr. David Fisman: The resurgences will happen. It's just how this works. It's simple math. The reproduction of a disease is number of contacts times the probability of transmission per contact times how long a person is infectious for. We can forget about immunity right now, because immunity is low. Even if it's 5%, it's too low to bring the reproduction number down. Therefore, as contacts go up, the reproduction number predictably goes up.

The Chair: Doctor, could you please hold the mike?

Dr. David Fisman: My apologies.

We're going to go too far. We're going to try to open things up and go too far. That's why we need strong surveillance systems, to see that as it happens.

Mr. Don Davies: I want to move to testing. Maybe you and Dr. Attaran can comment on this.

We hear repeatedly at this committee, from every expert, that we have to test, test, test, and that it's key to getting control of this disease and reopening. However, we've barely done a million tests since January. Wuhan is gearing up to do a million tests per day. We're behind Germany. We're behind South Korea. In fact, we're at barely half of Dr. Tam's target of 60,000 tests a day.

Why are we unable to test at the rate that all experts are telling us we need to? Where is the problem here?

Dr. David Fisman: I don't know. Mr. Ciciretto is an expert on how labs work and could probably give you a more meaningful answer than I could.

We do work with local public health units. My concern at the moment is that it's not just the testing. If people are saying we're going to do contact tracing once we open up and we're going to track the contacts of cases as they did in Korea—I think they had a couple of hundred secondary cases associated with a nightclub outbreak—I don't think we could do that.

We have lags all the way along and it gets back to the 1990s technology where it takes time to test, the tests get faxed, it takes a while for them to percolate through the public health system and—

● (1740)

Mr. Don Davies: I'm sorry to interrupt, but I want to give Dr. Attaran a chance to weigh in on this too.

Other countries are testing at much higher rates. Why can't Canada do it?

Prof. Amir Attaran: Again, I am not a testing expert. What I can say is that it's obviously a systemic and administrative problem, because for Ethiopia or Rwanda to be surpassing us in testing.... They're getting the reagents and supplies from somewhere. They are pulling it off.

I did mention the city of Addis Ababa, the capital of Ethiopia. They have actually sent health workers around to every door in the city already to interview people about their travel or exposure history and test them if necessary. If Ethiopia can do that, I refuse to believe Canada can't. We just need to understand better—and I'm not the person to give you the answer—what the administrative holdup is in the testing, but it's clearly administrative not scientific.

Mr. Don Davies: Thank you, Dr. Attaran.

I have one quick question for you.

Your chart spoke for itself. The question I have is why is Canada performing below comparative countries like Australia and other countries you mentioned. Your chart clearly shows we are. What are the reasons for that?

Prof. Amir Attaran: In terms of bending the curve, or the testing, specifically?

Mr. Don Davies: Bending the curve.

Prof. Amir Attaran: In terms of bending the curve, Dr. Fisman can be more detailed on this, but it's clear that we have not adopted as rigorous a lockdown as some other countries have. We've also had a slow-burning problem in the care homes and this has taken what could have been a sharp peak and broadened it into something of a plateau.

I am very uncomfortable with the fact that we are opening up without the testing at the necessary level, or the tracing. I'm not saying I don't want to open up. I hate being locked up as much as anyone else—you should see my children. There has to be groundwork done, and it is the fact that the governments of this country—some of them, especially the federal government—just haven't done the groundwork.

Mr. Don Davies: Thank you.

The Chair: That ends round one.

We will start round two.

Mr. Jeneroux, please go ahead. You have five minutes.

Mr. Matt Jeneroux: Thank you, Mr. Chair.

Thank you to the witnesses for joining us here again today.

I want to address Dr. Khan and some of the comments you made. In particular, I am hoping to get a grasp on when BlueDot—obviously ahead of the curve, early on—provided the first data regarding the coronavirus to the Public Health Agency of Canada.

Dr. Kamran Khan: As I mentioned in my opening remarks, our surveillance system had picked this up on December 31. You may also be aware that the Public Health Agency of Canada has a platform called the Global Public Health Intelligence Network, GPHIN. There are some parallels with the platform we're using. I think we may be using a bit more machine learning and artificial intelligence in our system.

I believe, with respect to awareness of the event in Wuhan, this was at a similar time; I believe it was around the end of December or beginning of January. We have had, as I mentioned, a relationship with the Public Health Agency, going past detection of threats and then looking at dispersion, how they might spread and where they might go next. All of the systems that we use internally—software systems, all of the internal data on commercial flights, passenger movements around the planet—are accessible by the Public Health Agency. This is part of our partnership.

I also did share the results of some of our analysis directly with Dr. Tam back in early January—I believe it may have been January 4 or 5, a few days after the new year. I communicated some of our initial findings and then had a follow-up meeting, I think, around the January 9 or 10 to discuss some of this in person.

● (1745)

Mr. Matt Jeneroux: What information did you provide exactly? Did you provide that information from December 31 that you had attributed to the beginning of this?

Dr. Kamran Khan: Because the Public Health Agency already has a surveillance system and GPHIN had picked up news of the outbreak in Wuhan around the same time as BlueDot, we didn't send them that information because it was something they already had access to. But we have been working with the Public Health Agency around contextualizing this.

Understanding that something is appearing in the world is very different from understanding what risk it presents to Canada and where those risks are greatest at the particular moment. Is it in British Columbia, in Halifax, or somewhere else?

We shared some of our findings on the movements of travellers across the world with Dr. Tam and her office and then met in person to discuss some of the results and, more broadly, really, the need for systems. We had some earlier comments about data internally within Canada. We're clearly not a closed population; we are a microcosm of the world, one of the most connected populations on earth.

It was critical for us to have better systems not only to detect threats but also to quickly assess what risks they present, so that we could be a step ahead and mobilize our resources, heighten our surveillance in the right places at the right time, and to share with you the specifics of the risks associated with the events in Wuhan. That was really just a few days after New Year's in early January.

Mr. Matt Jeneroux: Did you make any recommendations at that time about shutting down borders and what that would mean to Dr. Tam, and perhaps her team?

Dr. Kamran Khan: We discussed obviously what the risks were, but, of course, as you remember, in early January we didn't even know this was the coronavirus. Clearly it caused enough concern from our end just because there were some parallels with the SARS event that had emerged in late 2002 in Guangdong. We had some concerns given the parallels with SARS.

However, as more information became available, as soon as we knew this was a novel coronavirus, we did follow up directly with Dr. Tam and her office. Obviously, they were aware, but our concerns at that point were that we knew the last two novel coronaviruses, MERS and SARS, had killed a third and 10% of their patients, respectively. They have no known vaccines, no known effective antivirals.

A novel coronavirus means that the whole world is susceptible, and that's a lot of fuel for an outbreak, and it's in the middle of wintertime, which is when you have respiratory illnesses. Given the signal-to-noise ratio and the detection of this behind a whole background of febrile illnesses, that certainly caused us quite a bit of concern.

The last point I will make is that I believe it was on January 13 when the first case was reported in Bangkok. By the way, coincidentally, it was the top city that we had identified as being at risk. At that moment we knew this was not a few dozen cases. In order for there for cases to be showing up in a city of 11 million, we had to be dealing with hundreds, maybe even thousands of cases. That was really the moment we became quite concerned, but of course with emerging diseases, unfortunately, you learn as you go. You don't have all the answers and you have to make decisions as new information becomes available.

The Chair: Thank you, Mr. Jeneroux.

Mr. Matt Jeneroux: Mr. Chair, do you mind if I request that Dr. Khan share that early information he provided to the Public Health Agency with the committee?

The Chair: Sure.

Mr. Matt Jeneroux: Thanks.

Dr. Kamran Khan: I'd be happy to do that.

The Chair: Thank you, Mr. Jeneroux.

We go now to Dr. Jaczek.

Dr. Jaczek, please go ahead for five minutes.

Ms. Helena Jaczek (Markham—Stouffville, Lib.): Thank you very much, Chair.

Thank you to all the witnesses. This session has certainly been fascinating. There has been a real divergence of views, especially from the first three witnesses.

Thank you, all three, for your very considered opinions. We go from one extreme, with Dr. Attaran saying that we haven't gone nearly far enough, to Dr. Schabas saying that perhaps we have gone too far.

Speaking as a member of this committee, of course we're very interested in all of your opinions, but part of what we need to do is to find some commonality, to find where there is agreement. The area where there seems to be agreement, and that we have heard a great deal about from many witnesses, is that there needs to be more of a national data surveillance system as it relates to public health. It's been exemplified by many of you that in fact provinces are collecting data differently. Even in the use of the case definition, there has been a difference from province to province.

Dr. Schabas, given all of your experience, and having known you for so very many years in the trenches, in both urban and rural settings, I will address this question to you. At the end of your remarks, you made a comment in relation to a national surveillance system. I'd like to hear from you on what kind of data you would like to see and where the important areas are that need to be collected. I'm sure you've had to make decisions based on inadequate data, or not as much data as you would like to have had, on many occasions. Could you flesh out for us how you see that national surveillance system?

● (1750)

Dr. Richard Schabas: Thank you, Helena, and thank you again for arranging my invitation to this meeting. It's been great. It's been fascinating listening to David and Amir. Maybe at some point I'll have a chance to rebut some of the other things that have been said.

On the notion of having a national agency, we were always very envious of the Americans. They had the Centers for Disease Control, a highly respected agency that led and that took the high ground. It was where everyone turned to for advice and direction and guidelines. We had the old Laboratory Centre for Disease Control at Health Canada. There were some very good people there, but it didn't have the same clout—

The Chair: Dr. Schabas, could you speak a little bit closer to the mike and maybe a little bit slower for the interpreters?

Dr. Richard Schabas: I'm sorry.

The idea emerged almost 20 years ago—I actually wrote an editorial in the Canadian Medical Association Journal on this—of really proposing a national agency that would fulfill some of those roles. I think we had an opportunity 15 years ago after SARS, when there was this surge in interest in public health and improving our national public health capacity, which led to the—

The Chair: Pardon me, Dr. Schabas.

The interpretation has stopped. We'll suspend for a minute until that resumes.

● (1750)

_____(Pause)_____

● (1755)

The Chair: The meeting has now resumed.

Dr. Schabas, please carry on.

Dr. Richard Schabas: As I was saying, 15 years ago, the vision I had hoped we would adopt was not so much one of a federal agency, but a national agency. We had some resources with the federal government, but it was also a time when Ontario was developing Public Health Ontario and British Columbia was augmenting the BCCDC.

There was a real advantage in developing a sense of co-operation between the federal government and the provinces, because the reality is that the provinces collect the data and the provinces make most of the public health decisions. You don't have the federal authority to tell them what to do. They're going to do what they want to do. The only way to get consistency in a truly national approach to a problem like this is to get people to buy in, to get people to be willing to do it because they think it's the right thing to do and because the prestige of the direction they're getting from the national agency is sufficient for them to.... I'm not going to say fall in line, but be consistent with their approach.

We don't ever expect everything to be the same. Here's a great example: Why should British Columbia be doing with COVID what Quebec is doing? They are very different sorts of situations. I think we would all be much happier if we knew there was a common purpose, common objectives and a common directive.

I'm hoping, maybe a little naively, that there will be another surge in interest in public health—I'm sure there will be—after the COVID crisis comes and goes. I hope we rethink how we set things up. That's not a criticism of the Public Health Agency of Canada. I just think it would function better if it was better integrated with the provincial agencies and if the provinces and the federal government were truly partners in this.

The Chair: Dr. Jaczek, your time is pretty much up but because of the problem in the middle, I'll give you one more question.

Ms. Helena Jaczek: Thank you, Chair.

Dr. Khan, perhaps I can ask you. Obviously you and BlueDot have been very helpful to the Public Health Agency of Canada. What kinds of interactions have you and BlueDot had with the provincial agencies, such as Public Health Ontario?

● (1800)

Dr. Kamran Khan: We have had interactions with the ministry of health in Ontario and have been actively working with the province there. At BlueDot, we're a team of about 50 people. We're also working via Global Affairs Canada—

The Chair: I'm sorry, Dr. Khan. Please adjust your microphone.

Dr. Kamran Khan: I'm so sorry about that.

We are also working with Global Affairs Canada to support capacity building—as I mentioned in my opening remarks—in 10 countries in Southeast Asia. We're working with the State of California.

In many regards I think we would be very eager to support public health responses across the country and work closely with the provinces and territories. We've had, in some ways, an issue with respect to capacity to do this in the midst of the COVID-19 pandemic. However, we have had engagement at the federal level, and are producing analytics across the entire country on a week-over-week basis, and also with the Province of Ontario.

I'm not sure if that answers your question, but a lot of the analytics are focused on understanding issues related to social distancing and how that is related to epidemic activity. Also, keep in mind that while today we're in a bit of a lockdown, as the economy reopens and we have a highly susceptible population, we're going to have to start.... We may find ourselves in the same place as New Zealand in the future, where we have to start looking outward again and start to think about introductions that could trigger the next wave.

We've been involved in supporting both an internal look and tackling this in our own backyards, as well as monitoring the global situation and potential introductions.

The Chair: Thank you, Dr. Jaczek.

Dr. Kitchen, it's over to you for five minutes, please.

Mr. Robert Kitchen: Thank you, Mr. Chair,

Thank you, everybody, for your presentations today. They've been greatly appreciated.

Dr. Attaran, yesterday I spoke to Dr. Tam and asked her a question about data sharing between the provinces and organizations with the federal government. You've answered a lot of those questions I had for you, but further to that, I was asking her about demographic data, in particular how New York City has come up with a lot more demographic information, etc. She indicated to me that it's on the Public Health Agency of Canada's website, so I took the opportunity this morning to go onto that site. With some help from my staff, I finally managed to find some information on that.

They talk about updating the data as of today and about 4,201 cases of clinical presentations, and of those, 561 cases or 13% were clinically or radiologically diagnosed with pneumonia. My point about that is it provides a lot of information and then, all of a sudden, I find a little bit further down a little statement: “The epidemiology update is based upon information received for 38,746 cases. Not all data fields are complete, only cases with data available are included.” The bottom line is they're providing inappropriate information on the data that we have.

How is it that we ask you or other epidemiologists to come up with data and provide modelling when we put this out with inappropriate information?

Prof. Amir Attaran: Dr. Kitchen, thank you for a very intelligent question. You're exactly right. You mentioned there were roughly 38,000 cases in the data that you looked at. I'm going by memory here, but I think we've had about 80,000 cases reported in Canada so far, so that's under 50%. What that means is that at the high-water mark, anyone like Dr. Fisman or Dr. Khan doing modelling, or me when I do it in my amateurish way, are working with less than half a deck.

Mr. Robert Kitchen: Right, and—

Prof. Amir Attaran: There are obvious problems with that.

Mr. Robert Kitchen: When the Public Health Agency is making these decisions based on World Health Organization data, which is maybe coming in from China or wherever, which is inappropriate, again how do you come up with that proper information?

Dr. Fisman, do you have any comments?

● (1805)

Dr. David Fisman: I'll tell you, my group at University of Toronto call ourselves “data raccoons”, because we've sort of managed to thrive for about 15 years on data that most people regard as garbage, so it's sort of a bit of the normal state of affairs for us with public health data analysis. The stuff we have is pretty good by our standards.

Working with folks here in Ontario, there's been a modelling table convened over the last few weeks. We've been given access to case files. There's a lot you can learn, but there are also a lot of fields that are missing. We could potentially do better, but I think it's also important to remember that those fields are being filled in by very harried front-line public health epidemiologists.

I suspect that what you're seeing from the Public Health Agency of Canada is that they're putting out the data where they have complete fields, and that it's their way of dealing with missing data. Missing data is just part of epidemiologic data analysis. It happens no matter how good the data are that you have. I'd sort of want to know more about how they've made those decisions, but sometimes it's good enough.

Mr. Robert Kitchen: That's a challenge, though, when you don't have proper data and you don't understand that.

I'm going to go on a little bit further.

Mr. Ciciretto, you talked about high-quality antibody testing. We've heard a lot from you today and all of the witnesses about testing. Last week Health Canada approved the first serological test for detecting antibodies in those who contracted or may have contracted COVID-19. The approved serological test comes from an Italian biotechnology company.

Do we have the capacity to produce these tests domestically? Do you know that?

Mr. Vito Ciciretto: The answer to the question is, we do have capacity. The particular test that was approved was from a company called DiaSorin. We don't have that testing platform, in particular, so that's critical. Could we acquire it? Yes, we could acquire it.

There are other companies that we're working with right now, large diagnostics organizations that are looking to get Health Canada approval as well for a serological test. Once that happens, I have 200 collection centres and 850 phlebotomists who can collect those samples and bring them into a laboratory and onto existing test platforms that we have today that could do that testing quickly, efficiently and accurately.

The Chair: Thank you, Dr. Kitchen.

We'll go now to Mr. Kelloway.

Go ahead. You have five minutes, please.

Mr. Mike Kelloway (Cape Breton—Canso, Lib.): Thanks, Mr. Chair.

Hello, colleagues.

I want to say a really special thank you to the witnesses today. I'll echo Dr. Jaczek's that it's interesting to see such a rich series of viewpoints, insights, opinions and also backgrounds in a variety of areas. I really appreciate it. It's very illuminating.

Dr. Khan, I find your work very fascinating in terms of the technology you use. I don't necessarily want to look to the past but to potentially a second or third wave.

Can you talk about how your technology may be able to be used to track and identify, in many ways, a second or third wave? Could you illuminate a little bit what the biggest risk factor is that could trigger the next wave?

Dr. Kamran Khan: Maybe the way I could sort of frame what we have been building with the metaphor of a smoke detector and fire extinguisher. For six and a half years, we've been building systems to be able to detect threats early, because we know, as I mentioned, that time is our most valuable resource.

To be able to quickly go from detection to what kind of risks we are facing—not just from the dispersion of the disease, but what kind of disruption might occur—is very important because diseases spread around the world all the time. They don't all cause outbreaks or pandemics. That is a complex requirement because every disease behaves differently. Zika virus is different from Ebola, which is different from COVID-19 or measles for that matter.

We've been spending a number of years building up that capacity to have a bird's-eye view of what's happening around the planet, to be able to relate it to geographies across the planet, and to do this in, really, a matter of seconds.

With respect to once an outbreak starts to spread and is now occurring locally, this is where we have been using—again, I want to underscore, anonymously—just the pings, the digital locations from hundreds of millions of mobile apps and mobile devices.

That kind of information can help us understand. Ultimately, this is a virus that spreads, as Dr. Fisman mentioned, through the movements and interactions of people. These are really rich datasets—over three billion data points a day—that can really allow us to understand how those movements are occurring so that we can then start to anticipate how the epidemic might evolve. It also allows us to generate insights about some of the non-pharmaceutical interventions like physical distancing or recommendations for quarantine. Are those being adhered to at a population level?

I do want to highlight that we're not tracking anyone who is infected or their contacts. We're looking at population movement.

With respect to going forward to the next wave, I think the simple reality is that no one really quite knows what this is going to look like or exactly how it's going to unfold. We are dealing with a completely novel disease. Certainly, we have concerns that as we get into the latter months in the fall.... We know that coronaviruses tend to be in cooler, drier climates where they may be more efficiently transmitted. As that occurs, currently we are relating a lot of this mobility data to understanding how the epidemic curve is evolving. Perhaps there are lessons that we can learn about which geographies and which locations seem to be opening up society in such a way that they can, you know, generate some sense of normalcy and some kind of economic activity without having an exponential increase in the epidemic. I think that's really the $6,400 question. How do we do this gracefully? How do we thread the needle?

These are things that I, candidly speaking, don't know anyone has the answers for just yet. I think it goes back to the point that surveillance, testing and monitoring are critically important, because as we start to reopen society, it is going to be incredibly important for us to be watching very closely what the response is in terms of epidemic activity and transmission.

I hope that I perhaps have given you a little bit of a sense of what we're thinking going forward.

● (1810)

Mr. Mike Kelloway: You have.

I think you mentioned measuring disruption in society. Maybe I'm miscategorizing that.

Can you unpack that a bit?

Dr. Kamran Khan: Yes, thank you. It's a really big and very important issue.

The four Ds that we work on are detection, dispersion, disruption and dissemination. Detection speaks for itself, early detection. Dispersion mean, how do these things leap across continents in hours? How do we anticipate the next move? Without getting into a lot of detailed epidemiology, what sometimes is called the infectious disease triangle is a disruption or an outbreak that really lies at the crossroads of the characteristics of the microbe or the germ itself, the characteristics of the population, and the environmental conditions.

The Zika virus is not going to spread here locally in Toronto, because there's no mosquito and it's too cold; it might spread in Miami in July, but maybe not in January. That is a very complex set of data and we're bringing in hundreds of data sources, from real-time satellite data to insect observations, demographics, etc. We can do this for over 100 different diseases so we can try to get a sense of whether the necessary ingredients are there for this to actually cause a disruption, an outbreak.

As you can imagine, this is not a data problem. It requires deep subject matter expertise integrated with deep data analytical expertise and data science. This is the area we're actively involved in. We're well on our path and well on our way, but this is a formidable challenge that really is going to take years.

The Chair: Thank you, Mr. Kelloway.

Mr. Mike Kelloway: Thank you very much.

The Chair: We go now to Mr. Thériault.

Mr. Thériault, please go ahead for two and a half minutes.

[*Translation*]

Mr. Luc Thériault: Thank you, Mr. Chair.

My question is for Professor Fisman. Perhaps Mr. Schabas can express his opinion as well.

We do not yet have a vaccine or antivirals. Serological tests are just beginning. Faced with the desire for reopening, we have suddenly and a little hastily seen the notion of herd immunity appear. But there is no real certainty about the exact data, about the connection between COVID-19 and herd immunity.

Can you tell us where we are at in terms of knowledge or studies on herd immunity with COVID-19? Can you describe the situation?

If reopening were at an ideal rate, would we achieve herd immunity? At what rate would we need to achieve it to make everything safe?

● (1815)

[*English*]

Dr. David Fisman: Thank you very much.

There are a lot of moving parts here. Herd immunity can be approximated as a function of the reproduction number of the disease. The higher the reproduction number, the more people need to be immune if the disease is not to take off. That's why we see measles outbreaks when vaccine levels fall off just a little bit, because the reproduction number for measles in a susceptible population is about 20. You can get about 20 new cases from an old case.

This is a much less infectious disease. The reproduction number is somewhere between two and three. That means you need somewhere between half and two-thirds of the population to be immune to have herd immunity, so that if you bring an infectious case into the population you won't don't have an epidemic.

Where are we right now? We don't know. I've been doing a running meta-analysis on seroprevalence studies as they've come out. I'm up to about 50 of them. You can compare antibody prevalence in populations to what those communities think they have going on in the number of cases they have. It's called a cumulative meta-analysis, just adding study to study to study. The long and short of it is that I think we probably detect about 7% of cases. We have an inflation factor of somewhere between tenfold and twentyfold.

If we look at Canada with 80,000 recognized cases, that would be somewhere between 800,000 and 1.6 million cases in reality. That puts us—I'm going to get hung up in trying to do the math on the fly—at 4%.

If we're there now, New York is well ahead of us. New York has good seroprevalence data. They're at about 15%, but they had to go through hell to get there. They did experience a wholesale collapse of hospital systems in much of the city, including the Bronx and Queens, to get to 15%. That means they might be able to get to 50%, 60%, or 70% herd immunity by going through that a few more times. I don't think they will allow that to happen. They've lost approximately 20,000 New Yorkers of all ages, I would add, to get to that point.

What we have to do right now—a lot of countries around the world, indeed a lot of provinces in Canada, show us that we can knock this disease down to low levels and then we can use good public health practice. I agree with Dr. Schabas that you can't do contact tracing if you're having 200 cases a day, as we are in Toronto. It's just too much. If you're having five cases a day, you sure can. If you're testing a lot, you sure can. You need to use the distancing to knock the reproduction number down. We're still at around one in Quebec and Ontario. I would add that the Canadian epidemic, at this point, is a Quebec and Ontario epidemic. The other provinces have got the job done at this point. If you can do that, then we can start to use other public health measures, like contact tracing, to keep a lid on this and get through the summer and allow the economy to reopen.

We haven't touched on masks at all. There's pretty good ecological evidence at this point that the countries that are doing much better than us are mostly mask-adopting countries. You can argue the science, and we can have a symposium in five years about who was right, or we can use the precautionary principle and move towards masks now, which I think Dr. Tam has started to do.

We can do a lot to keep that reproduction number low and reopen our economy to a degree, and muddle through.

Exciting stuff is happening with vaccines. There are RNA vaccines that weren't on the table 10 years ago. There's a really exciting live virus vaccine from the U.K., where AstraZeneca, the pharmaceutical company, is manufacturing the vaccine at scale while the trials go on. If the trials are a success, they're going to have millions of doses ready to put into people's arms.

We need to avoid mass death situations until we can get through to a point where we can effectively deal with this pandemic. We will, but it's a matter of tenacity, patience and competence, and that's very patchy across the country. Some places have shown it; other places haven't. I'm sad to tell you that I feel that my province, at a provincial level, is one of the places that hasn't shown that, although individual local public health units have really shone and distinguished themselves.

● (1820)

The Chair: Thank you, Mr. Thériault.

We go now to Mr. Davies for two and a half minutes, please.

Mr. Don Davies: Thank you.

Dr. Fisman, last week, you stated, “I continue to be concerned that there hasn't been enough attention given to epidemiology in kids. I know folks are starting to study that in Germany and Switzerland, but we haven't really studied it in North America.” Then you said, “For those of us who have been really concerned about the possibility that children may be important vectors of this disease..”.

Given that we haven't done much research in North America and your concern that children may be important vectors, how do we square that with sending our kids back to school?

Dr. David Fisman: Honestly, it's a dilemma.

I think I mentioned earlier that the signature of this disease is that it takes off with big gatherings, so there's a lot you can probably reopen economically, safely, if you stay away from large gatherings of people. The one big gathering that's really, really tough to cancel—and which has huge economic implications—is at schools. That's the hardest thing.

The reason to be concerned about aggregating kids is that we see evidence from other respiratory infectious diseases that kids don't die of them, but they are tremendously good at transmitting these diseases.

Mr. Don Davies: That being the case, why would we be sending kids, who are vectors of this disease, to gather in large gatherings and to come back to homes where they may be in contact with seniors?

I don't see what the dilemma is there. What is the dilemma?

Dr. David Fisman: I think the idea is that economically it holds a country back. Even if we have 40% of our workforce able to work from home, for the parents, it's often difficult to get their jobs done if they're minding children in parallel.

However, yes, it's an issue. Countries like Korea have kept their schools closed. Hong Kong continues to have its schools closed. I think they're just starting to reopen, because they have approximately zero cases at this point.

I think places with good public health leadership have done it very cautiously. Kids are the transmitters of infectious disease for many respiratory diseases, even if they themselves tend not to be sick from them.

Mr. Don Davies: Thank you.

Dr. Khan, I will go quickly to you.

I know you did a commendable job. An article in U of T News said that BlueDot was among the first to warn the world of a potentially dangerous new illness, COVID-19. You rang the alarm on December 31, 2019, before both the U.S. Centers for Disease Control and Prevention or the World Health Organization. You also predicted the next 11 cities that the novel coronavirus would hit.

You're quoted as saying, “We didn’t necessarily know it would be of this size.... But what we did know is that it had the ingredients.”

Approximately when were you aware that COVID-19, or the novel coronavirus, had the potential for serious, significant, widespread transmission?

Dr. Kamran Khan: I think the point—and this is sort of a gradient—was literally December 31. First seeing that information certainly caused some alarm. Around the middle of January—and I'd have to double-check the exact date—was when the first case showed up in Bangkok.

I'll give you a bit of a sense of the increasing concern.

When we learned that this was a novel coronavirus, I believe somewhere around January 8 or so, there was concern for all the reasons I mentioned earlier, MERS and SARS, and comparing those: no vaccine, no effective antivirals, no underlying immunity and we were in the middle of flu season.

What we had been learning up until that point is that the number of cases being reported in China were in the dozens. When the case showed up in Bangkok, which was the top place we had concerns about because of the movement of travellers from Wuhan out into the region, in a city of 11 million.... The math doesn't work if you have a case show up in another city and knowing the volume of travellers who were leaving. That was the moment for me and our team, when we were really quite concerned.

Again, we didn't have all the answers, but we were quite concerned that this was a novel coronavirus. The outbreak was much larger than it appeared to be. This inevitably told us this was not just a spillover event. This was not just the people who were at the market who became infected. If there were hundreds or thousands of cases, this had to be something that was more efficiently being spread from person to person.

It was roughly around the middle of January that we had serious concerns about how this might unfold.

● (1825)

The Chair: Thank you.

That brings round two to a close. We start round three with Mr. Webber.

Mr. Webber, go ahead, please, for five minutes.

Mr. Len Webber (Calgary Confederation, CPC): Thank you, Mr. Chair, and thank you to all our presenters, whose opening remarks were very interesting indeed.

My first question is for you, Dr. Attaran. Thank you for sharing with the committee your paper on the pandemic data sharing. In this paper, you mentioned the SARS issue back in 2003 and how the World Health Organization demanded epidemiological data from Canada about the scope of the epidemic back then, particularly in Toronto. The problem was that Canada had no way to fulfill the World Health Organization's demand because of the jurisdictional fight that you described today with regard to data sharing.

Because of that, Health Canada was in no position to answer the World Health Organization's questions, so they grew afraid of Canada. They thought that Canada was concealing this epidemiological data, which then resulted in the World Health Organization recommending against travel to Canada, making Canada one of only two countries—that and China—that they sanctioned back then.

Sadly, I see this occurring again. Dr. Attaran, do you see this occurring? What will the implications be of being sanctioned once again?

Prof. Amir Attaran: Mr. Webber, you summarized that exactly right. Back in SARS, there were two countries in the world that got slammed with a WHO travel advisory, and we were one. China, not exactly having been honest, shall we say, was the other. Now, we weren't trying to deceive, the way China was. We were just unable to be honest. We were unable to get the data from Ontario to Ottawa and then onward to Geneva, where the WHO is.

Nothing has changed. That is a risk that could repeat itself. Yesterday, I believe it was Dr. Kitchen who asked about the multilateral information sharing agreement, which is an accord between the provinces and the federal government to share data. It is so secretive and ineffectual that to this day we don't know which provinces have signed that agreement and which have not. Can you believe it?

As for the Public Health Agency, I've asked them that question directly. Which provinces have signed the information sharing agreement and which haven't? They won't answer the question. Parts of that agreement actually stand in the way of data analysis, the sort that Dr. Fisman does. Under that agreement, provinces have to give their permission before analyses using their data can be published, which means that they have the ability to suppress analyses that can save lives. It's terrible.

Mr. Len Webber: It's unbelievable, Dr. Attaran, it really is. Thank you for sharing your testimony today.

Dr. Fisman, again, thank you as well, and thank you for your work, your commitment and your sacrifices, too, along with those of all health care workers in Canada. Thanks to all of them.

You've talked about some of the best practices around the country. It's in Nova Scotia, I think, that you indicated they hunt the virus, and you also talked about how in Saskatchewan they deal swiftly with and contain areas of outbreak.

Then you talked about Alberta and how they've scaled up their testing and are the most potent and aggressive testing province in the country. I'm just at odds here. I don't understand. How come Alberta can do it but the rest of Canada cannot? Where are they getting their testing material? What's their secret in Alberta?

● (1830)

Dr. David Fisman: Do you know what? I'm not sure to what extent I can talk about private conversations in this public forum but, as I speak to colleagues across the country, what is clear to me is that the places that got the job done were aware of their deficiencies as laboratory systems and worked with commercial partners to automate processes in their labs. It's one thing to be testing 100 specimens a day. It's another to be testing 10,000 a day.

I think that the laboratories that are able to have high throughput here, and—Mr. Ciciretto is probably the better one to answer this question—we do have folks in the country who know this stuff. From the time the specimen arrives until the report goes out to the public health unit, not by fax but electronically, operations can be tremendously streamlined so you don't get the bottlenecks that we've had in Ontario.

I think a lot of the problems got blamed on the supply chain but clearly, as the supply chain has cleared up, it's still a rocky ride. In Ontario there have been a lot of politics as well. I think you see that. You've had access to some testing data via the modelling process. You see that there's still this hugging going on where, even as testing is supposed to get dispersed out to hospital labs and private labs, it's still getting hugged by the public health laboratory system.

I think, in a time of national crisis, it's time to check your ego and work with whoever you can work with. Essentially, the folks in Newfoundland.... It was a remarkable experience to interact with them. Perhaps this is a size thing, but it seemed a lot to me like an ego thing. They have a provincial working group that has some former politicians, some leaders from health, leaders from business and a couple of academics, and they're all at the table and they're all exchanging ideas. It reminds me of the children's story, *Stone Soup*, where everyone brings something and puts something in. At the end of that, they all have a good soup to enjoy together.

That's how they do it in Newfoundland. It was a revelation to me, as someone coming from Ontario who's used to being asked for information that then goes off into a dark place and you're never really sure who's seen it, used it or responded to it. It's just a very different way of doing business, and I think it's served them well. They got the idea of hunting the virus from Iceland. They looked over to the east and thought, “Well, you know we've got Canada over to the west and we've got this other country over to the east, and the country to the east is doing a bang-up job. Let's talk to them.”

I think being humble and looking for folks who are doing this better than you, and learning from them, is part of the magic.

Mr. Len Webber: Absolutely, it is.

The Chair: Thank you.

Mr. Van Bynen, go ahead, please. You have five minutes.

Mr. Tony Van Bynen: Thank you, Mr. Chair. Thank you, Dr. Fisman, for joining our committee today. It's so refreshing to hear such a wide variety of perspectives, and that certainly helps us to develop a good understanding of the situation that we're trying to find some solutions for.

It's my understanding that you co-authored a study that examined the impact of enhanced contact tracing and restrictive physical distancing measures in comparison to a combination of enhanced contact tracing and less restrictive distancing measures.

Could you please share with the committee the findings of your study and what the implications may be?

Dr. David Fisman: I think what you're referring to was our paper in the Canadian Medical Association Journal, CMAJ, in March. Our model looks a lot like most other models by competent modelling groups. It looks like the publication by a guy named Steve Kissler, in Science, that happened about a month after.

What we projected was that reducing transmission through a variety of means can knock down the reproduction number of the disease and prevent intensive care units from overflowing. Something we learned.... We didn't really anticipate that a lot of deaths in Ontario would come in the long-term care facilities. We knew that long-term care facilities were vulnerable, but we assumed, as we were doing our modelling, that people would try to protect them, which turned out not to be the case.

What we've found is that various combinations of case identification with contact tracing or straight physical distancing are sufficient to knock the reproduction number down enough that ICUs don't overflow. This has been the case in Canada, which is wonderful.

Moving forward, we now have a second iteration of that model in press, in a journal called Annals of Internal Medicine. Thanks to the provincial modelling table, we've been able to calibrate the model. That means we've fit the model to real data. We couldn't do that beforehand because we didn't have an epidemic to fit it to. We can fit it to ICU occupancy in Ontario and can fit it to hospital deaths. The long-term care stuff is very challenging to try to fit into any sort of model. What we see is that, basically, the lower disease activity goes and the slower we reopen, the longer it will be before we have a resurgence.

In our paper in March, in the Canadian Medical Association Journal, my colleague, Dr. Ashleigh Tuite, who I've referenced previously and is a brilliant modeller, came up with the idea of dynamic social distancing, which depends on really good public health surveillance, so that you know when your hospital is starting to fill up again and when you have to strengthen distancing measures. I really think the group at Harvard, who we're friends with, may have copied that from us. That came out in the Science paper as well a couple of weeks later. It's this idea—and journalists refer to it as surfing the wave—that we're likely to go up and down and up and down with this disease for a while until we have a vaccine, which may come sooner than I ever would have imagined.

● (1835)

Mr. Tony Van Bynen: Thank you.

Yesterday I asked Dr. Tam about the provinces and territories and their plans to reopen their economies, as well as people starting to leave their homes as the weather gets nicer. As a follow-up, with the information obtained from your study in mind, what are your thoughts on how this can be implemented safely?

Dr. David Fisman: This is not our work. There's a marvellous mathematician at Waterloo by the name of Chris Bauch who has a paper looking at regional reopening in Ontario as opposed to blanket policies, with the outcome of interest being how we can minimize the amount of time in lockdown.

I think some organic reopening is happening anyway as the weather gets better, and that's all right. This doesn't seem to be an infectious disease that spreads particularly well in parks or as people are out enjoying themselves, as long as they're maintaining a bit of distance. This disease really continues to show that it likes big crowds and indoor places. I think our most recent superspreader event here in Ontario was among greenhouse workers in Chatham, which fits the description to a T: 50 people were infected working in a greenhouse. When folks are in small groups and there's a low upper bound on the number of people they're working with—we call that “work bubbles”—or when folks are enjoying themselves outside to stay fit, going to parks or enjoying the outside with their kids, that generates minimal risk for us.

What we do need is good, strong surveillance systems—and this circles back to our initial conversation about testing—that let us know when we're getting into danger again, as we were in March. I do think we're going to struggle in the fall. Again, there's a lot of hindsight at this point. This thing emerged in January, but we didn't really get serious about it until March, and I think we're going through that again. Anyone who looks at disease dynamics for a living can tell you that we're in a lull now but the disease is probably going to be coming back in September or October. We have some golden time now to get prepared for a likely resurgence in the fall. I think we need to build those surveillance systems and get much better at this by the time we get to the fall, because we're going to have to be more nimble then. There's much we can do, and there's much we can do safely if we avoid large gatherings.

The bubble idea—and a lot of corporations have already instituted this— is simply that if you divide people up into relatively small teams, they don't work simultaneously in the office and there's a deep clean between when teams are in the office, you have an upper bound on how many people are going to get infected if someone comes into the bubble with infection.

I think there's a lot of ingenuity and a lot of wiggle room in reopening the economy safely, as long as we have the surveillance systems that allow us to see when we're getting back into trouble.

The Chair: Thank you.

Ms. Jansen, please go ahead. You have five minutes.

Mrs. Tamara Jansen: Dr. Khan, I'm curious about your thoughts, as a infectious disease specialist, on the current deal that Health Canada has made with China on developing a COVID-19 vaccine.

The announcement mentioned that the National Research Council is working with CanSino Biologics to advance a vaccine, which is being developed jointly with the People's Liberation Army. Apparently Health Canada has even approved the first human clinical trial that will be run at Dalhousie University in spite of the fact that CanSino has not published any data from its first trial phase for any sort of public scrutiny.

This really shocked me. Vaccine development cycles are normally 10 to 15 years, and the shortest ever was four years. Our Five Eyes intelligence alliance has raised concerns regarding China's transparency regarding this particular pandemic. They even denied, initially, human-to-human contact. And some whistle-blowers have disappeared.

If we want Canadians to buy into a COVID-19 vaccine, wouldn't it make more sense to be working with a more trustworthy partner on this sort of thing? Does it strike you as being dangerous?

● (1840)

Dr. Kamran Khan: Thank you for the question. I'm going to try to see if I can tackle it.

With respect to vaccine development and partnerships, I would say that I'm not fully aware of all the details of how Canada is looking at vaccine development, perhaps, with the Government of China or with scientific groups in China.

I think all of the points that you've raised are very important. Clearly, there is a race to get to a vaccine as quickly as possible, not only from a preventative standpoint but also to develop therapeutics.

I think I'm probably not well equipped to speak to the broader ethical issues here. I'm just less informed about the specifics of this particular circumstance.

But clearly, the points that you're raising around transparency are critical in any scientific endeavour. I think that is a critical issue.

I'm not sure if, perhaps, Vito or others want to chime in on that.

Mrs. Tamara Jansen: My time is limited. I have another question, but not specifically for you.

Going back to Professor Attaran, you mentioned that we could ask you questions about yesterday's meeting.

I asked Dr. Tam about her flip-flop on the use of masks. Up until early April, Dr. Tam stated that an asymptomatic person shouldn't wear a mask. It didn't work. It might even be harmful. Then on April 6, she changed her mind and said that a mask was good for additional protection.

Her response to my question on why her message changed was that, apparently, new evidence had come to light.

As this was a respiratory pathogen, I imagine that out of the abundance of caution, masks would have been helpful right from the beginning.

In your opinion, what sort of new evidence has come to light over the course of this pandemic that would substantively change the way we consider the effectiveness of masks as prophylactics?

Prof. Amir Attaran: There's no easy way for me to say this, but Dr. Tam was not being truthful.

In the week or 10 days.... Pardon me, I don't know the exact time span between her statement that masks were not to be recommended to the public and then changing her view to give permissive guidance that masks of a non-medical sort could be used. In that short period of, as I say, about a week or 10 days, there was no new evidence that emerged to justify that change.

There have been additional studies of masks, of course, some of it biophysics, what particle size will penetrate a mask in what conditions. But there was definitely not in that crucial window a game-changing study.

Mrs. Tamara Jansen: I have a really quick question. My time is almost out.

You provided a chart in your submission that showed that Australia and, I believe, South Korea had much better pandemic trajectories than Canada did. As with all catastrophic emergencies, there's never just one thing that goes wrong that causes the tragedy, and I assume that's the same when things go right.

What, in your estimation, are the critical things that ensured better outcomes in those countries compared to Canada?

Prof. Amir Attaran: Australia, for instance, was very quick at cutting off travel with China. It did so at the same time as President Trump did, but for sounder reasons than Mr. Trump.

It was also incredibly quick at organizing coordination between the states—the provinces, if you will—and the federal government. As I mentioned, they signed an accord on co-operation on March 13. Such an accord doesn't exist in this country yet.

The Australians have, generally speaking, a very strong sense of biosecurity because they are an island continent and they have honed that over years. They're much more attuned to risks coming in from abroad than we have been. The error of not being tougher on travel sooner is one that we will, of course, regret for many years to come.

The Australians also, I feel, were extraordinarily good at their social distancing. Now, precise measures of how aggressive social distancing is are hard to come by. Dr. Fisman would be able to speak to that far better than I could, but even from my inexpert point of view on this, it's clear the Australians did take the social distancing more seriously early on than did Canadians, and that has had an effect.

● (1845)

The Chair: Thank you.

Ms. Sidhu, go ahead, five minutes.

Ms. Sonia Sidhu (Brampton South, Lib.): Thank you, Chair.

Thank you everyone for coming today.

As you know, I really like all the witnesses. Yesterday Dr. Tam and her team were here.

This committee has really been focusing on supporting Canadians and how we can better help all Canadians.

Today I really want to say thank you to all the witnesses and my first question is to Dr. Khan.

You talked about the rigorous factor and triggering the next wave. Can you explain to the committee how your technology can be used to track second or third waves of COVID-19? What do you see as the biggest risk that's coming?

Dr. Kamran Khan: In the technology that we've developed, and I'm going back to that metaphor of smoke detector and fire extinguisher, we've really been focusing much more on developing the early warning systems that could give us a signal that there is a threat coming.

COVID-19 is here now and we're all very well aware of it and we're now sort of more in firefighting mode, grabbing the fire extinguisher to put fires out.

From the standpoint of our technology, the area where we are supporting public health decisions is around an understanding of population movements and how that relates to the transmission of COVID-19 across the country.

With respect to the next set of waves, I have two thoughts. One is clearly the vast majority of the population in Canada remains susceptible, as we've heard. We either could see an uptick in cases later in the fall because of a variety of factors including climate conditions and dynamics of how people are interacting, or we could find ourselves in a similar position to some countries like Australia and New Zealand, where imported cases become the catalyst for another wave.

So we're going to have to be thinking both internally and externally. These are a couple of examples of how our technology is looking internally within the country domestically as well as globally.

Ms. Sonia Sidhu: Thank you.

My next question is for Mr. Ciciretto. Your company is based in Brampton. Your company recently moved to providing COVID-19 test results online instead of over the phone. How has that increased the efficiency of your testing process?

In Canada today, 1.3 million people have been tested. What do you think? How has online reporting instead of over the phone reporting increased the efficiency of your testing process?

Mr. Vito Ciciretto: The ability to transmit results directly from an analyzer onto your laboratory information system and into provincial health repositories is critical from at least two perspectives. One is from a timeliness perspective. As soon as that test result is available you want to make sure that you're able to release it.

The second and perhaps even more important perspective has to do with accuracy. The minute that there's any type of human interaction, of taking a manual result from a machine and then transmitting it onto a computer, there's always that risk of error, and that's not something you want, obviously.

● (1850)

Ms. Sonia Sidhu: Dr. Fisman, as you know the Public Health Agency has its opinion on non-medical masks.

You also mentioned the mask adoption strategy; how is this beneficial to Canadians?

Dr. David Fisman: We don't know but we can be highly suspicious that it would help us a lot. Especially if we can get the reproduction number of the disease down to around one. That's a tipping point. At that tipping point, very small changes in infection transmissibility can really make the epidemic fall through the floor and go away.

What you have to remember about masks and disease like this is that masks work in both directions. They reduce the likelihood that you get infectious particles into your nose, mouth and eyes potentially, if you keep your hands off your face. They also prevent you from infecting other people. Probably the more important part with this disease is the reduction of transmission, which happens very efficiently even with cloth masks. The reason that's so important with this particular disease is that what we know of the work of Gabriel Leung and his colleagues in Hong Kong, which was published in Nature about a month ago, is they estimate about 44% of transmissions in Hong Kong occur in presymptomatic individuals. Those are people who are going to feel sick tomorrow, but they feel just fine today. They haven't changed their behaviour.

Masks can be extremely impactful because if I'm wearing a mask and I become infectious but I don't know it yet, I don't infect you. Everybody wants to wear a mask to protect themselves from other people. I'm fine to have folks leverage that to get the masks on. It's pretty clear. There's a reason why surgeons wear masks in the operating room because they block extrusion of respiratory droplets that infect with bacteria the patients they're operating on. This would be the same idea except out in public you're wearing a mask not to protect yourself necessarily—although it might—but to protect other people from you if you're infectious but don't have symptoms.

As I say, we've had reproduction numbers in Ontario and Quebec, which is basically where our epidemic lives now, rumbling along around a reproduction number of one. In Ontario it's been there since early April, we just can't seem to get it down. If anything knocks that reproduction number down to 0.7 or 0.6, we're going to get back to a lot more rapid economic opening up. We're going to be able to open up more. The lower we keep that reproduction number, the more we'll be able to open up the economy while still staying safe.

To me it's a no-brainer. We can argue about class 1A evidence or what have you. We can have a symposium about this in five years and decide what exactly the science shows. But now is the time for action.

As Professor Attaran said, we're burning through $12 billion a week. Getting masks on Canadians and teaching them how to use them is change from between the couch cushions relative to what we're burning through by keeping our society closed. To me it's worth the gamble.

● (1855)

The Chair: Thank you.

We go now to Mr. Desilets for two minutes and a half, please.

[*Translation*]

Mr. Luc Desilets (Rivière-des-Mille-Îles, BQ): Thank you, Mr. Chair.

My thanks to all the witnesses for joining us. The content they have shared with us is very interesting.

My first question is for—

[*English*]

The Chair: Pardon me, Mr. Desilets, your sound is bad as well.

Could you try and unplug your headset and plug it back in?

I will suspend for a minute.

● (1855)

_____(Pause)_____

● (1900)

The Chair: I declare this meeting resumed.

Please go ahead, Mr. Thériault, on behalf of Mr. Desilets.

[*Translation*]

Mr. Luc Thériault: Okay.

Earlier, when I asked Dr. Fisman a question, I noticed that Dr. Schabas was reacting. I think he wants to answer the question.

It had to do with the rate of safe reopening that Canada should adopt in order to have herd immunity, given that we don't have a vaccine yet, we don't have antivirals, and we are just beginning serological testing.

My question is for Dr. Schabas.

[*English*]

Dr. Richard Schabas: One really profoundly unfortunate thing about what's happened in Canada, where we in fact did the lockdown in advance of our outbreak, unlike many places in western Europe or in the United States, is that in a sense we've had the worst of both worlds. We have achieved very little herd immunity, certainly no more than 5%, at least in the whole country, yet we've had a lot of deaths. We've had a lot of deaths because of the outbreaks in the long-term care homes. The population death rate in the city of Montreal is twice as high as it is in Stockholm, Sweden and is starting to close in on the city of New York. It's not been a very happy experience.

There were two kinds of outbreaks. There was the long-term care outbreak, which drives mortality, and then there's the community outbreak, where there has been very little mortality.

The fundamental question is: Is it safe to reopen in the presence of active disease? No, not in the sense that we're not going to see more COVID disease. We will. When we start to open up, we are going to see more COVID disease.

The whole thrust of my presentation is to look at it the other way. Is it safe not to open up? We talked, and one of the earlier questions was: When are we going to open the schools? Why are we opening the schools? There's going to be more COVID spread. Well, the reason you open schools is that children have to go to school. It's a fundamental right of children to have an education. If we deprive a whole generation of children of six months or a year of education, we're going to be paying the public health price for that for years to come.

There is no nice solution. Dr. Fisman and Dr. Attaran talk about doing more testing and contact tracing, something which, by the way, has never been done to control a respiratory virus. It may work well on a spreadsheet; the real world is more complicated. I hope they're right. I hope they're right and that works, but the real world is a rather more complicated place.

I was just going to say what I'm really worried about is that when they try the strategy and the disease resurges in the fall and the strategy fails, as I believe it almost certainly will, we can't go back into this kind of lockdown because we will do more long-term damage to our public health than COVID-19 could ever do.

● (1905)

The Chair: Thank you, Mr. Thériault.

We go now to Mr. Davies.

Mr. Don Davies: Thank you.

Dr. Schabas, you wanted a chance to explain, so I'm going to put a few things to you. After SARS, you wrote, “In the unlikely event of another SARS outbreak in Canada, public health officials should quarantine no one.” Now, our current pandemic is a SARS outbreak. The virus is SARS-CoV-2. We fought it mainly with lockdown and quarantine. My first question is, are you standing by your extraordinary statement that we should quarantine no one?

Before I get to that, I want to contrast that. In 1990, when you were Ontario's chief medical officer, you classified HIV as a virulent disease, which is the worst category of characterization, and you recommended that we forcibly confine people with HIV who may have had sex with someone else, even if they used a condom and even if they disclosed that to their partner.

My final piece, before I let you answer, is that you said that we should treat this more like the 1957 flu, but the fatality rate in the 1957 flu was about 0.1%, which is about one-twelfth that of COVID-19.

Throwing all those together, can you help me understand your point of view?

Dr. Richard Schabas: I'll try to remember all of them.

First of all, let me start with the SARS 1 and the quarantine. I was talking about SARS 1. SARS 1 was a disease that was not transmissible asymptomatically and was not even transmissible in its early symptomatic stage, so quarantine made zero sense with SARS 1, and my hope was that it wouldn't happen again.

Yes, we've used it widely in SARS 2. Whether it's really been very effective, or whether it's a useful tactic, because as I've said before, you can maybe flatten the curve.... In fact, I'm quite impressed by our ability to implement quarantine, and I think it probably has to some degree flattened the curve, but the question is ultimately to what end? The virus isn't going anywhere, and unless the measures you're using to flatten the curve are somehow sustainable in the long term, I'm not sure they really get us anywhere.

On the third question, as related to HIV, yes, I had recommended it. I didn't do it. It wasn't up to me. I had recommended to the minister that it be classified in the same category as diseases like tuberculosis, syphilis, gonorrhea and hepatitis B. It was a classification that would give a judge the authority to incarcerate someone who was deliberately spreading the disease. That was the context of it. It actually never happened, and that's not quarantine. Please understand that quarantine is when you lock someone up who you think is incubating the disease.

Case isolation, which is a totally different thing, is that when you know somebody has the disease, you take steps to isolate them. I'm not recommending that we do this for HIV. That's a different context. That's what we do, in fact, when people have COVID or we have good reason to believe they have COVID. We isolate them. That's not quarantine. Quarantine is when you lock them up when you think you're incubating them.... The term “quarantine” itself derives from the 40 days of Lent. That's a medieval strategy and, by and large, I think it belongs back in the Middle Ages.

● (1910)

The Chair: Thank you.

Mr. Don Davies: I have a point of privilege to raise before we adjourn, Mr. Chair.

I would like to move a motion that this committee inquire into reports that a witness appearing before the health committee, Dr. Amir Attaran, may have been threatened, punished, intimidated or otherwise harmed by the Public Health Agency of Canada, Statistics Canada or the federal government in some other form, because of testimony he has given at the health committee, and to determine if a prima facie issue of privilege has been raised and, if so, report such findings to the Speaker of the House.

Mr. Chair, I'm quoting from Bosc and Gagnon, which says this:

> ...the intimidation of a committee witness has also been found to be a prima facie breach of privilege. In 1992, a witness who had testified before a subcommittee was advised by a Crown corporation employee that the issue of her testimony was being referred to the corporation's legal department. The witness informed a Member, who raised a question of privilege in the House. The matter was found by Speaker Fraser to be prima facie contempt and was referred by the House to the Standing Committee on House Management for consideration.

In its report, the committee said this:

> The protection of witnesses is a fundamental aspect of the privilege that extends to parliamentary proceedings and those persons who participate in them. It is well-established in the Parliament of Canada, as in the British Parliament, that witnesses before committees share the same privileges of freedom of speech as do Members. Witnesses before parliamentary committees are therefore automatically extended the same immunities from civil or criminal proceedings as Members for anything that they say before a committee. The protection of witnesses extends to threats made against them or intimidation with respect to their presentations before any parliamentary committee.

Mr. Chair, I could go on. There are many more. I move that there has been a violation of my privileges as a member of this committee, and I would ask that you act on the motion that I have moved.

The Chair: Mr. Davies, you're in a point of order. You can't make a motion on a point of order.

As far as the question of privilege goes, as I mentioned earlier, I believe that's out of scope for our authority to conduct these video conference meetings. We are restricted to solely receiving evidence relating to the government's response to COVID-19, and we are also allowed to make motions regarding the invitation of witnesses.

Certainly, as I've mentioned before, I will take the matter under advisement. I will look for a legal opinion from the clerk and from the legal clerk as well, and we can take this up at another time. I'll take that under advisement and—

Ms. Sonia Sidhu: Mr. Chair, I would like to raise a point of order.

There were comments made in testimony today that I believe break parliamentary language. It was deeply disrespectful to call Canada's public servant untruthful. That comment should be removed from the committee record.

The Chair: Thank you for that point of order.

Certainly, we are bound by the rules of Parliament in our conduct here. I would certainly urge all participants, going forward, to be prudent in their language.

Thank you, everybody. I'd like to—

Mr. Matt Jeneroux: Mr. Chair, this is to Mr. Davies' point of order.

The Chair: Go ahead.

Mr. Matt Jeneroux: I'm reading the motion adopted by the House of Commons in the sitting on Tuesday, March 24, 2020. Section (i) states the following:

> ...if committee is not satisfied with how the government is exercising its powers under the Act, it may adopt a motion during a meeting by videoconference or teleconference to report this to the House by depositing a report with the Clerk of the House which shall be deemed to have been duly presented to the House on that day;

I would point to you, Mr. Chair, and also the clerk, to reference that point when coming back and addressing Mr. Davies' question of privilege.

Mr. Don Davies: If I might, Mr. Chair—

The Chair: I'm sorry, I—

Mr. Don Davies: —I want to be very clear that I am not raising a point of order. I am raising an issue of privilege.

I can further quote that it says in the—

The Chair: Just hold on, Mr. Davies.

Thank you, Mr. Jeneroux, for your contribution.

I believe you did start your remarks, Mr. Davies, on a point of order. You then went into a question of privilege. It's kind of beside the point. I will take under advisement your motion. We will get back to you once I have a ruling from the law clerk.

● (1915)

Mr. Don Davies: Mr. Chair, with respect, it's very important that you....

You're misunderstanding my point. Earlier I raised a point of order. I am now raising a question of privilege. That's what I did in my second intervention. You clearly have the power, in fact you have the duty, to receive my question of privilege as it's raised in committee, because this is where I have to raise that.

I'm happy for you to go back and reflect on it, but I want to be very clear that I am raising a question of privilege and I am asking for your consideration of the motion that I have moved.

The Chair: Thank you, Mr. Davies. As I said, I will take the matter under advisement. We will get back to the committee in due course.

Mr. Don Davies: Thank you.

The Chair: Thank you, everybody.

Thank you to our witnesses. It's been a lively and robust discussion. Thank you for sharing so much of your time with us and for putting up with our technical issues.

Thank you to the House staff and the technical people for being with us to work through those issues and thank you to the members for all the great questions.

Have a good day, all, and thank you.

The meeting is adjourned.

This is **Exhibit "C"** to the
Affidavit of David Fisman,
affirmed before me by videoconference
July 21, 2020

A Commissioner, etc.

Observations: Brief Research Reports

Reporting, Epidemic Growth, and Reproduction Numbers for the 2019 Novel Coronavirus (2019-nCoV) Epidemic

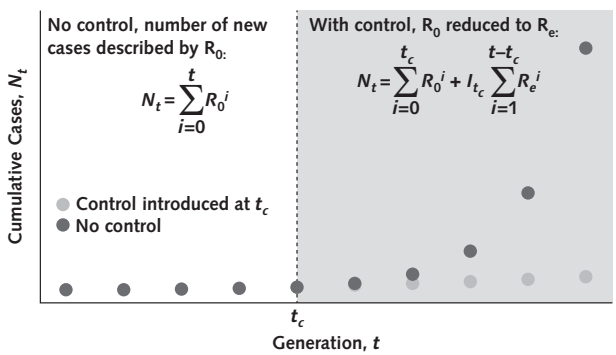
Background: Virologically confirmed cases of 2019 novel coronavirus (2019-nCoV) in China and other countries have increased sharply (1, 2), leading to concerns regarding its pandemic potential. Viral epidemiology has been characterized sufficiently to permit construction of transmission models that predict the future course of this epidemic (3).

Objective: To provide insight into the changing nature of case findings and epidemic growth.

Methods: We developed a simple disease-transmission model in which the 2019-nCoV epidemic was modeled as a branching process starting in mid-November 2019, with a serial interval of 7 days (time between cases) and a basic reproduction number (R_0) of 2.3 (new cases from each old case), based on available data and assuming no intervention (**Figure 1**). The epidemic start date aligned our modeled case counts to point estimates from international case exportation data (4). The model estimated plausible values of the effective reproduction number (R_e; reproduction number in the presence of control efforts) after implementation of a quarantine in Wuhan and surrounding areas of China on 24 January 2020 (3) (**Figure 1**).

R_e values after intervention can be plotted as epidemic curves in a series of "contours," similar to altitude values on a map. Because many combinations of model parameters create plausible epidemic trajectories, we have created an interactive tool that produces models with and without control efforts (https://art-bd.shinyapps.io/nCov_control).

Figure 1. Estimation of cumulative cases with and without implementation of control measures.



Serial interval is the average time between cases in a chain of transmission and is used to calculate the number of generations in an epidemic (time since epidemic start ÷ serial interval duration). In the absence of control measures, the total number of cases after t serial intervals depends on R_0 (the number of new cases created by an index case in a completely susceptible population in the absence of intervention) and the number of epidemic generations (left-hand equation). Introduction of control is assumed to reduce the reproduction number to R_e. The last generation with uncontrolled growth is indicated by t_c, with an incident case count of I_{tc}, and we can use the right-hand equation to calculate case numbers in the presence of control. The difference between the 2 curves shows the effect of introducing control measures vs. continued epidemic growth without control. R_0 = basic reproduction number; R_e = effective reproduction number.

Findings: Comparison of cumulative case numbers versus model-generated counts shows that reported case numbers remain lower than modeled estimates, but ascertainment is increasingly complete over time (**Figure 2**). Based on previously published model estimates (4), the fraction of cases reported increased from 2.4% on 12 January 2020 to 11% on 18 January 2020 (4). Our model suggests that (assuming R_e remained close to 2.3 after the quarantine on 24 January 2020) reported cases increased to 59% by 31 January 2020 (9930 reported cases vs. 16 860 modeled cases) (1, 2). The fraction of cases reported would be even higher if the reproduction number were lower because of control efforts.

Figure 2 shows a narrowing (horizontal distance) between case counts generated by the model and those reported by public health authorities over time. This suggests decreasing reporting times (from >10 days on 27 January 2020 to approximately 4 days by 3 February 2020). Contours generated by the model with intervention give us information about which (average) reproduction numbers may be plausible and which are implausible (**Figure 2**). If R_e had fallen to 1.0 after 24 January 2020, the model predicts fewer cases than are currently being reported (as of 3 February 2020), making this level of control implausible. By contrast, reduction to an R_e of 1.5 is plausible on the basis of reported cases and model estimates up to 3 February 2020, but it would also imply complete reporting.

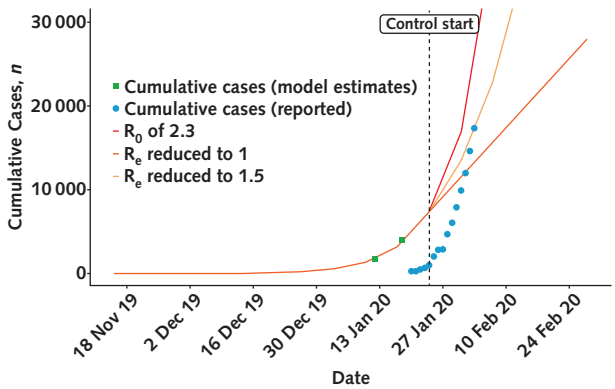
Discussion: Using a simple model of epidemic growth that includes the representation of control efforts can provide helpful insights into the growth of the 2019-nCoV epidemic that are not directly observable in publicly reported data. Comparison of modeled and reported case counts suggests that reporting lags are decreasing and case ascertainment increasing over time. The narrowing gap between modeled and confirmed cases shows that the massive public health effort under way in China is increasing ascertainment of 2019-nCoV cases. Large leaps in reported case counts represent both disease activity and a surveillance effort that is "catching up" with an epidemic.

Contour plots can be used to indirectly estimate R_e after introduction of control efforts, because case counts exceeding a given contour suggest that an R_e value is implausible. Potential limitations of this model include underrepresentation of mild infections and its focus on an epidemic currently centered in China. If this epidemic becomes a pandemic, epidemiology in individual countries may diverge. Nonetheless, the tool may help policymakers by allowing inferences about likely underlying dynamics of the epidemic, even when available disease data are delayed or incomplete.

We will continue to plot case counts against such projections moving forward (with updated counts incorporated into our online tool). If cumulative case counts flatten and intersect with contour lines horizontally, either control is improving and the mean reproduction number is decreasing or (a pessimistic interpretation) case ascertainment efforts are flagging because of limited laboratory or human resources. Conversely, if

This article was published at Annals.org on 5 February 2020.

Figure 2. Simulated epidemic trajectories and reported cumulative case counts for 2019-nCoV.



The initial growth of the epidemic is based on introduction of the pathogen in mid-November 2019, with R_0 = 2.3 and a serial interval of 7 d. The model reproduces estimates of case counts based on volume of internationally exported cases (*green squares*) (4). Daily cumulative counts of virologically confirmed cases are based on publicly available reports (1, 2) (*blue circles*). Case counts reported on 3 February 2020 are not compatible with reduction of R_e to 1 but could be compatible with reduction to 1.5. If control is achieved, reported case counts will intersect horizontally with the contour lines on this graph. When reported cases move beyond contours vertically, the reproduction numbers represented by those contours become implausible. 2019-nCoV = 2019 novel coronavirus; R_0 = basic reproduction number; R_e = effective reproduction number.

reported case counts cross the contour lines above them, that would imply an ever higher minimum value for R_e.

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Disclaimer: The tool, available at https://art-bd.shinyapps.io/nCov_control, was developed by the authors for this article using a third-party application, which may have limited access and functionality. Neither *Annals of Internal Medicine* nor the American College of Physicians is responsible for the content and functionality of this online application. Questions regarding the use of the application should be addressed to the corresponding author (e-mail, david.fisman@utoronto.ca).

Disclosures: Authors have disclosed no conflicts of interest. Forms can be viewed at www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M20-0358.

Reproducible Research Statement: *Study protocol and statistical code:* Described in Methods. *Data set:* Derived from reference 1 and available at https://docs.google.com/spreadsheets/d/19qC9EK2ydaSoKDMkmbbarXBo8Ism_1_6zeMrJh5kZ9Y/edit?usp=sharing.

doi:10.7326/M20-0358

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This is **Exhibit "D"** to the
Affidavit of David Fisman,
affirmed before me by videoconference
July 21 2020

A Commissioner, etc.

LETTERS

Open access epidemiologic data and an interactive dashboard to monitor the COVID-19 outbreak in Canada

A recent publication in *CMAJ*[1] highlights the critical need for timely, accurate and accessible epidemiologic data for the ongoing coronavirus disease 2019 (COVID-19) outbreak to inform public health response efforts. In Canada, the first case was reported on Jan. 25, 2020, in a returning traveller. As of Mar. 30, 2020 there have been 7448 reported cases and 89 reported deaths across the country.

Individual-level case data are particularly valuable during outbreaks but are seldom made available in real time. Interactive data visualizations are also needed to contextualize this information and provide a pan-Canadian summary. These tools engage not only the public health and research communities but also the general public whose cooperation is essential to effectuate response efforts.

We developed an individual-level data set of confirmed and presumptive positive cases of COVID-19 in Canada (https://github.com/ishaberry/Covid19Canada), including demographic characteristics, location, report date, travel history and exposure source. Time series of deaths, recoveries and testing are also recorded. This data set feeds into an interactive dashboard (https://art-bd.shinyapps.io/covid19canada/), which enables users to view the data and follow the outbreak. All data are openly accessible and updated daily.

Data are collated from government health authorities as well as news media. Data are entered manually and coordinated by a team at the University of Toronto. Our data set aligns with the Public Health Agency of Canada's COVID-19 outbreak updates[2] and is more detailed, timely and amenable to analysis than the federally reported aggregate data.

Given the high engagement with this data set to date, we plan to continue updating it to provide a robust epidemiological picture of the COVID-19 outbreak in Canada. We hope these data are used to inform epidemiologic and modelling analyses during this outbreak. Data sharing, standardization and visualization will continue to be crucial for supporting evidence-based control strategies and directing public health response efforts in Canada.[3]

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Competing interests: None declared.

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A Commissioner, etc.

RESEARCH

Impact of climate and public health interventions on the COVID-19 pandemic: a prospective cohort study

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Cite as: *CMAJ* 2020 May 25;192:E566-73. doi: 10.1503/cmaj.200920; early-released May 8, 2020

ABSTRACT

BACKGROUND: It is unclear whether seasonal changes, school closures or other public health interventions will result in a slowdown of the current coronavirus disease 2019 (COVID-19) pandemic. We aimed to determine whether epidemic growth is globally associated with climate or public health interventions intended to reduce transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

METHODS: We performed a prospective cohort study of all 144 geopolitical areas worldwide (375 609 cases) with at least 10 COVID-19 cases and local transmission by Mar. 20, 2020, excluding China, South Korea, Iran and Italy. Using weighted random-effects regression, we determined the association between epidemic growth (expressed as ratios of rate ratios [RRR] comparing cumulative counts of COVID-19 cases on Mar. 27, 2020, with cumulative counts on Mar. 20, 2020) and latitude, temperature, humidity, school closures, restrictions of mass gatherings, and measures of social distancing during an exposure period 14 days previously (Mar. 7 to 13, 2020).

RESULTS: In univariate analyses, there were no associations of epidemic growth with latitude and temperature, but weak negative associations with relative humidity (RRR per 10% 0.91, 95% confidence interval [CI] 0.85–0.96) and absolute humidity (RRR per 5 g/m^3 0.92, 95% CI 0.85–0.99). Strong associations were found for restrictions of mass gatherings (RRR 0.65, 95% CI 0.53–0.79), school closures (RRR 0.63, 95% CI 0.52–0.78) and measures of social distancing (RRR 0.62, 95% CI 0.45–0.85). In a multivariable model, there was a strong association with the number of implemented public health interventions (p for trend = 0.001), whereas the association with absolute humidity was no longer significant.

INTERPRETATION: Epidemic growth of COVID-19 was not associated with latitude and temperature, but may be associated weakly with relative or absolute humidity. Conversely, public health interventions were strongly associated with reduced epidemic growth.

Seasonality and climate dependency of influenza are well established. Suggested mechanisms for the slowdown of influenza epidemics in summer months in temperate climates are related to higher temperature, higher humidity or higher solar radiation.[1] These 3 characteristics are all associated with geographic latitude, a measure that can be determined effortlessly and with precision. Another possible explanation for the slowdown of influenza epidemics during summer months is school closures for summer breaks.[2–4]

To slow the growth of the current coronavirus disease 2019 (COVID-19) pandemic, many countries have mandated school closures[5] and other public health interventions, such as restrictions of mass gatherings, social distancing or closure of nonessential businesses. However, it is unclear whether these interventions, or seasonal changes mediated by climate,[6] affect the pandemic. We performed an analysis of the current epidemic growth in geopolitical areas affected by COVID-19 to determine whether epidemic growth was associated with climate, school closures or other public health interventions aimed at reducing contact rates in the population and thereby reducing transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the coronavirus driving the pandemic.[7–9]

Methods

We designed a prospective cohort study of geopolitical areas with documented outbreaks of COVID-19 to determine the association of epidemic growth of COVID-19 during a prespecified

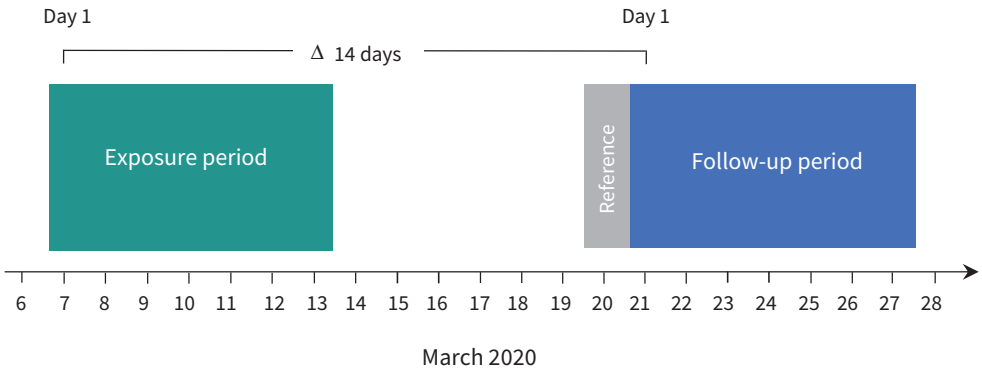

Figure 1: Study design. Δ = difference between day 1 of exposure period and day 1 of follow-up period.

follow-up period (Mar. 21 to Mar. 27, 2020) with characteristics ascertained during an exposure period 14 days previously (Mar. 7 to Mar. 13, 2020). The time lag between exposure and follow-up was set to 14 days, to reflect the assumed time between transmission of SARS-CoV-2[10] and reporting of confirmed COVID-19 cases (Figure 1).[11] Analyses were performed according to a prespecified protocol. Results of a preliminary unpublished analysis, conducted according to protocol version 1.0, are summarized in protocol version 1.2 (available in Appendix 1, at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.200920/-/DC1). An explanation of protocol changes is provided in the supplementary methods in Appendix 2, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.200920/-/DC1.

Eligibility

We included all geopolitical areas (states for Australia and the United States, provinces and territories for Canada, countries and overseas territories for the rest of the world) with at least 10 cases as of Mar. 20, 2020 (reference), and documented local transmission according to the World Health Organization's (WHO) Situation Report 61.[12] China was excluded as its epidemic growth had decelerated and the outbreak appeared to be contained. South Korea, Italy and Iran were excluded as their epidemics were fully established, being further ahead on the epidemic curve than the rest of the world, with the possibility of reaching the hyperendemic state during the follow-up period.

Exposure

The exposure period was prespecified to last from Mar. 7 to Mar. 13, 2020 (Figure 1). Geographic latitude was prespecified as the primary exposure variable, with mean temperature, absolute humidity, school closures, restrictions of mass gatherings and measures of social distancing as secondary exposure variables. Data on latitude, mean temperature and mean relative humidity (to derive absolute humidity) were collected for the capital of each geopolitical area, and data on school closures, restrictions of mass gatherings and measures of social distancing were collected at the level of the geopolitical area. Absolute humidity describes the absolute water content in g/m^3, and relative humidity describes absolute humidity relative to the maximum possible humidity in percent given the current temperature. We gave precedence to absolute humidity over relative humidity, as it was more strongly associated with influenza than relative humidity[1] and showed less variation than relative humidity, but included relative humidity as a post hoc exposure variable. Mean temperature and humidity were calculated for the entire exposure period, deriving arithmetic means across all available measurement time points (median 8 per day, interquartile range [IQR] 8 to 45).[13] For school closures, restrictions of mass gatherings and measures of social distancing, we determined whether they were implemented by a prespecified cut-off, in the middle of the workweek of the exposure period (Wednesday Mar. 11, 2020).

Outcome

The analysis of confirmed cases[11] is complicated by potentially dramatic differences in detection and reporting of individuals infected with SARS-CoV-2,[14] which prevent a meaningful analysis of absolute event rates across different countries. Conversely, an analysis of epidemic growth,[15] which can be expressed in relative terms — a rate ratio comparing the current cumulative count of reported cases with the cumulative count of cases reported 1 week earlier — is likely to account for some of the variation in detection and reporting. This approach analyzes the slope of the cumulative frequency rather than absolute rates, using each geopolitical area as its own comparison (Appendix 2, Figure S1). The follow-up period was prespecified to last from Mar. 21 to Mar. 27, 2020 (Figure 1). The prespecified outcome was epidemic growth, defined as the rate ratio comparing the cumulative count of confirmed COVID-19 cases at the end of the follow-up period on Mar. 27, 2020, with the cumulative count 1 week previously, on Mar. 20, 2020 (reference).

Additional covariates

Altitude, gross domestic product (GDP) per capita, health expenditure as percent of GDP, life expectancy, percentage of inhabitants aged 65 years or older, the Infectious Disease Vulnerability Index,[16] urban population density, number of flight passengers per capita and closest distance to a country with already established epidemic (city of Wuhan, South Korea, Iran, Italy) were additional prespecified covariates. Table S1 in Appendix 2 provides a justification for the choice of these covariates.

Data collection

Information on data sources is presented in Appendix 2, Table S1. On Mar. 28, 2020, we downloaded data covering the COVID-19 outbreak until Mar. 27, 2020, from the online interactive dashboard hosted by the Center for Systems Science and Engineering at Johns Hopkins University, Baltimore.[11] The dashboard reports the cumulative number of cases daily at province level in China; at city or county level in Australia, Canada and the US; and at level of countries and overseas territories elsewhere.[11] The case data reported on the dashboard align with the daily WHO situation reports.[11,12] The data reported at city or county level for Australia, Canada and the US were aggregated to state or province level. Overseas territories, such as Réunion or Guam, were handled separately from their home country for the purpose of this study.

Temperature in degrees Celsius (°C) and relative humidity were collected for the exposure period of Mar. 7 to Mar. 13, 2020, from a publicly accessible meteorological website,[13] with absolute humidity calculated from relative humidity and temperature for each measurement time point.[17] Data on school closures were obtained from the United Nations Educational, Scientific and Cultural Organization[18] and complemented with information on scheduled school holidays. Data on school holidays, restrictions of mass gatherings and measures of social distancing were obtained by 1 of 4 investigators (P.J., P.B., D.G. and a research assistant) from official school schedules; provisions and press releases of relevant administrative and governmental bodies; and newspaper articles, and checked by at least 1 other investigator (P.J. or P.B.). Data on restrictions of mass gatherings and measures of social distancing were subsequently verified against timelines reported in the online encyclopedia *Wikipedia*.[19] No documents were excluded based on language. Team members were able to read documents in English, German, Czech, Danish, Dutch, French, Greek, Italian, Portuguese, Slovak and Spanish directly. We used Web-based translation services for remaining languages. "Social distancing" was defined as any measure that attempted to prevent small clusters of 10 individuals or fewer, such as strong recommendations or formal requirements of social distancing, closure of sit-in restaurants and bars, or closure of nongrocery stores.

We calculated the number of flight passengers per capita from published passenger statistics of major airports.[20–22] Data on the highest urban density in major metropolitan areas of a geopolitical area were obtained from Demographia World Urban Areas[23] and complemented with data from the US Census.[24] We obtained data on remaining covariates from the World Bank.[25] Latitude, altitude, temperature and humidity were collected for the capital of each geopolitical area, and the remaining covariates at the level of the geopolitical area. For Ecuador, we collected data for the de facto capital, Guayaquil.[25] The Infectious Disease Vulnerability Index[16] was available only at country level; therefore, values of the home country were assigned to states, provinces and overseas territories. To make interpretation of the index more intuitive, we inverted it so that larger values indicate higher vulnerability to infectious diseases. All data were supplemented with publicly available information for overseas territories, states or provinces for the US, Australia and Canada, and — in cases where data were missing or implausible in the databases used — using the latest available information (Appendix 2, Table S1).

Statistical analysis

We used weighted random-effects regression[26] to determine the association between the log rate ratio of COVID-19 and exposure variables. Rate ratios were calculated as cumulative count of confirmed cases in a geopolitical area since the beginning of the epidemic as of Mar. 27, divided by the cumulative count of confirmed cases since the beginning of the epidemic as of Mar. 20 (Appendix 2, Figure S1). The observation time was identical across all areas. Because the populations in question were large, they could be considered equal at both time points and cancelled out in calculations of rate ratios. A rate ratio of 2 indicates that the number of cases in a geopolitical area doubled within 1 week. As the exposure period of Mar. 7 to Mar. 13 was near vernal equinox, no transformation was necessary to reflect the association of the log rate ratio of COVID-19 with the square of the latitude. Associations were expressed as ratios of rate ratios (RRRs) per 400 degrees^2 increase in latitude, 5°C increase in temperature, 10% increase in relative humidity, 5 g/m^3 increase in absolute humidity, and RRR comparing geopolitical areas with versus areas without implementation of school closures, restrictions of mass gatherings or measures of social distancing. The units of analysis were geopolitical areas; log rate ratios of COVID-19 (dependent variable) and exposure variables (independent variables) were defined at the level of geopolitical areas. An RRR less than 1 indicates that an increase in a continuous exposure variable or the presence of a public health intervention is associated with a decrease in epidemic growth, with an RRR of 0.60 corresponding to a 40% relative reduction in epidemic growth.

We determined associations of epidemic growth with exposure variables in univariate analyses, and in different multivariable models and analysis sets to determine robustness of associations as prespecified in the protocol (see Appendices 1 and 2). Then, we developed 2 parsimonious multivariable models. For Model 1, we first prioritized covariates on theoretical grounds and then used unsupervised cluster analysis for variable selection (Appendix 2, Table S2);[27] for Model 2, we used stepwise backward selection of covariates based on the adjusted R^2 statistic. We prespecified that Model 1 would take precedence over Model 2, as it would not be at risk of overfitting. Cluster analysis indicated clustering of the 3 public health interventions (Appendix 2, Figure S2). We therefore derived a post hoc composite of exposure to any of the 3 interventions. In addition, we prespecified to perform tests for trend according to the number of public health interventions implemented (0, 1, or 2 or more) under the assumption that the RRRs for the association of epidemic growth with school closures, restrictions of mass gatherings or measures of social distancing would have the same direction and a similar magnitude. We forced major geographical regions (Asia, Oceania, Europe, Africa, Americas) into both models to account for the geographic progression of the pandemic. Analyses were performed in Stata, Release 14 (StataCorp, College Station, TX) and R (R Foundation for Statistical Computing, Vienna, Austria).

Ethics approval

This study did not require research ethics approval, as publicly available, anonymized aggregate data were used for all analyses.

Table 1: Characteristics of analyzed geopolitical areas (*n* = 144)

Variables	Median or *n*	IQR or %
No. of cases	558	221–1419
Case count (per 1 000 000 inhabitants)	87.6	31.4–193.7
Rate ratio	3.56	2.41–4.66
Latitude (degrees)	38.4	21.8–44.6
Temperature (°C)	12.8	7.3–21.2
Relative humidity (%)	69.0	60.3–76.6
Absolute humidity (g/m^3)	7.1	5.2–10.8
Altitude (m)	82.5	16.0–274.0
Passenger flights (passengers/capita/yr)	2.3	1.0–4.7
Urban density (1000 inhabitants/km^2)	3.6	1.8–6.2
Population (1 000 000 inhabitants)	7.1	3.1–20.6
Percentage of inhabitants aged 65 yr or older	14.0	8.3–17.2
Life expectancy at birth, yr	79	76–81
GDP (1000 USD/inhabitant)	40.1	8.4–56.3
Health expenditure as percentage of GDP	9.2	6.3–13.5
Infectious Disease Vulnerability Index	0.87	0.64–0.92
Any public health intervention	*38*	26.4%
Restrictions of mass gatherings	*24*	16.7%
Social distancing	*10*	6.9%
School closures	*25*	17.4%
No. of public health interventions		
0	*106*	73.6%
1	*24*	16.7%
2 or 3	*14*	9.7%
Global region		
Asia	*30*	20.8%
Oceania	*6*	4.2%
Europe	*36*	25.0%
Africa	*10*	6.9%
Americas	*62*	43.1%
Closest distance to established epidemic (1000 km)	4.3	1.3–8.0

Note: GDP = gross domestic product, IQR = interquartile rage, USD = United States dollars.

Results

We included 144 geopolitical areas with 375 609 cases in our analyses (Appendix 2, Figure S3 and Table S3). The median COVID-19 case count per 1 million inhabitants for the 144 geopolitical areas was 87.6 (IQR 31.9–193.7); the median rate ratio representing epidemic growth was 3.56 (IQR 2.41–4.66, Table 1). Most geopolitical areas were in the northern hemisphere, near sea level, with temperate climates. The median temperature was 12.8°C (IQR 7.3–21.2), the median relative humidity was 69.0% (IQR 60.3–76.6) and the median absolute humidity was 7.1 g/m^3 (IQR 5.1–10.8). Temperature was strongly associated with the square of the latitude and, to a lesser extent, so was absolute humidity; relative humidity was not associated (Appendix 2, Figures S4–S6). In 38 geopolitical areas, at least 1 public health intervention had been implemented by Mar. 11, 2020, with 24 areas having 1 implemented (16.7%), and 14 areas having 2 or 3 interventions (9.7%); the remainder had no public health interventions in effect (73.6%). The implementation of public health interventions was correlated (Appendix 2, Figure S2). The median percentage of the population aged 65 years or older was 14.0%; the median life expectancy at birth was 79 years; on average, 9.2% of GDP was spent on health (IQR 6.3%–13.5%); and the median distance to the closest established epidemic was 4300 km (IQR 1300–8000; Table 1).

In univariate analyses (Figure 2), there was no association between epidemic growth and latitude (RRR per 400 degrees^2 increase 0.99, 95% CI 0.96–1.03, p = 0.72) or mean temperature (RRR per 5°C increase, 0.97, 95% CI 0.93–1.02). Conversely, there was a negative association with relative humidity (RRR per 10% increase 0.91, 95% CI 0.85–0.96) and with absolute humidity (RRR per 5 g/m^3 increase 0.92, 95% CI 0.85–0.99). In Appendix 2, Figures S7–S10 show bubble plots of the rate ratio of COVID-19 on a logarithmic scale against latitude, temperature and relative and absolute humidity.

The composite of any public health intervention (RRR 0.62, 95% CI 0.53–0.73) and its components, restrictions of mass gatherings (RRR 0.65, 95% CI 0.53–0.79), school closures (RRR 0.63, 95% CI 0.52–0.78) and measures of social distancing (RRR 0.62, 95% CI 0.45–0.85), all showed strong negative associations with epidemic growth during the follow-up period between Mar. 21 and Mar. 27 (Appendix 2, Figures S11–S13). The negative association was more pronounced in geopolitical areas that had 2 or 3 public health interventions compared with regions that had implemented 1 intervention (p for trend < 0.001; Figure 3). Epidemic growth varied by continent, health expenditure, Infectious Disease Vulnerability Index and distance to closest established epidemic.

In prespecified multivariable analyses and restricted analyses, associations with latitude and temperature remained nonsignificant (Appendix 2, Tables S4 and S5). The associations of epidemic growth with relative and absolute humidity attenuated and became mostly nonsignificant (Appendix 2, Tables S6 and S7). Negative associations with public health interventions all remained robust, except for measures of social distancing (Appendix 2, Tables S8–S12).

The main multivariable model (Figure 4) showed a weak, nonsignificant negative association of epidemic growth with absolute humidity (RRR per 5 g/m^3 0.92, 95% CI 0.84–1.00, p = 0.064), but a continued strong association with the number of public health interventions implemented (p value for trend = 0.001). A multivariable model based on stepwise backward selection (Appendix 2, Figure S14) showed a weak negative association with absolute humidity (RRR per 5 g/m^3 0.87, 95% CI 0.77–0.99) and a strong negative association with the number of implemented public health interventions (p for trend = 0.004), and additionally suggested a negative association of epidemic

	RRR	*p* value
Latitude (per 400 degrees^2)	0.99 (0.96–1.03)	0.72
Temperature (per 5°C)	0.97 (0.93–1.02)	0.21
Relative humidity (per 10%)	0.91 (0.85–0.96)	0.002
Absolute humidity (per 5g/m^3)	0.92 (0.85–0.99)	0.024
Altitude (per 100 m)	1.01 (1.00–1.03)	0.088
Passenger flights (per 1 passenger/capita/yr)	0.99 (0.96–1.01)	0.25
Urban density (per 5000 inhabitants/km^2)	0.98 (0.91–1.06)	0.63
Percentage of inhabitants aged 65 yr or older (per 5%)	1.04 (0.97–1.12)	0.23
Life expectancy at birth (per 5 yr)	0.96 (0.88–1.05)	0.40
GDP (per 20 000 USD/inhabitant)	1.04 (0.98–1.10)	0.17
Health expenditure as percentage of GDP (per 5%)	1.26 (1.16–1.37)	< 0.001
Infectious Disease Vulnerability Index (per 0.1)	0.95 (0.91–0.99)	0.018
Any public health intervention	0.62 (0.53–0.73)	< 0.001
Restriction of mass gatherings	0.65 (0.53–0.79)	< 0.001
School closures	0.63 (0.52–0.78)	< 0.001
Social distancing	0.62 (0.45–0.85)	0.003
Number of public health interventions		< 0.001
1 intervention	0.67 (0.55–0.82)	
2 or 3 interventions	0.54 (0.42–0.70)	
Major geographical regions		< 0.001
Oceania	1.88 (1.31–2.70)	
Europe	1.13 (0.93–1.38)	
Africa	1.68 (1.24–2.28)	
Americas	1.92 (1.60–2.31)	
Closest distance to established epidemic (per 1000 km)	1.07 (1.05–1.10)	< 0.001

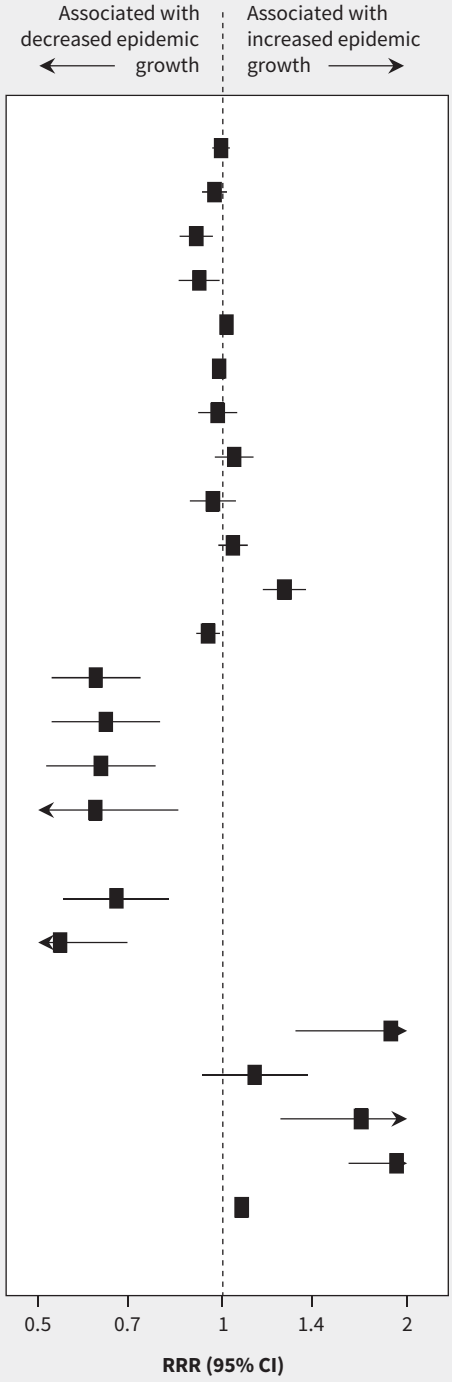

Figure 2: Caterpillar plot presenting results of univariate analyses. Shown are ratios of rate ratios (RRRs) with 95% confidence intervals (CI) and 2-sided *p* values. The *p* value for number of public health interventions is a *p* value for trend. Reference categories are no public health intervention for number of public health interventions, and Asia for major geographical regions. An RRR of 0.62, for example, indicates a 38% relative reduction in epidemic growth. Note: GDP = gross domestic product.

growth with increased life expectancy at birth, and residual variation by continent. Post hoc analyses based on a different metric to estimate epidemic growth showed more pronounced reductions with public health interventions (Appendix 2, Tables S13 and S14).

Interpretation

In this prospective cohort study of 144 geopolitical areas with 375 609 confirmed cases of COVID-19, epidemic growth of COVID-19 during the follow-up period from Mar. 21 to Mar. 27, 2020, was not

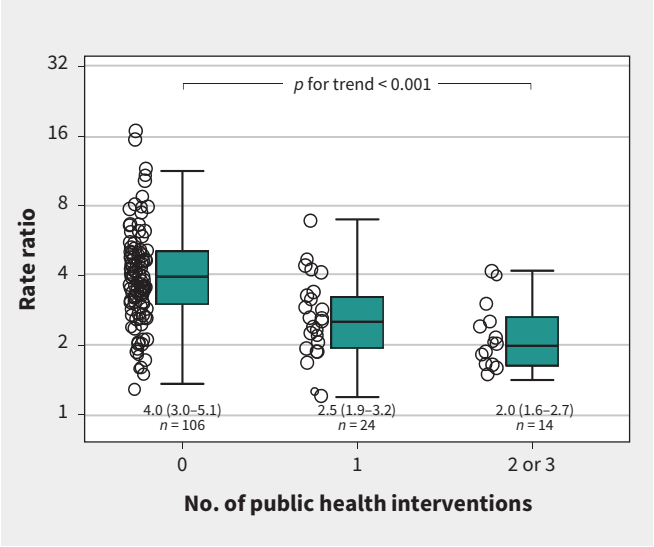

Figure 3: Bubble plot of epidemic growth against the number of public health interventions (0, 1, or 2 or more). Each bubble represents a geopolitical area, with the size of the bubble proportional to the weight of the geopolitical area in weighted random-effects regression with inverse-variance weights. Box and whisker plots: the box represents median and interquartile range; whiskers the most extreme values within 1.5 times of the interquartile range beyond the 25th and 75th percentile. The *p* value for trend is from univariate weighted random-effects regression (see Figure 2). A rate ratio of 2, for example, indicates that the cumulative case count in a geopolitical area doubled within 1 week; a rate ratio of 3 indicates that it tripled.

associated with geographic latitude, nor with temperature during the exposure period 14 days before, when SARS-CoV-2 transmission was assumed to have occurred. We found associations with relative and absolute humidity, but these were attenuated in multivariable models. The associations of epidemic growth with both dimensions of humidity, despite their low mutual correlation,[28] were suggestive of a minor role of humidity in the epidemiology of COVID-19, but this remains hypothetical. On the other hand, it is of considerable importance that we found strong negative associations with 3 public health interventions commonly used to contain the COVID-19 pandemic: restrictions of mass gatherings, school closures and measures of social distancing. Even though we were unable to reliably quantify the independent contribution of the 3 interventions, our results are of immediate relevance, as many countries currently consider the removal of some of the implemented public health interventions.

Our results are concordant with 3 studies from China,[29–31] which reported no evidence for an association of epidemic growth with temperature and relative humidity,[29] but strong decreases in epidemic growth associated with public health measures.[30,31] A recent rapid systematic review concluded that the evidence to support national closure of schools to combat COVID-19 is very weak and that data from influenza outbreaks suggest that school closures could have relatively small effects on SARS-CoV-2 owing to its high transmissibility and apparent low clinical effect on school children.[32] Our results suggest that school closures are likely to have a larger effect than suggested in this review, but the clustering of school closures with other public health interventions means that we were unable to reliably estimate the independent effect of this intervention on the COVID-19 pandemic. The effect of restrictions of mass gathering, measures of social distancing and school closures on viral transmission is understudied.[32–34] However, mathematical models and limited observational evidence suggest that they can interrupt disease transmissions. Our study provides evidence using global data from the COVID-19 pandemic, that these interventions are strongly associated with reduced epidemic growth.

Limitations

Our study has a number of important limitations. First, because of considerable differences in testing practices between different geopolitical areas, actual rates of COVID-19 could not be reliably estimated. We assumed, however, that rate ratios as measures of epidemic growth could be reliably estimated, as testing practices would affect both counts used to calculate the rate ratio in the same way during the ascertained 1-week follow-up period. We were unable to identify reliable information on the number of SARS-CoV-2 tests per million inhabitants, and on different testing strategies, and therefore could not directly verify this assumption. Health expenditure as percent of GDP and Infectious Disease Vulnerability Index[16] may be associated to some extent with a health care system's capacity to test and could serve as imperfect surrogates. They were indeed both associated with epidemic growth in the univariate analysis, but the main multivariable model did not suggest an association with health expenditure. In addition, the random effects used in the regression model implicitly accounted for residual variation in characteristics of geopolitical areas that remained unexplained, including variation in testing strategies. Second, we assumed that SARS-CoV-2 testing strategies did not vary during the follow-up period. Testing capacity was limited globally in March 2020 and was unlikely to change rapidly during the follow-up period in most geopolitical areas. In addition, we believe that the time window of 1 week was short enough so that reported confirmed cases in each geopolitical area were likely to represent a constant percentage of the true actual cases.

Third, only 38 geopolitical areas had implemented public health interventions by the cut-off date of Mar. 11, 2020, and the implementation of interventions was clustered. We therefore refrained from exploring the individual contributions and potential interactions between these interventions in multivariable models and merely constructed a binary composite variable, and a variable representing the number of interventions implemented. This means that we were unable to reliably estimate the individual contributions of the 3 public health interventions that we analyzed. We therefore consider the magnitude of the association of epidemic growth with the composite of any public health intervention and the linear trend of the association with the number of public health interventions more reliable and relevant for decision-making than the magnitude of associations of epidemic growth with the 3 public health interventions individually. Fourth, there was variation in measures of social

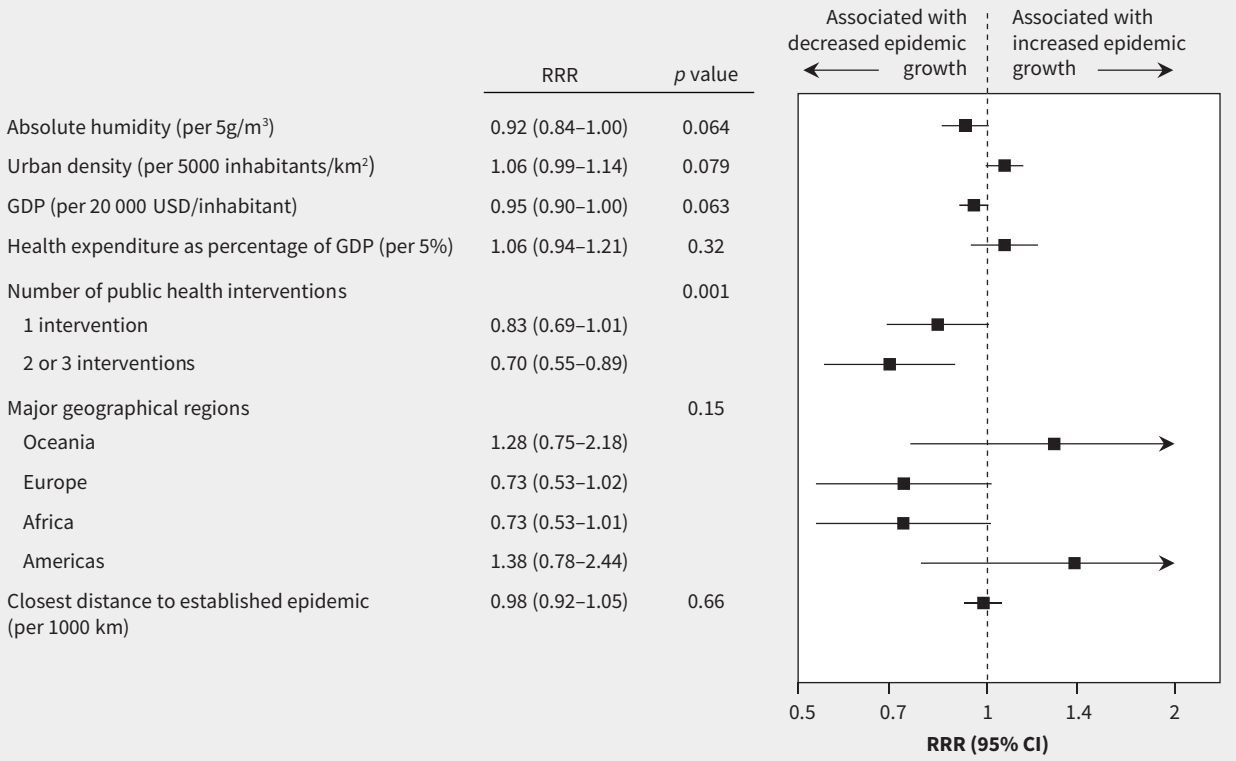

Figure 4: Caterpillar plot presenting results of the main parsimonious multivariable model. Shown are ratios of rate ratios (RRRs) with 95% confidence intervals (CIs) and 2-sided *p* values. The variables presented are those included in the parsimonious model. The *p* value for number of public health interventions is a *p* value for trend. Reference categories are no public health intervention for number of public health interventions, and Asia for major geographical regions. An RRR of 0.70, for example, indicates a 30% relative reduction in epidemic growth. Note: GDP = gross domestic product.

distancing reported by different geopolitical areas, including recommendations or requirements regarding social distancing, closure of sit-in restaurants and bars, or closure of nongrocery stores, and the derived average association will not shed light on the specific components of social distancing. Fifth, we analyzed only when restrictions of mass gathering were instituted, irrespective of the size of mass gatherings that were restricted. Sixth, we were unable to quantify compliance of the population with social distancing and restrictions of mass gatherings. Conversely, even though there may be local variations in strategies to implement school closures, we consider a high adherence to this intervention likely.

Seventh, data on latitude, temperature and humidity were collected for the capital of each geopolitical area, which may not have accurately represented area-wide climate patterns. The limited granularity of the available data may therefore have resulted in nondifferential misclassification of exposure, which in turn may have biased estimates of associations toward the null (see Appendix 2, Tables S15–S23 and Figure S15 for details on risks of bias for individual exposure variables). The association between relative and absolute humidity and epidemic growth was suggestive but not consistent. Even if humidity proves important in the epidemiology of COVID-19 in the future, seasonal effects will likely be attenuated by the high levels of susceptibility associated with pandemic diseases.[35]

Conclusion

Epidemic growth of COVID-19 was not associated with geographic latitude, nor with temperature during the exposure period, in our global analysis. Only area-wide public health interventions were consistently associated with reduced epidemic growth, and the greater the number of co-occurring public health interventions, the larger the reduction in growth. Taken together, these findings suggest that seasonality is likely to play only a minor role in the epidemiology of COVID-19, while public health interventions (school closures, restricting mass gatherings, social distancing) appear to have a major impact. The important effect of public health interventions needs to be weighed carefully against potential economic and psychosocial harms when deciding when and how to lift restrictions.

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Data sharing: The authors welcome proposals for joint use of the study data. Proposals for joint use of the study data should be sent to the corresponding author (peter.juni@utoronto.ca). Data will be made available with investigator support, with a signed data access agreement, after approval of a proposal by the investigators of the study.

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This is **Exhibit "F"** to the
Affidavit of David Fisman,
affirmed before me by videoconference
July 21, 2020

A Commissioner, etc.

RESEARCH HEALTH SERVICES

Mathematical modelling of COVID-19 transmission and mitigation strategies in the population of Ontario, Canada

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ABSTRACT

BACKGROUND: Physical-distancing interventions are being used in Canada to slow the spread of severe acute respiratory syndrome coronavirus 2, but it is not clear how effective they will be. We evaluated how different nonpharmaceutical interventions could be used to control the coronavirus disease 2019 (COVID-19) pandemic and reduce the burden on the health care system.

METHODS: We used an age-structured compartmental model of COVID-19 transmission in the population of Ontario, Canada. We compared a base case with limited testing, isolation and quarantine to scenarios with the following: enhanced case finding, restrictive physical-distancing measures, or a combination of enhanced case finding and less restrictive physical distancing. Interventions were either implemented for fixed durations or dynamically cycled on and off, based on projected occupancy of intensive care unit (ICU) beds. We present medians and credible intervals from 100 replicates per scenario using a 2-year time horizon.

RESULTS: We estimated that 56% (95% credible interval 42%–63%) of the Ontario population would be infected over the course of the epidemic in the base case. At the epidemic peak, we projected 107 000 (95% credible interval 60 760–149 000) cases in hospital (non-ICU) and 55 500 (95% credible interval 32 700–75 200) cases in ICU. For fixed-duration scenarios, all interventions were projected to delay and reduce the height of the epidemic peak relative to the base case, with restrictive physical distancing estimated to have the greatest effect. Longer duration interventions were more effective. Dynamic interventions were projected to reduce the proportion of the population infected at the end of the 2-year period and could reduce the median number of cases in ICU below current estimates of Ontario's ICU capacity.

INTERPRETATION: Without substantial physical distancing or a combination of moderate physical distancing with enhanced case finding, we project that ICU resources would be overwhelmed. Dynamic physical distancing could maintain health-system capacity and also allow periodic psychological and economic respite for populations.

The coronavirus disease 2019 (COVID-19) pandemic represents a global public health emergency unparalleled in recent time. In the 2 months since the initial World Health Organization report describing the COVID-19 outbreak concentrated in Wuhan, China,[1] the number of confirmed cases has risen sharply from 282 to more than 330 000, with 14 510 reported deaths across all regions of the globe.[2] The first imported case of COVID-19 in Ontario, Canada, was reported on Jan. 25, 2020, and community transmission was first documented on Mar. 1, 2020, in British Columbia, Canada.[3]

This pathogen represents a substantial challenge for public health, pandemic planning and health care systems. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is highly transmissible.[4–7] It causes moderate to severe clinical outcomes in about 20% of all recognized infected individuals.[5,8,9] In the absence of a vaccine, public health responses have focused on the use of nonpharmaceutical interventions.[10] These nonpharmaceutical interventions include "case-based" measures such as testing, contact tracing, isolation (of infected cases) and quarantine (of exposed cases); and "non-case-based" measures such as reducing the probability of transmission given an effective contact (e.g., hand hygiene and cough etiquette) and physical-distancing measures to reduce the contact rate in the population. Physical distancing minimizes opportunities for

person-to-person transmission of the virus to occur. These physical-distancing measures include some combination of school closure, teleworking, cancellation of group activities and events, and a general overall reduction in community contacts. Although these measures are expected to be effective in reducing transmission of SARS-CoV-2, they are also associated with substantial economic costs and societal disruption.

Epidemiologic models can contribute important insight for public health decision-makers by allowing for the examination of a variety of "what-if" scenarios. The Canadian Pandemic Influenza Plan for the Health Sector (the backbone of which informs COVID-19 pandemic preparedness and response) identifies 2 main objectives for responding to a pandemic: to minimize serious morbidity and mortality, and to minimize societal disruption.[11] The overarching goal of pandemic response is to find a combination of nonpharmaceutical interventions that would minimize the number of cases requiring in-patient medical care (e.g., hospital and intensive care unit [ICU] admissions) and deaths, while also minimizing the level of societal disruption. Societal disruption could be reduced by limiting the overall duration that the intervention needs to be in force to achieve the associated reductions in morbidity and mortality. A challenge for pandemic response is that, in a fully susceptible population, although nonpharmaceutical interventions may slow disease transmission while they are in place, once the intervention is lifted (or compliance with the intervention becomes low), the transmission of the pathogen rebounds rapidly.[10,12] In the case of COVID-19, it may not be possible to minimize morbidity and mortality, and societal and economic disruption at the same time.

Given these considerations, we used a transmission dynamic model of COVID-19 to explore the potential impact of case-based and non-case-based nonpharmaceutical interventions in the population of Ontario, Canada. Our analysis focuses on identifying strategies that keep the number of projected severe cases (hospital and ICU admissions) within a range that would not overwhelm the Ontario health care system, while also considering the amount of time these interventions would be in place.

Methods

Model overview

We developed an age-structured compartmental model that describes COVID-19 transmission in the province of Ontario, Canada. We used a modified "susceptible-exposed-infectious-recovered" framework that incorporated additional compartments to account for public health interventions, different severities of clinical symptoms and risk of hospital admission. An overview of the model compartments and movements between them is provided in Figure 1, and model equations and additional details are provided in Appendix 1, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.200476/-/DC1. The model was run for a period of 2 years, and we assumed that recovered individuals remained immune from re-infection for the duration of the epidemic. Individuals remained infectious until they recovered or were admitted to hospital; we did not model transmission within health care settings. For simplicity, we assumed that all deaths occurred in cases requiring intensive care. We included cases in hospital (non-ICU) and requiring intensive care to estimate health care requirements over the course of the epidemic. The model was constructed in R.[13]

Model parameters

The model was stratified by 5-year age groups using 2019 population estimates.[14] Contacts within and between age groups were based on the POLYMOD study,[15] using contact data specific for the United Kingdom. The model was further stratified by health status to account for differential vulnerability to severe infection among those with underlying health conditions. We obtained comorbidity estimates by age from the Canadian Community Health Survey (CCHS)[16] for Ontario and included the following conditions: hypertension, heart disease, asthma, stroke, diabetes and cancer. For younger age groups (< 12 yr), we used estimates from Moran and colleagues.[17] A limitation of the CCHS is that it may undersample individuals from socioeconomically disadvantaged populations.

Parameters describing the natural history and clinical course of infection were derived from published studies (Table 1, full details in Appendix 1). The rate of growth of epidemics is governed by reproduction numbers, or the number of secondary infections caused by a primary infectious case. For a pandemic disease, in which prior immunity is absent, the operative reproduction number is referred to as the basic reproduction number (R_0).[23] To capture variability in transmission, specifically the observation that the basic reproduction number for COVID-19 is overdispersed, with some cases transmitting to many others (superspreader events), while many other cases transmit much less, we have added volatility to the transmission term.[24–26] This causes each model run to have a different outcome owing to stochasticity (i.e., random variation between model runs). The model was initiated with 750 prevalent cases (based on 150 reported cases in Ontario on Mar. 19, 2020, and an assumed reporting rate of 20%), that were randomly distributed across the infectious compartments.

Interventions

Testing was assumed to move individuals with nonsevere symptoms from the infectious to isolated compartments. Isolated cases were assumed to have reduced transmission compared with nonisolated cases. Physical-distancing measures were assumed to reduce the number of contacts per day across the entire population. Details of parameters that were varied under different interventions are included in Table 2. For the base case, we assumed that there was a degree of testing and isolation occurring and that a proportion of exposed cases were quarantined. We then added in additional control measures: (i) enhanced testing and contact tracing; (ii) restrictive physical-distancing measures; and (iii) a combination of enhanced testing and contract tracing, along with less restrictive physical distancing than in (ii). We considered 2 approaches to implementing interventions: (i) fixed durations and (ii) a dynamic approach with interventions turned on and off based on the number of

cases requiring ICU care in the population. When interventions were not implemented, values for physical distancing and enhanced testing and contact tracing returned to base case levels. We focused on ICU capacity, given that this is expected to be the most limited resource during the COVID-19 epidemic. Before the emergence of COVID-19, Ontario had about 2000 ICU beds (0.14 beds per 1000 population), but 90% were occupied by individuals with non-COVID-19 illness. In mid-March 2020, the Ontario government made 300 additional ventilator-associated ICU beds available (for a total of 500 unoccupied beds (0.034 per 1000 population). As such, we used 200 COVID-19 cases in the ICU (across all of Ontario [0.014 per 1000]) as a threshold for turning the intervention on. This value was based on about 40% saturation of available beds, combined with the recognition that there is a lag between cases acquiring infection and requiring intensive care, such that one would expect ICU needs to grow rapidly once initial COVID-19 cases present for care.

Outputs

Key model outputs included final epidemic attack rates (% of population infected at the end of the 2-year period), prevalence of hospital admissions and ICU use, and deaths. For comparison, we show the maximum and current ICU capacity per 1000 population relative to model projections. For the dynamic-intervention scenarios, we also calculated the amount of time over the 2-year model period during which the intervention was implemented, as a measure of intervention intensity. We present model outputs as medians and credible intervals from 100 model replicates per intervention; 95% credible intervals represent the range of outcomes from the 2.5th to 97.5th percentiles, across all model replicates.

Ethics approval

Because this study involved the use of publicly available aggregate data, approval by a research ethics board was not required.

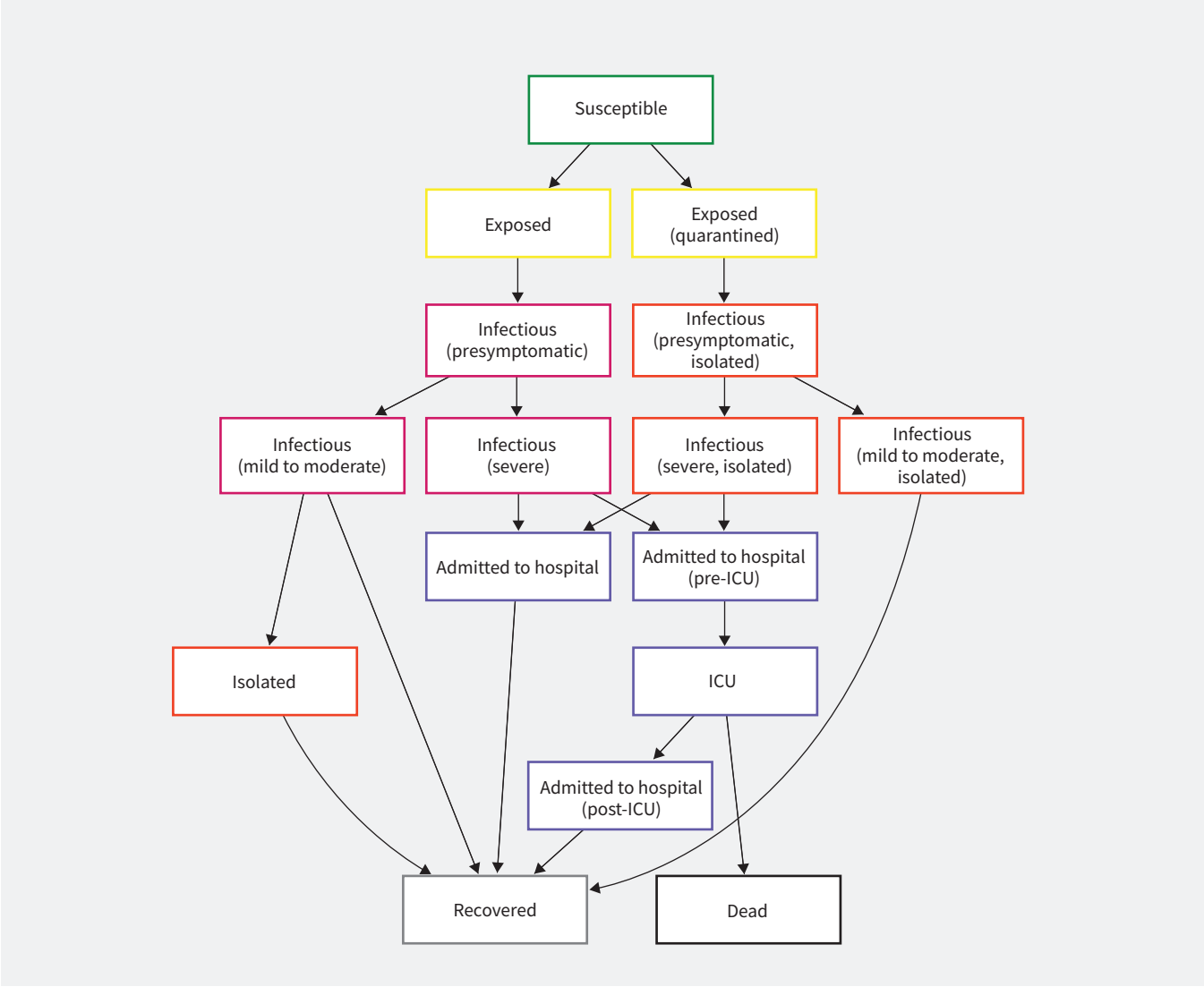

Figure 1: Model structure of COVID-19 transmission. Exposed cases can be either quarantined or not; quarantined cases would represent those who were identified via contact tracing. Cases admitted to hospital are assumed to be no longer infectious to others (owing to recognition of infection) and are included in the model to estimate health care requirements. The model is stratified by age group and presence or absence of comorbidities. Note: ICU = intensive care unit.

Table 1: Model parameters used in the transmission model*

Parameter	Age group, yr	Health status	Value	Details	Source
Latent period, d	All	All	2.5	Time from exposure to onset of infectiousness	References 18–20
Presymptomatic infectious period, d	All	All	1	Duration of infectiousness before symptom onset	References 18–20
Infectious period (mild to moderate), d	All	All	6	Symptomatic infectious period for mild-to-moderate cases (in absence of isolation)	References 18–20
Infectious period (severe), d	All	All	6	Symptomatic infectious period for infectiousness for severe cases; assumed equal to time to hospital admission	References 18–20
Basic reproduction number	All	All	2.3	Average number of secondary infections derived from a primary infection in a susceptible population	Reference 6
Time in quarantine, d	All	All	14	Duration of quarantine for exposed cases	Current policy
Relative risk of transmission for cases in isolation	All	All	0.1	Isolated cases are assumed to have reduced transmission relative to unrecognized cases	Assumption
Average length of stay in hospital for cases not requiring ICU care, d	All	All	10		Reference 21
Average length of stay in hospital before ICU admission, d	All	All	3	For severe cases requiring ICU care	Reference 21
Average length of stay in ICU, d	All	All	21	For severe cases requiring ICU care	Reference 22
Average length of stay in hospital after ICU, d	All	All	21	For severe cases requiring ICU care	Reference 22
Probability of severe infection				Severe infections requiring hospital admission	Reference 21
	< 15	No comorbidities	0.01		
	15–49	No comorbidities	0.03		
	50–69	No comorbidities	0.12		
	≥ 70	No comorbidities	0.35		
	< 15	Comorbidities	0.02		
	15–49	Comorbidities	0.06		
	50–69	Comorbidities	0.25		
	≥ 70	Comorbidities	0.76		
Probability severe case requires admission to ICU	All	All	0.26		Reference 21
Probability of death in cases admitted to ICU					Reference 22
	< 15	No comorbidities	0		
	15–49	No comorbidities	0.2		
	50–69	No comorbidities	0.36		
	≥ 70	No comorbidities	0.58		
	< 15	Comorbidities	0		
	15–49	Comorbidities	0.53		
	50–69	Comorbidities	0.9		
	≥ 70	Comorbidities	1		

Note: ICU = intensive care unit.
*A full model description is provided in Appendix 1 (available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.200476/-/DC1). Age group and health status refer to the population groups to which the parameter value was applied.

Table 2: Details of model scenarios*

Parameter	Age group, yr	Scenario			
		Base case	Enhanced case detection	Physical distancing	Enhanced detection with limited physical distancing (combination)
Nonquarantined cases tested and isolated, %	< 15	10	40	10	40
	15 – 49	40	60	40	60
	≥ 50	70	80	70	80
Exposed cases in quarantine before infectious, %	All	10	30	10	30
Reduction in contacts with physical distancing, %	All	0	0	60	25

*For each scenario, the model parameters that were varied are provided above. All other parameters were as described in Table 1. When the interventions were turned off, parameter values returned to base case values.

Results

Base case

In the model base case, with limited testing, isolation and quarantine, we estimated that 56% (95% credible interval 42%–63%) of the Ontario population would be infected over the course of the epidemic. This would include cases of all severities. Attack rates were projected to be highest in those aged 5–14 years (77%, 95% credible interval 63%–83%) and 15–49 years (63%, 95% credible interval 48%–71%). Lower attack rates were projected in individuals aged younger than 5 years (50%, 95% credible interval 37%–58%) and adults aged 50–69 years (47%, 95% credible interval 34%–55%) and 70 years and older (30%, 95% credible interval 21%–36%). An example of the outbreak trajectory across model simulations is presented in Figure 2. At the peak of the epidemic, in the absence of any resource constraints to provide care (i.e., assuming all cases requiring medical care receive it), we projected 107 000 (95% credible interval 60 760–149 000) cases in hospital (non-ICU) and 55 500 (95% credible interval 32 700–75 200) cases in ICU. The high prevalence of cases in ICU reflects the mean length of ICU stay associated with COVID-19 infection in other countries.

Fixed-duration interventions

All of the interventions considered were projected to delay the epidemic peak and reduce the number of cases requiring ICU care at the peak (Figure 3). The effectiveness of the interventions scaled with intervention duration. For all interventions, when the intervention duration was 6 months or less, there was no appreciable difference on final attack rate. With 12 and 18 months of heightened response measures, the proportion of the population infected at the end of the 2-year period was reduced, and, in some simulations, the prevalence of cases requiring intensive care fell below Ontario's current capacity for all or part of the period. The largest effect was observed for the restrictive physical-distancing intervention. The combination intervention, with enhanced case detection and less aggressive physical distancing, was projected to substantially reduce attack rates when implemented for 18 months, while enhanced case detection in the absence of physical-distancing measures had a more modest effect, on average. There was substantial variability in model projections, owing to model stochasticity.

Dynamic interventions

We also explored dynamic interventions that were turned on and off in response to the current state of the epidemic. Dynamic interventions were projected to be effective for reducing the proportion of the population infected at the end of the 2-year period, with potentially shorter durations of physical distancing than the fixed-duration approach (Figure 4). For example, when implemented dynamically, 13 months of physical distancing, cycled on and off, reduced the median overall attack rate to 2%. For the physical distancing alone and combination intervention scenarios, we observed atypical epidemic curves, with the number of cases increasing and decreasing repeatedly over time. In these scenarios, the median number of cases in ICU was reduced below current estimates of Ontario's ICU capacity.

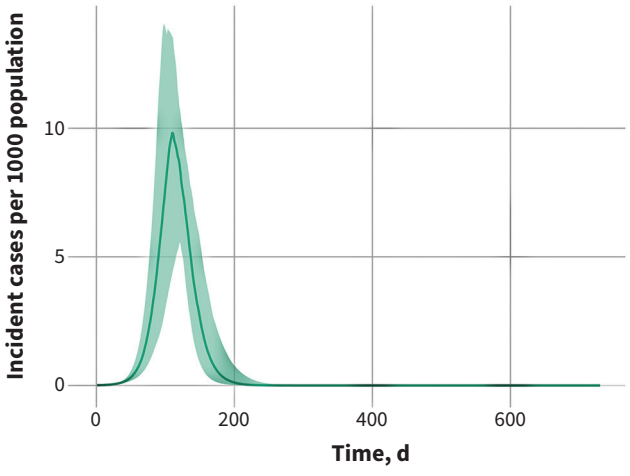

Figure 2: Projected COVID-19 epidemic trajectory for the base case model with minimal intervention. Daily incident cases per 1000 population are presented. The line represents the median value of 100 model simulations, and the shaded area indicates the 95% credible interval.

Interpretation

COVID-19 poses an extraordinary challenge to societies. Whereas severe illness, particularly in older individuals, is frequent enough to overwhelm a society's ICU capacity,[27] mild unrecognized illness (particularly in younger individuals) contributes to spread,[28] and outbreaks may be recognized only when superspreader events occur,[25] often in settings like health care facilities.[26] In contrast to severe acute respiratory syndrome (SARS),[29] the high frequency of mild cases means that strategies that focus on case identification and isolation alone are likely to fail to prevent epidemic spread and overburdening of our health care system.[26] As such, population-level interventions, with their attendant economic costs, have been used to prevent health systems from collapsing.[30] Although events in China, Singapore, Hong Kong and elsewhere have shown that COVID-19 epidemics can be contained,[30–33] the seeding of epidemics in countries around the globe, many with weak health systems,[34] means that reintroduction of COVID-19 will continue to occur for some time. As successful containment efforts maintain a large number of susceptible individuals in populations, vulnerability to repeated epidemics is likely to persist until a COVID-19 vaccine is developed and manufactured at scale, or until large fractions of the population are infected and either die or develop immunity.[35]

Control strategies for COVID-19 thus need to balance competing risks: the risks of mortality and health system collapse, on the one hand, against economic risks and attendant hardships (and health consequences) on the other. In this work, we evaluated plausible strategies for attenuating the COVID-19 epidemic in Ontario, Canada. We focused on ICU resources for 2 reasons: first, because this component of most health systems represents a scarce resource prone to being saturated; and second, because such saturation results in

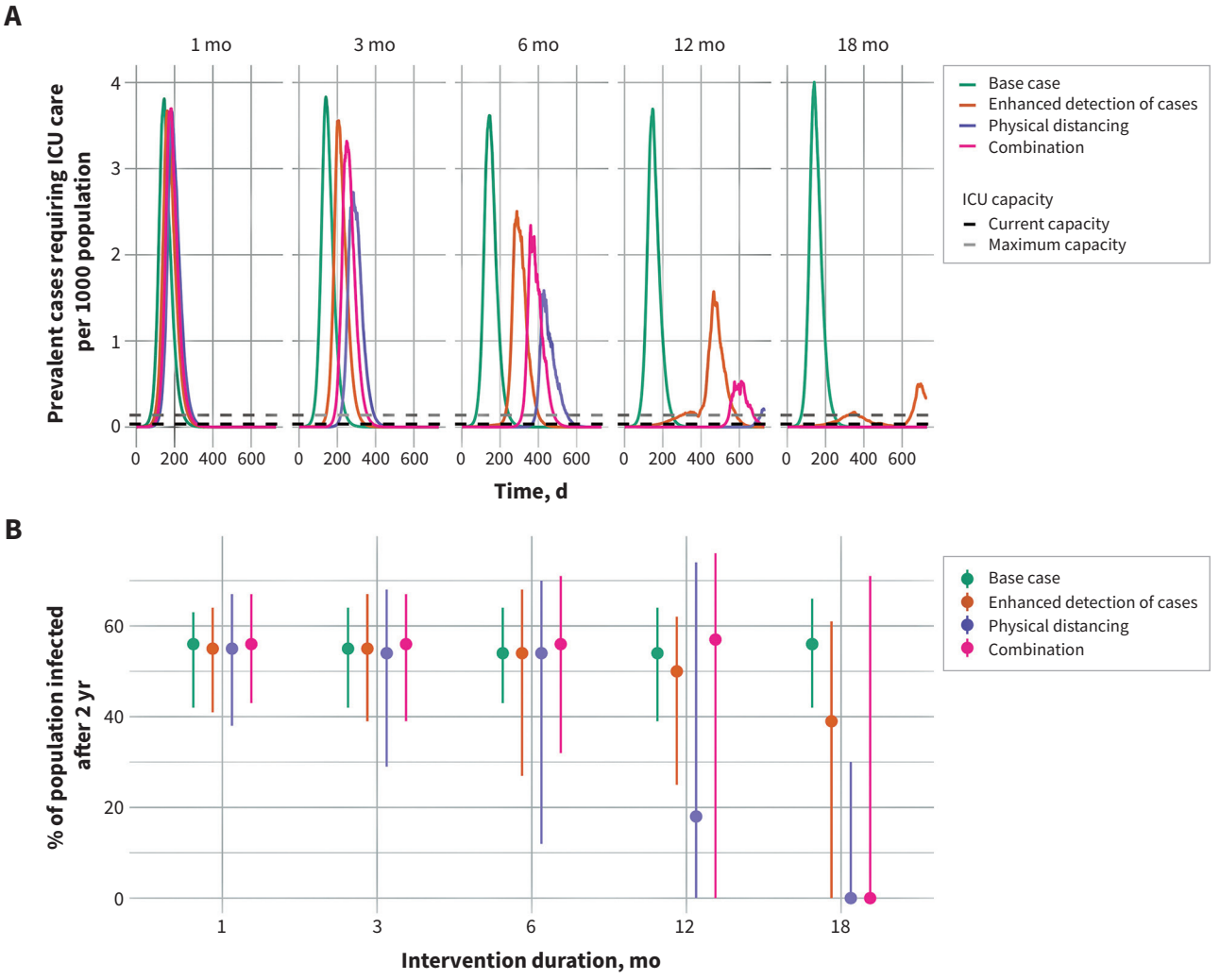

Figure 3: Projected intensive care unit (ICU) bed requirements and attack rates for fixed-duration interventions. (A) Prevalent cases requiring intensive care are shown for intervention durations of 1, 3, 6, 12 and 18 months. Maximum and current ICU capacity in Ontario are indicated by the dashed horizontal lines. Median values are presented. (B) Model-projected percentage of the population infected over the 2-year period. Attack rates include all infections, regardless of severity. Note that the slight variability in epidemic size for the base case (with no additional intervention) reflects model stochasticity across simulations. More extreme durations of physical distancing create the possibility of stochastic extinction ("die out") of the disease.

abrupt surges in case-fatality, as individuals with acute respiratory distress syndrome will die quickly without the capacity for mechanical ventilation. In broad terms, we find that prolonged physical distancing is the preferred strategy for maintaining ICU resources, but an extreme fixed duration of physical distancing is required to prevent the epidemic from overwhelming ICU capacity. That said, physical distancing, even without reducing overall outbreak size, has the added benefit of delaying the epidemic peak, which gains time that can be used to build health system capacity and identify therapies and vaccines. However, societies remain vulnerable to resurgences as long as a critical fraction of the population remains susceptible to disease (that fraction can be approximated as $1/R_0$). Evaluating how that vulnerability changes over time will require seroepidemiologic studies, which have not yet been performed in Canada.

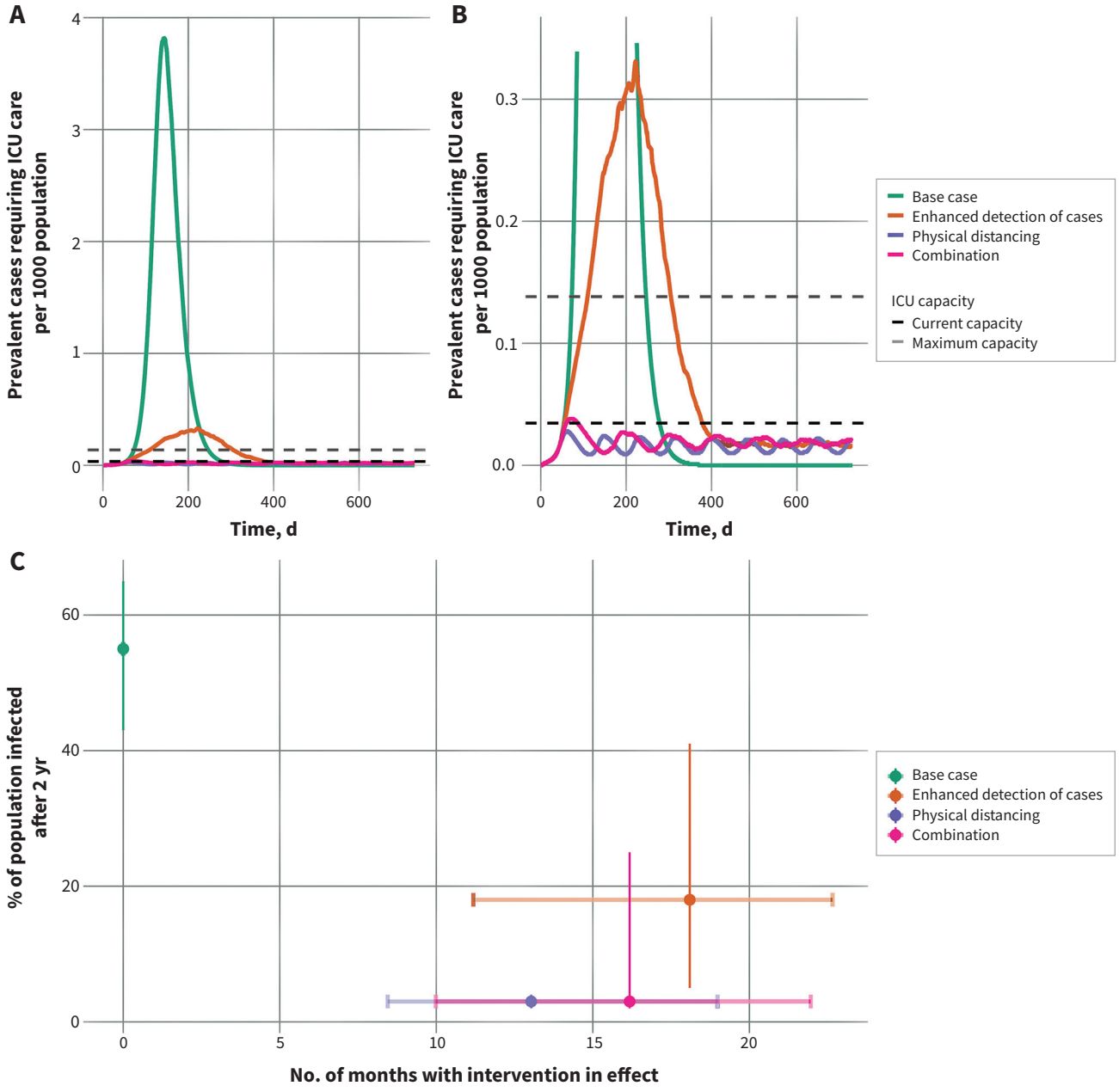

Figure 4: Projected intensive care unit (ICU) bed requirements and attack rates for dynamic interventions. (A) Prevalent cases requiring intensive care are shown for the base case and 3 intervention scenarios. Interventions are turned on and off (returning to base-case parameter values), depending on the number of COVID-19 cases in the ICU. Maximum and current ICU capacity in Ontario are indicated by the dashed horizontal lines. Median values are presented. (B) Zoomed view of prevalent ICU cases to show the dynamics for the enhanced physical-distancing and combination scenarios. (C) Model-projected estimates of percent of the population infected over the 2-year period. Attack rates include all incident infections, regardless of severity. The amount of time the dynamic interventions are in place is shown on the x-axis. Points indicate the median duration and lines the 95% credible intervals for each scenario.

In contrast to fixed-duration physical distancing, we find that dynamic physical distancing, with interventions turned on and off as needed, based on ICU capacity crossing a given threshold, represents a more effective, and likely more palatable, control strategy. Physical distancing can be relaxed, but this inevitably results in resurgent disease in the population, requiring reinstatement. Nonetheless, dynamic physical distancing is projected to maintain ICU capacity, and dramatically reduces overall attack rates, while requiring less total physical distancing time than would be required by a fixed-duration strategy of comparable effectiveness. This may be counterintuitive; however, an important insight from our model is that dynamic interventions can be reactivated when resurgent outbreaks are still relatively small, leading to the high potency of such interventions.

Furthermore, dynamic physical distancing has the potential to allow populations, and the economy, to "come up for air" at intervals, which may make this strategy more sustainable. We also found that a combination approach, with less restrictive physical distancing along with enhanced testing, case isolation and quarantine, could have a similar effect in the dynamic scenario as more restrictive physical distancing alone. It is plausible that, as testing capacity increases, a combination approach that is less reliant on physical distancing will strike the right balance between disease control and societal disruption.[36]

Calibration to actual physical-distancing data is possible[37] and is an area for future research. However, in broad terms, less restrictive physical-distancing regimes may be characterized by voluntariness and allowance of small gatherings, whereas more restrictive regimes include "lockdowns," with individuals confined to home and facing legal sanction for emerging without legitimate reasons for doing so.[38] Moving forward, any such disease-control regimes need to be coupled with improved surveillance systems, which permit needed adjustments in response to data.

Limitations

At the time of writing, well-documented limitations in testing capacity in Ontario,[39] and a lack of information on ICU occupancy by COVID-19 patients, made it challenging to know where on the epidemic curve we currently find ourselves. The challenges in both scope of testing and pace of testing[39] make case counts a poor metric of underlying disease activity. Acquisition of ICU occupancy data from the province has proved challenging, though needed metrics have recently become available from investigative reports.[40] Importantly, we do not include within-hospital transmission cycles in this iteration of our model. Transmission in health care settings has the potential to quickly and dramatically reduce ICU capacity, by removing trained nurses, physicians and respiratory therapists from active duty, and by rapidly filling ICUs with new patients (health care workers, and patients admitted for other reasons with nosocomial COVID-19 infection).

Any model involves trade-offs between simplicity and realism, and in this work we have not attempted to model physical-distancing measures in a highly realistic way, but rather generically as reductions in contact frequency. Our understanding of the natural history of SARS-CoV-2 infection continues to evolve, and the precise role of presymptomatic and subclinical transmission is uncertain. Physical distancing becomes a more important control measure in the face of incomplete case ascertainment owing to asymptomatic or mildly symptomatic cases.

We do not offer precise policy prescriptions in terms of how the reductions associated with physical distancing that we model here are to be achieved, and we do not regard this model as a realistic recreation of current events in Ontario. As such our model is best interpreted qualitatively, rather than quantitatively.

The model does not include seasonality; it is possible that transmission will attenuate in the summer,[41] resulting in a decline in cases that would be expected to resurge with the return of colder weather. Although our model's several limitations are a source of uncertainty, nonetheless, the qualitative insights around the role of physical distancing, the relatively long intervention durations required to bend the epidemic curve, and the potential use of cyclic interventions can be used by policy-makers and decision-makers, along with emerging empirical evidence from other countries, to consider the best approaches for epidemic control over the coming months.

Lastly, we have not modelled the fact that abrupt surges in death resulting from full ICUs would result in lower demands for ICU beds. Our goal here is to inform policy so that such outcomes are avoided to the extent possible.

Conclusion

We have modelled plausible contours of the COVID-19 epidemic in Ontario, Canada, with a focus on maintenance of ICU resources. In the absence of substantial physical distancing or a combination of moderate physical distancing with enhanced case detection and isolation, we project that ICU resources would be quickly overwhelmed, a conclusion consistent with that in other modelling work,[12] as well as current events in Italy and Spain. On a more positive note, we project that dynamic physical distancing, that reacts to changes in ICU occupancy, could maintain health system capacity and also allow periodic psychological and economic respite for populations.

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Contributors: All authors contributed to the conception and design of the work; acquisition, analysis and interpretation of data; drafting the work and revising it critically. All authors gave final approval to the version to be published and agreed to be held accountable for all aspects of the work.

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Data sharing: All data used for parameterization of this model is in the public domain and can be accessed through references cited in the manuscript and technical appendix. Model code is not currently available, but will be made available in the coming weeks, when it is properly annotated and cleaned. In the interim, those interested in model code should contact David Fisman directly (david.fisman@utoronto.ca).

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This is **Exhibit "G"** to the
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A Commissioner, etc.

Estimation of COVID-19 outbreak size in Italy

Italy is currently experiencing an epidemic of COVID-19 which emerged in the Lombardy region.[1] During the interval between Feb 25–29, 2020, we identified 46 cases of COVID-19 reported in 21 countries in Europe, Africa, North America, and South America that were either in individuals with recent travel from Italy, or who had presumed infection by a traveller from Italy.[2] In six cases, in four of the affected countries (Switzerland, France, Austria, and Croatia), land travel was a likely route of introduction, or was documented to have been the route of introduction.[2]

We used air travel volume between Italian cities and cities in other countries as an index of connectedness, using data available from the International Air Transport Association for February, 2015, (2·61 million total departing international air passengers from Italy). We used the methods of Fraser and collegues[3] to estimate the size of the underlying epidemic in Italy necessary for these cases to be observed with a reasonable probability. To estimate the time at risk of COVID-19 exposure for travellers departing Italy, we obtained data from the United Nations World Tourism Organization for the proportion of international travelers that are non-residents of Italy (63%)[4] and the average length of stay of tourists to Italy (3·4 days),[5] and assumed the Italian epidemic began 1 month preceding Feb 29, 2020.[6]

We also did sensitivity analyses in which we included outbound travel to all countries regardless of reported case importations, inflated travel volumes by 35%, to account for the relative increase in flight numbers from 2015–19, and excluded cases in bordering countries or which were documented to have been introduced by overland travel.

	Estimate	95% CI	% Unreported*	Unreported range (%)*
All cases	3971	2907–5297	72	61–79
All cases (adjusted to 2019)	2937	2150–3917	62	48–71
Exclude bordering countries and overland travel	4533	3238–6172	75	65–82
Exclude bordering countries and overland travel (adjusted to 2019)	3352	2395–4564	66	53–75
Include travel to all countries	2099	1500–2859	46	25–60
Include travel to all countries (adjusted to 2019)	1552	1109–2114	27	0–47

*Based on reported case count of 1128.

***Table*: Estimated COVID-19 outbreak size, Italy, Feb 29, 2020**

When all cases were considered we estimated a true outbreak size of 3971 cases (95% CI 2907–5297), as compared with a reported case count of 1128 on Feb 29, 2020, suggesting non-identification of 72% (61–79%) of cases. In sensitivity analyses, outbreak sizes varied from 1552 to 4533 cases (implying non-identification of 27–75% of cases; table).

We have previously used similar methods to estimate a much larger epidemic size in Iran, with a far greater degree of under-reporting, based on many fewer exported cases. The reason for this difference relates to the relatively high volume of travel from Italy, relative to Iran.[7] In summary, we suggest that the numerous COVID-19 case exportations from Italy in recent days indicate an epidemic that is larger than official case counts suggest, and which is approximately on a par with that currently occurring in South Korea, which reported 3526 cases (and fewer deaths) as of Feb 29, 2020.[2] Since initial submission of this letter, aggressive case finding efforts combined with ongoing epidemic growth have resulted in a dramatic increase in reported cases in Italy, which as of March 12, 2020, stand at 15 113.[8]

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This is **Exhibit "H"** to the
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A Commissioner, etc.

Observation: Brief Research Report

Estimation of Coronavirus Disease 2019 (COVID-19) Burden and Potential for International Dissemination of Infection From Iran

Background: The coronavirus disease 2019 (COVID-19) epidemic began in Wuhan, China, in late 2019 and continues to spread globally (1), with exported cases confirmed in 109 countries at the time of writing (2). During the interval between 19 February and 23 February 2020, Iran reported its first 43 cases, with 8 deaths. Three exported cases originating in Iran were identified, suggesting an underlying burden of disease in that country greater than that indicated by reported cases. A large epidemic in Iran could further fuel global dissemination of COVID-19.

Objective: To quantify the COVID-19 outbreak size in Iran on the basis of known exported case counts and air travel links between Iran and other countries, and to anticipate where infections originating in Iran may spread next.

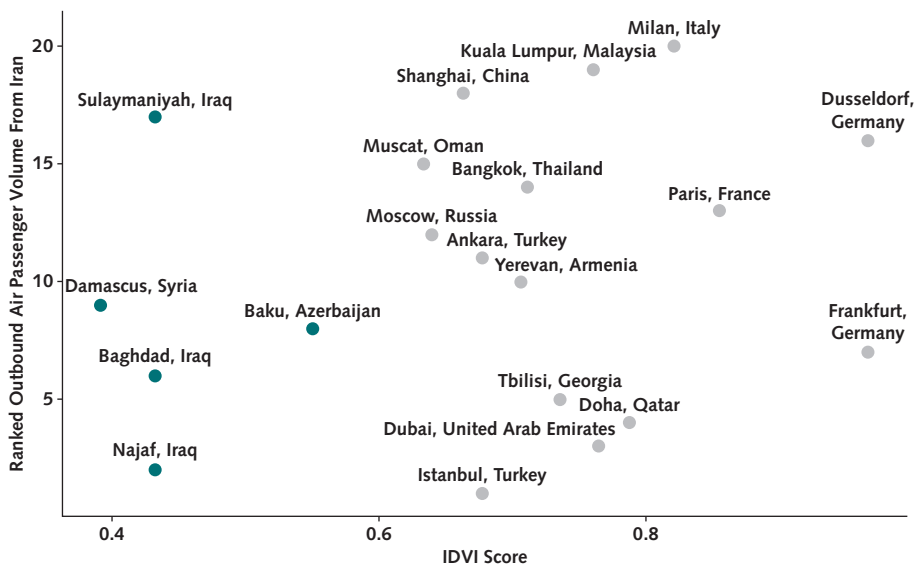
Methods: We assessed interconnectivity between Iran and other countries by using direct and total traveler volumes and final destination cities of travelers originating in Iran in February 2019, according to data from the International Air Transport Association (accounting for 90% of global air travel, with the other 10% modeled by using market intelligence). Because exported cases were identified in United Arab Emirates (UAE), Lebanon, and Canada, we used the methods of Fraser and colleagues (3) to estimate the size of the underlying epidemic in Iran that would be needed for these cases to be observed with a reasonable probability. To estimate the time at risk for COVID-19 exposure among travelers departing Iran, we obtained data from the United Nations World Tourism Organization for the proportion of international travelers who are residents of Iran (4) and the average length of stay of tourists to Iran (5), and assumed that the Iranian outbreak began in early January 2020. We evaluated the relationship between the strength of travel links with Iran and the ranking of destination countries on the Infectious Disease Vulnerability Index (IDVI), a validated metric that estimates the capacity of a country to respond to an infectious disease outbreak. Scores range from 0 to 1, with higher scores reflecting greater capacity to manage infectious outbreaks.

Findings: A total of 212 000 persons traveled from Iranian airports (Tehran, Rasht, and Arak) to international destinations in February 2019. Although Qom has reported COVID-19 cases, its international airport is still under construction. Global cities receiving the greatest number of total travelers from Iran during this period include Istanbul, Turkey (n = 46 550); Najaf, Iraq (n = 24 659); and Dubai, UAE (n = 16 340). Among the top 10 traveler-receiving cities, 4 (Najaf, Baghdad, Damascus, and Baku) are in countries with an IDVI score lower than 0.6, suggesting elevated vulnerability to infectious disease outbreaks as well as limited ability to detect cases (Figure 1).

United Arab Emirates, Lebanon, and Canada ranked third, 21st, and 31st, respectively, in outbound air travel volume from Iran in February 2019. We estimated that 18 300 COVID-19 cases (95% CI, 3770 to 53 470 cases) would have had to occur in Iran, assuming an outbreak duration of 1.5 months in the country, in order to observe these 3 internationally exported cases reported at the time of writing.

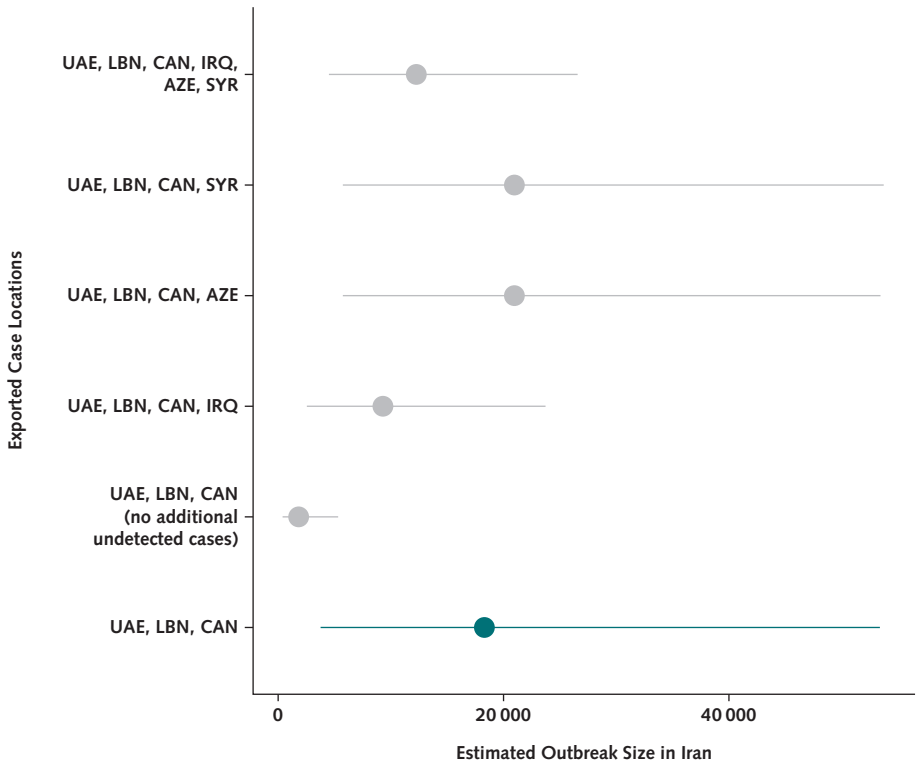
Given the low rankings for Lebanon and Canada for outbound air travel, it is unlikely that cases would be identified in these countries and not in Iraq, Syria, or Azerbaijan (countries

Figure 1. Top 20 international cities connected to Iran by commercial air travel and associated vulnerability to infectious disease outbreaks.



Vulnerability is measured at the country level by using the IDVI score, with a lower value indicating reduced capacity to respond to outbreaks. Countries with the lowest IDVI scores are indicated in green. The top 20 cities accounted for 70% of international outbound traveler volumes from Iran in February 2019. The first and 20th ranked cities, Istanbul and Milan, had 46 550 and 2500 outbound passengers, respectively, during this period. IDVI = Infectious Disease Vulnerability Index.

Figure 2. Estimated outbreak size in Iran required to observe exported cases internationally.



The estimated cumulative number of COVID-19 cases in Iran required to observe 3 cases exported to UAE, LBN, and CAN is shown in green. We also estimated the outbreak size required under alternate scenarios, including no additional exported cases to any other international destinations despite perfect case detection and 1 additional exported case to IRQ, AZE, or SYR (independently or to all 3 countries). Means and 95% CIs are presented. The rate at which persons become infected while in Iran was assumed to be the same for residents and visitors. The rate of infection among air passengers (λ) was estimated as number of exported cases ÷ person-time at risk while in Iran. Person-time at risk was calculated as number of outbound air passengers × (average length of stay for visitors × proportion of air passengers who are visitors + outbreak duration × proportion of air passengers who are residents of Iran). Outbreak size in Iran was then estimated as λ × population size of Iran × outbreak duration. AZE = Azerbaijan; CAN = Canada; COVID-19 = coronavirus disease 2019; IRQ = Iraq; LBN = Lebanon; SYR = Syria; UAE = United Arab Emirates.

with higher travel volumes but low IDVI scores). Considering traveler volume alone, the odds of a single case being imported into Iraq rather than Canada or Lebanon would be 33.6 to 1 and 15.4 to 1, respectively; for Azerbaijan, the odds would be 3.8 to 1 and 1.7 to 1, respectively; and for Syria, the odds would be 3.7 to 1 and 1.7 to 1, respectively. As such, we performed exploratory analyses in which we assumed that an unidentified exported case of COVID-19 was present in Iraq, Syria, Azerbaijan, or all 3 countries, in addition to Lebanon, Canada, and UAE, and estimated the outbreak size in Iran that would produce these results (**Figure 2**). We also evaluated a scenario in which we assumed perfect case detection in travelers from Iran, such that disease is truly absent in countries not reporting cases. Under this "best-case" scenario, the estimated outbreak size in Iran was smaller but still substantial (1820 cases [CI, 380 to 5320 cases]).

Discussion: Given the low volumes of air travel to countries with identified cases of COVID-19 originating in Iran (such as Canada), Iran probably is currently experiencing a COVID-19 epidemic of substantial size for such exportations to be occurring. Our analysis would be modified by travel restrictions from Iran due to the recent political situation and by variations in the R_0 value. Further, the lack of identified COVID-19 cases in countries with far closer travel ties to Iran suggests that cases in these countries are probably being missed rather than being truly absent. This is concerning, both for public health in Iran itself and because of the high likelihood for outward dissemination of the disease to neighboring countries with lower capacity to respond to infectious disease epidemics. Supporting capacity for public health initiatives in the region is urgently needed.

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This is **Exhibit "I"** to the
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July 21, 2020

A Commissioner, etc.

CORRESPONDENCE

Estimation of Coronavirus Disease 2019 Burden and Potential for International Dissemination of Infection From Iran

TO THE EDITOR: We read Tuite and colleagues' recent mathematical modeling study (1) with interest. However, we are concerned about the accuracy of the reported estimates and their underlying assumptions.

First, the authors assumed the onset date of the epidemic to be early January 2020 without providing any evidence. In the last week of February, when the study was done, Iran was not even among the top 50 international destinations from different cities in China; it is therefore unlikely that the epidemic in Iran started in early January (2). Moreover, relying on

data from the United Nations World Tourism Organization to estimate the proportion of international travelers who are residents of Iran, as well as the average length of tourists' stay in Iran, is problematic because these data do not provide the number of days that people infected with severe acute respiratory syndrome coronavirus 2 were actually in Iran. Because the incubation period of this virus ranges between 2 and 14 days, with possible outliers of up to 27 days (3), it is unclear whether the travelers identified in other countries were infected in Iran or were already infected before their last stay in the country.

Second, the Infectious Disease Vulnerability Index used to estimate Iran's outbreak response capacity is a tool to provide international agencies with a better understanding of countries' vulnerability to infectious disease outbreaks in "normal" situations. It therefore underestimates their capacities during outbreaks, when surveillance systems are much more sensitive and case detection is enhanced.

Finally, the authors assumed a similar prevalence of coronavirus disease 2019 (COVID-19) in cities with and without international airports; however, the chance of exposure to COVID-19 through national or international travel is uneven across these cities (4). Approximately 30% of Iran's population lives in rural areas. Furthermore, only 13 of the 54 airports in Iran are international airports, and these are located in 12 of the country's 434 cities (5). The assumptions we have noted here would have caused an overestimation of the overall number of patients with COVID-19 in Iran in this study.

There are substantial uncertainties about the magnitude of the COVID-19 epidemic in Iran, and several surveillance studies and epidemiologic field investigations are ongoing to help provide more reliable estimates. Although mathematical models of COVID-19 might provide some insight for COVID-19 response planning and decision making in Iran, they may be misleading if not viewed with a critical eye for their limitations and subjective assumptions.

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IN RESPONSE: We appreciate Dr. Sharifi and colleagues' thoughtful comments and concerns. We agree that models are simplified representations of reality and are limited by the data used to parameterize them. In our analysis, we assumed that COVID-19 had been circulating in Iran for 1.5 months at the time of our analysis in late February, which would be consistent with an initial case introduction in early to mid-January. In support of this assumption, data now suggest that there was rapid global dissemination of COVID-19 cases in January (before travel restrictions were implemented on 23 January) that was undetected because of the high prevalence of mildly symptomatic or asymptomatic infections (1). The use of data on average tourist behaviors was a required simplification and represented the best available data. We conducted multiple sensitivity analyses, and even our highly conservative estimate of the epidemic size in Iran—which assumed no undetected exported COVID-19 cases among all outbound air passengers—was more than 40 times the officially reported numbers at that time.

Dr. Sharifi and colleagues mistakenly assert that we used the Infectious Disease Vulnerability Index to estimate Iran's outbreak response capacity. We actually used this index to highlight other countries with high connectivity to Iran via air travel that would benefit from heightened surveillance. We concur that such a metric may not fully capture a country's capacity to respond to public health threats, especially in the midst of a public health emergency. However, we contend

that it is useful for stratifying risk and identifying particularly vulnerable countries when used in conjunction with other data, as was done in our analysis.

In conclusion, we recognize the limitations associated with our analysis, which mainly relate to simplifying assumptions. Despite these limitations, the key finding of our study has been validated by abundant observations consistent with a large COVID-19 epidemic in Iran (2, 3), including the appearance of new large burial sites there that became visible on satellite imagery after the epidemic began in that country (4). Our model results are one further piece of evidence lending support to this conclusion.

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It's Time to Revise the Uniform Determination of Death Act

TO THE EDITOR: We read Lewis and colleagues' commentary (1) with interest. When a person has a catastrophic neurologic event compromising their decision-making capacity, their legal representatives are required to confront multiple weighty existential issues. This is the case when they face discussions with health care providers related to the process of determining brain death.

Lewis and colleagues discuss the confusion that results from a lack of uniformity in the definition of "acceptable medical standards" for the determination of brain death and call for a revision of the Uniform Determination of Death Act to address this shortcoming (1). We agree that moving to consistency would be helpful but are concerned that the authors give primacy to showing the presence of "irreversible cessation of functions of the entire brain" without specifically including a key component of the determination of death by neurologic criteria. We believe that it is essential to first establish the cause of the neurologic injury that led to the cessation of brain function (2). Doing so largely obviates distracting discussions about philosophical and legal issues (such as the status of the hypothalamic–pituitary axis), which—although important—do not provide clarity to the determination of death or advance a legal representative's understanding of the patient's condition.

The principal questions are as follows: What caused the damage to the brain? Is the damage permanent? Does the damage to the brain irreversibly rob the patient of their essential personhood? The cause must be unequivocal, catastrophic, and clearly identified. Our concern was heightened because some profoundly comatose patients in our intensive care units exhibit findings on examination that seem consistent with brain death but may have been exposed to powerful synthetic drugs (termed *new psychoactive substances* by the United Nations Office on Drugs and Crime) that are not routinely assayed by clinical toxicology laboratories and therefore are not identified during urine drug screening (3). This fact poses the real operational conundrum of how a "[central nervous system] depressant drug effect" (2) can be excluded if a substance cannot be detected using currently available technology. Such patients, who can have examination findings compatible with "cessation of functions of the entire brain," may not have had a catastrophic irreversible structural brain injury.

The determination of death must first rest on establishing a clear cause for the patient's coma with evidence of structural damage to the integrity of the brain. This must be followed by documentation of persistent nonfunction of the brain, including the brainstem.

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IN RESPONSE: We agree with Drs. Kasarskis and Goldstein that clinicians must ensure that determination of death by neurologic criteria is performed accurately and consistently.

To that end, we recommend that the Uniform Determination of Death Act clearly specify the medical standards to use when evaluating for death by neurologic criteria (presently the 2010 American Academy of Neurology standard for determination of brain death in adults and the 2011 Society of Critical Care Medicine, American Academy of Pediatrics, and Child Neurology Society standard in pediatric patients). In addition, we (A.L. and R.J.B.) are working with the American Academy of Neurology to advocate for regulatory oversight to ensure that policies on death by neurologic criteria are uniform in hospitals throughout the country. We (A.L.) also have worked with the Neurocritical Care Society to produce a training module on death by neurologic criteria (1, 2).

As Drs. Kasarskis and Goldstein note, the process for determining death by neurologic criteria is nuanced; as such, clinicians must be appropriately educated on performing the evaluation. A false determination of death (that is, when the prerequisites are not appropriately met or the examination and apnea test or ancillary testing, where indicated, is not done completely and correctly) is unacceptable.

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High-Sensitivity Cardiac Troponin for the Exclusion of Inducible Myocardial Ischemia in Symptomatic Patients

TO THE EDITOR: Walter and colleagues (1) reported that a high-sensitivity cardiac troponin I (hs-cTnI) cutoff value of 2.5 ng/L failed to accurately exclude inducible myocardial ischemia in a cohort of "symptomatic" patients with known coronary artery disease (CAD). This differs from the findings in our recent publication, which derived and validated this value for exclusion of inducible myocardial ischemia in 2 independent cohorts of "asymptomatic" patients with stable CAD (2). Here, we explain why our findings differed.

First, the nature of the 2 cohorts differed. Walter and colleagues' cohort had a higher pretest probability of ischemia than ours (46% vs. 35%). This necessarily means that the negative predictive value (NPV) will be lower, as the NPV of a diagnostic test is inversely associated with the prevalence of the condition being excluded.

Second, we reported that the NPV of an hs-cTnI level less than 2.5 ng/L for predicting ischemia was higher in patients without a myocardial scar than in those with a scar (93% vs. 75%). Almost twice as many patients in Walter and colleagues' study had a prior myocardial infarction than those in our group, which also may have contributed to the lower NPV in their study.

Finally, the prevalence of "significant" ischemia involving at least 10% of the myocardium was similar in the 2 studies (15% vs. 14%), as was the NPV for exclusion of significant ischemia in both studies (99% vs. 93%). Techniques for diagnosing milder defects may have varied between the studies, and, importantly, the prognostic value of mild ischemia remains questionable. As shown in both studies, the medium-term prognosis in patients with hs-cTnI levels less than 2.5 ng/L was excellent regardless of whether they had inducible ischemia.

We have previously shown that resting levels of hs-cTnI are higher in those with stress-induced ischemia than in those without ischemia and that these levels are proportional to the magnitude of ischemia. In addition, we showed that circulating levels of hs-cTnI increase after exercise-induced ischemia, also in proportion to the magnitude of ischemia. These findings show the value of hs-cTnI as a measure of reversible ischemia (3).

In conclusion, both studies indicate that a resting hs-cTnI value can be useful in excluding significant (>10%) exercise-induced ischemia in patients with CAD and is particularly accurate in those with normal left ventricular function. This could "safely" eliminate the need for stress testing in 15% to 25% of this population, which would not only result in enormous cost savings but also provide valuable prognostic information to patients and physicians on the basis of the hs-cTnI level.

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IN RESPONSE: We thank Dr. Kim and colleagues for their attempt to explain the different findings observed in our respective studies (1). We fully agree that differences in patient population may have contributed to the observed variations in NPV. However, the fact that our study focused on patients with symptomatic rather than asymptomatic CAD is of major clinical relevance. In patients with symptomatic CAD, hs-cTnI cutoffs even lower than 2.5 ng/L fail to accurately exclude inducible myocardial ischemia. Similarly, even in subgroups of patients with symptomatic CAD with similar or even lower pretest probability of inducible myocardial ischemia than the MIPS (Mental Stress Ischemia Prognosis Study) population—that is, those with a pretest probability less than 35%—the proposed hs-cTnI cutoff of 2.5 ng/L could not accurately exclude inducible myocardial ischemia with acceptable performance (namely, an NPV and sensitivity ≥90%). This also pertains to the subgroup of patients with symptomatic CAD without a prior myocardial infarction.

The predictive value of very low hs-cTnI concentrations for future cardiovascular events seems to be robust (1). However, its use for clinical decision making as an alternative to dedicated cardiac imaging requires future studies before it should be recommended for routine clinical use.

In conclusion, the findings show that a much more cautious interpretation of the suggested approach and clinical utility of hs-cTnI is essential in patients with CAD with an actual clinical indication for the evaluation of inducible myocardial ischemia.

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Tenofovir Alafenamide for HIV Preexposure Prophylaxis

TO THE EDITOR: Krakower and colleagues' commentary (1) discussed the phase 3 DISCOVER trial, which compared the safety and efficacy of tenofovir alafenamide with emtricitabine (TAF–FTC) versus tenofovir disoproxil fumarate with emtricitabine (TDF–FTC) for HIV preexposure prophylaxis (PrEP) (2). The authors suggested that the renal and bone safety advantages of TAF–FTC observed in DISCOVER were not clinically meaningful. We agree that both drugs are generally safe and well tolerated; however, published data have consistently shown that use of TDF has a substantial effect on renal and bone safety in both HIV treatment and prevention clinical studies.

A recent meta-analysis in more than 32 000 persons (3) confirmed that use of TDF-based PrEP was associated with a 43% increase in the rate of renal adverse events (AEs) relative to no PrEP. Also, after 48 weeks of TDF–FTC PrEP in young men aged 15 to 19 years (4), there was only partial or incomplete return of bone mineralization even 48 weeks after PrEP discontinuation. In contrast, use of TAF has consistently been associated with improved renal and bone safety data relative to TDF during longer-term follow-up. Gupta and associates published a pooled analysis of 26 treatment-naive and switch studies in 9322 adults and children with HIV (TAF total exposure of 12 519 person-years vs. TDF total exposure of 5947 person-years). There were no cases of proximal renal tubulopathy in those receiving TAF versus 10 cases among those receiving TDF ($P < 0.001$). In addition, significantly fewer persons receiving TAF (3 of 6360) versus TDF (14 of 2962) discontinued use because of a renal AE ($P < 0.001$) (5). Similar results from real-world experience of patients receiving TAF-based regimens have been reported.

The improved clinical outcomes for TAF are particularly germane for persons with renal comorbidities (such as hypertension and diabetes), those who may have increased renal risk (such as African Americans), younger persons who have not yet reached peak bone mass, and older populations who may have age-related bone loss. The DISCOVER safety findings confirm that TAF has significantly less effect on renal and bone markers through 96 weeks of follow-up in a PrEP setting, data that are consistent with the TAF advantages reported in HIV treatment studies.

The recent U.S. approval of TAF–FTC as the second medication for PrEP gives health care providers greater flexibility to tailor treatment to individual needs. Increasing PrEP options in those considering PrEP may lead to higher uptake, and higher PrEP use among those at risk for HIV will move us closer to our shared goal of HIV elimination.

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Note: Drs. Brainard and McCallister are employees and shareholders of Gilead Sciences.

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IN RESPONSE: Drs. Brainard and McCallister assert that TAF–FTC has clinically meaningful renal and bone safety benefits over TDF–FTC for PrEP. They cite a meta-analysis confirming increased risk for renal AEs with TDF–FTC PrEP versus placebo or no PrEP (1), an open-label study of TDF–FTC PrEP for young men that found incomplete recovery of bone mineral density after PrEP discontinuation (2), and a pooled analysis of HIV treatment studies identifying higher rates of discontinuation after renal AEs with TDF versus TAF (3). We disagree that these studies show clinically meaningful benefits of TAF–FTC versus TDF–FTC for PrEP.

First, the meta-analysis description of increased risk for renal AEs included grade 1 serum creatinine elevations or higher (1). When focusing on serious renal AEs or withdrawals due to renal AEs, there were no significant differences between TDF–FTC and placebo or no PrEP. In addition, renal abnormalities generally resolved after PrEP cessation.

Second, incomplete bone recovery after discontinuation of TDF–FTC PrEP among young men is not clinically meaningful unless it presages osteoporosis or fractures, which has not been observed (2). Moreover, studies of TDF–FTC PrEP in adults found full recovery of bone mineral density by 12 to 18 months after discontinuation, including among persons aged 25 years or younger.

Third, the cited pooled analysis compared TDF versus TAF for HIV treatment, not HIV prevention. The risk for renal AEs is greater when TDF is used as part of combination antiretroviral treatment (such as when combined with boosting agents), which can increase TDF concentrations. Nonetheless, fewer than 0.5% of patients discontinued therapy because of renal AEs for both TDF and TAF (3).

The strongest evidence against clinically meaningful renal and bone benefits for TAF–FTC versus TDF–FTC for PrEP is the absence of such benefits in DISCOVER, the only head-to-head comparison. Moreover, TAF–FTC resulted in weight gain and less favorable lipid levels, with twice as many participants starting therapy with lipid-modifying agents with TAF–FTC versus TDF–FTC (1.6% vs. 0.8%; $P = 0.008$) (4).

We agree that TAF–FTC may be preferable for persons with underlying renal or bone disease, a small fraction of PrEP users. Conversely, TDF–FTC may be preferable for those with excess weight or dyslipidemia, which are common. With the impending availability of generic TDF–FTC, which will be substantially more cost-effective than TAF–FTC (5), keeping TDF–FTC as first-line therapy for PrEP will maximize access—and therefore population-level effectiveness—for all populations at risk for HIV.

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This is **Exhibit "J"** to the
Affidavit of David Fisman,
affirmed before me by videoconference
July 21, 2020

A Commissioner, etc.

Derivation and Validation of Clinical Prediction Rule for COVID-19 Mortality in Ontario, Canada

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Abstract

Background: SARS-CoV-2 is currently causing a high mortality global pandemic. However, the clinical spectrum of disease caused by this virus is broad, ranging from asymptomatic infection to cytokine storm with organ failure and death. Risk stratification of individuals with COVID-19 would be desirable for management, prioritization for trial enrollment, and risk stratification. We sought to develop a prediction rule for mortality due to COVID-19 in individuals with diagnosed infection in Ontario, Canada.

Methods: Data from Ontario's provincial iPHIS system were extracted for the period from January 23 to May 15, 2020. Both logistic regression-based prediction rules, and a rule derived using a Cox proportional hazards model, were developed in half the study and validated in remaining patients. Sensitivity analyses were performed with varying approaches to missing data.

Results: 21,922 COVID-19 cases were reported. Individuals assigned to the derivation and validation sets were broadly similar. Age and comorbidities (notably diabetes, renal disease and immune compromise) were strong predictors of mortality. Four point-based prediction rules were derived (base case, smoking excluded as a predictor, long-term care excluded as a predictor, and Cox model based). All rules displayed excellent discrimination (AUC for all rules ≥ 0.92) and calibration (both by graphical inspection and $P > 0.50$ by Hosmer-Lemeshow test) in the derivation set. All rules performed well in the validation set and were robust to random replacement of missing variables, and to the assumption that missing variables indicated absence of the comorbidity or characteristic in question.

Conclusions: We were able to use a public health case-management data system to derive and internally validate four accurate, well-calibrated and robust clinical prediction rules for COVID-19 mortality in Ontario, Canada. While these rules need external validation, they may be a useful tool for clinical management, risk stratification, and clinical trials.

Key words

COVID-19; SARS-CoV-2; ageing; logistic models; clinical epidemiology

Introduction

Since the COVID-19 pandemic was declared by the World Health Organization on March 12, 2020 (1), the spread of SARS-CoV-2 has taken a fearsome toll on global mortality. As of June 11, 2020, over 400,000 deaths worldwide have been attributed to SARS-CoV-2, with many more excess deaths likely related either to infection with the virus or disruption of health systems by epidemics (2). While most infections with SARS-CoV-2 are mild or even asymptomatic, approximately 20% of recognized infections are sufficiently severe to require hospitalization (3, 4). Among those hospitalized, 10-20% have an intensive care requirement, usually related to respiratory failure (3-5), though multiorgan system failure (6), clotting abnormalities (7) and angioneogenesis (8) with resultant bleeding are increasingly recognized as severe complications of COVID-19.

Numerous studies have identified clinical factors associated with requirements for intensive care and death among those with COVID-19 infection (9-11). Published prediction models to date have evaluated case-level factors that might predict care diagnosis, more severe disease requiring hospitalization, and poor outcomes (critical illness or death) (9). A recent review identified 16 prediction models focused on prognosis; 14 were based on the COVID-19 epidemic in China and the other two used aggregated public data from a variety of sources (9). The generalizability of these rules to the North American context is unclear. Furthermore, few of these efforts included conversion of prediction models into parsimonious, simple, score-based tools that can be used easily for risk stratification in clinical settings. In the context of COVID-19, a such rules might have important implications for risk-stratification of patients, streamlining decisions around hospital care vs. self-isolation (12), and prioritizing

individuals for enrollment in clinical trials of emerging therapies (e.g., convalescent plasma or antiviral drugs), as has been the case with similar tools developed for community acquired pneumonia (13).

Ontario, Canada, had identified over 30,000 virologically confirmed cases of COVID-19 in the province as of June 11, 2020 (14). Each confirmed case is the subject of epidemiological investigation by local public health authorities, who enter epidemiological, clinical and outcome data into the Province's Integrated Public Health Information System (iPHIS). Our objective was to make use of iPHIS data to develop and validate parsimonious, sensitive and specific prediction rules for infection-related death in individuals with COVID-19 in Ontario.

Methods

Study population and data collection

Ontario is Canada's most populous province, with a current population of 14.7 million (15) . The Province identified imported COVID-19 cases from China, and Iran, in January and February 2020 (16); local epidemic spread of SARS-CoV-2 has been evident since late February 2020 (17). Each of Ontario's 34 public health units is responsible for local case investigation and uploading of case information into the iPHIS data system, which is used for surveillance and case management of notifiable diseases in the Province (18). Ontario's case definition for a confirmed case of requires a positive laboratory test using a validated nucleic acid amplification test, including real-time PCR and nucleic acid sequencing (19).

Information on patient characteristics – including age group (by 10-year intervals), sex, medical comorbidities, long-term care residence, healthcare and emergency service work, case symptoms, dates of symptom onset, testing and reporting, hospitalization and intensive care admission, and mortality was collected for cases. Approximately 80% of all deaths during the Ontario COVID-19 epidemic have occurred in long term care facilities (20), and there has been little transfer of long-term care residents to intensive care units (17).

Statistical analysis

We randomly assorted cases into derivation and validation sets. Characteristics of the two sets are presented in **Table 1**. Univariable logistic regression was used to

identify factors associated with mortality in the derivation group. Continuous variables were dichotomized to facilitate score generation and ease of application in clinical settings. When a factor was found to be protective, the covariate evaluated was *absence* of the factor, so that resultant odds ratios were > 1.

Risk factors significant at $P < 0.2$, or which were thought a priori to confer important increases in risk (age and sex) were included in model building using a forward stepwise selection algorithm, with covariates selected for $P < 0.05$, and retained in the model for $P < 0.15$. We did not include interaction terms in efforts to keep a final prediction rule as simple as possible. The final regression model was transformed to a point-based rule, with each regression coefficient divided by half of the smallest coefficient and rounded to the nearest integer to obtain weighted values. Risk scores were calculated by summing the individual point values of all applicable risk factors. Risk of death can then be approximated from a graph of model-predicted probability versus calculated score (**Figure 1**) using the relation $p = 1/(e^{-(I + CS)}+1)$ where S is the individual's score, C is the prediction rule's coefficient in a logit model using score as a predictor of death, I is the intercept from the same model.

The discriminatory ability of the prediction rule in the derivation group was quantified through the area under the receiver-operating characteristic curve (ROC AUC), with 95% confidence intervals estimated through 1000 bootstrap replicates. Calibration was assessed visually and using the Hosmer-Lemeshow test for goodness of fit, which evaluates expected and observed probabilities in population deciles (21).

Survival Analytic Approach and Alternate Rules

Some analysts have expressed concern that failure to account for right censoring in could lead to bias in COVID-19 clinical prediction rules (9). As such we created a second prediction rule using Cox-proportional hazards analysis, by identifying factors associated with increased hazard of death using the same selection algorithm as applied to the logistic model described above. Log transformed hazard ratios were converted to point scores using the approach described above. Discriminative ability of the rule was evaluated using Harrell's C-statistic after constructing a Cox proportional hazards model with the score as the sole covariate in both the derivation and validation sets. ROC analysis, and score calibration, were performed by using the Cox-model-derived score as a predictor in a logistic model.

Smoking status emerged as a protective effect in our base case prediction model; this is likely to be controversial with some users. Furthermore, it might be argued that the known high mortality associated with COVID-19 in long term care settings favors creation of a rule for non-long-term care residents. As such, we made additional rules which excluded smoking status, and which excluded long-term care residents, using the approach described above.

Sensitivity Analyses

In the base case, models were built using only observations from individuals with complete data; we tested the robustness of our models by evaluating the discriminative ability and calibration of rules in datasets in which missing fields were replaced at random, and in datasets where an attribute was assumed not present if a field was left blank (e.g., if an individual had no record of presence or absence cardiac disease, they were assumed not to have cardiac disease). All analyses were performed

using Stata version 14.0 (Stata Corporation, College Station, TX). The study was approved by the research ethics board of the University of Toronto.

Results

Of 21,922 COVID-19 cases reported between January 23 and May 15, 2020, 57% were female, and 43% were aged > 59 years. The median time from symptom onset to case reporting was 5 days (IQR 4 to 10 days). Fourteen percent of cases were residents of long-term care facilities; 17% were healthcare workers. Thirteen percent of cases were hospitalized; 2% had record of intubation and/or mechanical ventilation, and case-fatality was 8%. Individuals assigned to the derivation and validation sets were broadly similar, but were significantly more likely to be smokers, less likely to have a history of chronic liver disease, and less likely to die (**Table 1**).

Derivation of the Prediction Rule

In univariable analyses, death was associated with a broad array of demographic characteristics and comorbid conditions. No association was seen between risk of death and mean neighborhood income or asthma which were not included in subsequent model building (**Table 2**). As age was provided as ordinal, 10-year age groupings (0 to 9, 10 to 19, 20 to 29, etc.) the age coefficient in models represents increased risk per increase in (age/10). Using a forward selection algorithm, we identified 7 independent predictors of death in the derivation group: age, long-term care residence, a history of renal disease, diabetes, chronic obstructive pulmonary disease, and immune compromise, and non-smoking. (**Table 3**).

The point-based prediction rule was well-calibrated between quantiles of observed and expected risk (Hosmer-Lemeshow x^2=1.58; p=0. 0.90) in the derivation group and discriminated extremely well between those who did and did not develop die (ROC AUC in the derivation group=0.95; 95% CI, 0.91-0.96). The median score (interquartile

range) was 13 (6) for survivors and 25 (6) for those who died (p<0.001 by the Wilcoxon rank-sum test). The rule displayed good calibration to outcomes in the validation set (Hosmer-Lemeshow x^2=9.16; p=0.16), as well as excellent discrimination (AUC 0.92, 95% CI 0.89 to 0.94) (**Figure 1** and **Figure 2**).

Alternate Prediction Rules

Three alternate rules (based on a Cox proportional hazards model, a logistic model excluding smoking status, and a model with long-term care residents excluded) were created. These models had excellent discrimination. We statistical found evidence for poor calibration of the model that excluded long-term care residents in the validation set (P = 0.04). The Harrell's C-statistic for a Cox model including age, male sex, diabetes, COPD, and immune compromise was 0.97 in the derivation set, and 0.96 in the validation set. Other fit statistics, and c-statistics for AUC, as well as values of the model intercept and smallest logit model coefficient (for calculation of death probability) are presented in **Table 3** and presented graphically in the **Supplement.**

Sensitivity Analyses

We re-evaluated all four prediction rules in datasets in which missing variables were assumed to not be present, and in which missing variables were replaced randomly. Discriminative ability remained good for both randomly replaced datasets (ROC curve AUC 0.84-0.90 for missing observations replaced with zeroes; AUC 0.79-0.83 for missing observations replaced randomly). The large number of observations in datasets with all missings replaced (N = 21,922) resulted in statistically significant differences between observed and expected mortality probabilities (P < 0.001 for all

analyses by Hosmer-Lemeshow test), but visual inspection suggested that calibration of rules remained very good (**Supplement**).

Discussion

Accurate prediction of mortality from COVID-19 has a number of potential applications, including rational decision making for hospital admission, prioritization of high-risk individuals for inclusion in trials of novel therapeutic agents, and to identify high risk individuals for policy purposes (e.g., to inform decisions around risks and benefits of remote work). We demonstrate here that COVID-19 mortality in identified cases can be predicted with remarkable accuracy based on the limited, readily available demographic and chronic health information available in public health line lists. The large number of COVID-19 cases that have occurred in Ontario provided sufficient statistical power for both model derivation and validation without resorting to bootstrap resampling. The discriminative ability of our rules (as reflected in AUC > 0.9 in both derivation and validation sets) places them among the upper tier of current COVID-19 prediction rules; the parsimoniousness of these rules and their conversion to an easy-to-calculate point score allows easy incorporation into clinical care.

While many of our predictors (age and comorbidities) could have been anticipated based on established epidemiology of COVID-19 (22-24), some (e.g., non-smoking as a predictor of mortality) are likely to be controversial, and it is for this reason that we derived alternate rules that exclude non-smoking. Apparent protective effects of smoking against COVID-19 acquisition (25) as well as under-representation of smokers among COVID-19 patients have been noted by others (26). However, other investigators have suggested higher risk of progression of COVID-19 in smokers(26, 27), and increased density of ACE-2 (a viral receptor) is present in the lungs of smokers (28), suggesting that apparent protective effects might result from selection

bias (e.g., individuals predisposed to very mild COVID-19 infection as a result of young age or good general health might be over-represented among those tested for COVID-19 due to smoking-related health concerns like cough). Regardless, a non-causal association with risk may still be useful for clinical prediction; if this association reflects peculiarities of Ontario's approach to COVID-19 testing we expect that it may not be generalizable to other jurisdictions that test more widely.

Similarly, the strong effect of long-term care residence on mortality is unsurprising, given the high fraction of long-term care deaths seen during the Canadian COVID-19 epidemic to date (20). As such we created alternate rules that exclude smoking and long-term care residence; these rules can be used in place of our base case rule, as they have similar discriminative ability. Lastly, to avoid biases that might be introduced by right-censoring (i.e., lack of mortality in individuals in the study cohort as a result of insufficient follow up time) we derived an additional rule using survival methods, which also performed well. There was substantial overlap between all four prediction rules in included covariates: notably, age, diabetes, and immune compromise were included in all four rules we derived, and renal or chronic obstructive pulmonary disease were included in 3 of four rules.

Our analysis had many limitations; the use of a public health record system not explicitly designed as a research tool means that we lack laboratory and radiological results that have been useful in other prediction models (23, 29). Furthermore, missing data was a significant limitation of our dataset, although our models appeared robust even with random replacement of predictors and outcomes that should bias associations towards the null. In that sense, the ability to derive simple, accurate and parsimonious rules, which perform well in split-halves validation, despite limitations

in our dataset, may suggest generalizability of application outside Ontario. We hope that other groups will evaluate our rules in other settings.

In summary, we developed and internally validated a prediction rule for COVID-19 mortality using a large and detailed public health line list in the Canadian province of Ontario. The rule was well calibrated and discriminated well and was robust in sensitivity analyses to assess the impact of missing information on predictor variables. If externally validated, this rule might facilitate decision making during future epidemic waves.

Figure Legends

Figure 1. Observed and Predicted Risk of Death by Score, Base-Case Rule

Plot of predicted probability of death (Y-axis) by model score (X-axis) for base case prediction rule. Curve represents model predictions, circles represent observed proportion who died. Circle size proportionate to number of deaths at a given score. Top panel: derivation set; bottom panel: validation set.

Figure 2. Receiver Operator Characteristic Curve, Base-Case Rule.

Sensitivity of rule (Y-axis) is plotted against false positive rate (1-specificify, X-axis) for different positivity criteria available from score. Confidence intervals for area under the curve derived via boostrapping. Top panel: derivation set; bottom panel: validation set.

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Table 1. Characteristics of Confirmed COVID-19 Cases in Ontario, Canada to May 15, 2020

Covariate	Overall (% or Median, IQR)	Derivation (% or Median, IQR)	Validation (% or Median, IQR)	P-value
All	21922 (100)	10957 (50)	10965 (50)	
Age > 59	9398 (43)	4672 (43)	4705 (43)	0.63
FSA Income*	$64,869 ($26,402)	$64,986 ($26,937)	$64,869 ($26,402)	0.73
Male gender	9389 (43)	4708 (43)	4681 (43)	0.68
Time from symptom onset to report	5 (6)	5 (6)	5 (6)	0.81
Long-term care resident	3102 (14)	1539 (14)	1563 (14)	0.50
Outbreak-associated case†	9438 (43)	4772 (44)	4666 (43)	0.14
Healthcare worker	3780 (17)	1888 (17)	1892 (17)	0.55
Homeless shelter worker	106 (0.4)	61 (0.6)	45 (0.4)	0.13
Homeless	226 (1)	102 (0.9)	124 (1)	0.11
Smoker (recorded)	515 (2)	285 (3)	230 (2)	0.01
Pregnant or post-partum	91 (0.4)	58 (0.5)	45 (0.4)	0.21
Comorbidity history				
Anemia or hemoglobinopathy	370 (2)	177 (2)	193 (2)	0.42

Chronic liver disease	94 (0.4)	38 (0.3)	56 (0.5)	0.06
Renal disease	358 (2)	185 (2)	173 (2)	0.55
Diabetes	1294 (6)	623 (6)	671 (6)	0.22
Chronic obstructive pulmonary disease	267 (1)	134 (1)	133 (1)	0.97
Asthma	880 (4)	409 (4)	390 (4)	0.58
Cardiovascular disease	2032 (9)	979 (9)	1053 (10)	0.15
Malignancy	460 (2)	211 (2)	249 (2)	0.06
Immune compromise	318 (1)	162 (1)	156 (1)	0.69
Tuberculosis	52 (0.2)	32 (0.2)	20 (0.2)	0.10
Obesity	295 (1)	137 (1)	158 (1)	0.16
Outcomes				
Hospitalized	2779 (13)	1355 (12)	1424 (13)	0.17
Record of intubation and/or mechanical ventilation	408 (2)	195 (2)	213 (2)	0.31
Died	1825 (8)	862 (8)	963 (9)	0.02

NOTE: Proportions compared with chi-squared test, continuous variables compared with Wilcoxon rank-sum test.

*Based on mean after tax income by FSA (2016 Canadian Census).

†Defined as case or cases with outbreak number signifying part of an outbreak investigation by a public health unit.

Table 2. Univariable and Multivariable Analyses, and Point Score Derivation, Base Case Prediction Rule

Covariate	Univariable OR (95% CI)	P-value	Multivariable OR (95% CI)	Logit	Points
Age (per 10-year increment)	3.48 (3.28 to 3.70)	<0.001	2.42 (1.78 to 3.29)	0.88	2
Low income*	1.04 (0.92 to 1.18)	0.55	---	---	---
Male gender	1.13 (1.02 to 1.25)	0.02	---	---	---
Time from symptoms to diagnosis ≤ 3 days†	1.27 (1.14 to 1.42)	<0.001	---	---	---
Long-term care resident	22.62 (19.08 to 26.83)	<0.001	6.24 (2.95 to 13.21)	1.83	4
Outbreak-associated case	9.15 (8.10 to 10.33)	<0.001	---	---	---
Non-healthcare worker‡	30.56 (15.77 to 59.22)	<0.001	---	---	---
Non-homeless shelter worker‡	5.79 (0.80 to 41.96)	0.08	---	---	---
Non-homeless‡	2.31 (0.94 to .712143	0.07	---	---	---
Non-smoker‡	1.65 (0.98 to 2.77)	0.06	6.86 (0.73 to 64.27)	1.93	4

Pregnant or post-partum	No deaths	---	---	---	---
Comorbidity history					
Anemia or hemoglobinopathy	5.08 (3.68 to 7.02)	<0.001	---	---	---
Chronic liver disease	6.06 (3.50 to 10.46)	<0.001	---	---	---
Renal disease	9.85 (7.31 to 13.26)	<0.001	2.37 (0.97 to 5.77)	0.86	2
Diabetes	6.49 (5.22 to 8.06)	<0.001	2.19 (1.08 to 4.42)	0.78	2
Chronic obstructive pulmonary disease	11.22 (8.14 to 15.44)	<0.001	3.26 (1.15 to 9.26)	1.18	3
Asthma	1.01 (0.71 to 1.44)	0.96	---	---	---
Cardiovascular disease	11.38 (9.12 to 14.20)	<0.001	---	---	---
Malignancy	6.36 (4.80 to 8.44)	<0.001	---	---	---
Immune compromise	4.12 (2.94 to 5.79)	<0.001	3.56 (1.12 to 11.35)	1.27	3
Tuberculosis	0.88 (0.21 to 3.70)	<0.001	---	---	---
Obesity	2.63 (1.78 to 3.89)	<0.001	---	---	---

*Residence in FSA in lowest quartile of income

†Lowest quartile lag between symptoms and diagnosis

‡Non-exposure status evaluated as risk factor to maintain positive covariate.

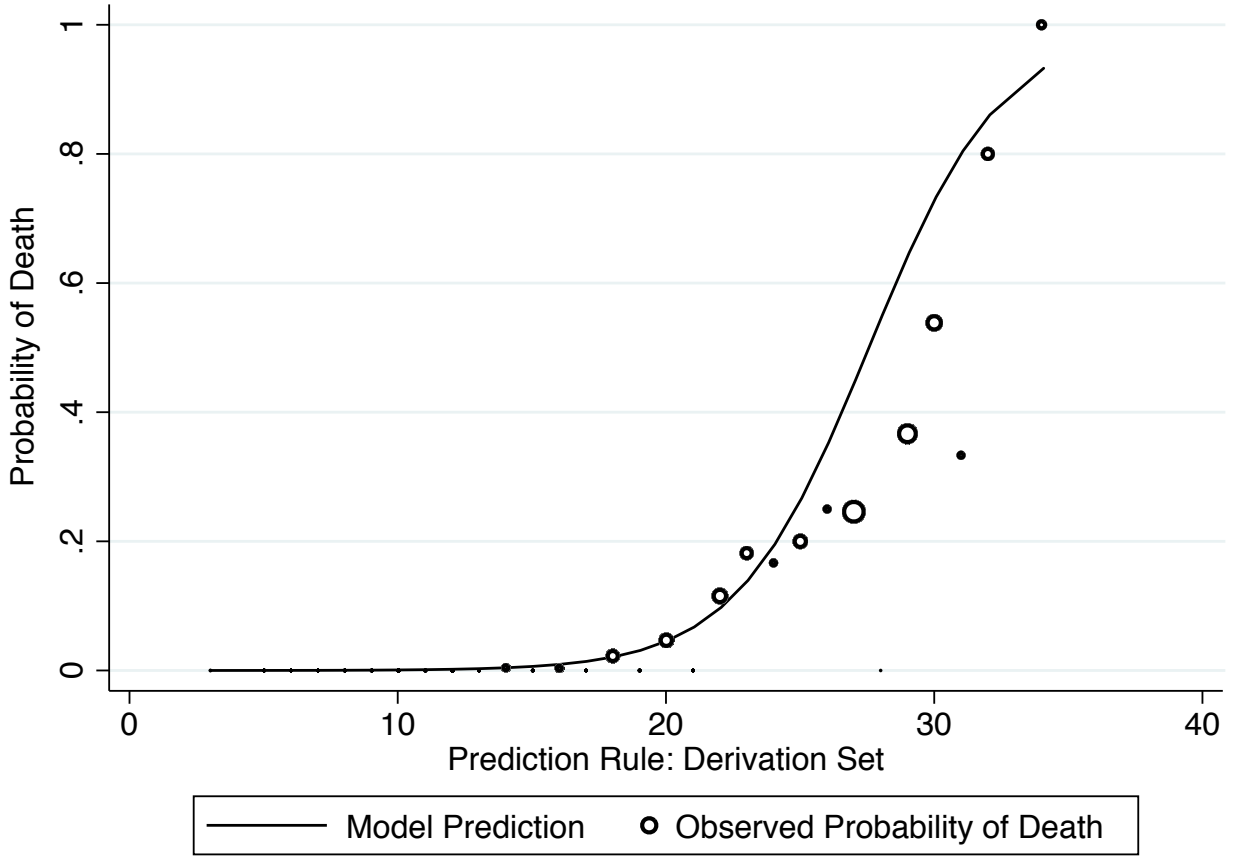
Table 3. Base Case and Alternate Clinical Prediction Rules

Covariate	Rule 1: Base Case	Rule 2: Cox model-based*	Rule 3: Non-smokers Excluded	Rule 4: Long term care residents excluded
Age	2	3	3	2
Male sex	---	2	---	---
Renal disease	2	---	2	3
Immune compromised	3	4	5	4
Diabetic	2	4	3	2
COPD	3	3	3	---
Cardiovascular disease	---	---	2	4
Long-term care resident	5	---	7	---
Non-smoker	5	---	---	---
Time from symptoms to diagnosis $\leq$ 3 days	---	---	---	2
Maximum points	40	40	50	40
Smallest logit model coefficient (C)*	0.36	0.34	0.25	0.52
Model intercept (I)*	-9.81	-9.99	-8.33	-12.51

AUC in derivation set (validation set)	0.95 (0.92)	0.93 (0.91)	0.95 (0.92)	0.92 (0.91)
Hosmer-Lemeshow goodness-of-fit test P-value in derivation set (validation set)	0.85 (0.20)	0.50 (0.24)	0.99 (0.40)	0.59 (0.04)

NOTE: AUC, area under the ROC curve; Hosmer-Lemeshow test based on deciles of risk score.

* Can be used to calculate probability of death as per text.


Probability of Death
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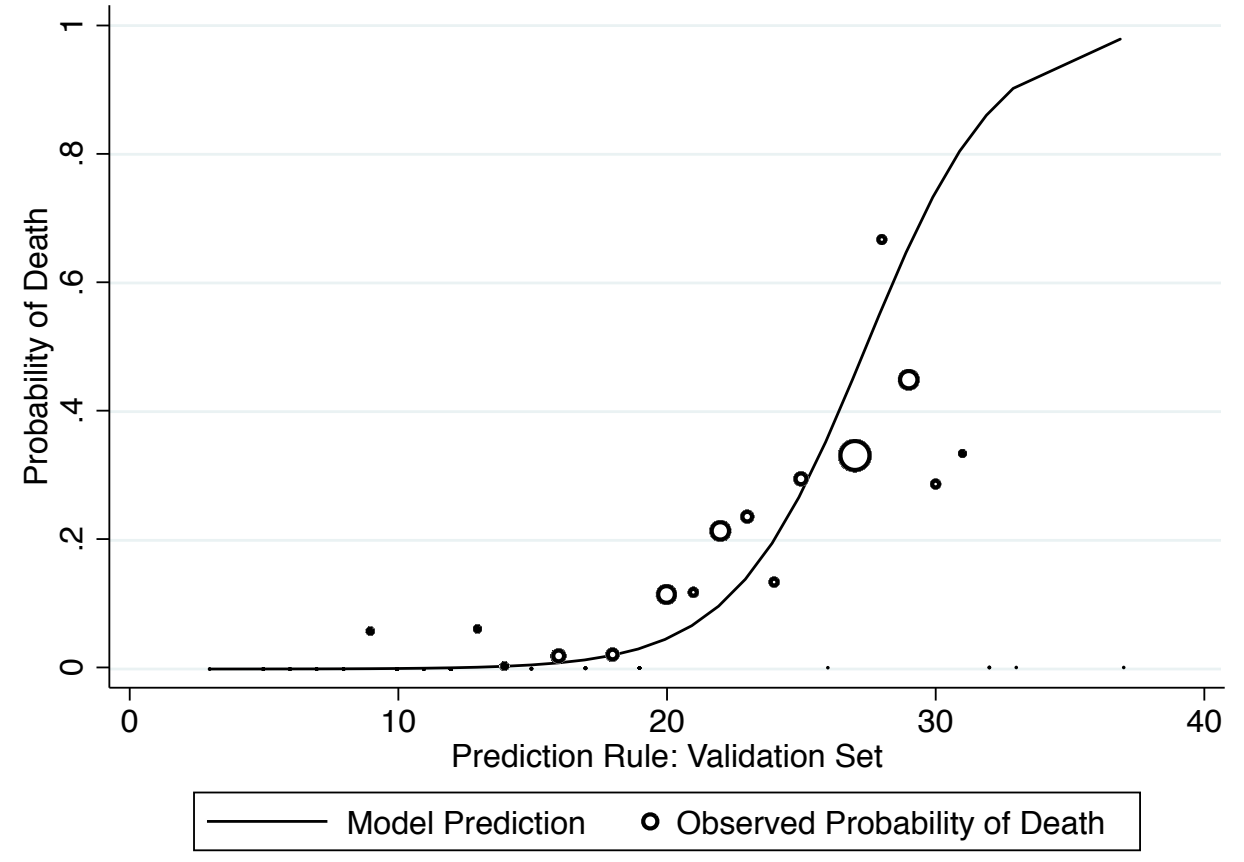
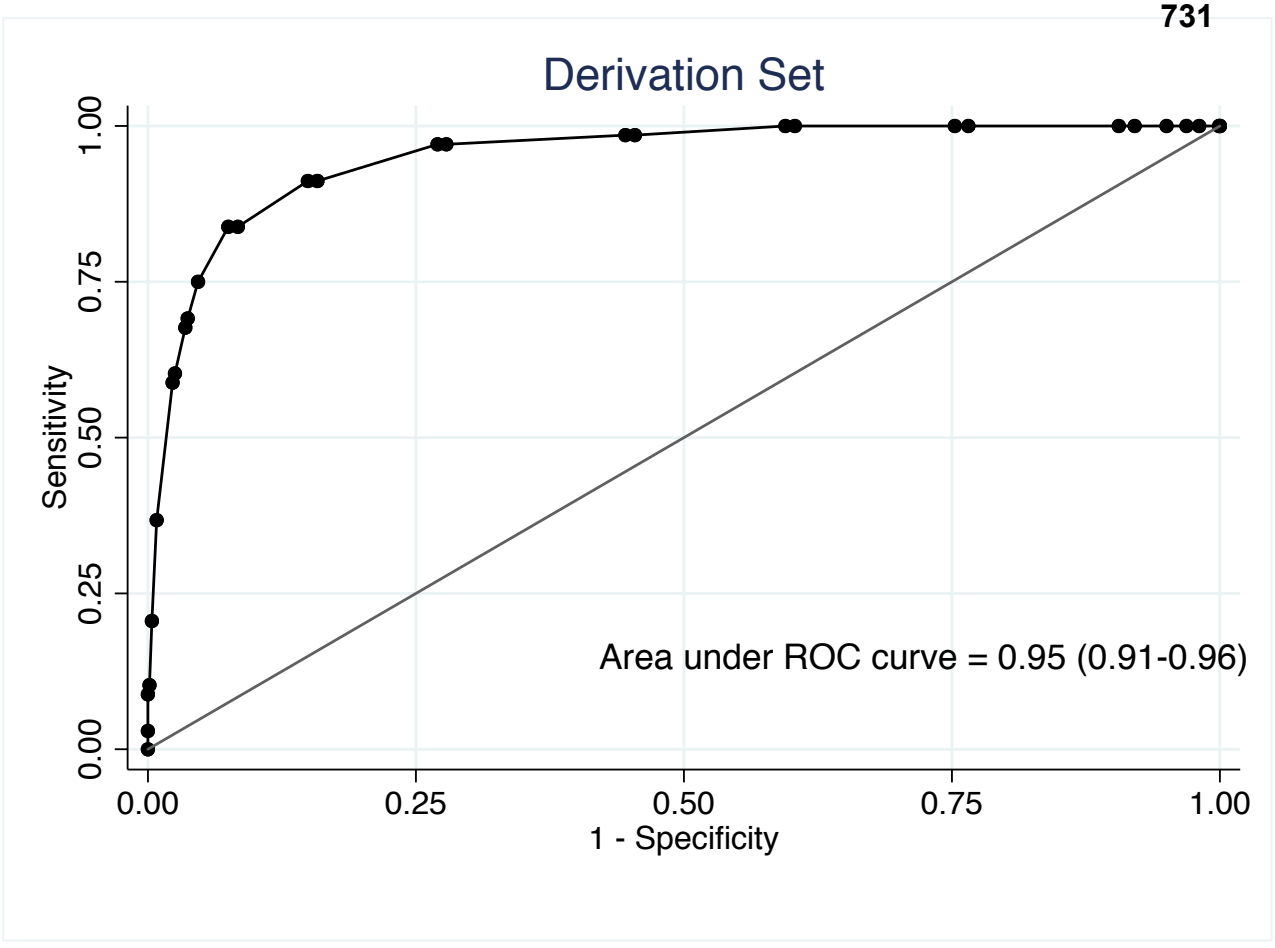
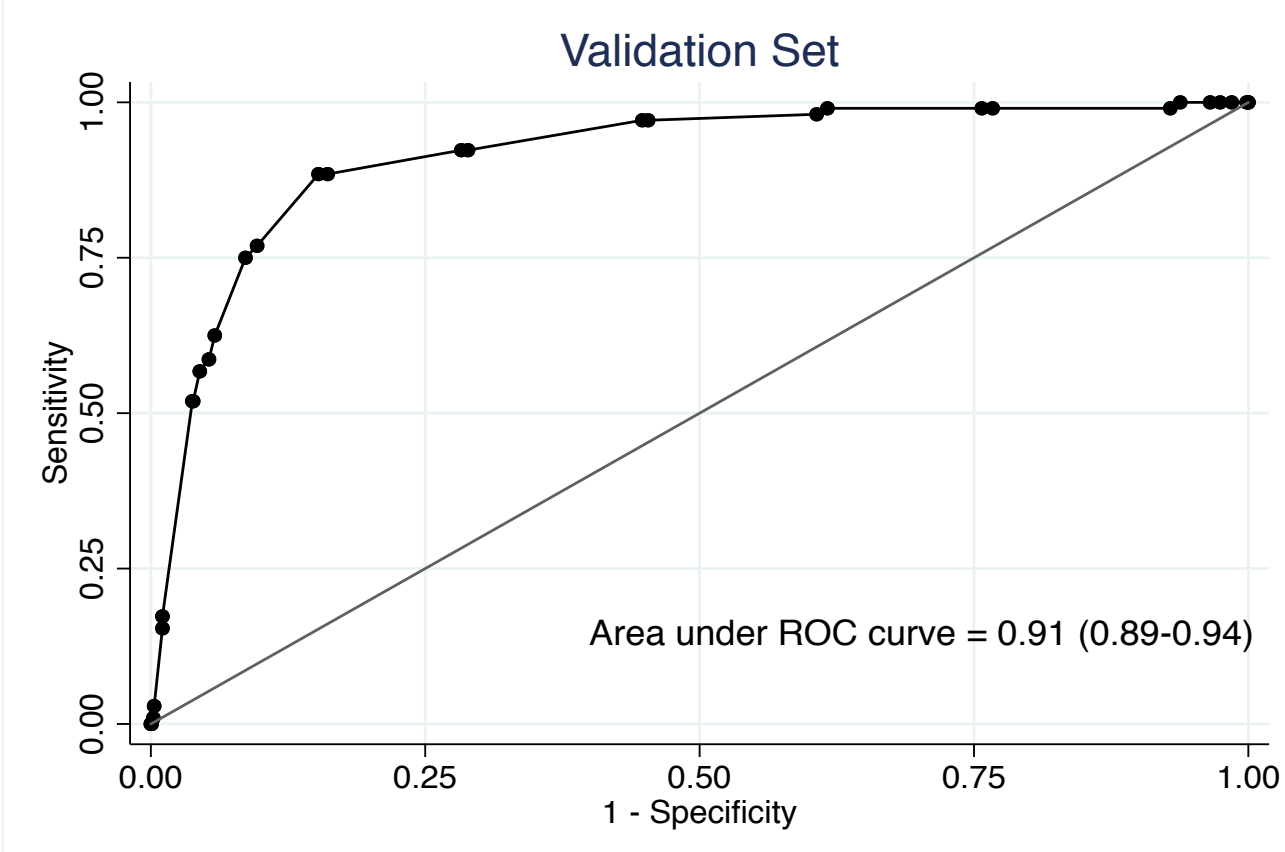
.2
.4
.6
.8
1
0
10
20
30
40
Prediction Rule: Derivation Set
Model Prediction
Observed Probability of Death


Probability of Death
0
.2
.4
.6
.8
1
0
10
20
30
40
Prediction Rule: Validation Set
Model Prediction
Observed Probability of Death


Derivation Set
Sensitivity
0.00
0.25
0.50
0.75
1.00
1 - Specificity
Area under ROC curve = 0.95 (0.91-0.96)


Validation Set
Sensitivity
0.00
0.25
0.50
0.75
1.00
1 - Specificity
Area under ROC curve = 0.91 (0.89-0.94)

Supplement: Derivation and Validation of Clinical Prediction Rule for COVID-19 Mortality in Ontario, Canada

1. Cox-model derived prediction rule.

As noted in the text, we used a Cox proportional hazards model to derive point scores for a prediction score. The use of Cox models was intended to avoid bias that might be introduced as a result of incomplete follow up and right censoring. Point scores were derived based on log-hazard ratios. The scores, and values for I and C necessary to predict mortality probability are presented in Table 3. The score itself was then evaluated as a single covariate in a logit model predicting mortality. Model calibration in derivation (top panel) and validation (bottom panel) sets are presented in Figure S1 below. Figure S2 presents the ROC curves for the derivation (top panel) and validation

(bottom panel) sets.

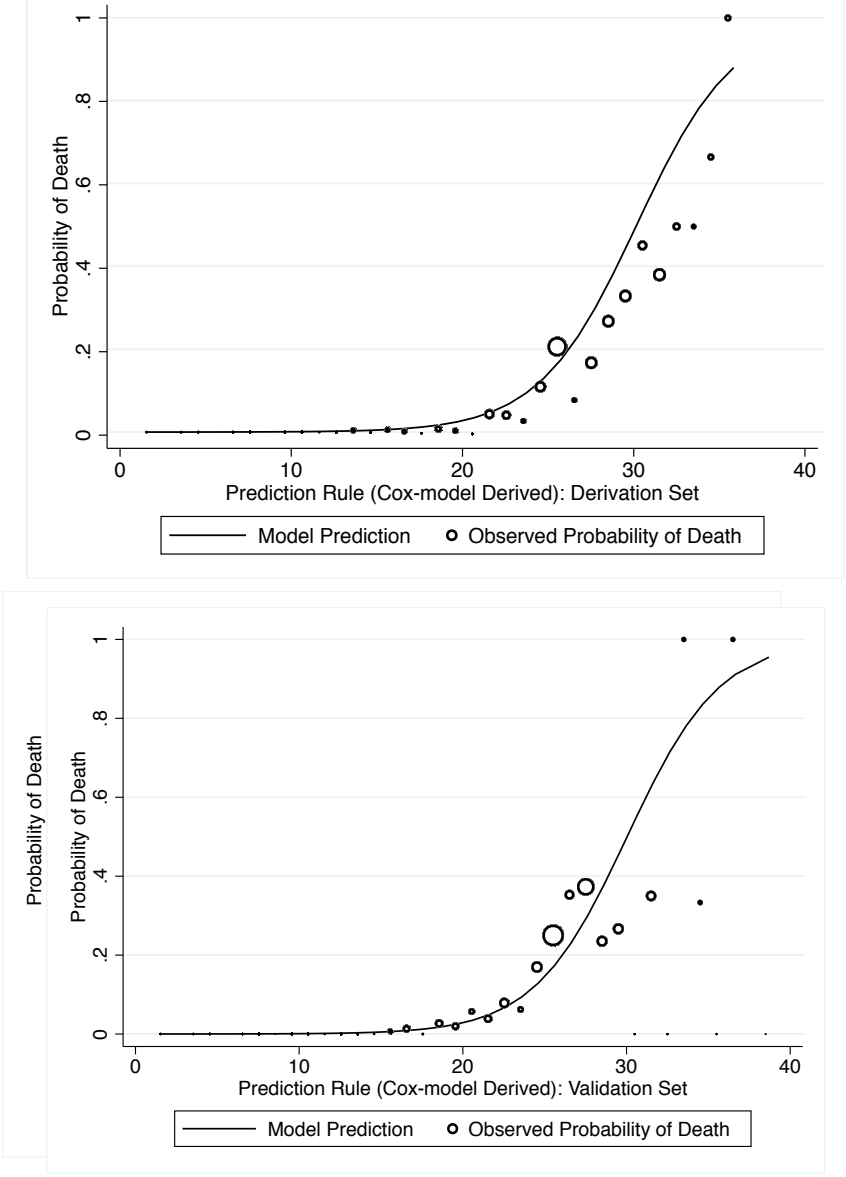


Figure S1. Observed (circles) and predicted (curve) probability of death in Cox model-derived alternate prediction rule. Circle size is proportionate to number of deaths for each score.

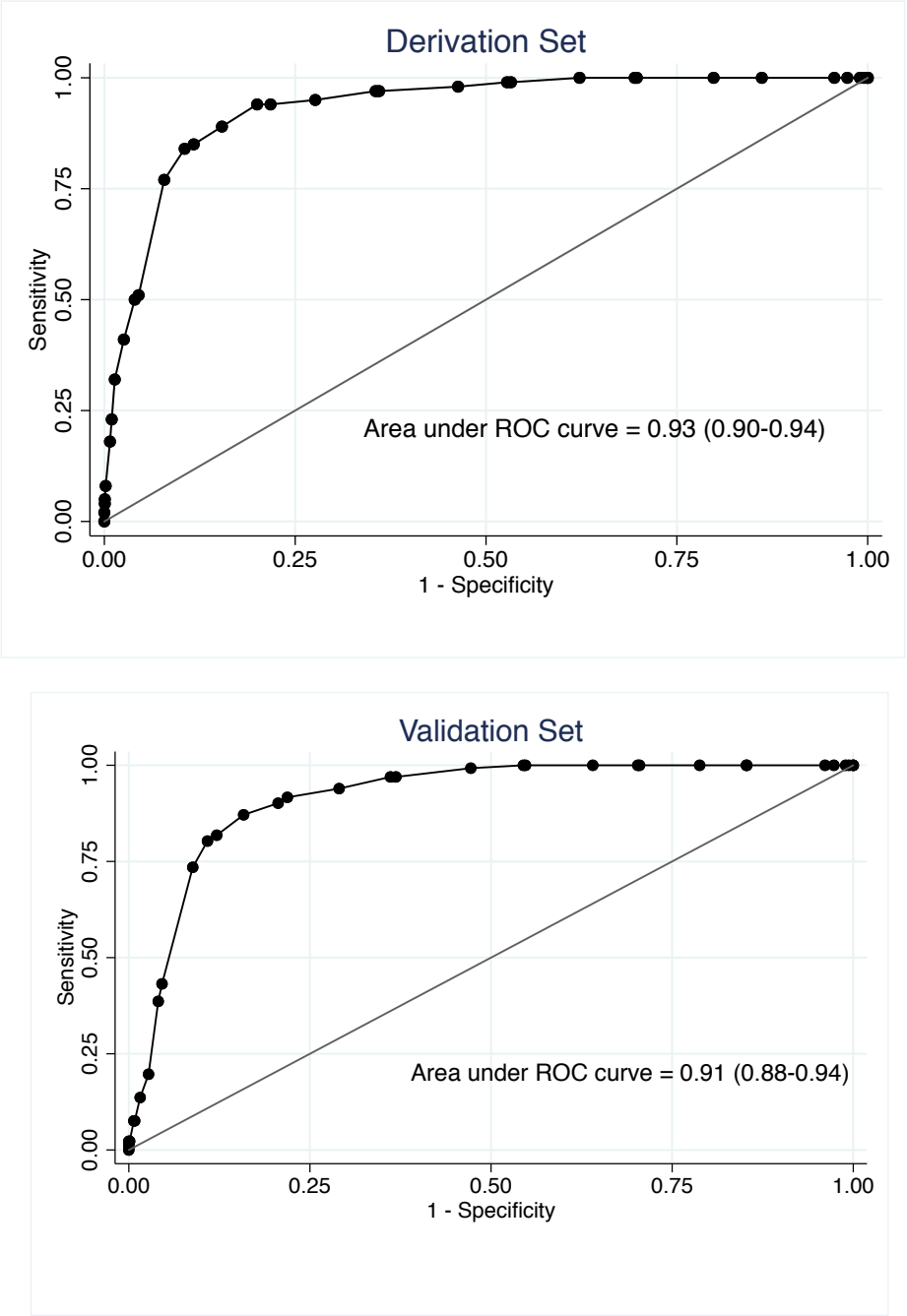
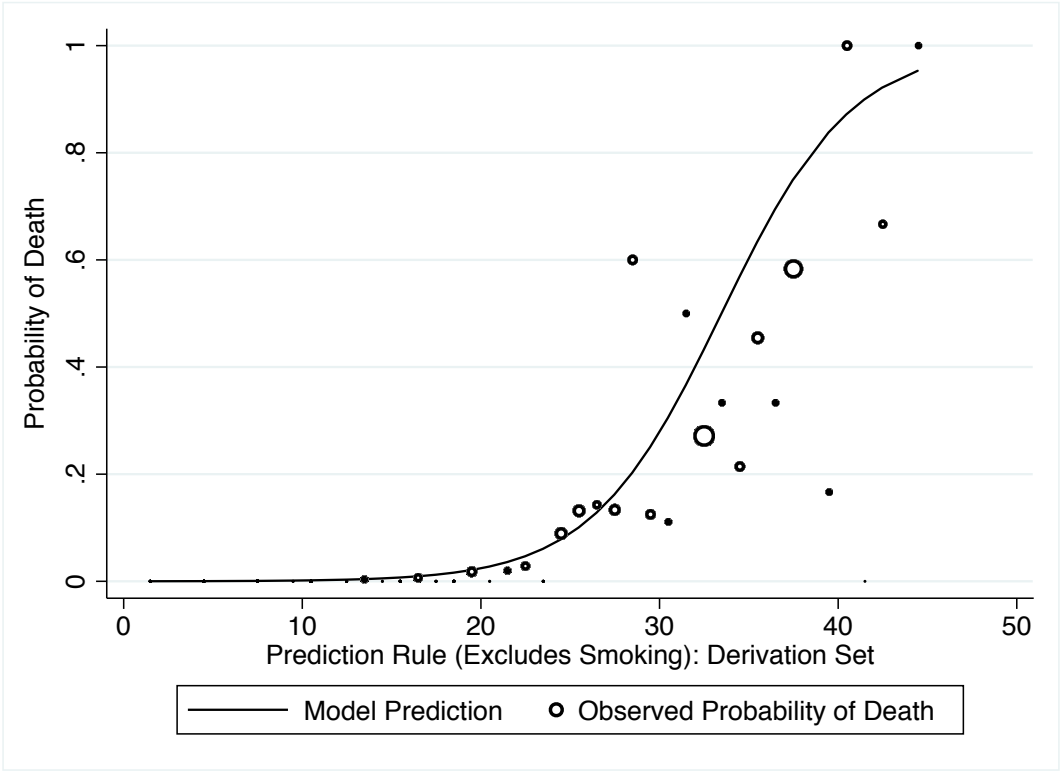


Figure S2. ROC curves for derivation (top) and validation (bottom) sets, Cox model-based prediction rule. Confidence intervals derived via bootstrapping.

2. Logit model-derived prediction rule with smoking excluded.

We anticipated that a prediction rule incorporating non-smoking as a risk factor for mortality would be controversial. As such, we created an alternate rule with non-smoking excluded. Again, rule-based scores, and values for I and C necessary to predict mortality probability are presented in Table 3. As above model calibration in derivation (top panel) and validation (bottom panel) sets are presented in Figure S3 below. Figure S4 presents the ROC curves for the derivation (top panel) and validation (bottom panel) sets.



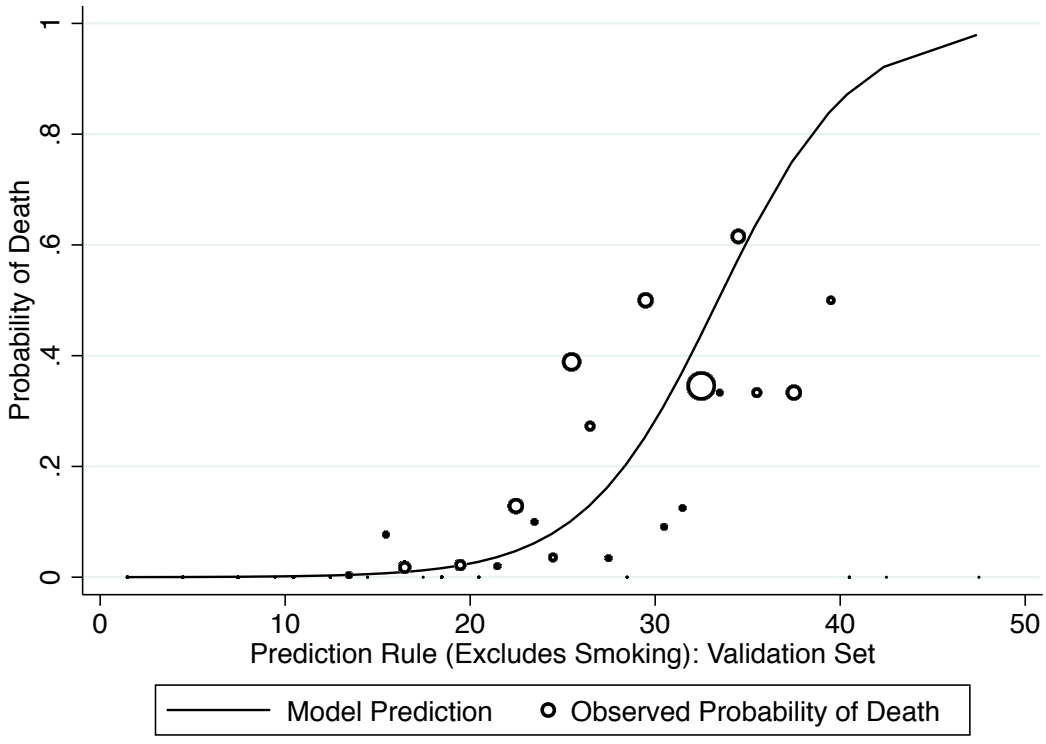


Figure S3. Observed (circles) and predicted (curve) probability of death in logit model-derived alternate prediction rule that excludes smoking status. Circle size is proportionate to number of deaths for each score.

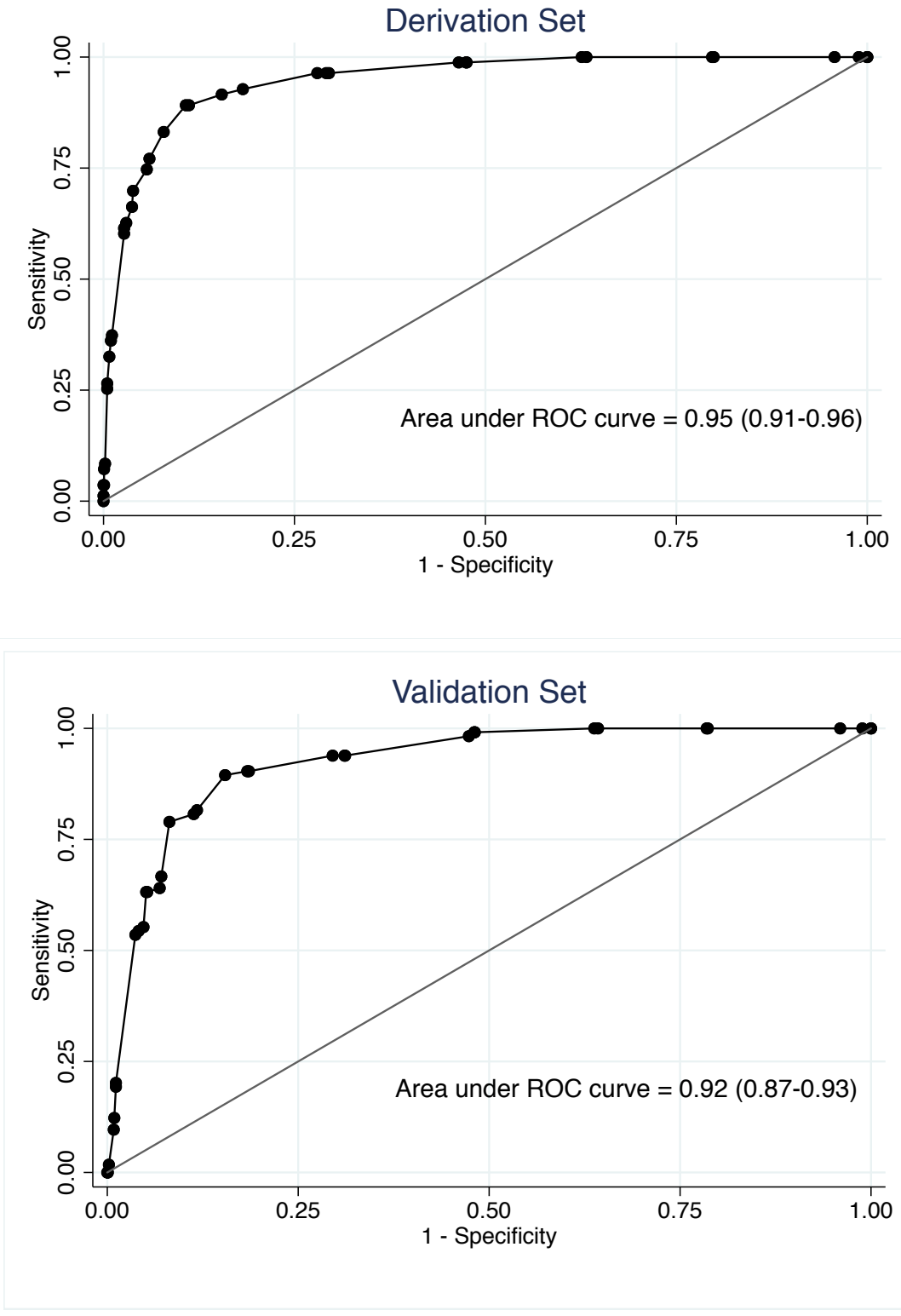
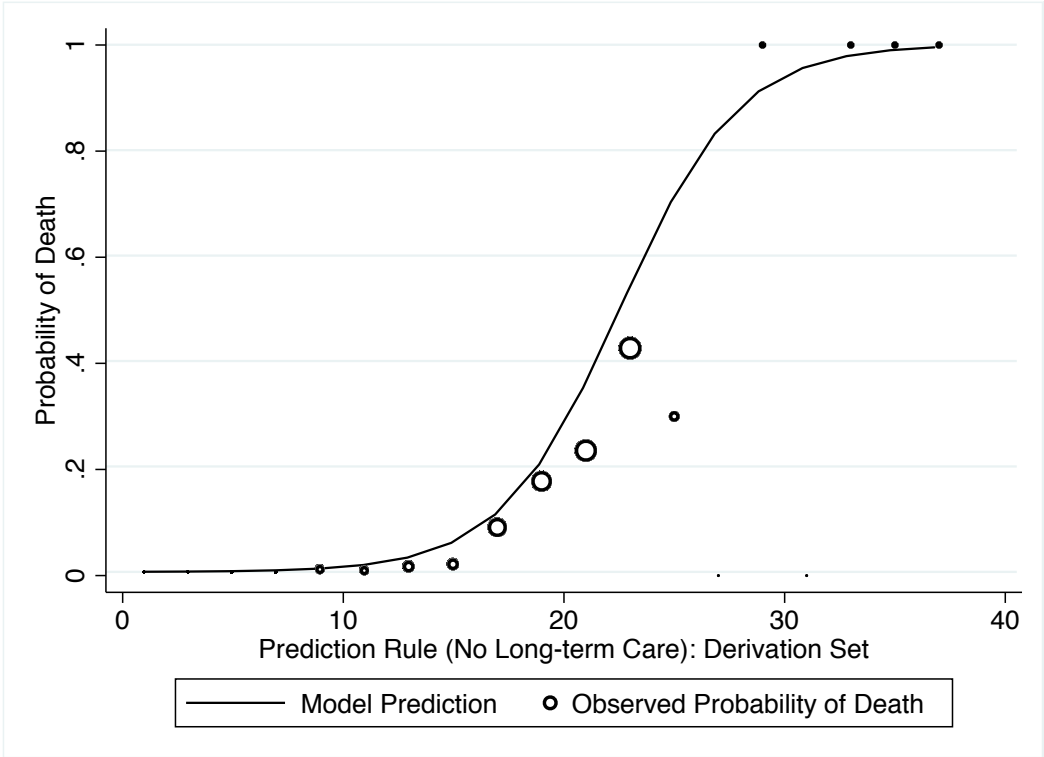


Figure S4. ROC curves for derivation (top) and validation (bottom) sets in logit model-derived alternate prediction rule that excludes smoking status. Confidence intervals derived via bootstrapping.

3. Logit model-derived prediction rule with long-term care residents excluded.

The extremely high mortality in the long-term care setting might make a prediction rule unhelpful. As such, we created an alternate rule with long-term care residents excluded. Again, rule-based scores, and values for I and C necessary to predict mortality probability are presented in Table 3. As above model calibration in derivation (top panel) and validation (bottom panel) sets are presented in Figure S5 below. Figure S6 presents the ROC curves for the derivation (top panel) and validation (bottom panel) sets.



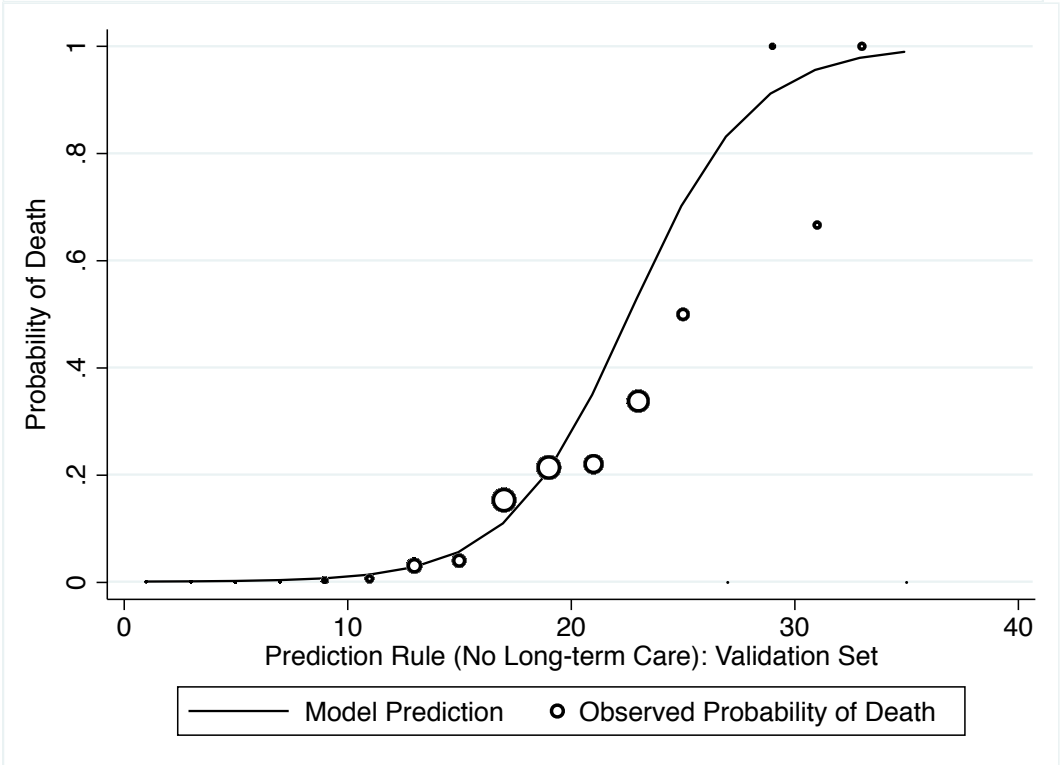
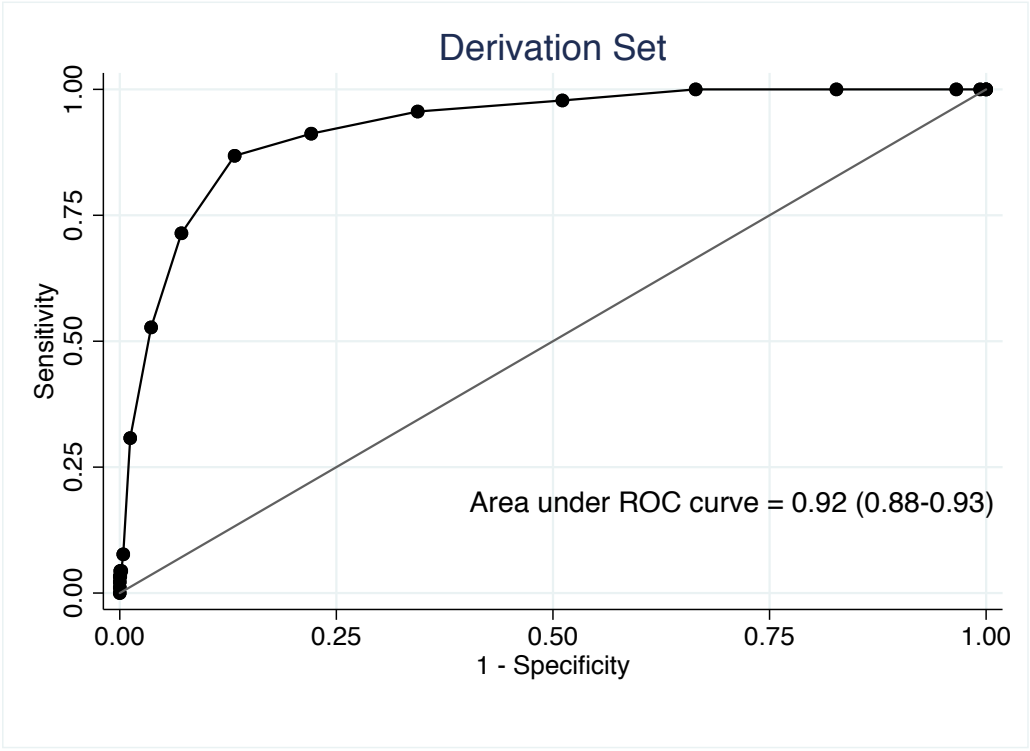


Figure S5. Observed (circles) and predicted (curve) probability of death in logit model-derived alternate prediction rule that excludes long term care residents. Circle size is proportionate to number of deaths for each score.



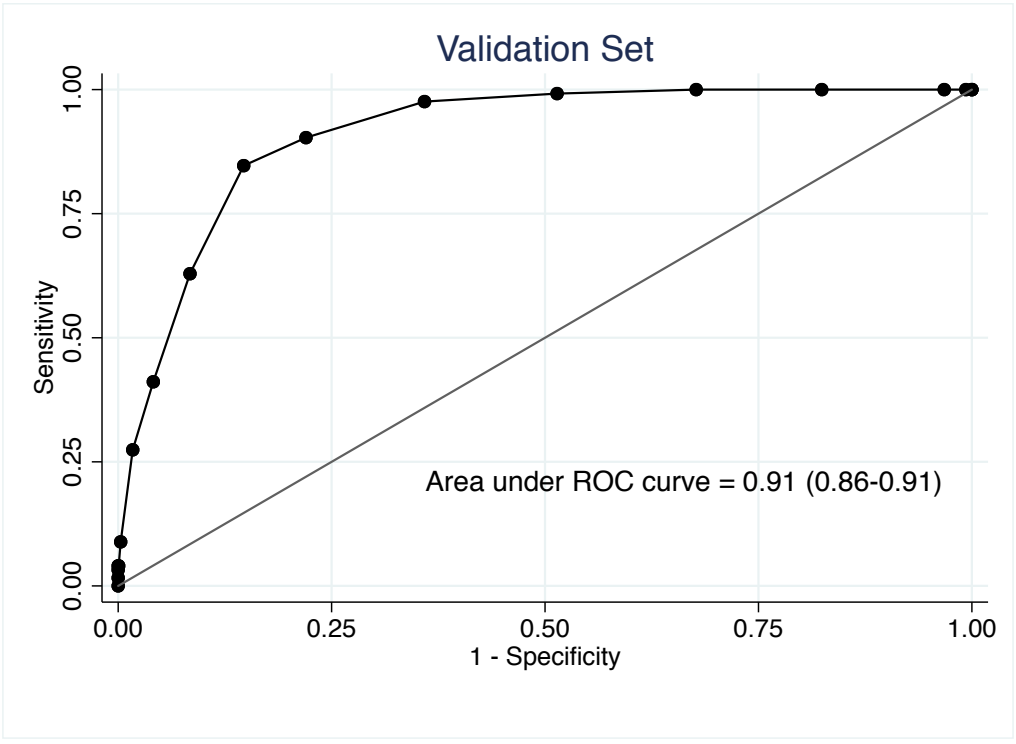


Figure S6. ROC curves for derivation (top) and validation (bottom) sets in logit model-derived alternate prediction rule that excludes smoking status. Confidence intervals derived via bootstrapping.

4. Sensitivity Analyses with Replacement of Missing Data

The iPHIS dataset was limited by substantial data missingness. To assess the robustness of our rules, we replaced missing variables in two ways: first, by assuming that missingness (for covariates or death) indicated that they were not present or did not occur (i.e., replaced missing values as zero); and second, by assuming that variables were missing completely at random, and replacing missing values randomly based on their frequency of observation among non-missings. The latter approach had the effect of substantially increasing the number of deaths available in the dataset. Notwithstanding the likely introduction of misclassification via both of these approaches, model calibration (based on visual inspection) and discrimination remained very good. Calibration (left sided panels) and discrimination (right sided panels) are presented graphically for all four prediction rules with missing values replaced as zeroes (Figure S7) and missing values replaced at random (Figure S8).

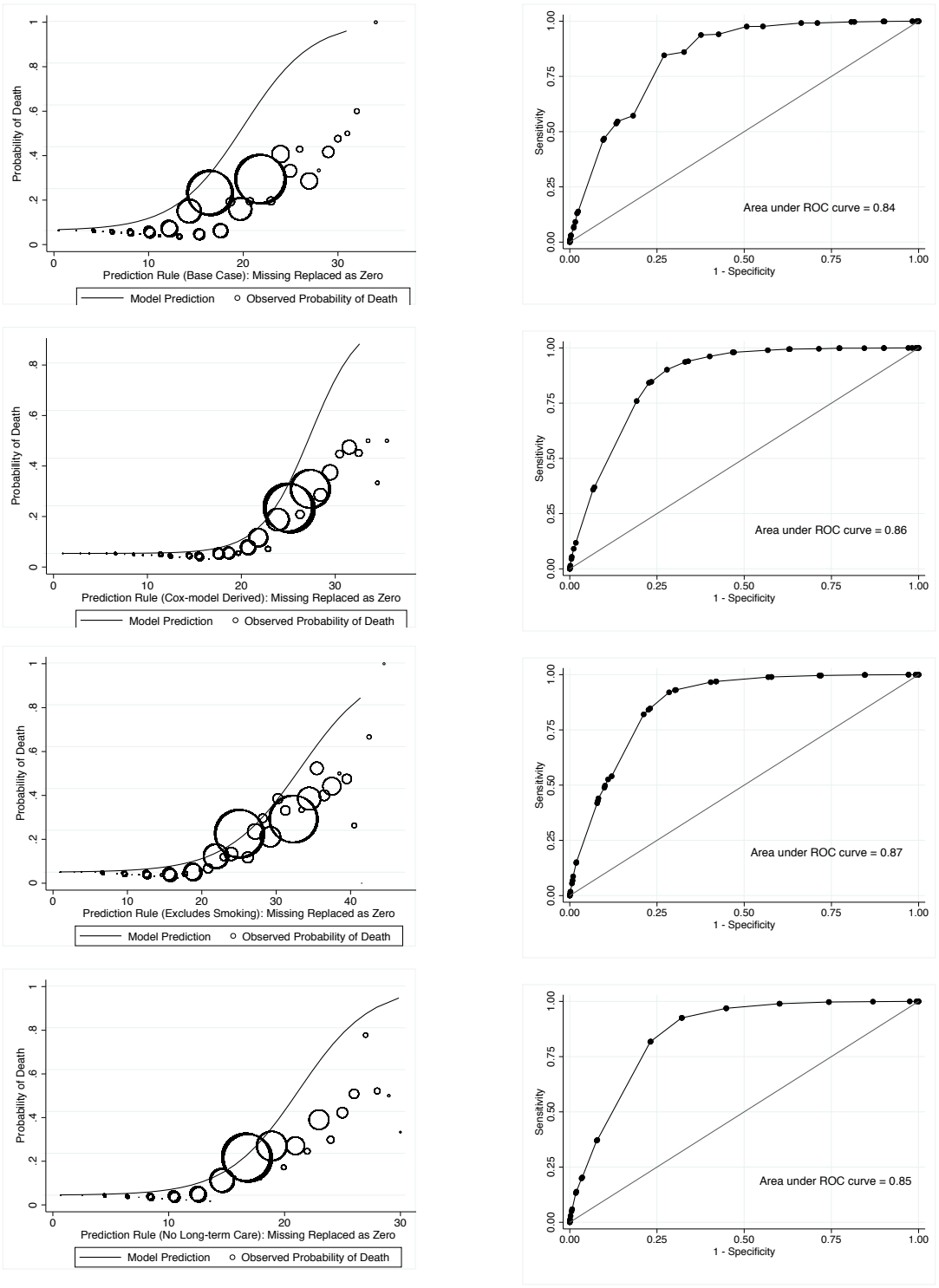


Figure 7S. Left panel figures present model calibration for all four prediction rules with missing variables replaced as zeroes. Lines represent model predictions and circles represent observed probability of death; circle size is proportionate to observed

numbers of deaths at each score level. Right panel figures represent ROC curves for the same prediction rules with missing variables replaced as zeroes.

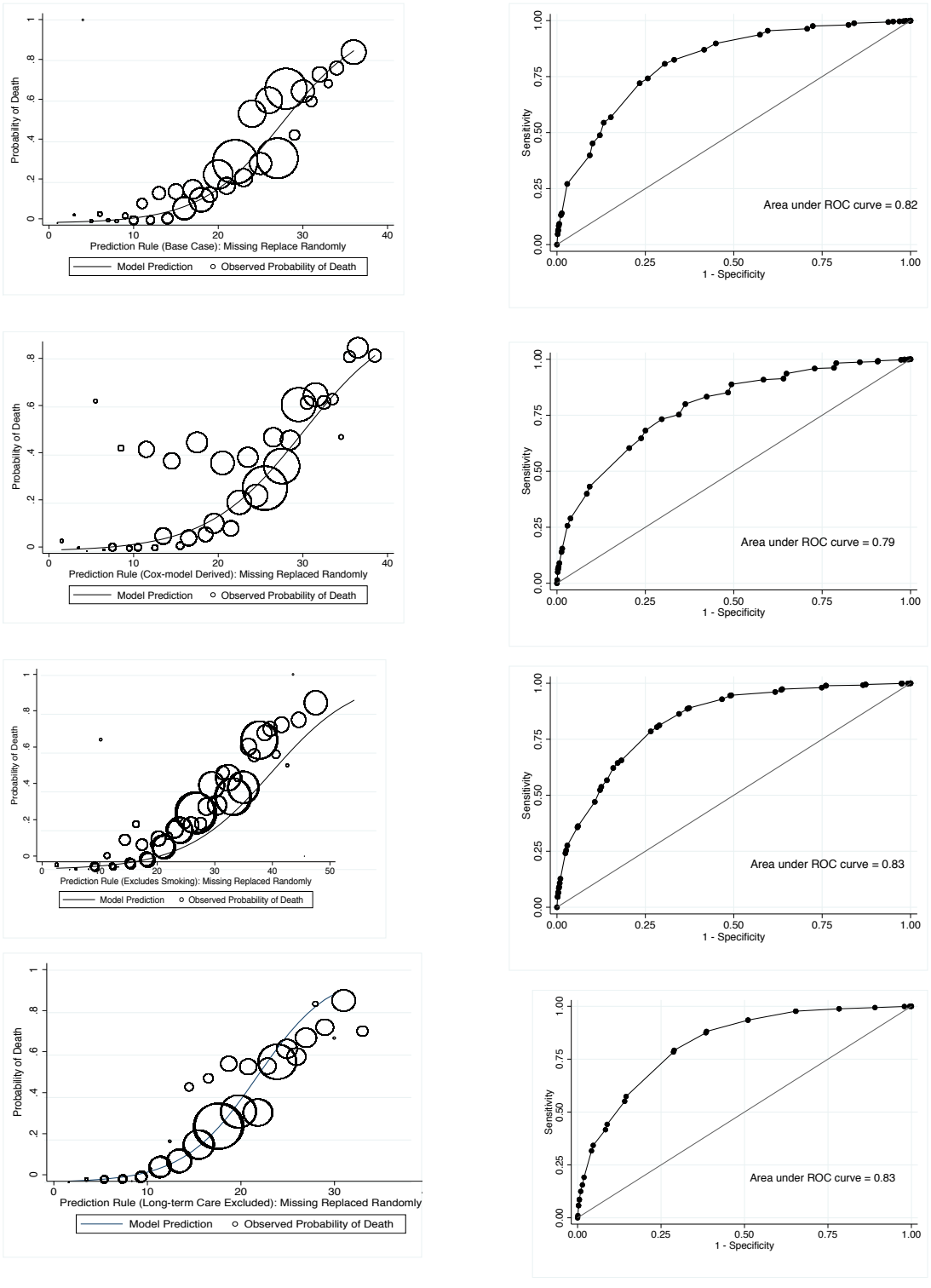


Figure 8S. Left panel figures present model calibration for all four prediction rules with missing variables replaced at random. Lines represent model predictions and circles represent observed probability of death; circle size is proportionate to observed numbers of deaths at each score level. Circles are large because missing death data has been replaced as either present or

absent, with the result that death numbers are far higher than in other analyses. Right panel figures represent ROC curves for the same prediction rules with missing variables replaced at random.

This is **Exhibit "K"** to the
Affidavit of David Fisman,
affirmed before me by videoconference
July 21, 2020

A Commissioner, etc.

Epidemiology of COVID-19: A Whirlwind Introduction

Respirology Rounds, May 29, 2020

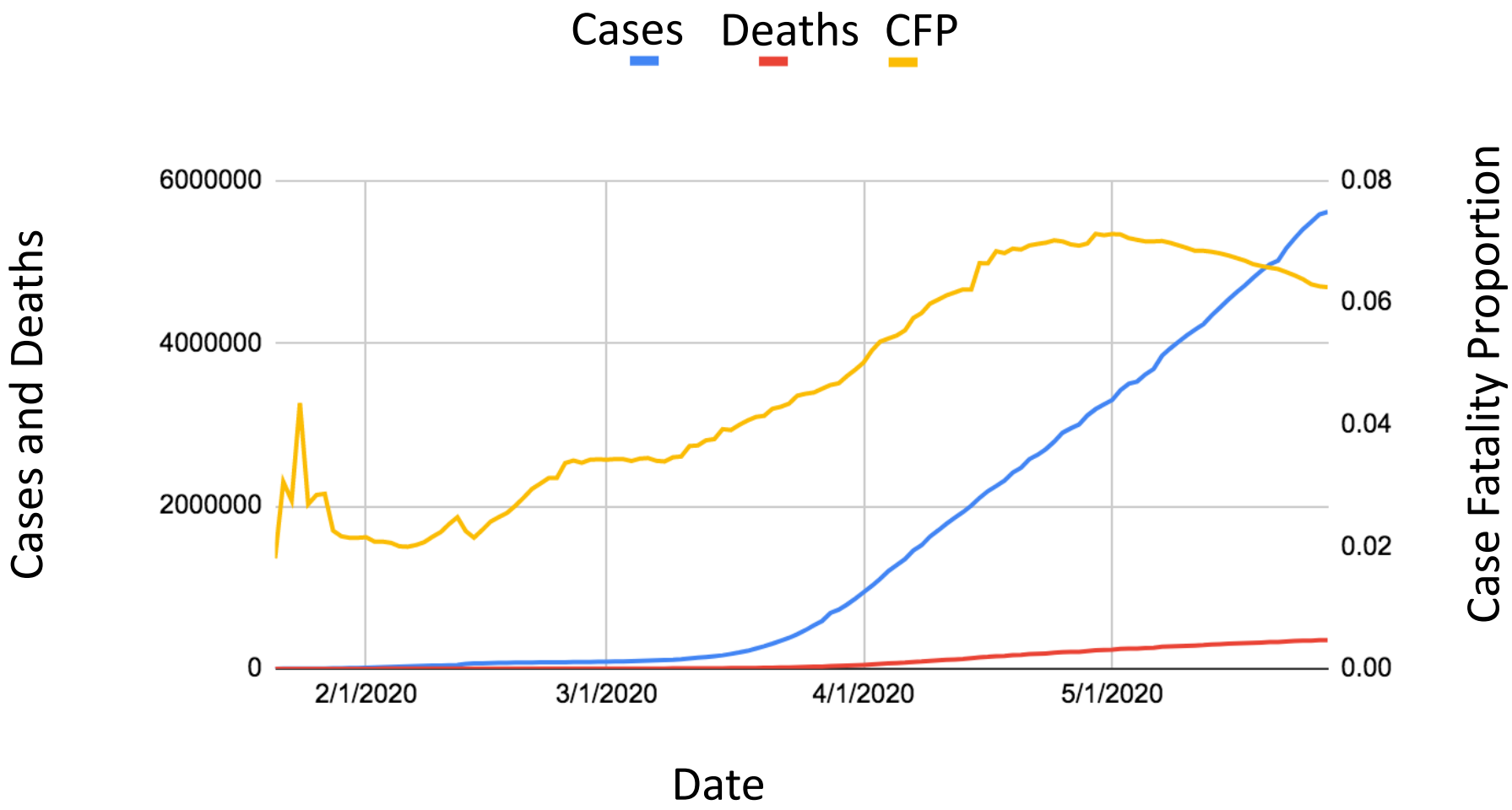
David Fisman, MD MPH FRCP(C)
Professor, Dalla Lana School of Public Health
University of Toronto

UNIVERSITY OF TORONTO

Acknowledgements

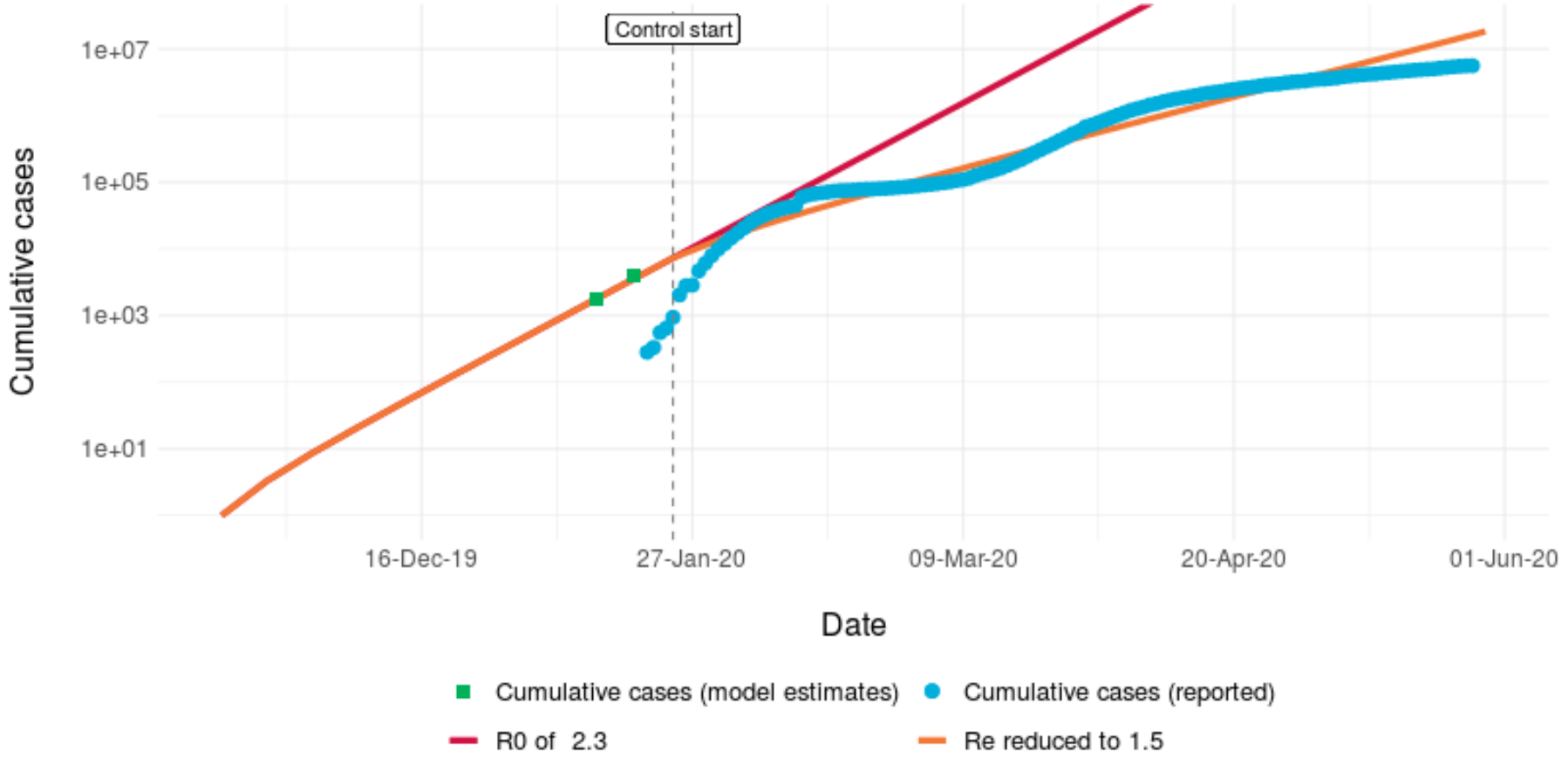
- Ashleigh Tuite, Jean-Paul Soucy, Isha Berry: University of Toronto (Canada)
- Amy Greer: University of Guelph (Canada)
- Asaph Young Chun and Paul Choi: Statistics Research Institute - Statistics Korea
- Steve de Keninck, Matrix Factory (Belgium)

Global Situation



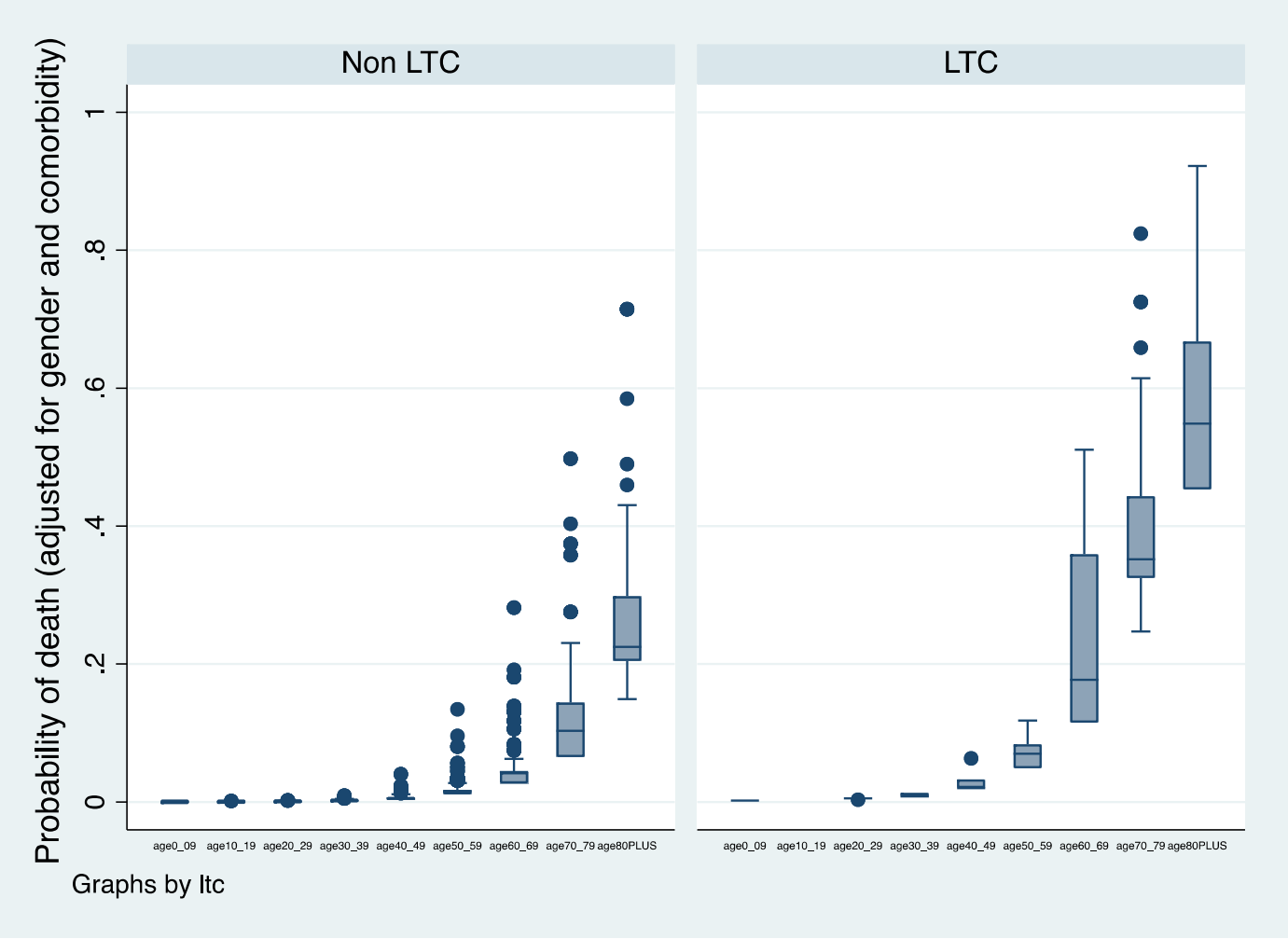
[Data source: https://bnonews.com/index.php/2020/01/the-latest-coronavirus-cases/, https://en.wikipedia.org/wiki/COVID-19_pandemic]

Reproduction Numbers

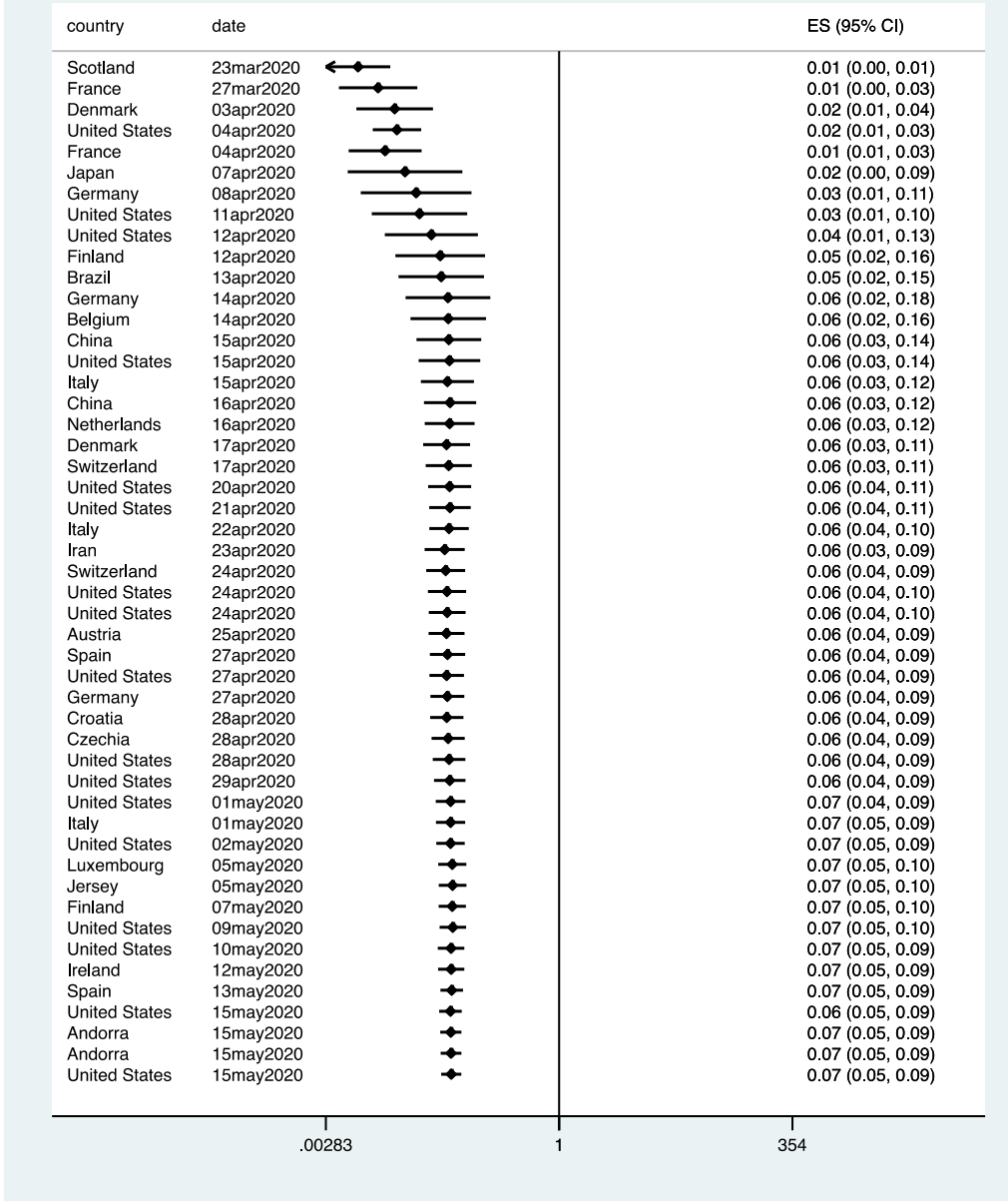


Source: https://art-bd.shinyapps.io/nCov_control/

Virulent Disease: IFR ~ 1%



Tip of the Iceberg



country	date	ES (95% CI)
Scotland	23mar2020	0.01 (0.00, 0.01)
France	27mar2020	0.01 (0.00, 0.03)
Denmark	03apr2020	0.02 (0.01, 0.04)
United States	04apr2020	0.02 (0.01, 0.03)
France	04apr2020	0.01 (0.01, 0.03)
Japan	07apr2020	0.02 (0.00, 0.09)
Germany	08apr2020	0.03 (0.01, 0.11)
United States	11apr2020	0.03 (0.01, 0.10)
United States	12apr2020	0.04 (0.01, 0.13)
Finland	12apr2020	0.05 (0.02, 0.16)
Brazil	13apr2020	0.05 (0.02, 0.15)
Germany	14apr2020	0.06 (0.02, 0.18)
Belgium	14apr2020	0.06 (0.02, 0.16)
China	15apr2020	0.06 (0.03, 0.14)
United States	15apr2020	0.06 (0.03, 0.14)
Italy	15apr2020	0.06 (0.03, 0.12)
China	16apr2020	0.06 (0.03, 0.12)
Netherlands	16apr2020	0.06 (0.03, 0.12)
Denmark	17apr2020	0.06 (0.03, 0.11)
Switzerland	17apr2020	0.06 (0.03, 0.11)
United States	20apr2020	0.06 (0.04, 0.11)
United States	21apr2020	0.06 (0.04, 0.11)
Italy	22apr2020	0.06 (0.04, 0.10)
Iran	23apr2020	0.06 (0.03, 0.09)
Switzerland	24apr2020	0.06 (0.04, 0.09)
United States	24apr2020	0.06 (0.04, 0.10)
United States	24apr2020	0.06 (0.04, 0.10)
Austria	25apr2020	0.06 (0.04, 0.09)
Spain	27apr2020	0.06 (0.04, 0.09)
United States	27apr2020	0.06 (0.04, 0.09)
Germany	27apr2020	0.06 (0.04, 0.09)
Croatia	28apr2020	0.06 (0.04, 0.09)
Czechia	28apr2020	0.06 (0.04, 0.09)
United States	28apr2020	0.06 (0.04, 0.09)
United States	29apr2020	0.06 (0.04, 0.09)
United States	01may2020	0.07 (0.04, 0.09)
Italy	01may2020	0.07 (0.05, 0.09)
United States	02may2020	0.07 (0.05, 0.09)
Luxembourg	05may2020	0.07 (0.05, 0.10)
Jersey	05may2020	0.07 (0.05, 0.10)
Finland	07may2020	0.07 (0.05, 0.10)
United States	09may2020	0.07 (0.05, 0.10)
United States	10may2020	0.07 (0.05, 0.09)
Ireland	12may2020	0.07 (0.05, 0.09)
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United States	15may2020	0.06 (0.05, 0.09)
Andorra	15may2020	0.07 (0.05, 0.09)
Andorra	15may2020	0.07 (0.05, 0.09)
United States	15may2020	0.07 (0.05, 0.09)

Canada and Ontario

Canadian Epidemiology

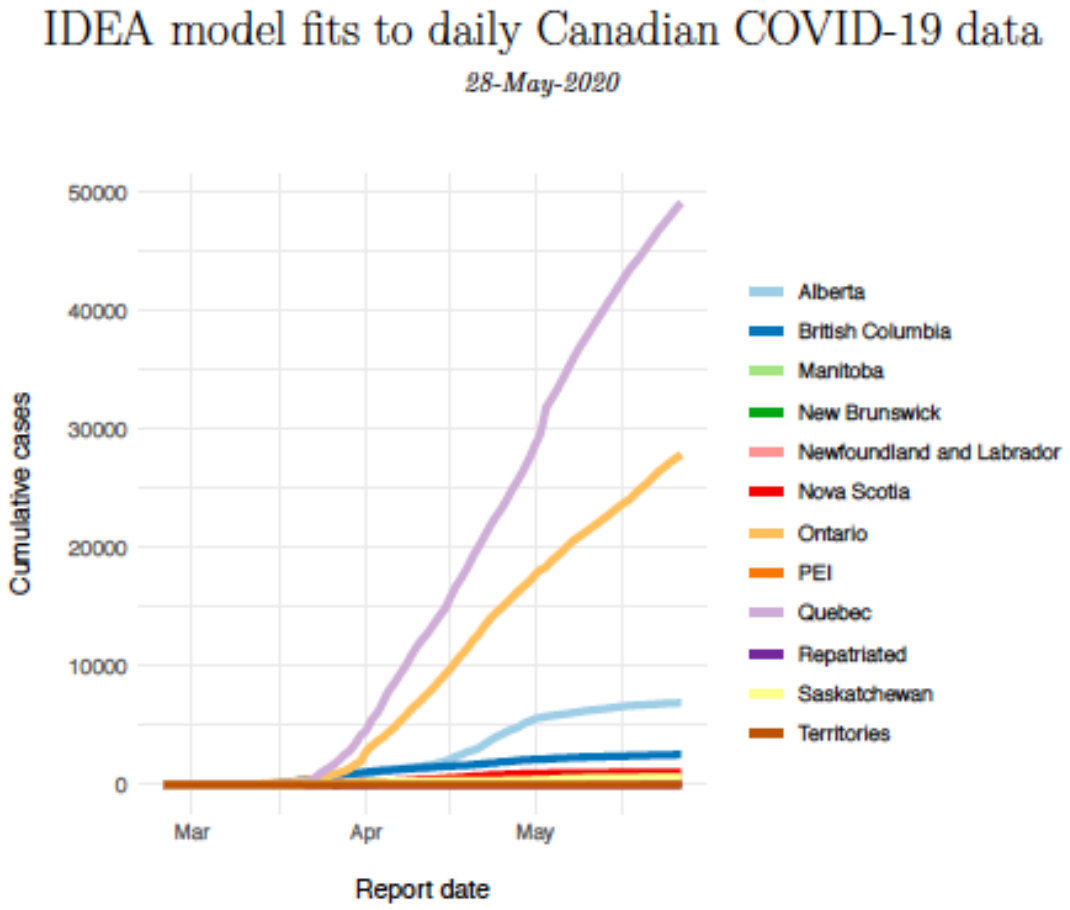
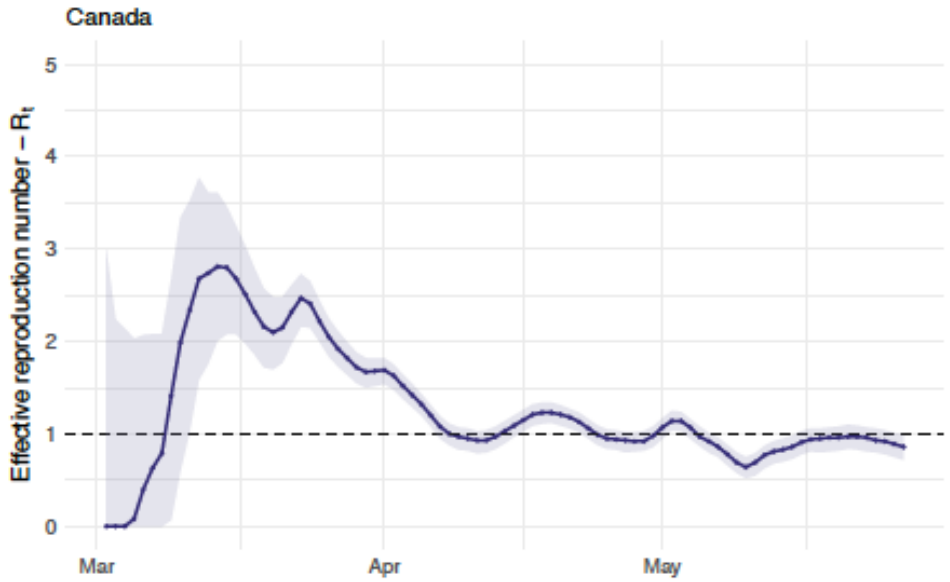


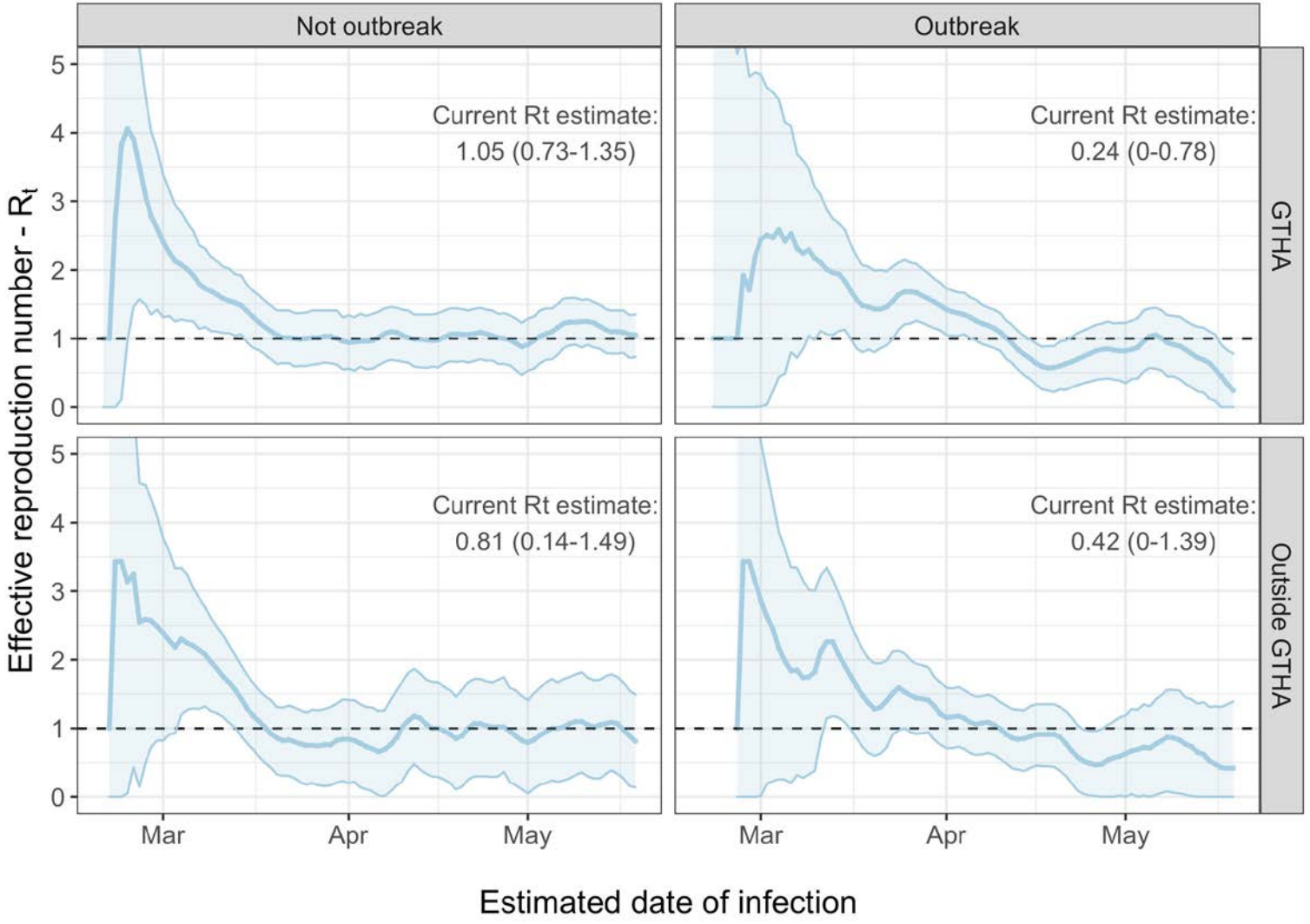
Table 1: Estimated effective reproductive numbers and 95% confidence intervals

Region	Rt	95% confidence interval
Canada	0.86	0.72-0.99
Alberta	0.81	0-1.51
British Columbia	0.72	0-1.79
Manitoba	1.00	0-4.53
New Brunswick	1.00	0-4.62
Newfoundland and Labrador	0.56	0-3.36
Nova Scotia	1.00	0-4.49
Ontario	0.79	0.57-1.01
Quebec	0.91	0.72-1.08
Saskatchewan	0.00	0-1.86

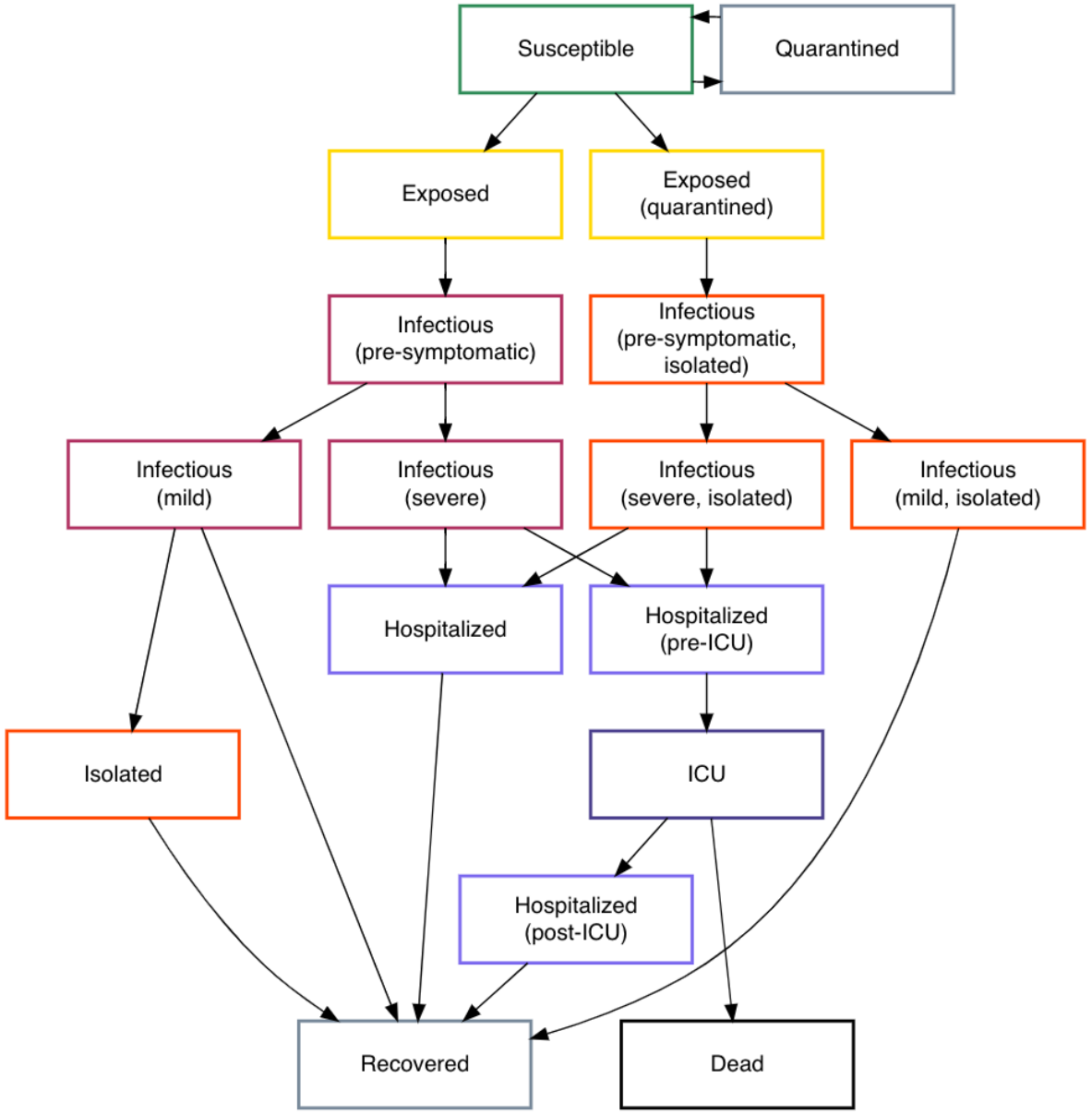


[https://art-bd.shinyapps.io/Ontario_Health_Unit_IDEA_model/]

Ontario Epidemiology

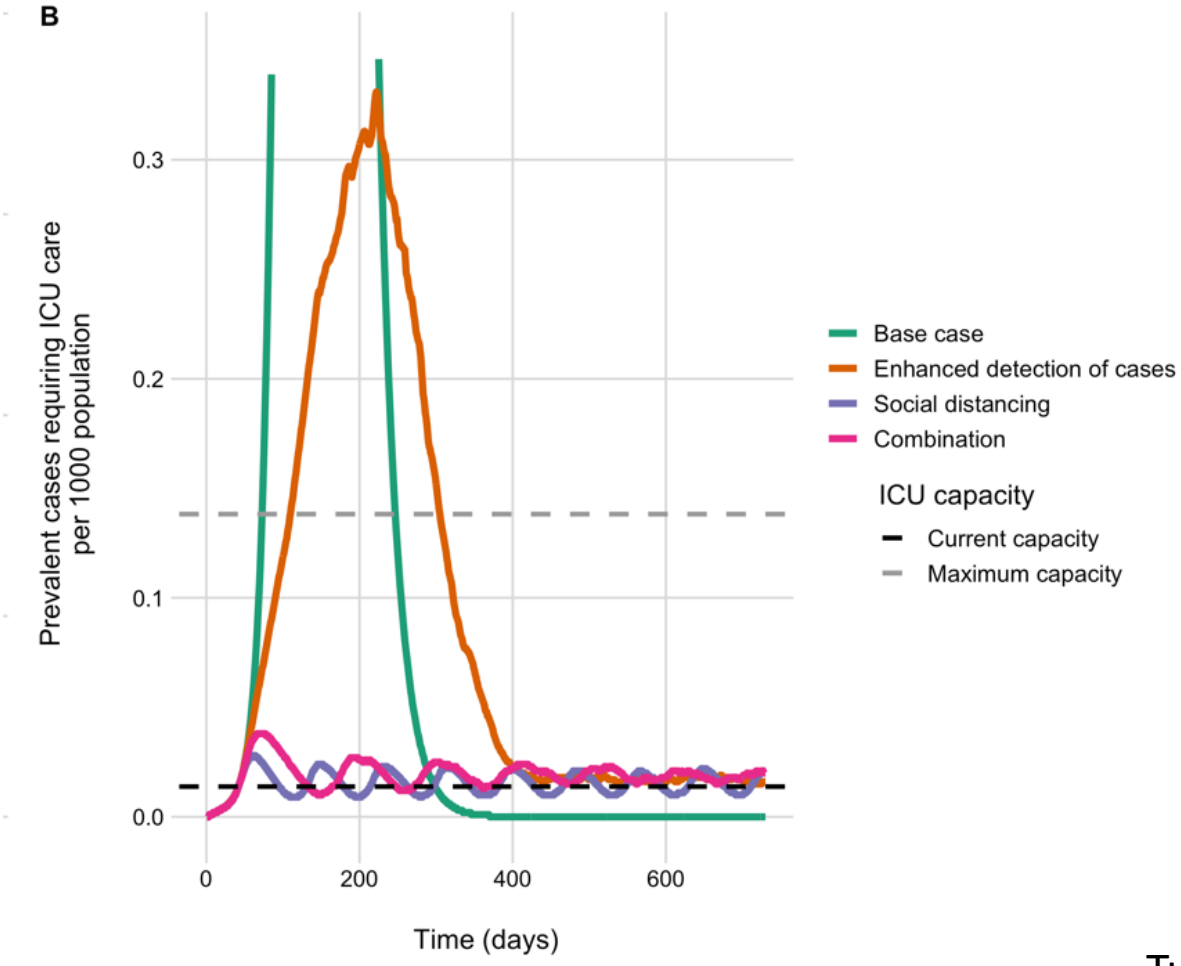


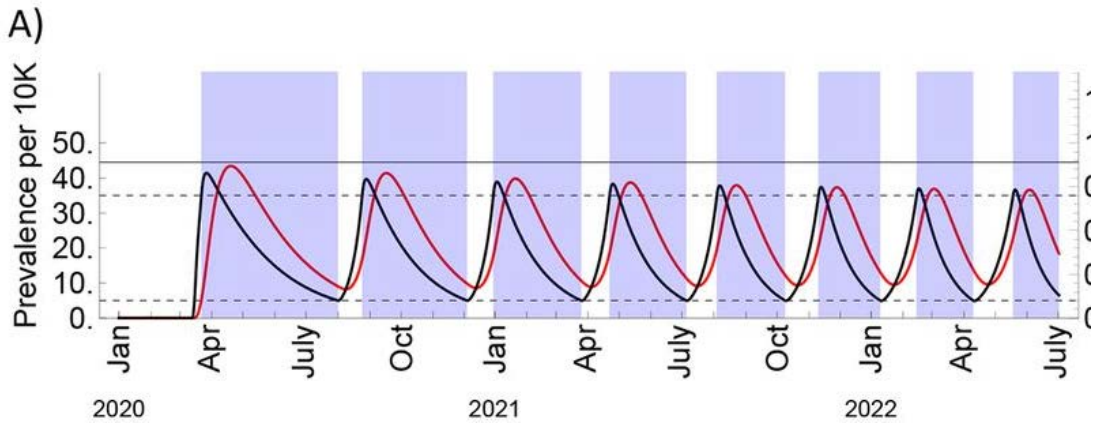
Compartmental Models



Tuite et al., CMAJ 2020

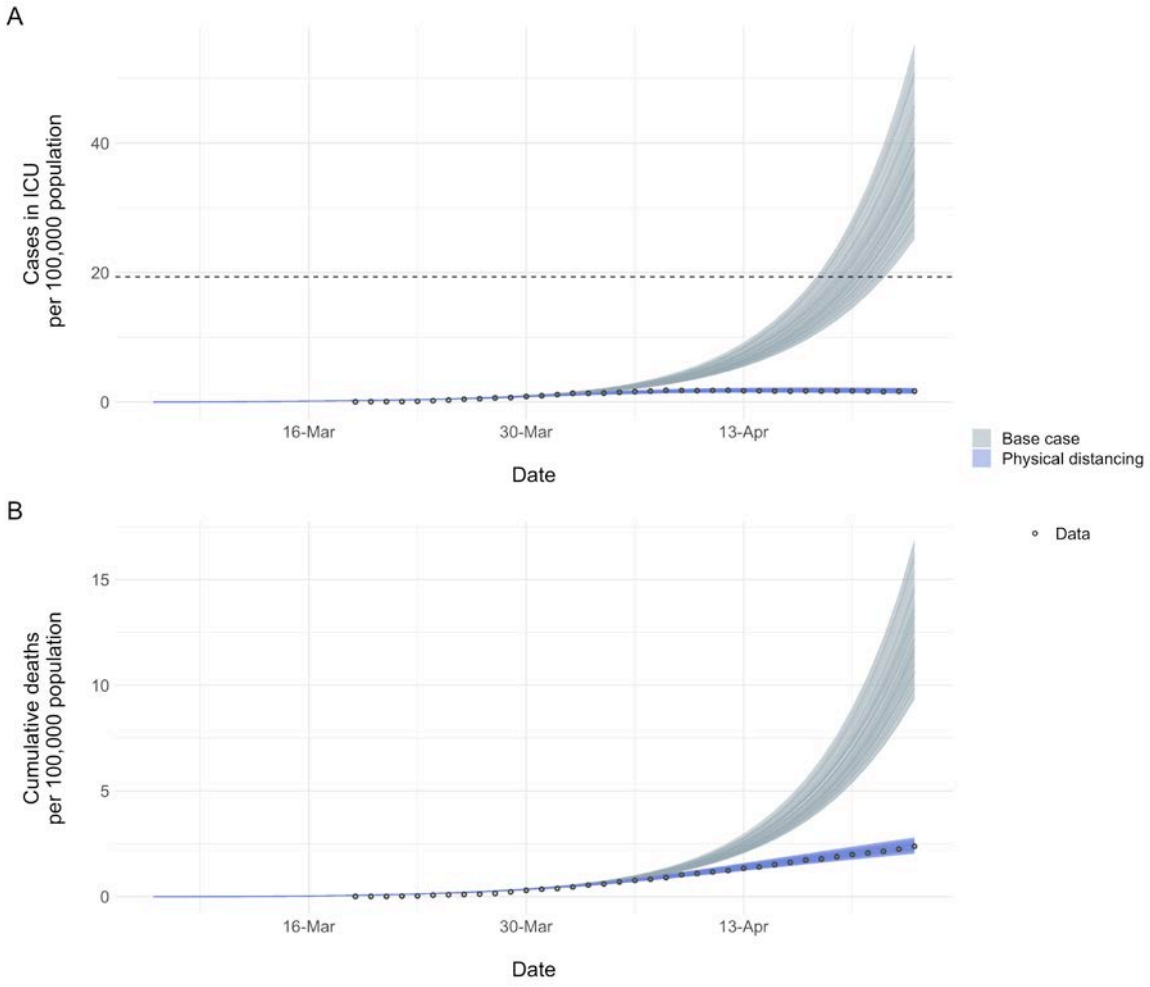
Dynamic Distancing: Paradox of Prevention

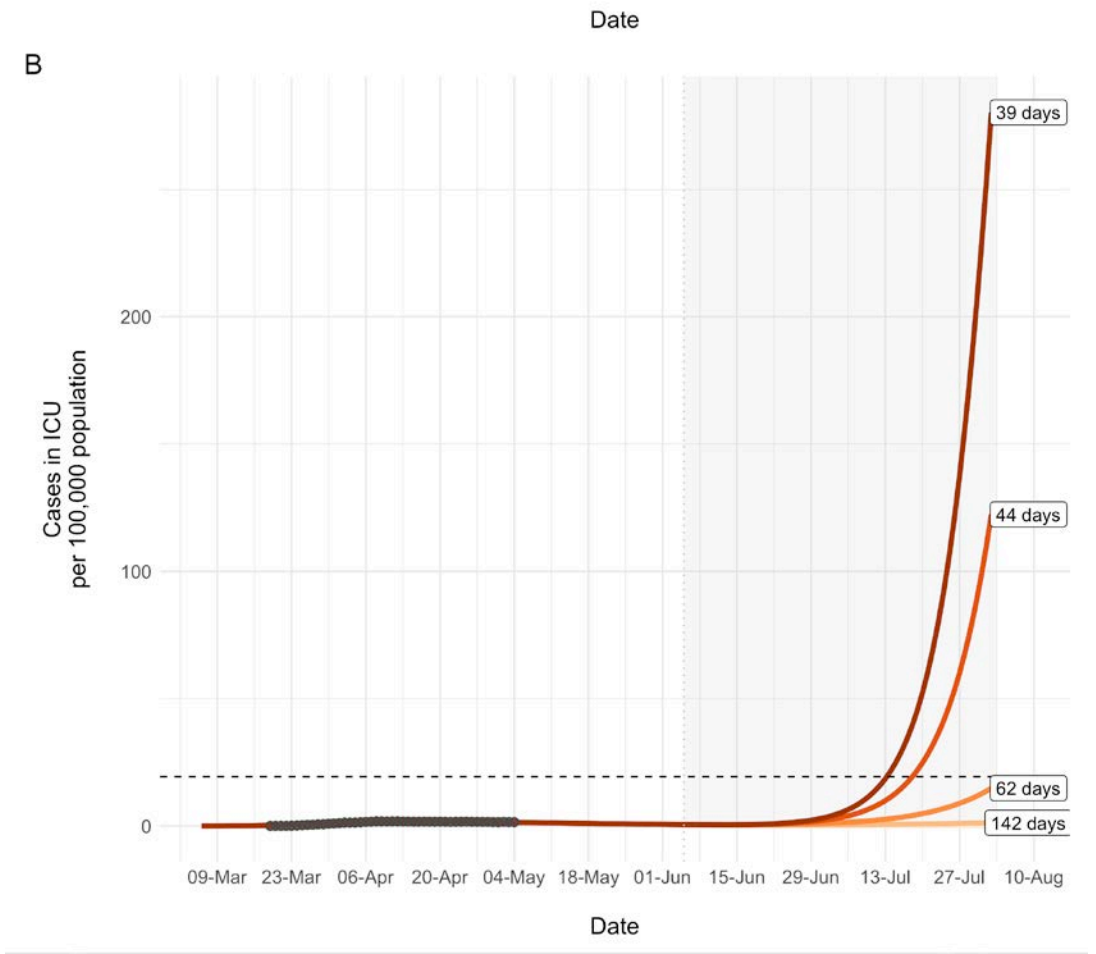




Tuite et al., CMAJ 2020; Kissler et al., Science 2020.

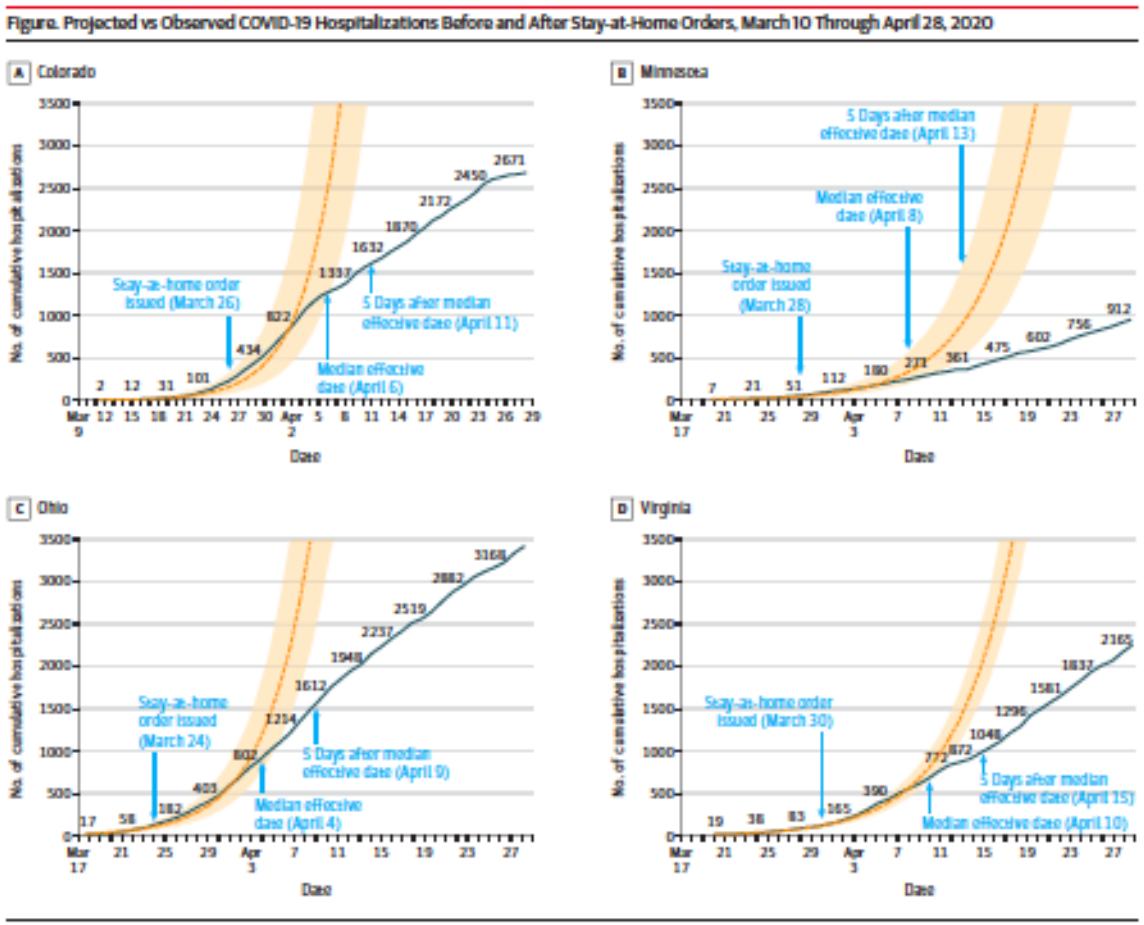
Calibrated Model: Ontario

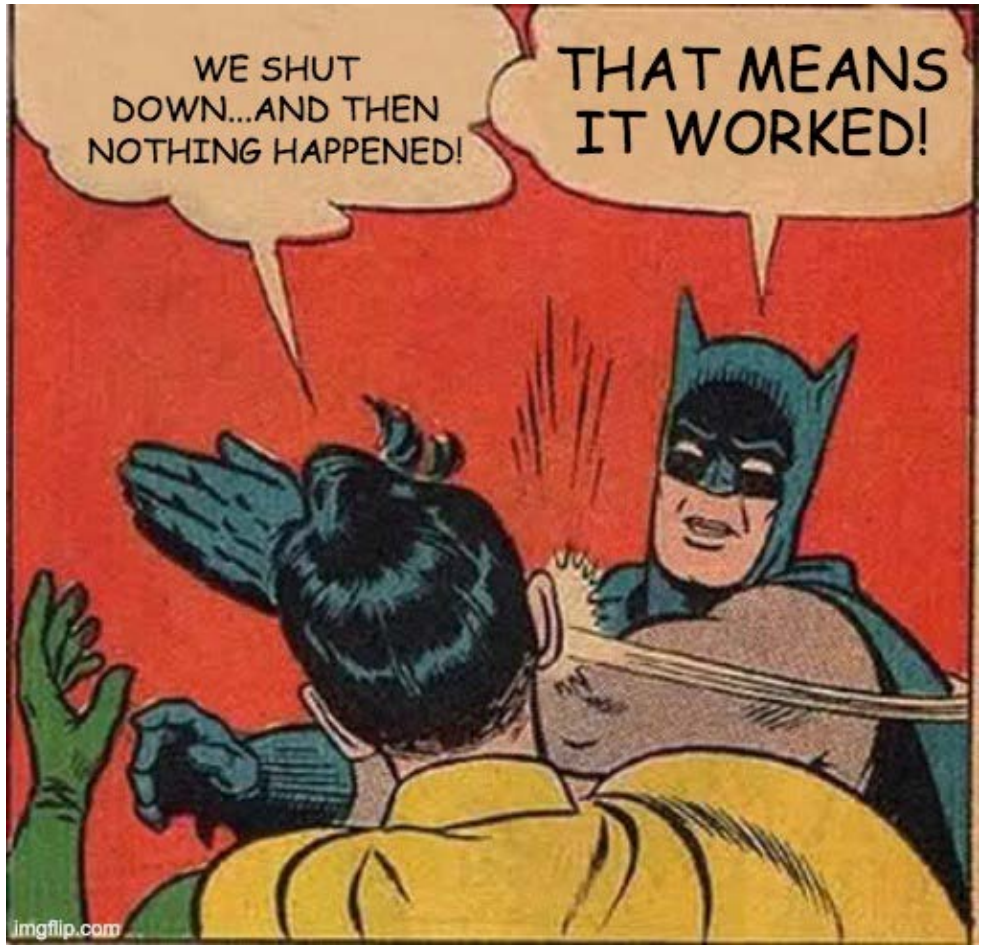




Tuite et al., Annals of Internal Med. 2020

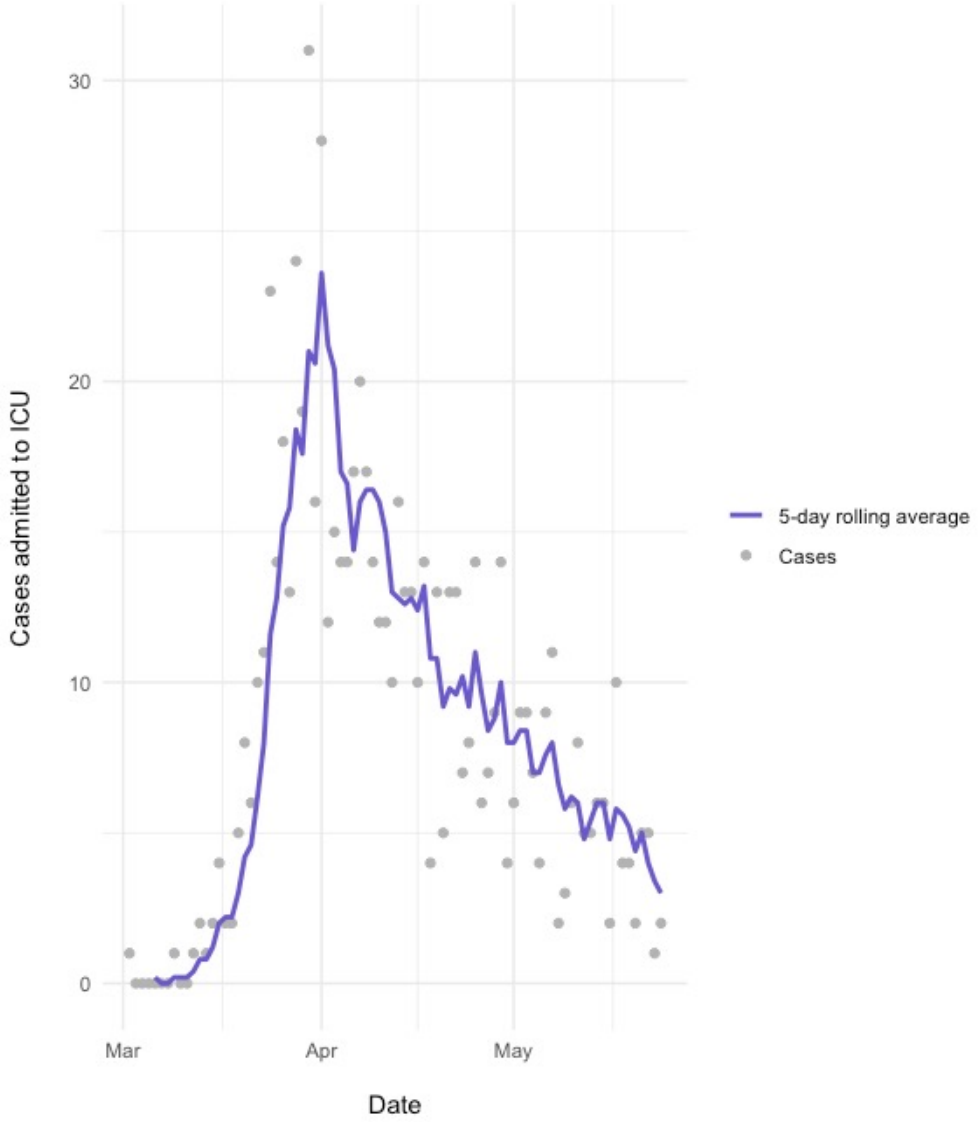
Other Similar Findings



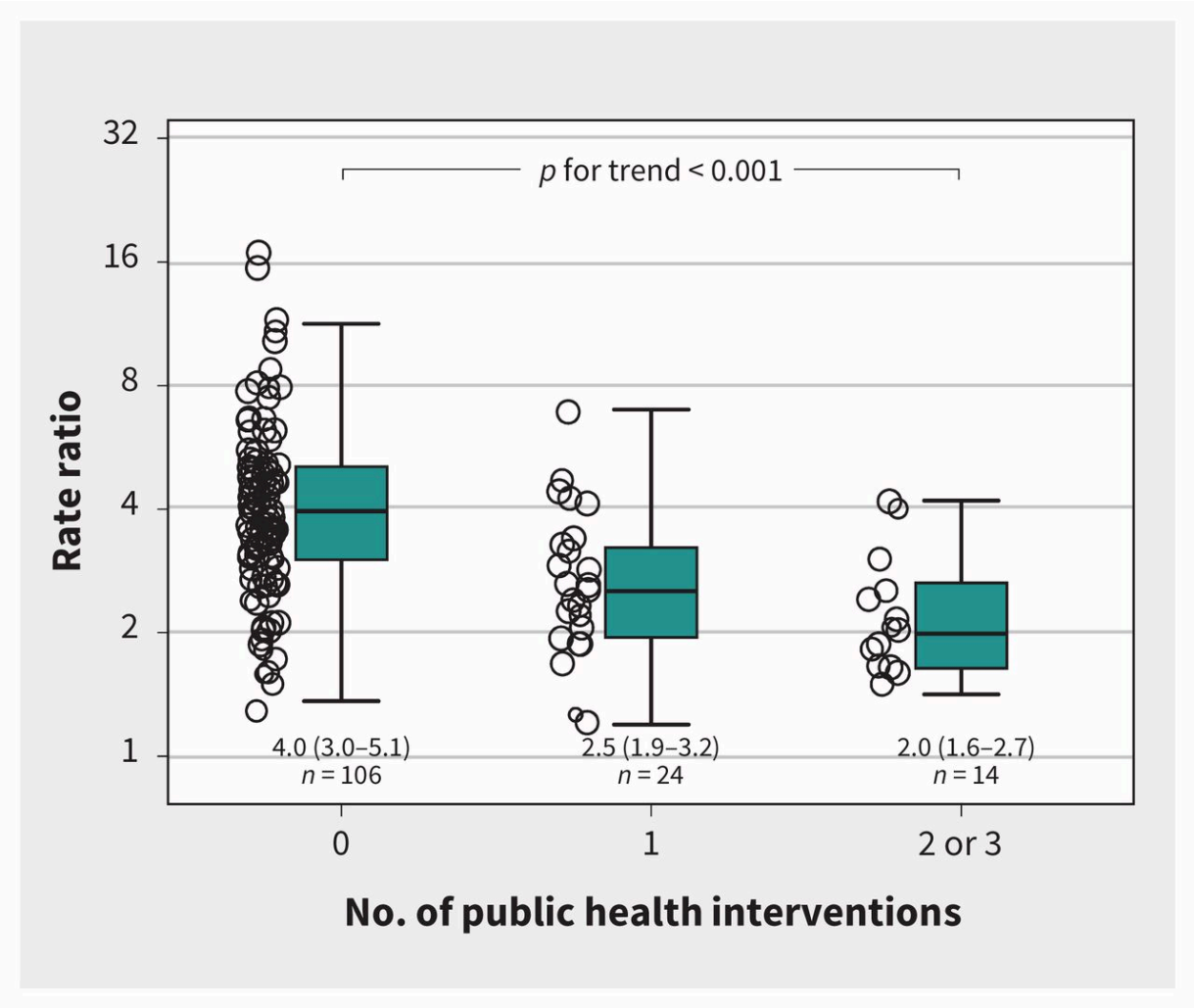


Sen et al., JAMA. 2020

We Didn’t Just Get Lucky



Bubble plot of epidemic growth against the number of public health interventions (0, 1, or 2 or more).

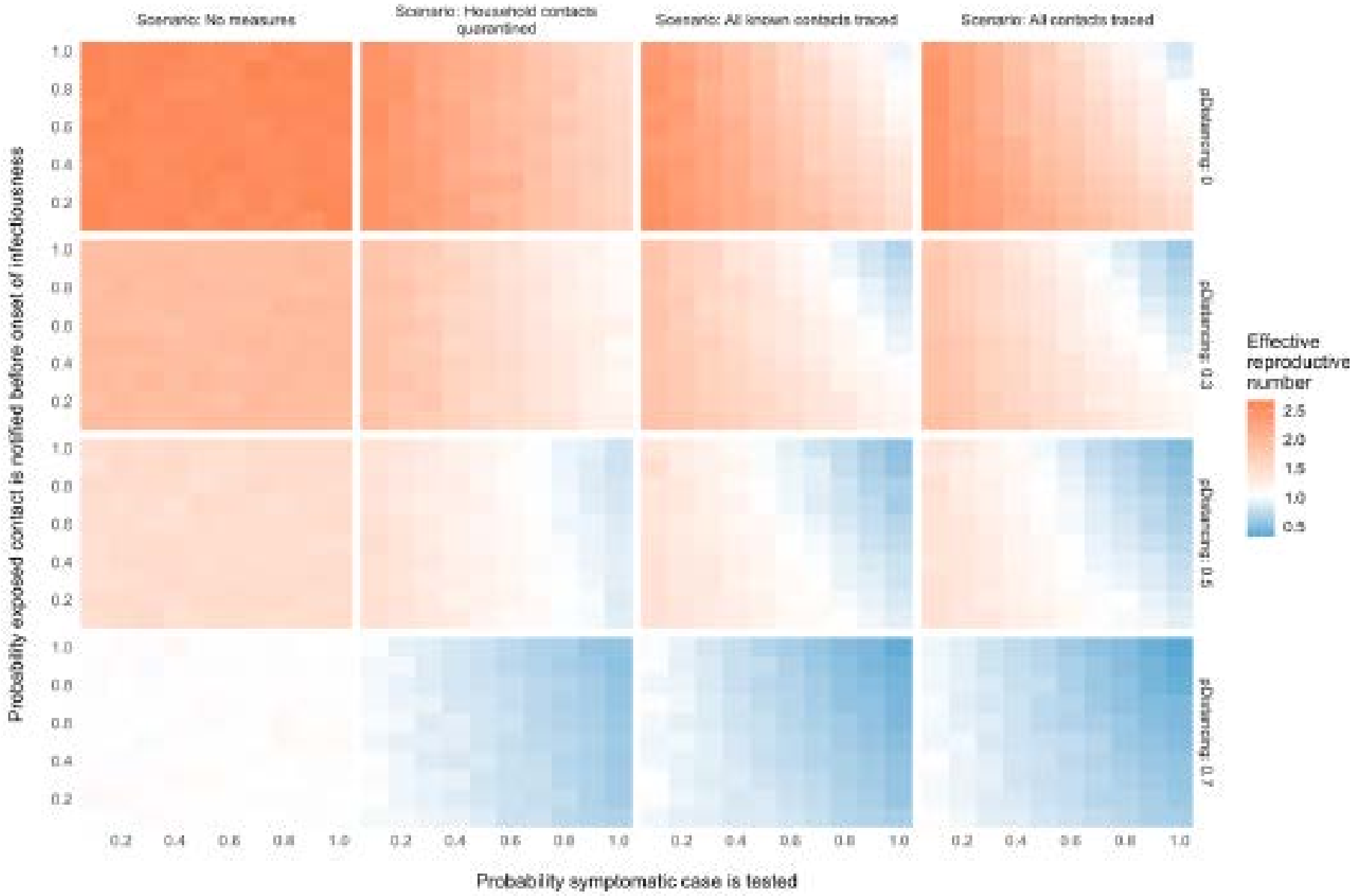


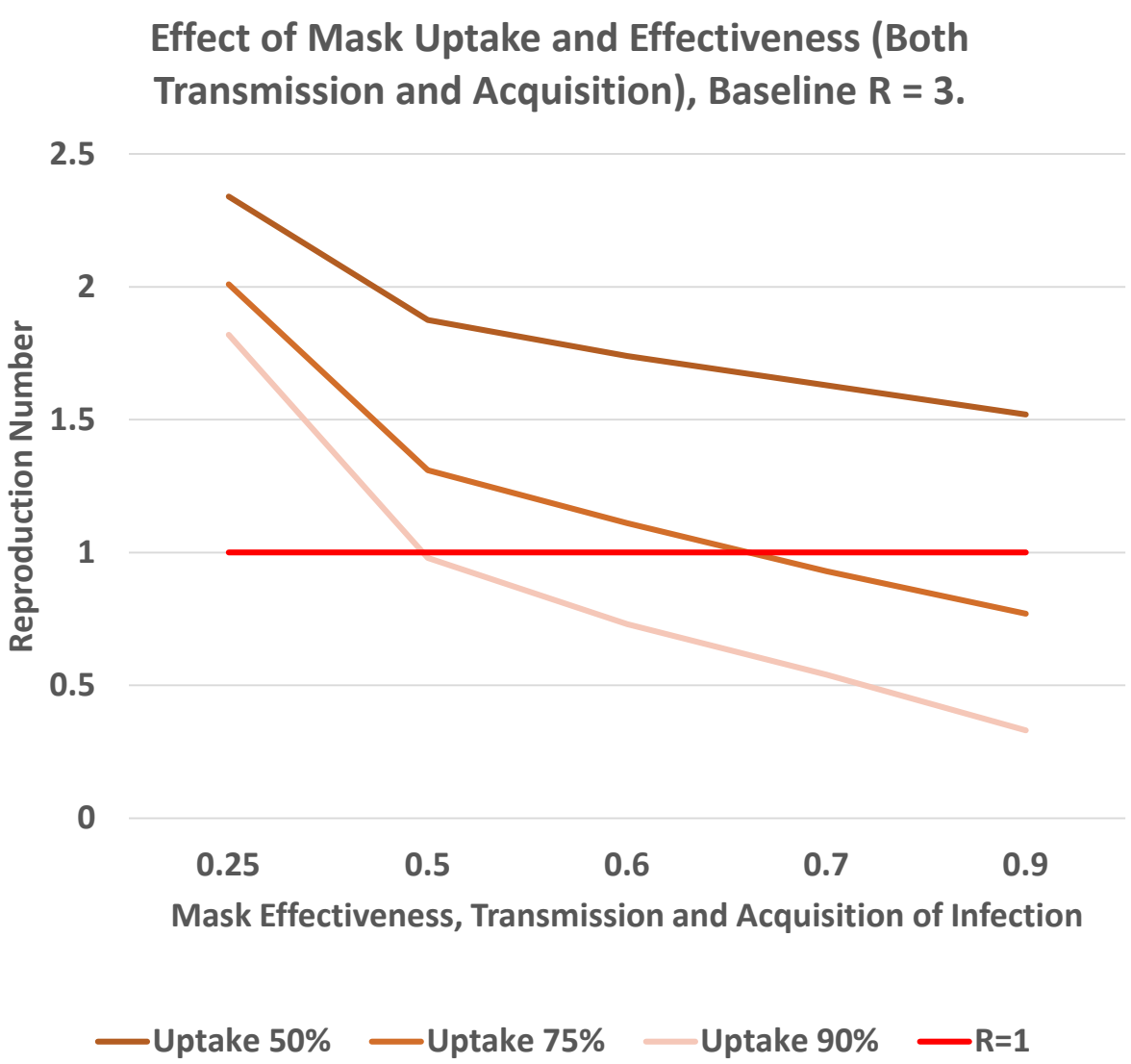
Peter Jüni et al. CMAJ 2020;192:E566-E573

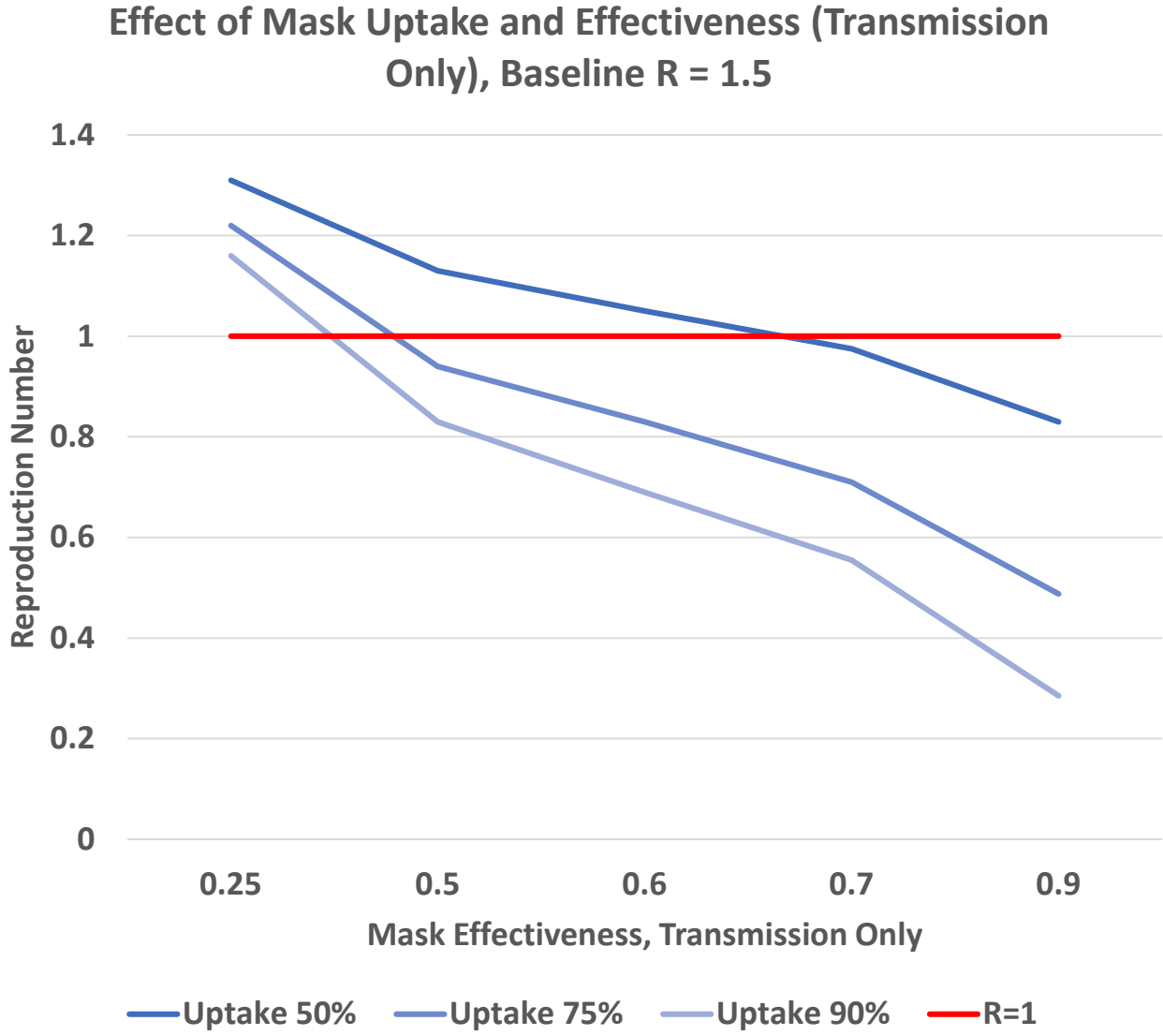
CMAJ·JAMC

Models and Economic Revitalization: Keeping R < 1, Playing Whack-a-Mole

Contact Tracing, Ontario. Slide courtesy of Dr. Ashleigh Tuite, based on work of Adam Kucharski et al.




Effect of Mask Uptake and Effectiveness (Both Transmission and Acquisition), Baseline R = 3.
Reproduction Number
2.5
2
1.5
1
0.5
0
0.25
0.5
0.6
0.7
0.9
Mask Effectiveness, Transmission and Acquisition of Infection
Uptake 50%
Uptake 75%
Uptake 90%
R=1


Effect of Mask Uptake and Effectiveness (Transmission Only), Baseline R = 1.5
Reproduction Number
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.25
0.5
0.6
0.7
0.9
Mask Effectiveness, Transmission Only
Uptake 50%
Uptake 75%
Uptake 90%
R=1

Contact Information

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This is **Exhibit "L"** to the
Affidavit of David Fisman,
affirmed before me by videoconference
July 21, 2020

A Commissioner, etc.

JOURNAL OF THE ROYAL SOCIETY Interface

J. R. Soc. Interface (2011) **8**, 756–760
doi:10.1098/rsif.2010.0494
Published online 1 December 2010

Report

Herald waves of cholera in nineteenth century London

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[2]*Departments of Anthropology, Biology and the Ancient DNA Centre,* [3]*M.G. DeGroote Institute for Infectious Disease Research, and* [4]*Department of Mathematics and Statistics, McMaster University, Hamilton, Ontario L8S 4K1, Canada*
[5]*Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario M5T 3M7, Canada*

Deaths from cholera in London, UK, were recorded weekly from 1824 to 1901. Three features of the time series stand out: (i) cholera deaths were strongly seasonal, with peak mortality almost always in the summer, (ii) the only non-summer outbreaks occurred in the spring of 1832, the autumn of 1848 and the winter of 1853, and (iii) extraordinarily severe summer outbreaks occurred in 1832, 1849, 1854 and 1866 (the four 'great' cholera years). The non-summer outbreaks of 1832, 1848 and 1853 appear to have been herald waves of newly invading cholera strains. In addition, a simple mathematical model confirms that a non-summer introduction of a new cholera strain can result in an initial herald wave, followed by a severe outbreak the following summer. Through the analysis of the genomes of nineteenth-century specimens, it may be possible to identify the strains that caused these herald waves and the well-known cholera epidemics that followed.

Keywords: London cholera; herald wave; waterborne disease model; disease seasonality; John Snow

The birth of modern epidemiology is often attributed to John Snow's famous investigation of the 1854 cholera epidemic in London, and his identification of the Broad Street pump as the most important node in the cholera transmission network [1,2]. More than 150 years later, we still do not know what factors triggered the enormous cholera outbreaks in London in the summers of 1832, 1849, 1854 and 1866. In addition to the intrinsic interest of identifying the mechanisms of historical disease invasions, improving our understanding of cholera specifically is important because it remains a serious public health concern in areas where clean water is unavailable [3]. The recent cholera epidemics in Angola in 2006 [4], Zimbabwe in 2008–2009 [5] and Haiti in 2010 [6] are stark examples.

Previous studies of nineteenth century cholera have focused on the 'great' cholera years while paying little attention to the years between severe outbreaks [7–9]. Here, we consider the great cholera years in the context of London's weekly mortality over the course of the nineteenth century as a whole. Cholera deaths were recorded in the Weekly Returns of the Registrar General's Office from 8 January 1842 to 28 December 1901 (the date on which the last cholera death was reported in London). We digitized these and earlier cholera records from the London Bills of Mortality to obtain a contiguous weekly record of cholera deaths for 77 years from 24 August 1824 to 28 December 1901.

Figure 1 displays the London cholera data in two ways. Figure 1*a* shows the weekly time series, while Figure 1*b* shows an intensity plot of week-of-year against year to bring out the pattern of seasonality over the years. The three striking features highlighted above are readily apparent: (i) London's cholera epidemics were strongly seasonal and most intense in the summer, (ii) typical outbreaks were far milder than the devastating outbreaks in the summers of 1832, 1849, 1854 and 1866, and (iii) atypically timed outbreaks occurred in the few months preceding the major outbreaks in 1832, 1849 and 1854. The data clearly separate into regular, mild summer outbreaks, together with outliers corresponding to the non-summer outbreaks and the great cholera years. These features persist when cholera deaths are normalized to account for changes in population size and reporting coverage over the century (see figure 2 and the electronic supplementary material).

What factors might have been responsible for the unusual timing of the non-summer outbreaks in 1832, 1848 and 1853, and the unusual severity of the outbreaks in the following summers? The most obvious hypothesis is that these features of the London cholera time series resulted from the introduction of new cholera strains into the city at random times of year. It is natural to expect that a non-summer introduction would result in an initial outbreak, with severity tempered by the season [10], followed by a severe outbreak in the summer when environmental conditions most strongly promote cholera transmission. The non-summer outbreaks thus appear to have 'heralded' the arrival of new cholera strains in London in 1832, 1848 and 1853. The absense of a 'herald wave' before the major epidemic in 1866 may simply reflect the invasion of a new strain coincidentally near the start of the normal cholera season that year.

The idea of herald waves has largely been confined to influenza [11], where it has been discussed extensively in relation to the 1918 [12–14] and 2009 [15,16] pandemics. To our knowledge, herald waves have never been described for cholera. Our finding of herald waves for London cholera suggests that herald waves may be a common feature of seasonal diseases.

We note that the identity and origins of new cholera strains in the nineteenth century are not known. Current

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Electronic supplementary material is available at http://dx.doi.org/10.1098/rsif.2010.0494 or via http://rsif.royalsocietypublishing.org.

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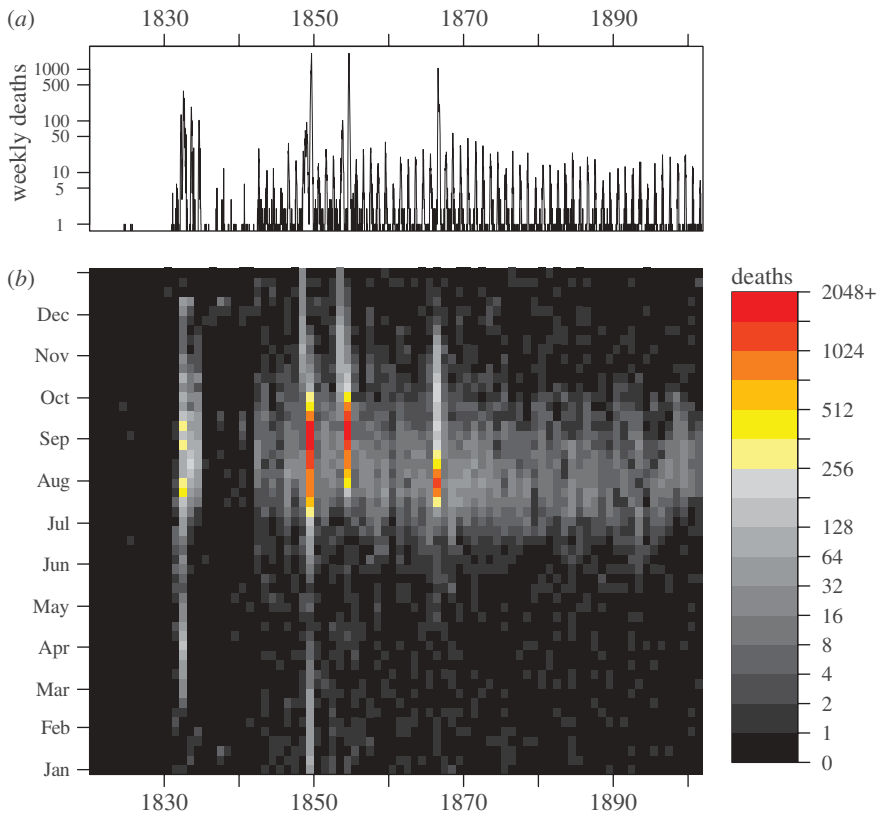

Figure 1. Weekly London cholera deaths from 1824 to 1901. (*a*) Weekly cholera deaths versus time and (*b*) cholera deaths versus time of year.

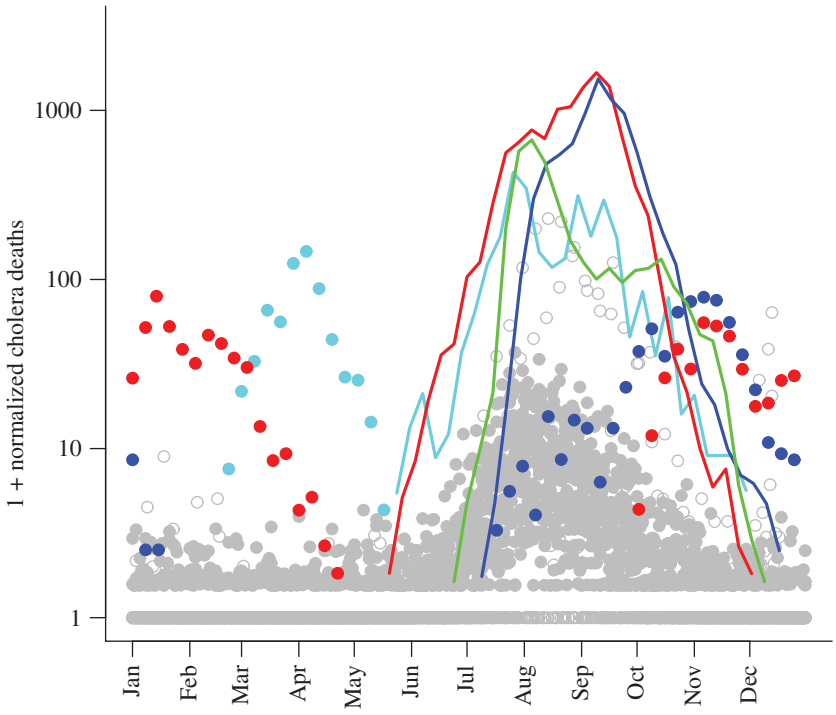

Figure 2. Weekly cholera deaths, normalized by all-cause mortality and plotted against time of year. Open circles correspond to Bills of Mortality data (years prior to 1842), filled circles to Registrar General data (1842 onwards). Filled light blue circles, 1832 herald; solid light blue line, 1832 summer; filled red circles, 1848 herald; solid red line, 1849 summer; filled dark blue circles, 1853 herald; solid dark blue line, 1854 summer; solid green line, 1866 summer.

evolution of new cholera strains appears to be facilitated by horizontal gene transfer among strains in different serogroups ([17]; see the electronic supplementary material). This mechanism might also account for the invasion of antigenically novel strains in the nineteenth century. Cyclical replacement of the predominant cholera serotype has also been observed [18], and may be relevant for London cholera.

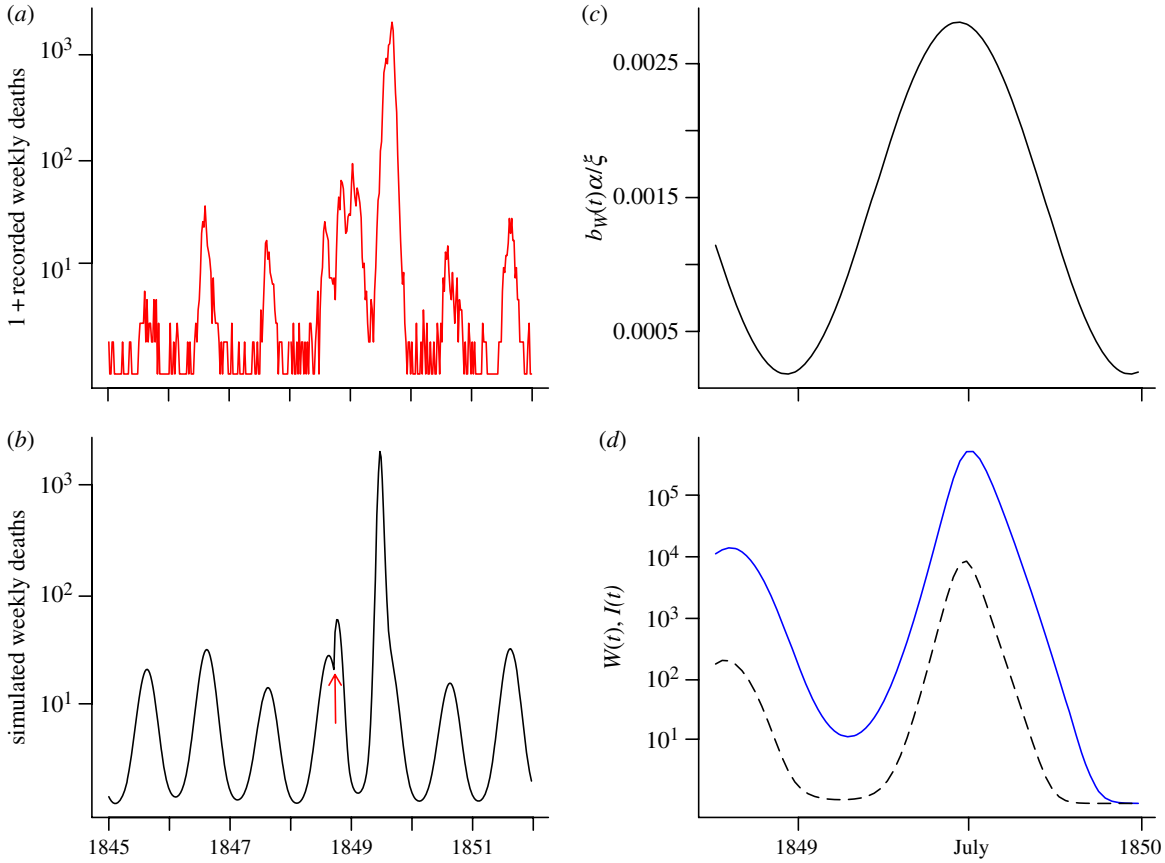

Figure 3. Model simulations of London cholera, compared with observed cholera deaths. (*a*) Observed weekly deaths from 1845 to 1852. (*b*) Simulation results corresponding to endemic cholera, together with the introduction of a new cholera strain in late September 1848 (arrow). (*c*) Seasonal variation in model disease transmission. (*d*) Simulated time courses of pathogen concentration in the water source ($W(t)$, in cells per millilitre) and individuals infected with the invading strain $I(t)$. $W(t)$ = solid blue curve, $I(t)$ = dashed black curve.

We used a simple mathematical model to verify theoretically that a non-summer introduction of a new cholera strain can result in a herald wave followed by a severe outbreak in the summer. The model extends the classical 'susceptible–infectious–recovered' (SIR) framework to include a water compartment (W), with transmission occurring through both person–person and person–water–person pathways ([19]; see appendix A for model equations).

As an example, figure 3 compares the London cholera mortality time series from 1845 to 1852 (figure 3*a*) with an SIWR simulation (figure 3*b*). Assuming the transmission rate in the water varies seasonally (peaking in the summer, as in figure 3*c*), simulated cholera time series resemble the typical pattern in London, with mild annual summer outbreaks (as in the period 1845–1848 in figure 3*b*). The arrow in figure 3*b* indicates the time at which we introduced a new cholera strain into the SIWR model (the end of September 1848). The population is completely susceptible to the new strain, resulting in an initial outbreak when the strain is introduced. However, owing to the season [10], disease transmissibility is waning at the time of introduction. Eventually transmission decreases past the point where an outbreak can be sustained (and the initial herald wave terminates), but the new cholera strain persists at low levels in the water (figure 3*d*).

Table 1. Variables for system (A 1), together with initial conditions used for simulations of endemic and introduced London cholera (figure 3).

		initial conditions	
		endemic	introduced
S	susceptible individuals	19 006	100 000
I	infected individuals	3	0
R	recovered individuals	80 991	0
W	pathogen concentration in water reservoir (cells ml^{-1})	610	14 000
D	individuals who have died from the disease	0	0
N	total population size	100 000	100 000

When transmissibility from the water rises again the following summer, it triggers an unusually severe epidemic owing to the large number of susceptible individuals (simulation details given in appendix A).

While the strain invasion hypothesis is simple—and appealing from the point of view of parsimony—many other explanations are possible, including misdiagnosis involving other diarrhoeal diseases. A direct test of the strain invasion hypothesis would require genetic information from the circulating cholera strains. Relevant

Table 2. Parameters for system (A 1), including values used for simulations of endemic and introduced London cholera (figure 3).

		units	endemic	introduced
demographic parameters				
ν	birth rate	yr^{-1}	0.044	0.044
μ	natural death rate	yr^{-1}	0.033	0.033
pathogen parameters				
γ^{-1}	mean infectious period	days	3	3
ξ^{-1}	mean pathogen lifetime in water reservoir	weeks	2	1
f	case fatality proportion	—	0.1	0.1
contact parameters				
b_I	person–person contact rate	$\mathrm{individuals}^{-1}\ \mathrm{yr}^{-1}$	9.12×10^{-4}	3.65×10^{-4}
α	rate of pathogen shedding into reservoir	$\mathrm{cells\ ml}^{-1}\ \mathrm{yr}^{-1}\ \mathrm{individuals}^{-1}$	3650	3650
$b_W(t)$	reservoir–person contact rate	$\mathrm{ml\ cells}^{-1}\ \mathrm{yr}^{-1}$		
B	average value of $b_W(t)$	$\mathrm{ml\ cells}^{-1}\ \mathrm{yr}^{-1}$	3.9×10^{-5}	2.14×10^{-5}
A	amplitude of seasonality of $b_W(t)$	—	0.5	0.88
t_1	time of maximum seasonal transmissibility	year	0.41 (May 31)	0.47 (June 20)
T	period of seasonal forcing	years	1	1

tissue samples from patients who died of cholera do exist in museum collections, and recent advances in the recovery and sequencing of DNA as well as the reconstruction of complete genomes from fossil materials [20,21] make sequencing substantial portions of the genomes of nineteenth century cholera strains a realistic goal (see the electronic supplementary material).

Given the fame and historical importance of the four major London cholera epidemics in the nineteenth century, it is surprising that the herald waves we have identified here have not been highlighted previously. Unravelling the mechanisms behind these herald waves will deepen our understanding of the evolutionary and ecological history of this important disease, and in turn help us understand the factors underlying severe cholera outbreaks in modern times. Our study of London cholera also suggests that herald waves may occur for more diseases than has been previously realized, and emphasizes the need for further work examining the relationship between the timing and magnitude of seasonal outbreaks [10]. The systematic digitization of lengthy historical records of disease incidence and mortality will be invaluable for this endeavour. In particular, evidence that herald waves have preceded major epidemics of other diseases may be hidden in untapped historical sources.

Many people deserve thanks for contributing to the acquisition and digitization of London's weekly mortality records, especially Kelly Hancock, Susan Marsh-Rollo, James McDonald and David Richardson. We thank Alison Devault for valuable discussions regarding cholera evolution and archival cholera samples. This project was funded primarily by a grant to D.J.D.E. from the J. S. McDonnell Foundation. D.J.D.E. and H.N.P. also thank NSERC and CIHR.

APPENDIX A. MATHEMATICAL MODEL

A.1. Model equations

Our SIWR model for waterborne disease modelling is expressed as a simple system of ordinary differential equations [19],

$$\left.\begin{aligned} \dot{S} &= \nu N - b_W(t)SW - b_I SI - \mu S, \\ \dot{I} &= b_W(t)SW + b_I SI - \gamma I - \mu I, \\ \dot{W} &= \alpha I - \xi W, \\ \dot{R} &= (1-f)\gamma I - \mu R, \\ \dot{D} &= f\gamma I, \end{aligned}\right\} \qquad (A\,1)$$

where the host population is divided into susceptible (S), infectious (I) and recovered (R) compartments. The variable W tracks pathogen concentration in a water compartment (e.g. the River Thames and natural wells), and D is the number of individuals killed by the disease. Recovered individuals are immune to further infection. The total host population size is $N = S + I + R$. The parameter ν is the birth rate, μ is the natural death rate, $1/\gamma$ is the mean infectious period and $1/\xi$ is the mean pathogen lifetime in the water compartment. The parameter α is the pathogen shedding rate into the water, and f is the case fatality proportion. Disease transmission can occur either through person–person contact, with rate parameter b_I, or through the water, with rate parameter $b_W(t)$. Seasonality in waterborne transmission is modelled using sinusoidal forcing,

$$b_W(t) = B\left(1 + A\cos\left[\frac{2\pi(t-t_1)}{T}\right]\right) \qquad (A\,2)$$

A.2. Simulation details

Model variables and parameters for system (A 1) are summarized in tables 1 and 2, together with initial conditions and parameter values for simulating endemic and introduced cholera (figure 3). The birth and natural death rates were chosen to match London's population growth between 1801 and 1901 (http://www.demographia.com/dm-lon31.htm). An expected infectious period of 3 days was used in the model (the typical infectious period is 1–5 days for cholera patients [22]). The ability of *Vibrio cholerae* to persist outside of human hosts depends upon environmental factors such as salinity [23] and temperature

[24]. Under appropriate conditions, *V. cholerae* can persist for extended periods of time in environmental water sources [25]. Here, we model the expected pathogen lifetime in the water to be of the order of one to two weeks. Case fatality rates for cholera in modern times range from a few per cent to as high as 50 per cent [26], and was fixed at 10 per cent for our model. We set α, the rate at which infected individuals shed pathogen into the water compartment, to 10 cells $\mathrm{ml}^{-1}\,\mathrm{d}^{-1}$, a value that has been used in previous modelling efforts [27,28]. The transmission parameters were tuned to give reasonable fits to the cholera mortality data. This tuning was accomplished by first locating a periodic orbit for the model when $\nu = \mu$, such that this orbit matched the general seasonal pattern of London cholera in 'typical' years. Initial conditions for endemic cholera were taken from this periodic orbit. An initial population size of 100 000 was used in the simulations, rather than the population size of the entire city of London, since only a portion of the city's population was at risk for cholera (e.g. John Snow's finding that Vauxhall and Southwark Waterworks customers were at greatly elevated risk of infection [29]).

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This is **Exhibit "M"** to the
Affidavit of David Fisman,
affirmed before me by videoconference
July 21, 2020

A Commissioner, etc.

predictive of poor outcome.[3] Hypothermia can decrease the rise in NSE levels and may lead to reduced sensitivity for poor outcome, but the drop in NSE levels in patients who have had hypothermic treatment may also reflect increased neuroprotection.[4] It seems unlikely that NSE levels would rise after hypothermic treatment to produce a higher rate of false positives for poor outcome; elevated serum levels of NSE should still have prognostic value for poor outcome. The clearance rate of some drugs may be affected by hypothermia, but this effect would not significantly compromise the results of testing in patients paralyzed with cisatracurium or sedated with propofol (drugs commonly used during hypothermia), which are still cleared quickly, especially once patients are normothermic.

Prospective data are needed to examine the validity of the AAN practice parameters in a group of patients who receive hypothermic treatment after having cardiac arrest. It is highly likely that the factors that have been shown to be reliable predictors in the past — such as loss of pupillary and corneal reflexes and of somatosensory-evoked responses — will be validated. However, the timing of the testing of some variables may require adjustment.

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Older Age and a Reduced Likelihood of 2009 H1N1 Virus Infection

TO THE EDITOR: Early epidemiologic reports regarding the 2009 pandemic influenza A (H1N1) virus suggest that cases of infection and deaths are concentrated in adults between the ages of 20 and 40 years.[1] This finding could reflect age-related differences in susceptibility or differential testing and diagnosis in this age group. Increased susceptibility to infection in young persons is characteristic of influenza pandemics and has important implications for disease-control policy.[2] We examined whether the reported excess of cases in younger persons derives from testing practices or reflects a differential risk of infection in Ontario, Canada.

Our study sample included all persons who were tested for 2009 H1N1 virus infection under an enhanced, provincewide, laboratory-based surveillance regimen from April 20, 2009, to June 10, 2009. Patients with confirmed infection were compared with those who tested negative for the 2009 H1N1 virus. Using multivariate logistic regression and zero-inflated Poisson regression, we evaluated the association between age group (which was defined according to the relationship between birth year and the predominant circulating influenza strains) and the risk of infection with the 2009 H1N1 virus.

Of 11,560 patients who were tested, 1819 (15.7%) had positive results for the 2009 H1N1 virus. Persons who were born before 1957 had a reduced risk of infection, and estimates did not substantially change after adjustment for travel to Mexico, public health unit of residence, or calendar week (adjusted odds ratio for older age group, 0.15; 95% confidence interval [CI], 0.12 to 0.18; unadjusted odds ratio; 0.17; 95% CI, 0.14 to 0.21). Persons who were born between 1957 and 1975 were at intermediate risk for infection (adjusted odds ratio, 0.42; 95% CI, 0.37 to 0.48). Similar effects were seen in zero-inflated Poisson models that used testing volumes and population as model offsets. There was no significant relationship between age group and the risk of infection with seasonal influenza A viruses (either H3N2 or H1N1) (Fig. 1).

Among persons who were at risk for infection with 2009 H1N1 virus, being born before 1957 was associated with a lower infection risk. The reduced

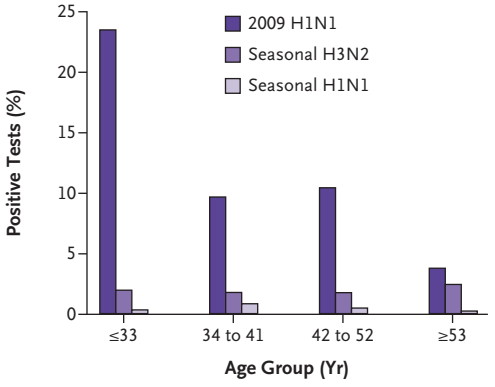

Figure 1. Age-Related Probability of Seasonal Influenza A and 2009 H1N1 Influenza in 11,560 Tested Patients.

Patients who were born after 1957 (i.e., ≤53 years of age) have an increased risk of infection with the 2009 pandemic influenza A (H1N1) virus. The results of testing show no significant relationship between age group and the risk of infection with seasonal influenza A viruses (either H3N2 or H1N1).

number of infections was not simply a reflection of decreased testing in this group. The mechanism for this association is unclear but is compatible with the reported age-related increase in the prevalence of neutralizing antibody titers against the 2009 H1N1 virus[3] and may reflect some immunity to infection as a result of exposure to similar viruses in early life. Maximally effective host immune responses to influenza may be generated by early-life infections.[4] These findings are consistent with the high frequency of outbreaks of 2009 H1N1 influenza in schools[5] and the decreased frequency of outbreaks in long-term care facilities that have been associated with this pandemic virus to date.

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Pathological Changes Associated with the 2009 H1N1 Virus

TO THE EDITOR: Between April 23, 2009, and May 15, 2009, we performed 15 autopsies on deceased patients in whom probable influenza had been diagnosed either clinically or macroscopically. Small samples of lung tissue were obtained and taken for analysis to the Institute of Epidemiological Diagnosis and Reference in Mexico City. Five infections with the 2009 pandemic influenza A (H1N1) virus were confirmed with the use of a real-time reverse-transcriptase–polymerase-chain-reaction assay, after it was determined that these patients were seronegative for influenza B virus, respiratory syncytial virus, parainfluenza virus (types 1, 2, and 3), and adenovirus.[1] From these five patients, organ samples were collected, fixed in 10% formalin, embedded in paraffin, and stained with hematoxylin and eosin. In the remaining 10 patients in whom the 2009 H1N1 virus was not detected, histopathological analyses identified bacterial pneumonia.

All five patients with diagnosed 2009 H1N1 influenza had been residents of Mexico City. Four of them were young adults (ages 22, 26, 28, and 37 years) who were hospitalized with the presump-

Court File No. T-539-20

FEDERAL COURT

BETWEEN:

**CANADIAN CIVIL LIBERTIES ASSOCIATION,
CANADIAN PRISON LAW ASSOCIATION
HIV & AIDS LEGAL CLINIC ONTARIO,
HIV LEGAL NETWORK,
& SEAN JOHNSTON**

Applicants

– and –

THE ATTORNEY GENERAL OF CANADA

Respondent

CERTIFICATE CONCERNING CODE OF CONDUCT FOR EXPERT WITNESSES

I, **David Fisman**, having been named as an expert witness by the Applicants, certify that I have read the Code of Conduct for Expert Witnesses set out in the schedule to the *Federal Courts Rules* and agree to be bound by it.

July 19, 2020

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Court File No. T-539-20

FEDERAL COURT

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**CANADIAN CIVIL LIBERTIES ASSOCIATION,
CANADIAN PRISON LAW ASSOCIATION,
HIV & AIDS LEGAL CLINIC ONTARIO,
HIV LEGAL NETWORK,
& SEAN JOHNSTON**

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**APPLICATION RECORD
VOLUME 2 OF 5**

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