The Need for a Multiple Accounts Cost-Benefit Analysis of COVID-19 Response Measures in British Columbia

By

Steven De Almeida
B.A., Royal Roads University, 2018

A Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of

MASTER OF PUBLIC ADMINISTRATION

in the School of Public Administration

Supervisory Committee

The Need for a Multiple Accounts Cost-Benefit Analysis of COVID-19 Response Measures in British Columbia

Submitted by

Steven De Almeida
B.A., Royal Roads University, 2018

Supervisor:	Robert Lapper, Supervisor School of Public Administration, University of Victoria
Committee Member:	Dr. David Castle, Second Reader School of Public Administration, University of Victoria

Abstract

By reviewing pre-existing academic literature, research, and data (both international and domestic), this report examines information from a variety of sources to contextualize the threat of COVID-19 against the negative consequences of COVID-19 non-pharmaceutical intervention (NPI) response measures. The qualitative and quantitative data in this report highlights costs associated with COVID-19 response measures relative to the threat of COVID-19 and has been collected to inform a Multiple Accounts Cost-Benefit Analysis (CBA). This report emphasizes the costs associated with NPIs as they relate to physical and mental health, as well as human rights and economic concerns.

Overall, a review of available evidence did find a relationship between COVID-19 NPI response measure implementation and negative outcomes. In fact, it remains unclear if NPIs are proportionate or even effective against the risk posed by COVID-19. How NPIs might be optimized (i.e., to reduce the negative effects of their implementation) remains unclear as mild to severe NPI implementation can yield similar outcomes.

Following the above analysis, this report provides recommendations to the Government of BC to ensure that COVID-19 response measures are optimized and proposes that a Multiple Accounts CBA of NPI implementation be completed.

Table of Contents

List of Figures and Tables

Acknowledgements

I would like to thank my supervisor Robert Lapper and Second Reader Dr. David Castle for their consistent support and guidance during the writing of this thesis.

Dedication

"*The cumulative knowledge of society is often more likely to be correct than the theories of intellectuals and political actors*" – Thomas Sowell

"*A friend to all is a friend to none*" – Aristotle

Chapter 1: Introduction

SARS-CoV-2, a virus believed to have originated in Wuhan, China in late 2019 quickly spread throughout the globe although the specific origin location and date is yet to be established (World Health Organization, 2021). As transmission of the virus crossed domestic and international borders (Hunter, 2020; Ludwig & Zarbock, 2020; Wang, Wang, Chen, & Qin, 2020), many jurisdictions implemented measures to mitigate the spread of COVID-19 (Nofal, Cacciotti, & Lee, 2020), the disease caused by SARS-CoV-2 infection (World Health Organization, n.d.). As a surge in reports concerning severe flu-like symptoms, excess deaths, and hospitals reaching and exceeding capacity increased around the world (Wang, Wang, Chen, & Qin, 2020) Subsequent mitigation measures were implemented with the intent to curb the spread of COVID-19, thereby reduce cases, hospitalizations, and deaths (World Health Organization, 2021b). Numerous jurisdictions implemented similar non-pharmaceutical interventions (NPIs), such as stay-at-home orders, school and business closures, lockdowns, and other social and physical distancing measures (Flaxman, et al., 2020). Some of the NPIs, however, have led to unforeseen or unintended consequences – both desirable and undesirable (Turcotte-Tremblay & Ridde, 2021). For example, NPIs have been correlated with negative consequences including, but not limited to, decreased mental health, increased substance abuse, increased drug overdoses, higher opioid related mortalities, suicide and suicidal ideation, depression, symptoms of anxiety, emergency visits related to mental health for children (Stijelja & Mishara, 2020; US CDC, 2020), potential deterioration of cardiovascular health and death (Pecanha, Goessler, Roschel, & Gualano, 2020), longer wait times at hospitals as well as postponed or reductions in necessary medical interventions (Garcia, et al., 2020; Kaufman, Chen, Niles, & Fesko, 2021; US CDC, 2020; Wiseman, Crump, & Sutherland, 2020) and even triggering a regression to authoritarian government behaviour (Thomson & Ip, 2020). A survey was conducted by the British Columbia (BC) Centre for Disease Control (CDC) in May 2020 to assess various impacts of the pandemic on approximately 200,000 participants across BC (BC CDC, 2021). Survey results revealed that:

- 46% have reported worsening mental health
- 27% have reported consuming more alcohol
- 15% have reported an increase in smoking
- 47% have reported one or more health conditions
- 78% have reported a reduction in children connecting with friends
- 90% have reported an increase in screen time among children
- 70% have reported a loss or removed childcare
- 76% have reported an increase in child impaired learning
- 59% have reported an increase in child stress
- 69% have reported work impairment
- 32% have reported current financial stress
- 43% have reported future financial stress (BC CDC, 2021).

The survey provides some early insight regarding the undesirable impacts of NPIs in BC; it is an indicator that suggests the need to complete a Multiple Accounts Cost-Benefit Analysis (CBA) to:

- Identify and compare the full costs and benefits of implementing NPIs against the full costs and benefits of response policies absent any NPI, and/or moderate government intervention; and/or
- Identify and compare the full costs and benefits[1] of COVID-19 infection versus the costs and benefits of NPIs.

Although this report does not perform a Multiple Accounts CBA, it articulates and justifies its necessity by providing an overview of the costs and benefits of NPIs and COVID-19 infection, with a focus on the BC population.

Problem Statement/Defining the Issue

COVID-19 has been described as "the defining health crisis of our time" which has put the world "at war with a virus that threatens to tear us apart" (Chappell, 2020), dictating the global population "will not be going back to the old normal" (Dr. Tedros Adhanom Ghebreyesus, 2020). The dominant narrative justifies the requirement and necessity of unprecedented mitigation strategies focused on social and physical distancing in an effort to mitigate the spread of COVID-19; therefore, NPIs have been viewed as necessary policy tools to meet these objectives (Chu D. , et al., 2020), despite the negative latent effects caused by them.

The problem addressed in this paper is the collective consequences of NPIs in the overall health context. Although efforts to mitigate the spread of COVID-19 may be effective, the cost of implementing such NPIs may become detrimental and defeat their purpose in reducing overall hospitalizations or deaths. At a high level, NPIs are designed to reduce COVID-19 cases, hospitalizations, and deaths – but at what costs? As pharmaceutical interventions are, NPIs should also be evaluated in terms of safety and efficacy. Additionally, the efficacy of NPIs, which research suggests can be correlated with adverse consequences (Oruc, Baxter, Keskinocak, Asplund, & Serban, 2021) require further examination. In summary, this paper analyzes the efficacy of NPIs to gauge whether they are mitigating the spread of COVID-19, thereby reducing COVID-19 hospitalizations and deaths, and if so, at what cost? The outcome of this analysis will be used to justify and inform a future Multiple Accounts CBA.

Briefly stated, the purpose of this report, with both the safety (i.e., negative health related consequences) and efficacy (i.e., the degree to which COVID-19 transmission, hospitalization,

[1] Although this may seem counter-intuitive, a reasonable argument regarding the benefit of contracting COVID-19 includes building natural immunity.

and death is mitigated) of NPIs in mind, is to identify if the costs associated with NPIs have been adequately assessed and considered in the development of public policy in the Province of BC. Specific examples of the negative consequences caused by NPIs are also identified.

By not completing a thorough, comprehensive, and all-encompassing analysis of the potential costs and benefits of NPI implementation, policy makers risk developing unnecessary, arbitrary, and harmful policies and measures which may inadvertently cause more harm than good, even among those considered vulnerable to COVID-19. For example, physical and social isolation is known to cause detrimental mental health issues, high chance of suicide, and increase morbidity and mortality among the geriatric population (Roy, Jain, Golamari, Vunnam, & Sahu, 2020; Shuja, Aqeel, Khan, & Abbas, 2020). The impacts of NPIs often seem incomprehensible, as the list of negative outcomes continue to be revealed. Therefore, are NPIs justified when all positive and negative impacts are considered and compared?

Contributing factors to implementing NPIs may be attributed to an over-reliance on mathematical modelling and hypothetical scenarios based on assumptions (inputs) regarding COVID-19 and the safety and efficacy of NPIs (outputs) (Chin, Ioannidis, Tanner, & Cripps, 2021). Other explanations may be peer pressure, political pressure, bureaucratic interference (International Alliance of Physicans and Medical Scientists, 2021), pharmaceutical industry and non-governmental organization (NGO) intrusion (World Doctors Alliance, 2020) and the advent of heightened globalization, interdependence of sovereign jurisdictions and pressure to conform with international norms collectively (Raymond, Daniel, & Hennes, 2021)[2].

Some jurisdictions across the world have implemented different measures to cope with COVID-19. For example, Sweden (e.g., recommendations vs requirements, nudge based) and Japan (e.g., autonomy, symbolic and information sharing, boost based) have implemented relaxed NPIs relative to France (e.g., severe restrictions and surveillance, decree based) and China (e.g., coercive, strict control, mandate based) (Yan, Zhang, Wu, Zhu, & Chen, 2020). In the USA, Texas and Florida have also implemented disparate COVID-19 response policies in comparison to states such as California and New York (Kettle, 2020). Throughout Canada, use of NPIs also remains high and pivotal (Detsky & Bogoch, 2020; Government of Canada, 2021; Government of Canada, 2021); despite the use of different policies around the globe, the purpose of this report (as stated above) is to focus on the implications of NPIs in BC.

Based on the assessment below, public policy concerning NPIs in BC would benefit from a Multiple Accounts CBA that would allow for a careful consideration of both the positive and negative implications of imposing NPIs.

[2] Preprint submitted to and forthcoming in *Perspectives on Politics*

The problem identified in this research is a descriptive research problem. This report aims to observe and describe the characteristics and impacts of a phenomenon (the absence of a CBA) by collecting both quantitative and qualitative data to articulate the relationships between the absence of a CBA and subsequent deleterious impacts with limited information. By researching COVID-19 response policy latent effect patterns, this report attempts to ascertain (through a literature review, case study and data analysis) when BC policy considered any NPI costs and if NPI policy implementation may have caused or contributed to the negative consequences which could have been captured if a comprehensive CBA was completed. The report will include a descriptive status and descriptive analysis; it will describe real-life situations and identify when and if a response policy may have negatively impacted members of the public in BC.

Significance of Study

As of spring 2022, conventional and mainstream response measures to the COVID-19 pandemic purport the necessity and efficacy of NPIs. This paper, however, aims to not necessarily dispute the dominant narrative, but carefully evaluate the underpinnings which substantiate the push for NPI implementation. Rather than focusing on potential benefits of NPIs (or ways in which NPIs can be incorporated into policy or legislation to reduce COVID-19 cases, hospitalizations, and deaths), this paper will consider the *negative* consequences of NPIs, thereby providing a comparative research approach. By exploring and examining negative consequences, this study provides a preliminary but innovative look at NPIs to gauge if their overall benefit is greater than the overall costs, which can subsequently be used toinform a future Multiple Accounts CBA. As the COVID-19 pandemic continues – and the consequences of NPIs become more apparent – it is crucial to re-evaluate their effectiveness and overall safety to ensure the potential costs are also mitigated or eliminated, which arguably should be incorporated into public administration and policy making. Overall, this report (a) identifies costs associated with NPIs (particularly in BC), and (b) justifies the need for a Multiple Accounts CBA.

Thesis Goals, Scope, and Research Questions/Hypothesis

The purpose and scope of this research is to identify if and when the Provincial Government of BC considered the negative impacts associated with NPI implementation to curb the spread of COVID-19 within its policies. Additionally, this report will provide a preliminary comparison of the human health impacts of policies which depend on NPIs against policies which either do not use, or minimally use, NPIs as well as ascertain the severity of COVID-19. As stated above, this report will also identify if BC has considered costs in policies as well as identify several NPI costs in BC. It is important to consider that NPIs – to any degree – are one of many possible approaches to managing or mitigating the spread of COVID-19. This research aims to gauge NPIs and determine when, if ever, they may ‘defeat their purpose’ in protecting human health and subsequently become detrimental to inform a future Multiple Accounts CBA. Alternatively, the analysis will also gauge the success of NPI during the COVID-19 pandemic and highlight their benefits. This research will focus on the Canadian context, in particular British Columbia,

but will include data from other jurisdictions to ensure all emerging data is considered to avoid gaps and ensure an adequate preliminary analysis is complete. Ultimately, the research may also act as a tool to improve upon existing COVID-19 response measures when and if improvements are warranted.

I have chosen to research COVID-19 from this perspective as any alternative is not likely to capture the fundamental underpinnings which guide policy and decision making. Rather than focusing on the success of and developing new or slightly modifying pre-existing NPIs, this paper re-evaluates the safety and efficacy of NPI mitigation strategies to justify the need for a Multiple Accounts CBA intended to ensure NPIs (a) do mitigate the spread of COVID-19 and (b) the costs do not outweigh the benefits. To accomplish these goals, this paper will determine:

- What NPI-related policies were implemented in BC.
- What informed policy making (e.g., evidence based, precautionary principles, international collectivism).
- What the costs and benefits associated with NPI measures in BC are.
- How the findings can inform a Multiple Accounts CBA in the future.

BC public policy around NPIs as a response to the COVID-19 pandemic may have failed to account for many of their associated costs, the main research questions in this report are as follows:

To what extent did BC public policy account for the costs of NPIs, and if so, what could future policy makers do differently to ensure unintended negative outcomes are properly identified and accounted for? In order to answer this question, several aspects of COVID-19 must be contextualized to fully understand COVID-19 and NPIs, such as:

- Domestic and international policies regarding COVID-19 response measures;
- Domestic and international justifications and evidence considered to inform policies;
- The human health impacts of COVID-19 (including the Infection Fatality Rate (IFR), symptoms, and hospitalizations);
- The human health impacts of NPIs;
- Other impacts of NPIs, including economic and human rights issues;
- Domestic and international hospital capacity rates;
- Hospital COVID-19 reporting and ICU criteria;
- How deaths with or of COVID-19 are identified;
- Whether or not COVID-19 death in isolation rises above the risk of death of any normal activity;
- Factors such as comorbidities and age regarding COVID-19;
- An analysis of the Polymerase Chain Reaction (PCR) test kit; and
- Provincial policy regarding PCR utilization including cycle thresholds (Ct) values.

The considerations mentioned above, and this research in general, are crucial as findings may be used as a tool to balance or offset negative human health impacts which may be paradoxically caused by efforts to mitigate the spread of COVID-19., This paper will also provide evidence and justifications for the recommendation that the Province of BC complete a comprehensive Multiple Accounts CBA.

Public policy in Canada has prioritized the total elimination of COVID-19 cases (Public Health Agency of Canada, 2020). Subsequent research, especially early in the pandemic, prioritized an analysis of COVID-19 case counts and the development of case reduction strategies[3]. This paper does not make the same approach, as conventional policy and research may have placed far too much of an emphasis on one target and metric (i.e., cases) at the expense of considering alternative metrics of equal (or possibly more) importance (e.g., all costs of NPIs). This report instead prioritizes researching the potential that policy makers in BC did not adequately consider the negative outcomes of NPI implementation. Research which solely focuses on case counts but fails to consider the costs of such policies may therefore inadvertently exacerbate other public health and economic issues. This is difficult to determine without a Multiple Accounts CBA. Again, this paper strives to analyze the costs and benefits associated with NPI implementation to justify the need for a Multiple Accounts CBA before, during, or post-NPI policy implementation.

Theoretical Framework

The Theoretical Framework which informs this paper is the Multiple Accounts CBA. The Multiple Accounts CBA was developed by Marvin Shaffer, an economist and adjunct professor at Simon Fraser University (Simon Fraser University, n.d.). A thorough description of Multiple Accounts CBA is outlined in Shaffer's *Multiple Accounts Benefit-Cost Analysis: A Practical Guide for the Systematic Evaluation of Project and Policy Alternatives*. According to Shaffer (2010), the purpose of a traditional CBA is to assess the advantages and disadvantages of alternative policies or projects measured by their compensating variations, that is, the willingness to pay for a benefit and the amount someone would have to be compensated to offset a cost (Shaffer, 2010). Furthermore, the objective of traditional CBA is to determine when and if the total benefits of a given policy or project exceed the total costs; however, traditional CBA often do not take into consideration of non-market consequences, such as social or environmental considerations (values that are difficult to estimate, enumerate, and monetize) which can be meaningfully included in a Multiple Accounts CBA (Shaffer, 2010). Shaffer (2010) stated within a Multiple Accounts CBA, "an evaluation framework is established with different accounts and indicators. Monetary measures are used for some of the accounts, but in others, where monetary measures would not be reliable or broadly accepted, physical indicators or descriptions of the impact and their significance may be used" (Shaffer, 2010, p. 31). Shaffer further argues that

[3] See Literature Review

accounts should be robust enough to capture all consequences experienced by everyone who is affected by a given policy or project (Shaffer, 2010). This CBA framework may be most appropriate in the context of COVID-19 where numerous criteria, or multiple accounts, which would be difficult to monetize have been impacted by both COVID-19 and responding NPIs, such as social, health and environmental factors. A CBA designed to compare the benefits and costs of policies which utilize NPIs versus the benefits and costs of policies which do not, or include minimal use of NPIs, or to ascertain the benefits and costs of COVID-19 policies in BC against COVID-19 itself, would be best completed through a Multiple Accounts CBA.

It is important to note that a Multiple Accounts CBA will not be completed in this paper; however, it will be used as the theoretical framework that guides research and data collection to inform a future CBA.

Importance of the Study

The results of this paper and future CBAs could provide meaningful insight regarding the necessity to appropriately account for both identified and perceived costs prior, during, or post NPI policy implementation. This report will be raising and analyzing several negative impacts associated with COVID-19 response policies. It will thereby highlight the need for future response plans, policy makers, academia, and members of the public to critically assess and compare the health impacts of NPIs if again considered for future crises, including COVID-19. As NPIs continue to be used, it is important to revisit the justifications for doing so to ensure the costs do not outweigh the benefits, and if the costs are too great, provide a new platform, perspective and field of study focused on critically assessing its use. For example, this report may provide the framework by identifying relevant indicators and metrics which ought to be used in a Multiple Account CBA, which should be used as a policy tool in response to a future, similar pandemic when and if one occurs. As this study looks to identify the costs associated with the use of NPIs in public policy as well as ascertain if BC Provincial policy has considered them (and if so, to what extent), those who may benefit from this research include the general public, researchers, and policy makers.

As described in Chapter 4: Literature Review, current literature (with some exception) has not focused on reviewing and evaluating the extent to which public policy has considered any deleterious impacts of COVID-19 and any corresponding strategies within these policies designed to mitigate consequences, especially in BC; therefore, this report may provide the initial platform in this regard.

Structure of Thesis

This paper will be structured into six further chapters, including background, methodology, literature review, findings, discussion and analysis, and conclusion.

Chapter 2: Background

The background will contextualize COVID-19 by providing high-level information regarding coronaviruses, SARS-CoV-2, and COVID-19. Additionally, the background will also describe some legislative and regulatory considerations in Canada and BC. This section will adequately position the reader for the following chapters.

Chapter 3: Methodology

This paper consists of a mixed-method approach and includes three methodological approaches: a literature review, case studies and data analysis. The purpose of each methodology is to justify and inform a future CBA.

Chapter 4: Literature Review

The literature review will critically examine existing qualitative and quantitative COVID-19 and NPI research and studies concerning the consequences of both. To ensure all emerging research is captured, pre-prints as well as published, peer reviewed journal articles will be included. Pre-prints will be clearly distinguished, however, to ensure the reader is aware when and if an article has not been published. The qualitative portion of the literature will be supported by quantitative research and data to further contextualize COVID-19 impacts to human health and NPI impacts to human health; therefore, numerous databases, both domestic and global, will be introduced here. The literature review will be the initial phase of identifying the costs and benefits of NPIs compared to the costs and benefits of policies (without monetizing them) that do not contain NPIs, or suggest only limited use of NPIs, by providing an analytic summary of past work relevant to this report.

Chapter 5: BC Case Study and Data Analysis

A Case Study is included to elaborate on and contextualize the COVID-19 outbreak in BC. In particular, the Case Study includes an analysis of COVID-19 health impacts as well as the impacts, both positive and negative, caused by the corresponding NPIs to human health and the economy. The analysis is designed to and collects information relevant to a future Multiple Accounts CBA. It will also assess the rationale of and what informed and guided COVID-19 policy making based on published, publicly available documents.

Chapter 6: Findings

This chapter will uncover the factual findings of and concisely report to the consequences of COVID-19 and NPIs in BC, gathered for the purpose of justifying and informing a future Multiple Accounts CBA. It will outline the results of both the qualitative and quantitative research and data analysis.

Chapter 7: Discussion and Analysis

This chapter will interpret and describe the research and data in both the literature review, BC case study, and findings chapters. It will explain any new, unforeseen data and also build on the existing understanding of NPIs. It will summarize and explain what the findings mean and answer the research question.

Chapter 8: Conclusion

The conclusion will synthesize the key points of the report, make recommendations for future research, and help the reader understand this report as a whole.

Chapter 2: Background

Coronaviruses, SARS-CoV-2, and COVID-19

The coronavirus disease 2019 (COVID-19) is the infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Ludwig & Zarbock, 2020; World Health Organization, n.d.). SARS-CoV-2 is one of the seven known human coronaviruses (HCoV), which also includes severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV), HCoV-229E, HCoV-OC43, HCoV-NL63, and HCoV-HKU1 (US CDC, 2020; Ye, et al., 2020), the latter four of which are endemic (Ludwig & Zarbock, 2020; Ye, et al., 2020). The first coronavirus was isolated in the mid-1960s (US CDC, 2020; Ye, et al., 2020) and has subsequently been divided into the categories of mammalian-associated and bird-associated coronaviruses (Ludwig & Zarbock, 2020). Coronaviruses are strongly believed to be of zoonotic origin, transferred from wild animals to humans which typically originate from bats and transmit to humans through an intermediate animal; hence, it has been detected in both animals and humans globally (Ludwig & Zarbock, 2020). According to Ludwig & Zarbock (2020), coronaviruses may cause mild to severe intestinal, respiratory, systemic diseases, or no symptoms in animals. Human coronaviruses account for a third of all common colds and typically cause relatively mild diseases (Ye, et al., 2020) or no symptoms; however, in the "immunosuppressed individuals, children, or persons with existing pulmonary diseases, progression to acute respiratory failure can also occur" (Ludwig & Zarbock, 2020, p. 94). For example, SARS-CoV, SARS-CoV-2, and MERS-CoV are highly pathogenic in comparison to the endemic human coronaviruses and may cause severe lower respiratory tract infection, especially in patients with a higher chance to develop extrapulmonary manifestations and acute respiratory distress syndrome (ARDS) (Ye, et al., 2020).

SARS-CoV-2 is 79.5% identical to SARS-CoV, the first SARS virus which caused severe respiratory diseases among 8,000 people in 2002-2003 with a crude Case Fatality Rate (CFR) of around 9.5% (Ludwig & Zarbock, 2020) to 10% (Ye, et al., 2020). COVID-19 may cause a broad range of common clinical symptoms, including fever, malaise, cough, fatigue, sputum production, shortness of breath, sore throat, headache and rare gastrointestinal symptoms including diarrhea and vomiting (Ludwig & Zarbock, 2020). Some infected patients may result in critical condition, develop ARDS, respiratory failure, organ failure, and possibly death (Ludwig & Zarbock, 2020).

COVID-19 Case Fatality Rate and Infection Fatality Rate

To assess severe pathogenicity and proportion of COVID-19 fatal outcomes, two metrics are frequently used: The CFR and the Infection Fatality Rate (IFR). The CFR "estimates [the] proportion of deaths among identified cases" whereas the IFR "estimates [the] proportion of deaths among all infected individuals" (World Health Organization, 2020). The CFR is the proportion of individuals who are first diagnosed with a disease and subsequently die; therefore,

it measures severity among detected cases only. The IFR considers and includes all infected individuals (World Health Organization, 2020). This can be accomplished through serological testing of a representative random sample of the population to detect exposure to a specific pathogen (Kritsotakis, 2020; Metcalf, et al., 2016; World Health Organization, 2020).

The World Health Organization (WHO) has simplified how both CFR and IFR are calculated using the following algorithms:

- CFR = (number of deaths from disease/number of confirmed cases of disease)100
- IFR = (number of deaths from disease/number of infected individuals)100

According to WHO, the COVID-19 CFR varies from less than 0.1% to over 25% (World Health Organization, 2020); whereas the IFR converges at approximately 0.5% to 1% (Perez-Saez, et al., 2020; Stringhini, et al., 2020; World Health Organization, 2020).

In the Lancet's article *Serology-informed estimates of SARS-CoV-2 infection fatalist risk in Geneva, Switzerland*, researchers estimated the IFR between age cohorts as follows:

- 5-9 years: 0.0016 (0 to 0.019)
- 10-19 years: 0.00032 (0 to 0.0033)
- 20-49 years: 0.0092 (0.0042 to 0.016)
- 50-64 years: 0.14 (0.096 to 0.019)
- ≥ 65 years: 5.6 (4.3 to 7.4)
- All ages: 0.64 (0.38 to 0.98) (Perez-Saez, et al., 2020)

The Public Health Agency of Sweden published *The infection fatality rate of COVID-19 in Stockholm – Technical report* in 2020. Researchers estimated the IFR between age cohorts as follows:

- 0-69 years: 0.58
- 70+ years: 4.29
- All ages: 0.58 (Folkhalsomyndigheten (Public Health Agency of Sweden), 2020)

In 2020, the US CDC stated COVID-19 has an IFR of:

- 0.00003% for those aged 0-19 years;
- 0.0002% for those aged 20-49 years;
- 0.005% for those aged 50-69 years; and
- 0.054% for those aged 70 years and older (US CDC, 2021).

In 2021, the US CDC updated the COVID-19 IFR:

- 0.002% 0-17 years;
- 0.05% 18-49 years;

- 0.6% 50-64 years;
- 9% 65+ years (US CDC, 2021).

In a study conducted by epidemiologist John P. Ioannidis and published by WHO, the inferred global COVID-19 IFR ranged from 0% to 1.63% depending on the country analyzed and available data, with a median IFR across all 51 locations examined of 0.27% (Ioannidis, John P. A, 2021). According to Ioannidis (2021):

> "uncorrected estimates of the infection fatality rate of COVID-19 ranged from 0.01% to 0.67% (median 0.10%) across the 19 locations with a population mortality rate for COVID-19 lower than the global average, from 0.07% to 0.73% (median 0.20%) across 17 locations with population mortality rate higher than the global average but lower than 500 COVID-19 deaths per million, and from 0.20% to 1.63% (median 0.71%) across 15 locations with more than 500 COVID-19 deaths per million. The corrected estimates of the median infection fatality rate were 0.09%, 0.20% and 0.57%, respectively, for the three location groups. For people younger than 70 years old, the infection fatality rate of COVID-19 across 40 locations with available data ranged from 0.00% to 0.31% (median 0.05%); the corrected values were similar" (Ioannidis, John P. A, 2021, pp. 21-26).

According to the above research completed by John P. Ioannidis, the CFR in BC ranges from .45% to .55%; whereas the inferred IFR is 0.59%, although 0.08% for individuals below the age of 70 (Ioannidis, John P. A, 2021).

It is still difficult to determine both the COVID-19 IFR and CFR. Many researchers have stated fatality rates may hover around 1% or below when factors such as age and severe underlying health issues are considered (Cai, et al., 2020; Ioannidis J. P., 2020; Russell, et al., 2020), which are the greatest factors regarding the onset of symptoms and likelihood of mortality (Onder, Rezza, & Brusaferro, 2020; Wu & McGoogan, 2020).

This paper will focus on IFR as the true severity of COVID-19 can be better understood using this metric (World Health Organization, 2020). According to WHO (2020), the IFR is a more accurate metric in comparison to CFR, as it accounts for overall exposure to a pathogen in a population (whereas CFR only accounts for confirmed, and typically the most severe cases, which can overlook mild, asymptomatic, and otherwise unidentified infections, for example). Chapter 5: Case Studies and Data Analysis will provide further analysis of the most recent COVID-19 IFR data in Canada. It is important to understand the IFR by age cohort and underlying health issues to ensure NPIs are appropriate to the context and needs of COVID-19 response measures.

Polymerase Chain Reaction and SARS-CoV-2 Positive Cases

The dominant test kit used to determine the presence of SARS-CoV-2 in an individual is the Polymerase Chain Reaction (PCR) assay (World Health Organization, 2020), considered the gold standard of SARS-CoV-2 diagnostics (BC CDC, 2021b; Government of Canada, 2020; World Health Organization, 2020). By amplifying small segments of deoxyribonucleic acid (DNA), the PCR assay may provide reliable genetic analysis of otherwise isolated pieces of DNA which would be nearly impossible to study (National Center for Biotechnology Information, 2017; National Human Genome Research Institute, 2020); therefore, DNA is amplified by duplicating the original strand numerous times. The National Human Genome Research Institute (2020) of the US National Institute of Health has described PCR amplification as follows:

> "This process results in the duplication of the original DNA, with each of the new molecules containing one old and one new strand of DNA. Then each of these strands can be used to create two new copies, and so on, and so on. The cycle of denaturing and synthesizing new DNA is repeated as many as 30 or 40 times, leading to more than one billion exact copies of the original DNA segment"

As described above, one strand of DNA can be duplicated numerous (e.g., billions) of times by increasing the PCR cycle threshold (Ct). This is done to duplicate the original strand of DNA to potentially reveal the presence of a specific pathogen (in this context, SARS-CoV-2) through amplification. When PCR is used to test for the presence of SARS-CoV-2, irrespective of cycles, positive identification results in a COVID-19 'case'.

According to Jaafar, et al. (2021), "several recent publications, based on more than 100 studies, have attempted to propose a cutoff Ct value" regarding RT-PCR testing sensitivity "with a consensus at approximately Ct >30" (Jaafar, et al., 2021, p. 932). Also, WHO indicated Ct values that are too high may result in false positives (World Health Organization, 2020). Pollock & Lancester (2020) have argued that PCR cannot distinguish live virus, meaning actual infection or infectiousness is not possible to detect (Pollock & Lancaster, 2020). Furthermore, Ct "values from PCR tests are not direct measures of viral load and are subject to error" (Pollock & Lancaster, 2020, p. 1) and should not serve as a substitute for clinical diagnosis (Pollock & Lancaster, 2020). According to LeBland et al. (2020), BC laboratories have Ct values between 35 to 40, similar to other provinces; however, some Ontario laboratories have Ct values of 45 (LeBlanc, et al., 2020). Jaafar, et al. (2021) states a Ct value greater than 30 should not influence public health decisions (Jaafar, et al., 2021). PCR requires more investigation, as the potential of false-positive cases in BC may guide decision and policy making, often including the use of NPIs.

NPIs

According to the US CDC, NPIs "are actions, apart from getting vaccinated and taking medicine, that people and communities can take to help slow the spread of illnesses…" (US CDC, 2020) and are the "primary tool used by governments and organizations to mitigate the spread of the ongoing pandemic of COVID-19" (McCoy, et al., 2020, p. 1). The Government of Canada published the *Individual and community-based measures to mitigate the spread of COVID-19 in Canada* guidance document designed for federal, provincial, territorial, regional, and public health authorities as well as individuals. In an effort to mitigate the spread of SARS-CoV-2 in Canada, the guidance document recommends the use of personal preventive NPIs such as:

- Self-monitoring of COVID-19 symptoms;
- Isolation (e.g., stay at home and monitor symptoms (Government of Canada, 2021));
- Quarantine (e.g., isolation encouragement or enforcement of cases and contacts);
- Physical distancing (e.g., reducing or eliminating interactions in close proximity);
- Use of masks to control the spread of SARS-CoV-2 infectious respiratory particles;
- Hand hygiene (e.g., washing hands with soap) and respiratory etiquette (e.g., coughing or sneezing into a tissue, not laughing or talking);
- Cleaning and disinfecting used surfaces and objects;
- Proper ventilation (e.g., replace indoor air with outdoor air); and
- Other practices (e.g., staying informed of gathering size limits, reducing non-essential trips within Canada, avoiding closed and crowded spaces, no non-essential travel outside of Canada) (Government of Canada, 2021).

As stated above, the guidance document also recommends community based NPIs in "settings where the public gathers, such as businesses and workplaces, child and youth settings, community gatherings and events, outdoor recreational spaces, congregate living settings, and public transportation" to be implemented by "governments, First Nations, Inuit and Métis leadership, employers, owners, organizers, planners, and administrators … to protect their employees and individuals who are accessing community settings" (Government of Canada, 2021). Community based NPIs include:

- Physical distancing measures (e.g., enforcement of distancing measures in businesses or schools);
- Promotion of personal preventative practices (e.g., communication to increase awareness);
- Preventing people with COVID-19 infection from entering community settings (e.g., passive and active screening measures, such as self-reporting or posing direct questions);
- Ventilation in non-residential settings (e.g., measures to improve fresh air flow);
- Enhanced cleaning and disinfecting of community settings (e.g., measures to clean and disinfect surfaces and objects likely to be contaminated); and

- Non-medical masks in community settings (e.g., following masking directives from provincial health authorities).

The Public Health Agency of Canada (2020) warns of risks associated with lifting or easing NPIs and have declared the preferred choice moving forward in the pandemic is applying NPIs with high enough intensity to eradicate SARS-CoV-2 (Public Health Agency of Canada, 2020), not simply mitigate the spread. Furthermore, researchers warn lifting the NPIs (including shutdowns) must be "accompanied by enhancements to other NPIs to prevent new introductions and to identify and control and new transmission chains" (Public Health Agency of Canada, 2020, p. 198).

A group of Canadian researchers catalogued and classified 1640 NPIs implemented across Canada at the federal, provincial, territorial, and municipal levels. NPIs were placed in Intervention Categories and accompanied with samples. The below table was pulled directly from the research completed by McCoy et al. (2020):

TABLE 1: TOP 15 CATEGORIES OF NPIS BY COUNT WITH DESCRIPTIVE EXAMPLES

Intervention Category	Count	Sample Intervention Summary
Public Announcement	157	Recommendation for residents to be vigilant, to refer to Sante Montreal
General case announcement	113	Announce 9 new cases, total 73 in BC
Emergency economic funding	91	Government to pay Alberta Energy Regulator industry levy for six months: $113 million
Emergency social services funding	72	$3-million Arts and Culture Resilience Supplement to be administered by the BC Arts Council
Non-essential workplace closure	68	State of emergency declared: All regulated health services providers will cease operations unless the services to be provided are to address essential health care or an emergency health-care situation.
Recreational / Entertainment Facility Closure	65	Closure of municipally-run cultural and recreational facilities/programs
Social Distancing Announcement	60	Government "strongly recommends" companies take travel and distancing measures
Healthcare facility restrictions	57	Banned visits to hospitals
School closure	55	Fanshawe College suspends on-site services until further notice
Recommended self-isolation	54	Recommendation of self-monitoring for returning travellers from conference in Toronto where there was a sick contact
Public event/ meeting cancellation or postponement	53	All March Break programming, camps and drop-in activities are cancelled
Emergency healthcare funding	41	Investing $27.6-Million to support child care for essential workers
Government building closure	40	Closure of recycling centres until further notice
Public park closure	39	Oshawa adds off-leash park to list of temporary closures
Travel Restriction (Internal)	37	Residents asked to use Transit for essential travel only

(McCoy, et al., 2020, p. 11)

McCoy et al. (2020) labelled NPIs based on Oxford Categories, which were adopted from the University of Oxford's Government working paper *Variation in Government Responses to COVID-19*. The labels are as follows: school closing, workplace closing, cancel public events, close public transport, public info campaigns, restrictions on internal movement, international travel controls, fiscal measures, monetary measures, emergency investment in healthcare, investment in vaccines, testing policy, and contact tracing (McCoy, et al., 2020).

The Unviersity of Oxford's Blatnik School of Government report provides the full, robust list of NPIs placed under five separate categories. This list is an excellent example of the types of NPIs used by different governments.Oxford's list is as follows:

- Containment and Closure
    - School closing
    - Workplace closing
    - Cancel public events
    - Restrictions on gathering size
    - Close public transport
    - Stay at home requirements
    - Restrictions on internal movement
    - Restrictions on international travel
- Economic Response
    - Income support
    - Debt/contract relief for households
    - Fiscal measures
    - Giving international support
- Health Systems
    - Public information campaign
    - Testing policy
    - Contact tracing
    - Emergency investment in healthcare
    - Investment in COVID-19 vaccines
    - Facial coverings
    - Vaccination policy
    - Protection of elderly people
- Vaccine Policies
    - Vaccine prioritisation
    - Vaccine eligibility/availability
    - Vaccine financial support
- Miscellaneous
    - Other responses (Hale, et al., 2021)

McCoy (2020) and Hale (2021) have both identified numerous NPIs used by a variety of governments to mitigate the spread of COVID-19. Both lists make it clear that a significant subset of NPIs involve physical and social isolation measures. These include government policies which restrict either physical or social encounters, such as non-essential workplace closures, recreational and entertainment facility closures, school closures, cancellations of public events, public park closures, stay at home requirements, and travel restrictions. In summary, NPIs examined in this paper will analyze several costs associated with isolation, quarantine, lockdowns, and other related physical and social distancing measures. As such, this report will not include an analysis of all NPIs identified above by McCoy (2020) and Hale (2021) but will analyze NPIs which contribute to physical and social isolation and attempt to provide preliminary 'costs' associated with their implementation.

As stated in the Background section, NPIs have been viewed as a necessary policy tool to mitigate the spread of COVID-19. This report examines NPIs related to physical and social distancing as these policies are highly intrusive, involve human rights considerations, and overall consequential to human health, despite a lack of research to support their efficacy (see the Literature Review for more information). Considering the extreme nature of these unprecedented measures, especially in comparison to other measures such as public health recommendations, contact tracing, public information campaigns, and investments to healthcare, it is crucial to analyze physical and social distancing related NPIs to assess whether or not these measures may defeat their purpose in protecting human health.

The Canadian Context

According to the Government of Canada (2021), the age distribution of COVID-19 cases deceased in Canada as of November 5, 2021, is:

- 0-19: 0.1% (n = 17);
- 20-29: 0.3% (n = 79);
- 30-39: 0.7% (n = 201);
- 40-49: 1.5% (n = 434);
- 50-59: 4.2% (n = 1,219);
- 60-69: 10.2% (n = 2,949);
- 70-79: 20.7% (n = 5,985); and
- 80+: 62.3% (n = 18,016) (Government of Canada, 2021)

These are confirmed cases, not all infections. It is important to remain cognizant of the frequency of COVID-19 deaths among Canada's aging population and deaths among individuals with one or more severe pre-existing health condition. 80% of COVID-19 deaths have occurred among adults aged 65 and older, over 80% of deaths occurred in long-term care, and "approximately 90% of COVID-19 related deaths that occurred between March and July 2020 occurred among individuals with pre-existing chronic conditions" (Government of Canada, 2021). The most

common comorbidities (i.e., the simultaneous presence of more than one disease) among individuals who died with or of COVID-19 in Canada include dementia, pneumonia, hypertensive diseases, and ischemic heart disease (Government of Canada, 2021). The Government of Canada statistics above include individuals with severe underlying health conditions and based on research in Ontario, it appears that deaths with or of COVID-19 may not be appropriately distinguished (Postill, et al., 2020). Similarly – for reference – Italian COVID-19 policy made no distinction between those who died with or of COVID-19, all deaths were recorded as such (Onder, Rezza, & Brusaferro, 2020); therefore, regardless of other pre-existing health issues, deaths were recorded as COVID-19. 99.2% of those who died of COVID-19 had pre-existing health conditions with a mean of 2.7 (Onder, Rezza, & Brusaferro, 2020).

The Government of Canada has, consistent with WHO guidelines, defined COVID-19 cases and deaths. In summary, a confirmed case is defined by a validated laboratory-based or point-of-care nucleic acid amplification assay (e.g., PCR) or a validated laboratory-based serological assay (Government of Canada, 2021). A probable case can be defined three ways:

1. A person who has compatible COVID-19 symptoms and "had a high-risk exposure with a confirmed COVID-19 case … or was exposed to a known cluster or outbreak" (Government of Canada, 2021). Additionally, the person must not have had a laboratory-based nucleic acid amplification test completed (or inconclusive results) or SARS-CoV-2 antibodies were detected using a laboratory-based serological assay within 4 weeks of symptom onset (Government of Canada, 2021).
2. A person who had a point-of-care nucleic acid amplification test or antigen test completed and results are preliminary/presumptive positive (Government of Canada, 2021).
3. A person had a validated point-of-care antigen test completed and the result is positive

According to the Government of Canada (2021), the signs and symptoms of COVID-19 are as follows:

TABLE 2: COVID-19 SYMPTOMS

COVID-19 Symptoms		
Common (>50%)	**Less frequent (≤ 50%)**	**Rare (<10%)**
• Fever • Chills • New or worsening cough • Fatigue or myalgia • Headache • Gastrointestinal symptoms	• Shortness of breath / difficulty breathing • Sore throat • Painful and/or difficulty swallowing • Conjunctivitis • New or unusual exacerbation of chronic conditions • Delirium	• Skin manifestations • Confusion • Runny/stuffy nose • Eye manifestations

COVID-19 Symptoms		
	• Decreased or loss of appetite • New loss of smell/or taste	

(Government of Canada, 2021)

The Government of Canada (2021) has considered deceased cases as follows:

> "A probable or confirmed COVID-19 case whose death resulted from a clinically compatible illness, unless there is a clear alternative cause of death identified (e.g., trauma, poisoning, drug overdose)"
>
> A Medical Officer of Health, relevant public health authority, or coroner may use their discretion when determining if a death was due to COVID-19, and their judgement will supersede the above-mentioned criteria.
>
> A death due to COVID-19 may be attributed when COVID-19 is the cause of death or is a contributing factor." (Government of Canada, 2021)

This classification is consistent with the WHO's *International Guidelines for Certification and Classification (Coding) of COVID-19 as Cause of Death* published April 20, 2020 (World Health Organization, 2020). WHO's guideline also states "A death due to COVID-19 may not be attributed to another disease (e.g. cancer) and should be counted independently of preexisting conditions that are suspected of triggering a severe course of COVID-19" (World Health Organization, 2020).

According to the Government of Canada and WHO's classification of a COVID-19 death, it is entirely possible a probable case (an individual who had a compatible COVID-19 symptom) who was exposed to a confirmed COVID-19 case, known cluster, or outbreak dies qualifies as a COVID-19 death, irrespective of other contributing or causal factors such as pre-existing chronic or acute health conditions, age, or the possible prevalence of other respiratory illnesses such as influenza or pneumonia.

Statistics Canada's most recent data (2015 – 2017) reflects average life expectancy in Canada of (absent COVID-19, of course) 82.1 years (Statistics Canada, 2019). Life expectancy is 82.66 years in 2021 and was 82.52 in 2020 (Macrotrends, 2021).

According to the WHO, Canada has 25.2 hospital beds per 10,000 people (World Health Organization, n.d.). Using available data from the WHO, the World Bank states there are 2.5 hospital beds per 1,000, effectively ranking it at 53rd in the world (The World Bank, n.d.). The table below reveals the World Bank's most recent data.

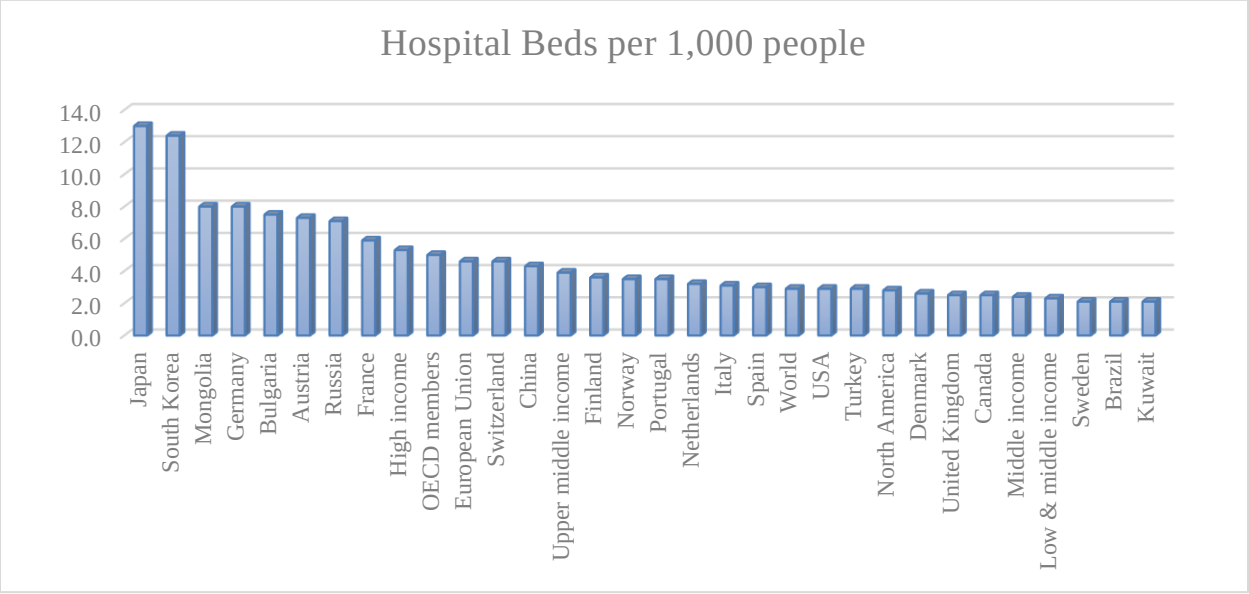
TABLE 3: HOSPITAL BEDS PER 1,000 PEOPLE (WORLD BANK – 2017-2019)

Hospital Beds per 1,000 People (World Bank – 2017-2019)					
13.0	Japan	**5.0**	**OECD members**	3.0	Spain
12.4	South Korea	4.6	Estonia	3.0	Ireland
8.0	Mongolia	4.6	Switzerland	3.0	The Bahamas
8.0	Germany	4.5	Malta	2.9	Antigua & Barbuda
7.5	Bulgaria	4.4	Slovenia	2.9	USA
7.3	Austria	4.3	Euro area	2.9	Brunei Darussalam
7.1	Russia	4.3	Luxembourg	2.9	Turkey
7.0	Hungary	4.3	China	2.8	Iceland
6.9	Romania	4.3	North Macedonia	**2.8**	**North America**
6.6	Czech Republic	4.2	Greece	2.7	Lebanon
6.5	Poland	4.2	Late-demographic dividend	2.6	Denmark
6.4	Central Europe & the Baltics	4.2	Sri Lanka	2.5	United Kingdom
6.4	Lithuania	**3.9**	**Upper middle income**	**2.5**	**Canada**
6.0	Barbados	3.9	Montenegro	2.5	Singapore
5.9	France	3.7	East Asia & Pacific	2.4	Uruguay
5.7	Slovak Republic	3.6	Grenada	2.4	Caribbean small states
5.6	Belgium	3.6	Finland	**2.4**	**Middle income**
5.6	Serbia	3.5	Norway	**2.3**	**Low & middle income**
5.5	Latvia	3.5	Portugal	2.2	Saudi Arabia
5.5	Croatia	3.4	Cyprus	2.2	Tunisia
5.5	Post-demographic dividend	3.2	Netherlands	2.1	Sweden
5.3	**High income**	3.2	Libya	2.1	Chile
5.3	Cuba	3.1	Italy	2.1	Brazil
5.0	Argentina	3.0	Trinidad & Tobago	2.0	Kuwait
4.7	Europe & Central Asia	3.0	Israel	1.9	Latin America & Caribbean
4.6	European Union	3.0	Suriname	1.9	Malaysia
4.5	East Asia & Pacific	**2.9**	**World**	1.7	Bahrain

(The World Bank, 2017-2019)

The table above only indicates beds per capita; it is important to note that this data does not suggest or include accessibility or quality of healthcare. Although Canada ranks low when compared to most developed countries or comparable categories, Canada still has similar beds per capita as the USA (2.9) and Denmark (2.6) and equals the United Kingdom (2.5). Canada also has more hospital beds per capita than Sweden; however, Canada remains lower relevant to high income and upper middle-income averages. Additionally, Canada also scores lower than the average of OECD member states (5.0) and the global average (2.9).

FIGURE 1: HOSPITAL BEDS PER 1,000 PEOPLE (WORLD BANK – 2017-2019)



According to World Atlas, Canada has 2.7 hospital beds per 1,000 people "based on the latest data available from the World Bank ranking it 67 on the list of countries by hospital beds per capita" (World Atlas, 2020). Although there appears to be some inconsistencies concerning hospital bed capacity data from different sources, Canada consistently ranks relatively low. Hospital bed capacity may factor in policy and decision making. Public Health Ontario released a report on December 9, 2020, titled *COVID-19 Infection Fatality Rates Reported in Two Studies by Ioannidis et al.* In this report, Public Health Ontario stated the Ontario government moved Toronto and Peel Region into lockdown level restrictions in response to rising cases and health system capacity (Public Health Ontario, 2020).

Chapter 3: Methodology and Methods

To assess the collective positive and negative consequences of NPIs, this paper will include:

- A literature review;
- A BC Case study; and
- Data analysis.

This paper will not require HREB approval. Interviews are not included in this research.

Methodology

The literature review will critically examine existing qualitative and quantitative COVID-19 and NPI research and studies concerning the consequences of both COVID-19, NPIs and social isolation. To ensure all emerging research is captured, pre-prints as well as published, peer reviewed journal articles will be included. Pre-prints will be clearly distinguished, however, to ensure the reader is aware when and if an article has not been peer reviewed. The qualitative portion of the literature will be supported by quantitative research and data to further contextualize COVID-19 impacts to human health and NPI impacts to human health; therefore, databases both domestic and global will be introduced here. The literature review will be the initial phase of identifying the costs and benefits of NPIs versus the costs and benefits of policies absent NPIs, or limited use of NPIs, by providing an analytic summary of past work relevant to this paper.

A BC case study will be included to contextualize COVID-19 and NPIs in BC. To ensure all available information, data will be pulled from other jurisdictions and extrapolated to BC to fill any information or data gaps.

The statistical analysis will be used to collect and interpret data, both domestic and global, to uncover specific patterns and trends related to the consequences of COVID-19 and NPIs in BC.

Methods

Review of Literature

In terms of both human health impacts of COVID-19 and social isolation, the backbone of this research will include extensive literature reviews of peer-reviewed journal articles. Literature will surround the nature of pandemics, pathogens, and diseases (of similar nature to COVID-19), coronaviruses, COVID-19, and social isolation – all with an emphasis on human health. The bulk of the research will be within the years of 2019 to 2022 but supporting information will preferably not exceed 20 years old. UVic's library database and Google Scholar will be the main sources of information.

Secondary Analysis

Statistical examination of data from databases will be imperative to this research. Publicly available data from different governments (e.g., Health Canada, BC Ministry of Health, BC CDC), departments (e.g., US Centers for Disease Control), and organizations (e.g., World Health Organization) will be required to (a) understand existing underlying assumptions regarding the harms of COVID-19, (b) critically assess the methods used for data collection and interpretation of the harms of COVID-19, and (c) contextualize COVID-19 and NPIs.

BC Case Study

This paper will consider to what extent public policy has considered NPI policy costs as well as identify how NPIs have positively and negatively impacted British Columbians.

Data Analysis

Descriptive analysis will be used to interpret existing data as it relates to human health impacts of COVID-19 and NPIs. Content analysis will involve the quantitative and qualitative research and interpretation of information and data collected from the above methods. Microsoft Excel will be used to store and organize statistical data, which will later be copied into Microsoft Word. Qualitative and quantitative data will consist of categories which surround COVID-19 cases, testing methods, deaths, recoveries, hospital capacity rates, demographics, average life expectancy, economic impacts, physical and mental health implications, and human rights issues.

Reliability and Validity: Establishing Credibility

This research will focus on empirically obtained information from peer-reviewed journal articles, pre-prints, publicly available government documents, reports, and databases. Although interviews and experiments are not included in this research, policies and outcomes will be analyzed similarly, organized, and placed in comparative tables to ensure appropriate comparisons are made. The research, policies, and outcomes will be articulated clearly to allow readers to replicate the research to obtain the same, consistent results.

This paper attempts to identify and analyze to what extent NPI related public policy in BC, as a response to COVID-19, accounted for its subsequent costs and benefits. I have operationalized the research questions to best measure, to what degree, the benefits and costs associated with NPIs were considered by thoroughly examining every COVID-19 response policy implemented in BC since March 2020. By doing so, this report could easily be repeated, provide the same results over time, and measure exactly what is intended to be measured.

Strengths and Limitations

Some limitations of this research include the novel nature of the COVID-19 pandemic leading to potential gaps in research and understanding of the virus. As data emerges, it may conflict with

earlier data. Additionally, it may be difficult to determine the outcomes of a policy without considering any confounds, such as culture and public perception which may impact the willingness to accept health orders; therefore, nullifying policies and reducing their efficacy. Furthermore, this report does not include interviews which may have potentially provided insight from Health Canada, the Ministry of Health, or other relevant and key policy makers or stakeholders – insight that is not evident in or available from current literature and public documents. Interviews may have provided further context, beyond what has been made publicly available, regarding the rationale of prioritizing cases as the metric of paramount (or arguably only) concern, further insight of constitutional analysis and consideration, to what extent the costs of NPIs were considered and mitigated internally, and how and when government collaborated with external and internal stakeholders to ensure dissenting opinions and concerns were considered.

Furthermore, this report does not include an analysis of all NPIs, nor does it include a comparative analysis between BC and other jurisdictions. Comparative analysis would provide further context to the outcomes of NPIs in BC if compared to other jurisdictions (globally and domestically) which implemented disparate or even similar policies; therefore, it may not be appropriate to extrapolate the findings in this report to generalize outcomes in other jurisdictions.

Some strengths include opening a new field of study by challenging underlying and generally accepted assumptions of COVID-19 and corresponding NPI policies. The BC Ministry of Health has also categorized and archived all implemented policies in response to COVID-19; therefore, analyzing BC public policy will be achievable; however, data regarding the costs and benefits of each policy may be difficult to gather. This report also does not provide any counter-factual to make comparisons, as I hope to focus on available data to articulate the impacts of COVID-19 and NPIs (rather than assumptions). I believe these concepts would be best left to a future Multiple Accounts CBA if completed.

As there may be limitations in data quality and availability in BC, data from other jurisdictions are used and extrapolated to inform any missing data gaps.

Chapter 4: Literature Review

Introduction

NPIs which emphasize the use of physical distancing and isolation have been utilized globally in an attempt to mitigate or eliminate the spread of COVID-19. Following the implementation of physical distancing/isolation NPIs in numerous jurisdictions around the world, researchers have analyzed the efficacy of these measures and have subsequently reached entirely incongruent conclusions. Several credible researchers appear to substantiate the effectiveness and/or promote the use of NPIs. At the same time, however, several credible researchers appear to disprove the effectiveness of NPIs and/or highlight the negative outcomes associated with implementing NPI driven policies. Some researchers, on the other hand, report mixed positive and negative results within the same study. The literature review below will identify and elaborate on research on all sides of the ongoing examination. Peer-review articles, pre-prints, academic editorials, and government reports are included.

Mapping the Process

Resources in this literature review were found using the UVIC Library Database and Google Scholar.

All search terms used include: “COVID-19”, “coronavirus”, “SARS-CoV-2”, “case”, “cases”, “physical distancing”, “physical isolation”, “social isolation”, “isolation”, “lockdown”, “collateral damage”, “transmission”, “spread”, “non-pharmaceutical intervention”, “NPI”, “policy, “policies”, “mental health”, “health”, “economy”, “economic” “cost”, “benefit”, “cost-benefit analysis”, “multiple accounts cost-benefit” “efficacy” and “effectiveness”.

The Foundation

Since the start of the COVID-19 outbreak, and continuously to this day, public health departments across the world (and in particular Canada) have made recommendations, advice, mandates, and orders by using mathematical models to predict potential future outcomes related to transmission, hospitalizations, and deaths caused by COVID-19 (Government of Canada, 2021; Nicola, et al., 2020). For clarity, a model is:

> “miniature representation of something; a pattern of something to be made; an example for imitation or emulation; a description or analogy used to help visualize something (e.g., an atom) that cannot be directly observed; a system of postulates, data and inferences presented as a mathematical description of an entity or state of affairs” (Simon Fraser University, 2013, p. 3).

With the definition of a model in mind, a mathematical model is “a representation in mathematical terms of the behavior of real devices and objects” (Simon Fraser University, 2013,

p. 4). Mathematical models are developed by first identifying the "real world" and "conceptual world"; the conceptual world is where we attempt to understand what is taking place – or will take place – in the real world and "can be viewed as having three stages: observation, modeling, and prediction" (Simon Fraser University, 2013, p. 4). Modeling is the analysis of real-world observations to explain behavior or predict future results that may yet be "unseen or unmeasured" (Simon Fraser University, 2013, p. 5). The prediction part is where the observations and models tell us what will happen in the future to help us anticipate and prepare for future outcomes. Most importantly for policy makers to remember, however, is that these:

> "are abstractions and models, they are themselves real only as models, and they should never be confused with the reality we are trying to model. Thus, if the behavior predicted by our models does not reflect what we see or measure in the real world, it is the models that need to be fixed-and not the world" (Simon Fraser University, 2013, p. 12)

Simply stated, a mathematical model is a projection and/or prediction of future events based on real world data; however, when the real-world data is not available, it is often replaced with assumptions. These assumptions (i.e., the inputs) then influence future mathematical modeling outputs. As the inputs may be simple assumptions, they may also be easily manipulated and can therefore drastically alter the outcomes of the projection. For example, if one decides to assume a far greater IFR, transmission rate, and lockdown efficacy beyond what has been collected by pure real-world data, one could assume that if lockdowns are not incorporated into public policy, an exaggerated and overstated number of individuals will be infected with COVID-19, die of COVID-19, and hospitals will subsequently be overwhelmed far beyond capacity. This is not to say that mathematical modelling is ever knowingly or intentionally manipulated to forge inaccurate outputs. This is not to state that any public health department around the world has acted with nefarious intentions. It is, however, a reminder that mathematical modeling can easily be incorrect – especially in an epidemiological context – and public health departments should be hesitant to rely solely on these models to inform public policy. As Nicola et al. (2020) stated, "the values produced by these models are dependent on the quality of the data employed" (Nicola, et al., 2020, p. 124). Furthermore, policy decisions without reliable data is of concern to epidemiologists (Ioannidis J. P., 2020; Nicola, et al., 2020) and key assumptions in each model should be paid full attention to while remaining cognizant of "how sensitive to errors these assumptions are" (Nicola, et al., 2020, p. 124).

The literature review below will include models and real-world data. It will not include all mathematical models and projections used but does provide insight to their use in relation to COVID-19 response policies domestically and globally. The mathematical models in this report are the models which appeared to have had the most influence on COVID-19 response policies globally, gauged by exploring and closely examining relevant media articles, government

(domestic and global) documents, World Health Organization reports, and frequently cited academic sources.

Main Themes of the Literature Review

EARLY STAGES OF THE COVID-19 OUTBREAK AND MATHEMATICAL MODELLING

Neil Ferguson, a physicist at the Imperial College London, created the first epidemiological model regarding the relationships between COVID-19 and lockdowns which subsequently influenced the UK government, policy makers, response policies, COVID-19 mathematical modeling and research around the world. Ferguson presented his findings and projections to the UK House of Commons in early 2020, which predicted catastrophic death tolls unless governments around the world adopted NPIs, including lockdowns and other physical distancing measures, to mitigate or eliminate the outbreak (Magness, 2021; UK House of Commons, 2021). As a result, after implementing several physical distancing measures, a full lockdown was implemented in the UK on March 23, 2020 (UK House of Commons, 2021). Although numerous tiered-NPI system were used, such as lockdowns, restrictions on certain gatherings and circuit breaker measures, the UK Government admits it will not fully understand how effective they have been until after the pandemic is over; however, according to Neil Ferguson, had a national lockdown been instituted a week earlier, the UK could have "reduced the final death toll by at least a half" (UK House of Commons, 2021, p. 32). Ferguson's modelling has not been met, however, without challenge. Magness (2021) argued that Ferguson and his team claimed credit for saving millions of lives by validating their model "by using its own hypothetical projections as a counterfactual of what would happen without lockdowns" (Magness, 2021) thereby potentially and even drastically over estimating COVID-19 severity and NPI efficacy. When Ferguson's modelling was applied in Sweden, his projected COVID-19 death count (96,000 by mid-April 2020) radically overshadowed the actual death count (Magness, 2021). As of January 1, 2022, the current death count in Sweden is 15,271 (Worldometer, 2022), low considering Sweden's rather relaxed approach briefly described previously in this report.

According to another projection model, Di Domenico et al. (2020) predicted lifting lockdowns with no exit strategy would lead to a delay in peak case numbers followed by a swift decline, having a profound negative impact on hospital bed and ICU capacity (Di Domenico, Pullano, Sabbatini, Boëlle, & Colizza, 2020). Other researchers projected that physical distancing measures implemented in the UK would have a substantial impact in a decline in COVID-19 cases (Jarvis, et al., 2020). Huang et al (2021) have found lockdowns are an effective method to control and mitigate the spread of COVID-19 and further asserts "delays in lockdowns cause a dramatic increase in cumulative case counts" (Huang, et al., 2021, p. 1). Ullrich et al. (2021) reported a decrease of notifications of several infectious diseases and pathogens as a result of NPIs such as lockdowns (Ullrich, et al., 2021). Of important note, however, Ullrich et al. (2021) stated "influenza notifications are influenced by testing behaviour for influenza and other

respiratory diseases, which in turn were affected by the severity of (current and previous) influenza seasons on the one hand, and by testing behaviour for COVID-19 on the other" (Ullrich, et al., 2021, p. 7). This may highlight the possibility of testing behavior changes during, pre- and post-lockdown which could influence total case counts if, indeed, case counts are highly malleable and variable to PCR testing frequency and sensitivity described in the Background section of this report.

ASSESSING NPI BEST PRACTICES

Researchers who compared COVID-19 data in Daegu and Seoul, South Korea, found a likely cause of reducing transmission was social distancing; however, extreme measures may not be required (Park, Sun, Viboud, Grenfell, & Dushoff, 2020). Consistent with this prediction, another mathematical modelling study found mitigation strategies could focus on isolating confirmed cases and their close contacts, in combination with other moderate physical distancing measures, to successfully control the spread of COVID-19 (Kucharski, et al., 2020). To be exact, Kucharski et al. (2020) estimated that strategies which combine isolation of symptomatic cases, tracing, and quarantining their contacts would be more successful than mass isolation and testing alone. In a 2020 pre-print, researchers also found partial lockdowns were as effective in reducing cases and deaths as stricter measures and state their "analysis suggests that the most extreme measures, such as those related to declaring a state of emergency or implementing curfews and immediate border closers, are not necessarily the most effective policies, even without considering their economic costs" (Bonardi, Gallea, Kalanoski, Lalive, & R, 2020, p. 21). Park et al. (2020) highlight the "necessity of prompt identification and isolation of case-patients in preventing spread" (Park, Sun, Viboud, Grenfell, & Dushoff, 2020, p. 2698). Due to insufficient data, the researchers were unable to account for delay distribution differences and testing capacities (Park, Sun, Viboud, Grenfell, & Dushoff, 2020). Ryu et al. (2020) also stated that interventions such as enhanced screening and quarantining of confirmed or suspected cases without a full lockdown reduced transmissibility in certain regions in South Korea (Ryu, Ali, Jang, Kim, & Cowling, 2020).

Other researchers have argued that only strict regulations and quarantine measures can effectively curb both the spread of COVID-19 cases and deaths (Bae, et al., 2020; Sjödin, Wilder-Smith, Osman, Farooq, & Rocklöv, 2020). The latter, a modelling study, had included inputs for various scenarios of spread, isolation efficacy, and degrees of community quarantine intensity based on preliminary knowledge and found that "transmission will continue to occur unless the most stringent community quarantine measures are being taken in a lockdown setting, which means near-complete reduction of all activities in the community" (Sjödin, Wilder-Smith, Osman, Farooq, & Rocklöv, 2020, p. 2); however, longer lockdown periods may cause socioeconomic challenges (Sjödin, Wilder-Smith, Osman, Farooq, & Rocklöv, 2020).

In another model-based study, Luo et al. (2021) projected the impacts of both NPIs and pharmaceutical interventions when combined. They also hoped to establish a balance between the use of NPIs and economic wellbeing (Luo, et al., 2021). Luo et al. (2021) found that by implementing strong NPIs (i.e., reducing cross-state trips), governments could depend less on pharmaceuticals while reducing new deaths, cases, and ICU admissions. This would mean that medical systems "would operate more smoothly hence the unit efficiency of the medical system would increase" (Luo, et al., 2021, p. 10).

In a pre-print modelling analysis, Milne and Xie (2020) stated the results generated from their simulation model indicate that both the timing and strength of social distancing measures, including school closure, community contact reduction, workplace non-attendance, and case isolation all have a substantial impact in reducing infections (Milne & Xie, 2020). Two social distancing measures, according to this modelling analysis, are highly effective: "case isolation and a 70% reduction in community-wide contact" (Milne & Xie, 2020, p. 14) which can both be strengthened by health authorities.

Milne and Xie (2020) also state it is challenging for public health authorities to balance between what is necessary with what is feasible, as some options available in one country may not be available in another, as taking pressure off the healthcare system may stretch beyond what the population can sustain during long duration of restrictive measures. For example, school closures are the least effective measure and disruptive for families.

Researchers also attempted to gauge the actual physical distance required between individuals to mitigate the spread of COVID-19 and make comparisons between different jurisdictions around the world to determine which areas, contingent on physical distancing requirements imposed by government, saw a reduction or overall lower number of cases. A meta-analysis established, by reviewing the best available evidence, that at least 1 m of distance is "associated with a large reduction in infection, and distances of 2 m might be more effective" (Chu D. K., et al., 2020, p. 1982); however, "most studies reported on SARS … or MERS" (Chu D. K., et al., 2020, p. 1979). Similar research, which reviewed a super spreader event in a beef processing plant in Germany, has indicated SARS-CoV-2 could transmit over distances more than 8 m (Günther, et al., 2020). An accepted manuscript, however, stated "increasing physical distancing requirements from 3 to 6 feet in school settings is not associated with a reduction in SARS-CoV-2 cases among students or staff, provided other mitigation measures, such as universal masking, are implemented" (van den Berg, et al., 2021, p. 13). Furthermore, physical distancing and the use of PPE did not provide full protection; research in this area, according to these researchers, will require further risk assessment and contextual considerations as no randomized trials were included in the meta-analysis and most research did not provide evidence from COVID-19 (Chu D. K., et al., 2020). Ultimately, there was a strong association found regarding the proximity of exposed individuals and the risk of infection, and the association of decreased transmission with

increased distancing was larger (Chu D. K., et al., 2020). Günther et al. (2020) also stated environmental conditions in the German beef processing plant "including low temperature, low air exchange rates, and constant air recirculation, together with relatively close distance between workers and demanding physical work" were factors which promote aerosol transmission of SARS-CoV-2 and could explain other, similar outbreaks (Günther, et al., 2020, p. 7). Consideration of these conditions, and the range of which these researchers believed COVID-19 could transmit, rationalize the need to impose strict NPI measures such as lockdowns, quarantine, and other physical distancing policies.

Although Mutnal et al (2021) focused on the need for rapid diagnosis and testing, they also explained that (at the time this article was published) because there were no proven drugs or vaccines to treat COVID-19, NPIs such as social distancing are integral to infection control and slowing the spread of the epidemic (Mutnal, et al., 2020). This is further supported by researchers who not only stated "the most important public health interventions to slow the spread will be rapid diagnosis and isolation of cases" (Adalja, Toner, & Inglesby, 2020, p. 1344), Adalja et al. (2020) recommended public health personnel within the US Government adopt social distancing measures, including cancelling large gatherings, implementing work from home policies, and school closures which impact all individuals, not only those who have tested positive for COVID-19 (Adalja, Toner, & Inglesby, 2020). Adalja, Toner & Inglesby (2020) do stress the importance, however, of considering the benefits along with negative societal costs if these measures are incorporated into public policy.

THE PURPORTED BENEFITS AND RATIONALE OF NPIS

There exist abundant credible sources which support the necessity and success of physical distancing and other NPIs (i.e., lockdowns, quarantine) to reduce the spread of COVID-19 (in other words, thereby reducing the number of COVID-19 cases). Immediately described in Lane et al (2021), researchers proclaim a "cornerstone of Australia's ability to control COVID-19 has been effective border control with an extensive supervised quarantine programme" (Lane, et al., 2021, p. 547). Australia's first wave of COVID-19 infections in March and April 2020, according to the authors, reached near elimination through nationwide public health interventions such as international and domestic travel restrictions (Lane, et al., 2021). A second wave of infections hit Australia between June and October 2020, believed to have been caused by flaws in Australia's mandatory hotel quarantine system (Lane, et al., 2021). According to Lane et al (2021), the spread of the second wave was halted by several measures including the "cessation of international arrivals to Victoria, increasingly widespread community lockdowns" and mandatory supervised quarantine for international arrivals (Lane, et al., 2021, p. 552), further advocating for immediate restrictions upon infection discovery including "short, sharp, circuit breaker-type lockdowns" (Lane, et al., 2021, p. 554). As of June 21, 2021, however, cases and deaths have risen significantly, resulting in a peak of 2,688 cases and 27 deaths on October 14, 2021 and October 28, 2021 respectively (Worldometer, 2021). This trend is yet to see a marked

or meaningful reduction[4] (Worldometer, 2021). Megarbane et al. (2021) found similar outcomes in New Zealand, France, Spain, Germany, the Netherlands, Italy and the UK[5] – countries which imposed early stay-at-home orders and other restrictions in response to the spread of COVID-19. These countries, according to the researchers, exhibited rapid decrease in infection and accelerated recovery (Megarbane, B; Bourasset, F; Scherrmann, J., 2021). In contrast, Sweden (no lockdown) and the USA (state dependent lockdowns) experienced a "prolonged plateau of SARS-CoV-2-infected individuals" (Megarbane, B; Bourasset, F; Scherrmann, J., 2021, p. 746).

Some researchers have also claimed that super-spreaders are to blame for COVID-19 transmission, and have labeled super-emitters of "breathing, speaking, singing, vocalizing, coughing and sneezing" as key factors for spread (Bouayed & Bohn, 2021, p. 1748). Furthermore, Bouayed & Bohn (2021) state "behavioural changes, especially in super-spreaders, are presented as a plausible key to the successful global spread of the new coronavirus" (Bouayed & Bohn, 2021, p. 1748). The researchers also stated that grey literature, for example mainstream media, have reported on individuals who ignore physical distancing and deliberately sneeze or cough in public or "on money, or even spitting on door handles, elevator buttons, shopping carts, credit cards, into people's faces, etc" (Bouayed & Bohn, 2021, p. 1749). As such, it appears Bouayed & Bohn (2021) argue actions like these, and super-spreaders in general (who the researchers argue account for 80% of the spread), justify the need for government to enforce NPI mitigation strategies, mentioning that those who intentionally spread COVID-19 may be charged as terrorists or imprisoned for life in the US and Australia, respectively (Bouayed & Bohn, 2021, p. 1748).

Another study published in 2020 analyzed the efficacy of social distancing measures on the transmission of COVID-19 in 10 highly infected countries. The countries included the US, Spain, Italy, the UK, France, Germany, Russia, Turkey, Iran, and China (Thu, Ngoc, Hai, & Tuan, 2020). Social distancing measures were categorized as (a) travel restrictions (international and domestic), (b) facilities shutdown (e.g., reducing crowds in bars, restaurants, and festivals as well as closing schools), and (c) social distancing (considered the highest level; required to stay at home) (Thu, Ngoc, Hai, & Tuan, 2020). According to the Thu et al. (2020), although "social distancing measures are evidently beneficial in limiting the spread of infection, they also greatly affect people's lives and the whole nation's economy in negative ways" (Thu, Ngoc, Hai, & Tuan, 2020, p. 2). Results were categorized as such:

- The relationship between social distancing measures and COVID-19 cases

[4] Case and death rates in Australia remain relatively high (in comparison to previous waves) as of December 5, 2021.

[5] It is important to note that Megarbane et al. (2021) focused on infections, not deaths. As described above, cases are highly variable to testing frequency and sensitivity; neither discussed in this article.

- The relationship between social distancing measures and COVID-19 deaths
- The growth rate of cases at the time of promulgating the highest levels of social distancing measures

Thu et al. (2020) summarized their findings as follows:

1. "In most of the 10 countries, it took 1–4 weeks since the point of highest level of social distancing measures promulgation until the numbers of daily confirmed-cases and daily deaths showed signs of decreasing.
2. The effectiveness of the social distancing measures on the spread of COVID-19 was different between the 10 focused countries. This variation is considered to be due to the difference in the level of promulgated social distancing measures, as well as the difference in the COVID-19 spread situation at the time of promulgations between countries.
3. The transition of daily confirmed-cases and daily death-cases in each country had similar trends.
4. The growth rates of daily confirmed-cases of EU member countries (except Germany), the U.K. and the U.S. at the time of promulgating the highest social distancing measures were higher than that of other focused countries. This means that the spread situation of COVID-19 was difficult to control at the time of promulgating the social distancing measures in these countries.
5. The growth rate of daily confirmed-cases at the time of promulgating the social distancing measures partly influences the decline rates of daily confirmed-cases after the spread reached its peak" (Thu, Ngoc, Hai, & Tuan, 2020, p. 8).

Another study examined the efficacy of social distancing policies (e.g., lockdowns) utilized by eight different countries, including: India, Japan, China, Spain, Italy, France, Iran, and USA (Kaur, Bherwani, Gulia, Vijay, & Kumar, 2021(b)). Interestingly, the authors state "while lockdown has a strong effect on the economy and many people will lose their jobs, creating financial insecurity, lockdown seems to be an efficient way of controlling the spread" (Kaur, Bherwani, Gulia, Vijay, & Kumar, 2021(b), p. 6691); however, it is believed that for every 1% increase in unemployment, there will likely be an associated increase of nearly 40,000 deaths by exacerbating latent consequences causing heart attacks, suicides, homicides, mental hospital admissions and incarcerations (Bluestone, Harrison, & Baker, 1981) (Carson, Thomas, & Hecht, 2015). Furthermore, Kaur et al. (2021) also state countries such as India and Japan have successfully reduced and controlled COVID-19 case numbers by implementing lockdowns and other social distancing measures early, whereas USA, Italy, Spain, and France continue to suffer as a result of "late action on the above mitigation measures" (Kaur, Bherwani, Gulia, Vijay, & Kumar, 2021(b), p. 6692).

There is no shortage of academic articles which propagate the necessity and efficacy of NPIs focused on physical distancing, many of them based on mathematical modelling.

That said, it is very common these articles highlight the importance that policy makers be familiar with the negative consequences caused by these mitigation efforts. On the other hand, numerous articles also focus on the negative consequences rather than discuss the efficacy of NPIs in the reduction of COVID-19 spread. Additionally, some articles refute the efficacy of physical distancing NPIs in reducing infections. These will be included below.

THE PURPORTED COSTS, CONCERNS, AND UNCERTAINTIES OF NPIS

On April 5, 2020, John Ioannidis, a professor of medicine and epidemiology at Stanford University (Stanford University, n.d.), wrote what may possibly be the first paper which highlighted to potential costs of implementing abrupt and/or severe mitigation strategies (Ioannidis J. P., 2020), contrary to recommendations made by Neil Ferguson. Among other concerns, Ioannidis (2020) highlighted the potential deleterious impacts of:

- Developing public policy based on inaccurate data, withdrawn papers, overstated health harms and transmission rates from spurious conclusions within COVID-19 research.
- Developing and implementing extreme, or even coercive, public policy (e.g., a country-level lockdown) of unknown efficacy out of an abundance of caution, thereby ignoring potential consequences/harms.
- Developing public policy which is based on the notion that "no opportunity should be missed to gain benefit, even in the absence of evidence or even with mostly negative evidence" (Ioannidis J. P., 2020, p. 2).
- The possibility that policy makers may implement harmful policies merely due to the pressure of inaction, leading to irrational priorities to avoid the risk of appearing negligent or irresponsible as other jurisdictions implement potentially rash response measures.
- Public policy which emphasizes lockdowns, which when "weaponized by suppressive regimes [could]…create a precedent for easy adoption in the future" (Ioannidis J. P., 2020, p. 3).

Chaudhry et al. (2020) analyzed socioeconomic factors and health capacity related characteristics among 50 countries with the highest number of COVID-19 cases (Chaudhry, Dranitsaris, Mubashir, Bartoszko, & Riazi, 2020). Chaudhry et al. (2020) stated that "countries with a higher median population age…, prevalence of [comorbidities such as] obesity…, and a longer number of days to any border closure… had significantly higher caseloads" (Chaudhry, Dranitsaris, Mubashir, Bartoszko, & Riazi, 2020, p. 4). Critical cases were also correlated with higher unemployment rates and per capita GDP. On the contrary, lower income dispersion, higher number of nurses, and for some inexplicable reason, higher prevalence of smoking was correlated with a reduction in critical cases. Furthermore, full lockdowns (rather than partial or curfews only) and border closures were strongly associated with recovery rates, lower case counts, and lesser peak of transmission which presumably would prevent health system

overcapacity. Equally inexplicable, although these response measures may reduce cases, the researchers also stated "government actions such as border closures, full lock-downs, and a high rate of COVID-19 testing were not associated with statistically significant reductions in the number of critical cases or overall mortality" (Chaudhry, Dranitsaris, Mubashir, Bartoszko, & Riazi, 2020, p. 5). In a similar study, Bendavid et al. (2021) estimated the COVID-19 case growth in relation to less-restrictive and more-restrictive NPI (e.g., mandatory stay-at-home orders and busines closures) implementation in 10 countries. In their analysis, the less-restrictive NPI countries included South Korea and Sweden, whereas the more-restrictive countries included England, France, Germany, Iran, Italy, Netherlands, Spain, and the USA (Bendavid, Oh, Bhattacharya, & Ioannidis, 2021). Bendavid et al. (2021) found that although NPIs were associated with reductions in case growth in 9 of the 10 countries, the researchers found no significant benefit of implementing more restrictive NPIs. Furthermore, Bendavid et al (2021) found that more-restrictive NPIs may cause an increase in case growth as "increased intra-household density and transmission… it is possible that stay-at-home orders may facilitate transmission if they increase person-to-person contact where transmission is efficient such as closed spaces" (Bendavid, Oh, Bhattacharya, & Ioannidis, 2021, p. 6). The researchers also indicate that NPIs may be associated with harms (some more prominent than others) and provide questionable benefits. For example, school spring school closures in the United States may have cost 5.5 million life years for children (Bendavid, Oh, Bhattacharya, & Ioannidis, 2021; Christakis, Van Cleve, & Zimmerman, 2020).

Similar findings articulated by Bendavid et al. (2020) were found by and several other researchers. For example, Coccia, M (2021) conducted a comparative analysis of six European countries and found longer lockdowns (about 60 days) did not appear to be associated with a significant reduction in cases and deaths and longer lockdowns negatively impact economic systems and increased socioeconomic issue. Additionally, potential response measures in future epidemics must be based on investments to the healthcare system, rather than longer lockdowns (Coccia, 2021). Spiegal & Tookes (2021) stated, that although some NPIs such as employee mask policies, mask mandates for the general population, restaurant and bar closures, gym closures, and high-risk business closures predict a reduction in week-ahead new fatalities, "some policies are associated with higher future new fatalities [including] … spa closures, restricting gatherings to 100 or more, and second-time closings of low- to medium-risk businesses, rules that limit elective procedures, mask recommendations, and stay-at-home orders" (Spiegel & Tookes, 2021). In another similar study, Bjørnskov (2021) explored the association between lockdown policies and mortality rates in 24 European countries (Bjørnskov, 2021). Bjørnskov (2021) claims that lockdowns did not work as intended, did not lower mortality rates (in fact, in some instances, appear to have been associated with an increase in mortality), have caused a recession more severe than World War 2, and have eroded fundamental human rights. Additionally, this study also stated a "limited lockdown could cause 185,000 excess deaths over the next years" (Bjørnskov, 2021, p. 327). Furthermore, Simandan et al. (2021) argue responses

to COVID-19 should be more intellectually rigorous and anti-authoritarian, stating lockdowns and other NPIs have had led to devastating impacts to the political economy (Simandan, Rinner, & Capurri, 2022). Simandan et al. (2022) further discusses the costs, which are often hidden, of NPI implementation such as negative psychological, political, environmental (e.g., mask disposal), and social consequences.

Some research also considers the political economy of mass hysteria and its subsequent negative impacts on the development of health-related policies, including those that encourage or mandate physical distancing, and otherwise health in general (Bagus, Peña-Ramos, & Sánchez-Bayón, 2021). Bagus et al. (2021) analyzed how governments, through COVID-19 public health messaging and response measure, have caused the development of mass hysteria among their governed population. This, subsequently, "exacerbates this phenomenon with adverse consequences for public health … [such as] alcoholism, suicides, or damage from deferred treatment and delayed recognition of illness … [and] economic decline and poverty, which in turn negatively impacts public health and life expectancy" (Bagus, Peña-Ramos, & Sánchez-Bayón, 2021, pp. 1, 10, 11). According to the researchers, mass hysteria has also contributed to policy decision-making, in particular lockdowns and other physical or social distancing mandates to curb the spread of COVID-19; however, these policies (with disputed efficacy) have increased anxiety, stress, alcohol consumption, adverse mental health conditions, suicide contemplations, and overall harmful impacts to public health, although "the probability to die from COVID-19 is not only very low in absolute terms, but is also lower than the probability to die from other diseases" (Bagus, Peña-Ramos, & Sánchez-Bayón, 2021, p. 5).

The need for a CBA of COVID-19 response policies, in particular the use of NPIs, have been either identified as a vital missing component when determined appropriate COVID-19 response policies or simply highlighted as a necessary, and desparately needed tool by Simandan et al. (2022) and Allen (2021). For example, the abstract of Allen's (2021) report *Covid Lockdown Cost/Benefits: A Critical Assessment of the Literature* reads as follows:

> "An examination of over 80 Covid-19 studies reveals that many relied on assumptions that were false, and which tended to over-estimate the benefits and underestimate the costs of lockdown. As a result, most of the early cost/benefit studies arrived at conclusions that were refuted later by data, and which rendered their cost/benefit findings incorrect. Research done over the past six months has shown that lockdowns have had, at best, a marginal effect on the number of Covid-19 deaths. Generally speaking, the ineffectiveness of lockdown stems from voluntary changes in behavior. Lockdown jurisdictions were not able to prevent noncompliance, and non-lockdown jurisdictions benefited from voluntary changes in behavior that mimicked lockdowns. The limited effectiveness of lockdowns explains why, after one year, the unconditional cumulative deaths per million, and the pattern

> of daily deaths per million, is not negatively correlated with the stringency of lockdown across countries. Using a cost/benefit method proposed by Professor Bryan Caplan, and using two extreme assumptions of lockdown effectiveness, the cost/benefit ratio of lockdowns in Canada, in terms of life-years saved, is between 3.6–282. That is, it is possible that lockdown will go down as one of the greatest peacetime policy failures in Canada's history." (Allen, 2021, p. 1)

A literature review and meta-analysis conducted by economists from John Hopkins University found similar results in comparison to Allen (2021). Lockdowns reduced mortality by an average of 0.2%, shelter-in-place-orders reduced COVID-19 mortality by an average of 2.9%, and "specific NPI studies also find no broad-based evidence of noticeable effects on COVID-19 mortality" (Herby, Jonung, & Hanke, 2022, p. 3). Furthermore, Herby, Jonung & Hanke (2022) stated:

> "The use of lockdowns is a unique feature of the COVID-19 pandemic. Lockdowns have not been used to such a large extent during any of the pandemics of the past century. However, lockdowns during the initial phase of the COVID-19 pandemic have had devastating effects. They have contributed to reducing economic activity, raising unemployment, reducing schooling, causing political unrest, contributing to domestic violence, and undermining liberal democracy. These costs to society must be compared to the benefits of lockdowns, which our meta-analysis has shown are marginal at best. Such a standard benefit-cost calculation leads to a strong conclusion: lockdowns should be rejected out of hand as a pandemic policy instrument" (Herby, Jonung, & Hanke, 2022, p. 43)

The need to conduct a full-scale CBA could easily be justified simply by considering findings by McIntrye and Lee (2020), who projected increases in suicide in Canada as a results of COVID-19, the subsequent economic downturn, social distancing and quarantine measures, although "social isolation measures are critical to reduce the spread of the coronavirus" (McIntyre & Lee, 2020, p. 3). COVID-19 NPI preventive measures, such as quarantine, isolation, lockdown, and curfew have impacted various psychological, social, economic factors, including loneliness, isolation, anxiety, stress, depression, fear of infection, withdrawal or substance misuse, and unemployment which, acording to "several studies reported that these above-mentioned factors will or have alrady increased suicide rates during COVID-19" (Ganesan, et al., 2021, p. 2). Furthermore, mental health issues caused by NPIs, such as acute stress, anxiety, frustration, guilt, anger, boredom, sadness, depression, worry, nervousness, helplessness, loneliness, depression, and sleep disorders were more "common among front-line workers, people with pre-existing mental health issues, and people with chronic physical health disorders" (Ganesan, et al., 2021, p. 2; Hao, et al., 2020; Tanaka & Okamoto, 2021; Wang, et al., 2021). Furthermore, lockdowns were associated with an increase in self-harm, "as was the case for 53.5% of the females

compared with 38.6% of the males [in this study], suggesting that lockdown may have been more stressful for females" (Hawton, et al., 2021, p. 441). Factors which contributed to self-harm included exacerbation of mental health problems, reducts availability of intervention services, isolation, entrapment, loneliness, reduced social contact with other individuals, and disruption of routine.

COVID-19 response policies which include NPIs designed to encourage or mandate physical distancing and isolation have had led to numerous negative consequences, resulting in perverse outcomes which have incongruously and drastically harmed individuals in several ways, including health and wellbeing (although the purported purpose of such NPIs are to improve these metrics). For example, researchers found that although, on average, older adults in four Spanish population-based cohorts during the first COVID-19 lockdown did not experience a deterioration in lifestyle risk factors due to strict confinement, moderate decline in mental health did not seem to reverse after restrictions ended (García-Esquinas, et al., 2021). Subgroups which were identified at an increased risk of developing unhealthy lifestyles include: males (physical activity and sedentariness); individuals without daily contact with family and friends (diet and physical activity); married participants (sleep quality); individuals who experience feelings of loneliness (diet and sleep quality); individuals with sub-optimal housing conditions (diet, physical activity, TV viewing time); individuals with unhealthy sleep patters and individuals with overall health or chronic morbitidies (physical activity, increased screen time), stating a "quantity of evidence supports a link between confinement and decline in mental health, both in middle-aged and older adults, and provides evidence that female gender and being younger are risk factors of these declines" (García-Esquinas, et al., 2021, p. 20; Saiz, et al., 2021; Vahia, Jeste, & Reynolds III, 2020). Lockdowns have been associated with greater mental health symptoms, increases in alcohol consumption (typically used to regulate negativemoods during state lockdowns), and portend greater substance addiction issues (Das, Singh, & Bruckner, 2022). Lockdown measures have also intensified depressive, anxiety, and insomnia symptoms (Pieh, et al., 2021), whereas psychological symptoms of depression and anxiety were two to three times higher relative to prepandemic samples (Ebrahimi, Hoffart, & Johnson, 2021) and children and adolescents exposed to lockdowns experienced anxiety and depression symptoms, irritability and anger, with lockdowns utlimately resulting psychological distress (Panchal, et al., 2021).

NPI policy implementation has also exacerbated the ongoing drug and opioid overdose pandemic which has already overwhelmed many countries around the world. NPIs have worsened the ongoing, destructive opioid crisis (Arnold, 2020; Linas, et al., 2021) by sharply increasing fatal overdose trends (Friedman, Beletsky, & Schriger, 2021) with a "statistically and clinically significant increase in the proportion of opioid overdoses in relation to the overall change in total ED visits" (Rosenbaum, et al., 2021).

NPIs have also had a profound impact on domestic violence. Pediatric emergency department presentations regarding domestic accidents significantly increased during lockdown period, citing "more domestic accidents than COVID-19 in children" (Bressan, Gallo, Tirelli, Gregori, & Da Dalt, 2021, p. 1). Domestic violence calls dramatically increased following lockdown and the "The largest increases in both at-home patterns and domestic violence occurred during weekday daytime hours, when most adults would have otherwise been at work and most children would have been in school" (McCrary & Sanga, 2021, p. 2).

Prior to the COVID-19 pandemic, in-school learning was proven to be more effective than distance or remote learning (Bonal & González, 2020). Unsurprisingly, school closures have been associated with a reduction in both instructional and learning time, widened the inequalities and achievement gap between students from different socioeconomic backgrounds, yielding an overall decrease in opportunities to learn and acquire skills (Skar, Graham, & Huebner, 2021), especially among those of lower socioeconomic background (Bonal & González, 2020) and even more so on learning outcomes and behaviors for children with special education needs (Sakarneh, 2021). Lockdown and school closures also reduced opportunities for after-school activities which continued to polarize "the gap between socially advantaged and disadvantaged children" (Bonal & González, 2020, p. 649).

Lockdowns impact physical inactivity, thereby increasing the likelihood of cardiovascular disease globally; therefore, researchers fear an increase in premature deaths related to the decrease in physical activity not only during the pandemic, but even after (Peçanha, Goessler, Roschel, & Gualano, 2020; Muhammad & Abubakar, 2021). Using estimates provided by earlier research regarding physical inactivity and cardiovascular disease, coronary heart disease may "scale up by ~535,000,~1.3 million, and ~2.7 million and by ~42,000,~105,000, and ~210,250 if inactivity hypothetically increases by 10, 25, or 50%, respectively, during the COVID-19 pandemic … [but] will be proportional to the period of inactivity" (Peçanha, Goessler, Roschel, & Gualano, 2020, p. 1444). Lockdowns may, ironically, may exacerbate the deleterious effects of physical inactivity among cardiac patients who are considered a vulnerable group (Peçanha, Goessler, Roschel, & Gualano, 2020). Furthermore, research has shown that early concerns regarding the association between NPIs and cardiovascular disease has manifested. An increase of sedentary behavior in patients with cardiovascular diseases (mainly heart failure patients), healthy individuals, and athletes has resulted in numerous health concerns and complications, resulting in a long-term worsening of people health status (Kirsch & Vitiello, 2022).

The impacts of lockdowns also appear to have staggered hospital visit and admission rates, especially cancer care, during the lockdown in comparison to pre-lockdown periods (Goenka, et al., 2021; Piketty, et al., 2022; Riemann, Speck, Gerstacker, Becker, & Knopf, 2021). In Italy, cancer diagnosis fell by 39% in 2020 relative to the averages recorded in 2018 and 2019; whereas prostate cancer, bladder cancer, and colorectal cancer had the greatest decrease (De

Vincentiis, Carr, Mariani, & Ferrara, 2021). Even modest delays in cancer surgeries is expected to incur significant impact on overall survival; a delay of approximately three to six months is expected to decrease 19%-43% of life years gained by appropriate hospitalization of equivalent volume of COVID-19 admissions (De Vincentiis, Carr, Mariani, & Ferrara, 2021; Sud, et al., 2020). Furthermore, a substantial increase in the number of avoidable deaths is expected as a result of diagnostic delays in England due to the response efforts regarding COVID-19. Four types of surgery (lung, esophagus, liver, and stomach) dropped to very low levels during the lockdown period in Wuhan (Zhou, et al., 2021). Ultimately, medical intervention, screening delays, and missed diagnoses caused by COVID-19 policies (e.g., lockdowns) are expected to increase, for example, lung cancer deaths in the 5 years after initial diagnosis by 4.8 to 5.3% (Wilkinson, 2022). NPIs appear to have increased, or are expected to increase, mortality rates in non-COVID-19 related health contexts. As an example, mortality rates for Alzheimer disease and dementia increased twice between March 21 April 11, 2020, and again between June 6 and July 25, 2020 (Woolf, et al., 2020).

NPIs were also viewed to be potentially associated with human rights violations, resulting in the possibility "these measures [may slip] … into human rights abuses by design or negligence" (Zweig, Zapf, Beyrer, Guha-Sapir, & Haar, 2021, p. 181). To be exact, 71.76% of the 10,720 NPIs considered had potential impacts to human rights. A summary of the potential human rights violations described by Zweig et al. (2021) is below:

TABLE 4: DESCRIPTION OF PUBLIC HEALTH INTERVENTIONS WITH POTENTIAL HUMAN RIGHTS IMPACTS

Intervention type	Potential Human rights impacted	Vulnerable groups affected
School closures	Right to access and quality of education; right to nutrition; right to work (for parents and teachers)	Low-income students and those without internet access; food-insecure families; parents without access to childcare who cannot stay at home; children with learning disabilities
Border closures	Freedom of movement; right to seek asylum; right to health and well-being	Refugees; asylum seekers; undocumented individuals; expatriates; people who travel for work
Quarantine and isolation	Freedom of movement	People with physical and mental health issues; essential in-person workers; low-income workers; unemployed people; people with disabilities; elderly people; unstably housed persons; people living in crowded conditions
Limiting gatherings	Right to assemble; free speech; freedom of movement	Refugees and internally displaced persons (IDPs); people experiencing homelessness;

Intervention type	Potential Human rights impacted	Vulnerable groups affected
		protesters; people living in crowded conditions; minorities (racial/ethnic, religious, or political)
Household confinement	Freedom of movement; right to health and well-being	People experiences homelessness; domestic workers; people with mental health conditions; refugees and IDPs; essential workers; elderly people; people living in crowded conditions
Leisure and entertainment venue closures	Right to leisure; right to participate in cultural life; right to work	Service industry employees; particularly low-wage workers
Retail store closures	Right to work	Retail industry workers, particularly low-wage workers; people without internet or with low retail store density
Restaurant (dine-in) closures and restrictions	Right to work; right to participate in cultural life	Food service workers, especially low-income people
Symptom screening at borders	Right to protection against interference with individual privacy	People with disabilities or chronic diseases
Office closures	Right to work	People who cannot work from home
Limiting movement within administrative borders	Freedom of movement	IDPs and refugees; unstably housed people
Public space closures	Freedom of movement; right to peaceful assembly	People from sociopolitical minorities; unstably housed people
State of emergency	Right to self-will	Groups who face discrimination
Testing symptomatic individuals	Right to protection against interference with individual privacy	People with disabilities or chronic diseases; people with poor access to health care; low-income people
Mandated face mask use	Right to freedom of expression (communication ability for disabled)	People with disabilities or underlying health conditions
Public transport closures	Right to a standard living adequate for health and well-being; freedom of movement	Low-income people; people experiencing homelessness; schoolchildren; elderly people; undocumented individuals; rural populations
Contact tracing	Right to protection against interference with individual privacy	People with poor access to health care; low-income populations; people without internet access; undocumented people
Closure of nursing homes and Long-term care facilities	Right to a standard of living adequate for health and well-being	Elderly people; people with disabilities or chronic diseases

Intervention type	Potential Human rights impacted	Vulnerable groups affected
Military or police deployment	Right to protection from violence and inhumane treatment or punishment; right to protection from arbitrary arrest	People at risk of police or military violence or harassment (racial/ethnic, religious, sexual, and political minority groups)
Testing asymptomatic individuals	Right to protection against interference with individual privacy	People with disabilities or chronic diseases; people with poor access to health care; low-income people
Religious venue closures	Freedom of worship and religious practice, teaching, and observance	People belonging to religious or faith-based groups, particularly stigmatized minorities

(Zweig, Zapf, Beyrer, Guha-Sapir, & Haar, 2021)

By tracking maritime vessel data as an indicator of economic activity, researchers reported that during the first eight months of 2020, a 4.4% reduction in global ports calls (i.e., ingoing and outgoing movement of maritime vessels) for trade-carrying vessels (Verschuur, Koks, & Hall, 2021); however, when passenger vessels were included, researchers reported a 17% reduction in ports calls (United Nations, 2020). Additionally, the United Nations Conference on Trade and Development reported that, as an impact of COVID-19 measures, China, the European Union, and the US in Q1 2020 saw an average reduction of 8% in the automotive industry, 8% in machinery, 8% in office machinery, and 11% in textiles and apparel (United Nations, 2020). Verschuur, Koks & Hall (2021), by analyzing ports calls of maritime trade (rather than total trade), found average losses in Q1 2020 for textiles and apparel of 6.2%; electrical equipment and machinery manufacturing of 9.2%; transport equipment of 6.5%; and other manufacturing of 8.4% (total trade loss estimate between 225 and 412 billion USD). Additionally, clear evidence of negative impacts of NPI to the economy were found, such as school closures, workplaces and public transport decreased daily exports (Verschuur, Koks, & Hall, 2021). In another report published by UNCTAD, global trade decreased by 8% in the first 3 quarters of 2020 (United Nations, 2021). Countries more dependent on tourism were "more likely to adopt a larger economic stimulus package" aimed at mitigating the negative economic impacts of COVID-19 response policies (Khalid, Okafor, & Burzynska, 2021, p. 2816), further highlighting the economic impacts of such policies. COVID-19 response policies have also impacted some economic sectors unexpectedly, including sport. Researchers found sport-related GDP in the United Kingdom declined 23% in 2020 and "the severity of this decline compared with the state of the UK economy overall implies that the profit margins would be put under pressure and the sport sector needs to prepare for such an outcome" (Kokolakakis, Lera-Lopez, & Ramchandani, 2021, p. 14). Furthermore, economic impacts in general which appear to be caused by NPIs impact individuals of poor socioeconomic backgrounds, ethnic minorities, and low-income countries to far greater degrees; subsequently having a profound, negative impact on global poverty (Buheji, et al., 2020; Josephson, Kilic, & Michler, 2021; Kokolakakis, Lera-Lopez, & Ramchandani, 2021; Mulugeta, Tadesse, Shegute, & Desta, 2021; Segarra-Blasco, Teruel, & Cattaruzzo, 2021; Sport England, 2020).

The Great Barrington Declaration, authored and signed by infectious disease epidemiologists and public health scientists on October 4, 2020, highlights the "grave concerns about the damaging physical and mental health impacts of the prevailing COVID-19 policies, and recommend an approach [called] Focused Protection" (Kulldorff, Gupta, & Bhattacharya, 2020). The Focus Protection policy proposal is defined as "the most compassionate approach that balances the risks and benefits of reaching herd immunity, [and] allow those who are at minimal risk of death to live their lives normally to build up immunity to the virus through natural infection, while better protecting those who are at highest risk." (Kulldorff, Gupta, & Bhattacharya, 2020). This declaration calls for those who are not vulnerable to resume life as normal. Schools and universities, extracurricular activities (e.g., sports), restaurants, business, arts, music, and cultural activities should all resume. Lastly, "People who are more at risk may participate if they wish, while society as a whole enjoys the protection conferred upon the vulnerable by those who have built up herd immunity" (Kulldorff, Gupta, & Bhattacharya, 2020).

CBA Applicability

As described earlier in this report (Theoretical Framework), a Multiple Accounts CBA is "an evaluation framework […] established with different accounts and indicators. Monetary measures are used for some of the accounts, but in others, where monetary measures would not be reliable or broadly accepted, physical indicators or descriptions of the impact and their significance may be used" (Shaffer, 2010, p. 31). Accounts should be robust enough to capture all consequences experienced by everyone who is affected by a given policy or project (Shaffer, 2010). Similarly, the Multiple Accounts Analysis (MAA) "allows indicators and values for intangible issues (e.g. aesthetics, risk etc.) as well as very tangible issues (e.g. costs, stability and safety etc.) to be included in an alternatives evaluation" to best weigh the advantages and disadvantages of each alternative (Robertson & Shaw, 2004, p. 1). Either the Multiple Accounts CBA or MAA have been used, among several other studies, to evaluate**:**

- Technical indicators, project economics, physical environmental indicators as well as ecosystem and socio-economic factors to determine sustainability optimization regarding the mining industry and major mining projects (Robertson & Shaw, 2004).
- Social (e.g., local communities and Indigenous Peoples' rights, ranching), economic, and environmental factors (e.g., water, vegetation, air, and wildlife) related to coal mining in Alberta (Winter, Bailey, Galley, Joseph, & Shaffer, 2021)
- The costs and benefits of Euro 2000, including economic as well as public and business opinion and perception through interviews (Oldenboom, 2005).

These approaches are likely most fitting to determine and evaluate both tangible and intangible indicators related COVID-19 NPI response policies (e.g., COVID-19 severity and NPI impacts to physical and mental health, potential human rights violations, and socioeconomic consequences), to best gauge costs, benefits, advantages, and disadvantages prior, during, and post policy implementation.

Summary

New and developing research and data continue to be collected and shared as countries around the world remain, to varying degrees, responding to the COVID-19 pandemic. According to the literature review above, consensus as to the efficacy and safety regarding NPIs such as physical distancing, stay-at-home recommendations, state enforced mass lockdowns, and any form of least- to most- restrictive mandates have not been established. It is difficult to determine what type of government response policy is best at reducing overall hospitalizations, deaths and negative wellbeing outcomes in general in both the context of COVID-19 and the context of adverse outcomes as a result of NPIs.

Early studies seemed to have focused on developing projections to anticipate future harms caused by COVID-19 and implementing corresponding and effective measures. The metric, at the core, which researchers tended to prioritize was COVID-19 cases, with an underlying assumption that reducing cases will thereby reduce COVID-19 hospitalizations and deaths (Magness, 2021; UK House of Commons, 2021). The association between lockdowns (from least- to most- restrictive) do appear to have a positive impact on COVID-19 cases (Adalja, Toner, & Inglesby, 2020; Bae, et al., 2020; Huang, et al., 2021; Jarvis, et al., 2020; Lane, et al., 2021; Megarbane, B; Bourasset, F; Scherrmann, J., 2021; Milne & Xie, 2020; Mutnal, et al., 2020; Sjödin, Wilder-Smith, Osman, Farooq, & Rocklöv, 2020); however, some studies have also found either limited impact (Chaudhry, Dranitsaris, Mubashir, Bartoszko, & Riazi, 2020) – or even worse – an increase in cases depending on the type NPI used (Bendavid, Oh, Bhattacharya, & Ioannidis, 2021). Additionally, the association between reducing cases and reducing COVID-19 hospitalizations and deaths appears weak (Bjørnskov, 2021; Coccia, 2021; Spiegel & Tookes, 2021). With that in mind, attempts at reducing cases have seemingly imposed incomprehensible, alarming, risky, and drastic physical health, mental health, human rights and economic consequences (Arnold, 2020; Bagus, Peña-Ramos, & Sánchez-Bayón, 2021; Bonal & González, 2020; Bressan, Gallo, Tirelli, Gregori, & Da Dalt, 2021; Buheji, et al., 2020; Christakis, Van Cleve, & Zimmerman, 2020; De Vincentiis, Carr, Mariani, & Ferrara, 2021; Ebrahimi, Hoffart, & Johnson, 2021; Ganesan, et al., 2021; García-Esquinas, et al., 2021) (Goenka, et al., 2021; Hao, et al., 2020; Hawton, et al., 2021; Ioannidis J. P., 2020; Josephson, Kilic, & Michler, 2021; Kirsch & Vitiello, 2022; Kokolakakis, Lera-Lopez, & Ramchandani, 2021; Linas, et al., 2021; Maringe, et al., 2020; McCrary & Sanga, 2021; McIntyre & Lee, 2020; Muhammad & Abubakar, 2021; Mulugeta, Tadesse, Shegute, & Desta, 2021; Peçanha, Goessler, Roschel, & Gualano, 2020; Pieh, et al., 2021; Piketty, et al., 2022; Riemann, Speck, Gerstacker, Becker, & Knopf, 2021; Saiz, et al., 2021; Segarra-Blasco, Teruel, & Cattaruzzo, 2021; Simandan, Rinner, & Capurri, 2022; Skar, Graham, & Huebner, 2021; Sport England, 2020; Tanaka & Okamoto, 2021; United Nations, 2021; Vahia, Jeste, & Reynolds III, 2020; Verschuur, Koks, & Hall, 2021; Wang, et al., 2021; Wilkinson, 2022; Zhou, et al., 2021; Zweig, Zapf, Beyrer, Guha-Sapir, & Haar, 2021).

Considering the social, economic, and health factors described above, the need for a Multiple Accounts CBA was articulated as a technique which could, by providing high-level examples, accurately identify and measure costs and benefits associated with COVID-19 NPI public policy (Oldenboom, 2005; Robertson & Shaw, 2004; Shaffer, 2010; Winter, Bailey, Galley, Joseph, & Shaffer, 2021).

The two studies which most closely resemble a CBA, Allen (2021) and Herby, Jonung & Hanke (2020), have both found similar, undesirable, and deleterious consequences regarding NPIs. Both studies claim that NPIs (e.g., lockdowns) have had little or no impact in preventing infection, hospitalizations and deaths of COVID-19, but paradoxically, have also caused increases in severely harmful collateral damage (e.g., physical and mental health as well as negative economic implications) (Allen, 2021, p. 1; Herby, Jonung, & Hanke, 2022).

The inconsistencies have highlighted the need to focus on appropriate metrics. The literature review emphasizes the need to deviate away from focusing on COVID-19 cases (a number highly variable to testing frequency and sensitivity) and more so on hospitalizations and deaths due to COVID-19 and all other causes. This, as described in the background section, may face hurdles as COVID-19 deaths have not been properly categorized or distinguished between 'with' or 'of' (Postill, et al., 2020); thereby potentially reducing the legitimacy of COVID-19 data, data collection, and data analysis. One example would be the impacts of prioritizing COVID-19 cases when attempting to project future consequences caused by COVID-19 infection if cases do not naturally represent the dangers imposed by COVID-19. Mathematical modelling based on preliminary and/or misleading data (i.e., COVID-19 case severity assumptions) as well as data misinterpretation can lead to poor and irrelevant policy making. Given current academic research, it is clear – even if certain NPIs are incredibly efficacious at mitigating cases – the benefits may not outweigh the risks. This continues to highlight the need of a thorough Multiple Accounts CBA in BC.

This literature review, admittedly, only skims the surface of the COVID-19 response policies 'iceberg'. Although research results have shared one consistency, that being an inconsistency of outcomes, these inconsistent outcomes highlight the desperate need for the Government of BC to conduct its own Multiple Accounts CBA regarding provincial and regional COVID-19 response measures. As of June 2022, BC has not conducted a comprehensive or meaningful full or partial CBA prior to, during, or after NPI implementation. Considering the literature review above, this may place members of the public at risk of policies which may inadvertently cause more harms than benefits.

Chapter 5: BC Case Study and Data Analysis

As described in the Background of this report, NPIs have been implemented to varying degrees around the globe. Many jurisdictions have elected to use no or minimal interventions, while many other jurisdictions have chosen to use stricter or more authoritarian interventions; that said, the degree to which different jurisdictions across the world have implemented NPIs highly differs. The purpose of this section is to elaborate on the COVID-19 pandemic in BC by (a) analyzing the impacts caused by COVID-19, and (b) analyzing the impacts of corresponding NPIs, whether positive or negative, to inform a future Multiple Accounts CBA. Furthermore, this chapter will also describe the Government of BC's rationale and justification for NPI mitigation policies and efforts as well as provide the relevant human health, economic, human rights, and constitutional considerations. At times, data throughout this section will be gathered (especially where data limitations may exist in BC) from other, similar jursdictions, such as the Federal Government of Canada, The United Kingdom (UK), and the United States (US).

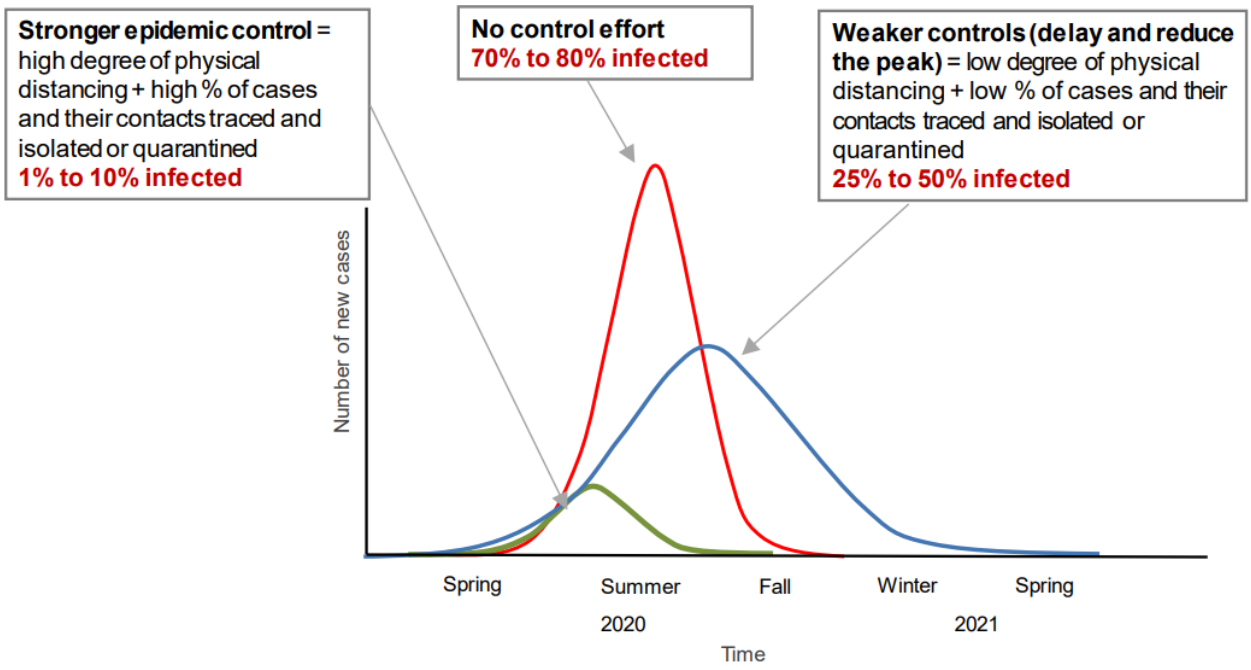
Physical isolation strategies have been implemented in what appears to be an effort to reduce COVID-19 deaths, cases and hospitalization rates – with an emphasis on cases (BC Centre for Disease Control, n.d; World Health Organizations, n.d.). According to the BC Centre for Disease Control, self-isolation is recommended for several different reasons but highlights the need to isolate as it is an important step to reduce the spread of COVID-19 (BC Centre for Disease Control, 2021). The Government of BC has set numerous restrictions including physical and social isolation measures regarding social gatherings, events, restaurants, fitness centres, recreation facilities and sports as well as mask mandates to "help stop the spread of COVID-19" (Government of BC, 2021). To mitigate the spread of COVID-19 and its variants in Canada, the Government of Canada has implemented mandatory quarantine and isolation for those travelling to Canada and are not currently exempt, including those who provide essential services or maintain the flow of essential goods (Government of Canada, 2021). These requirements are enforceable through penalties, fines and imprisonment. These social isolation measures are common across Canada and many jurisdictions around the world.

Mathematical Modelling

According to the Government of Canada, methematical modelling (defined in Chapter 4: Literature Review) has been used to guide public health action (Government of Canada, 2022). Mathematical modelling, in the context of COVID-19, has been used to (a) study how the disease spreads, (b) anticipate future outbreaks, and (c) guide health planning and infectious disease control by estimating how many cases may occur in the coming weeks or months (Government of Canada, 2022); therefore, COVID-19 mathematical models center themselves around cases as the most important and guiding metric (assuming cases will indicate forthcoming hospitalizations and deaths). Ultimately, modelling data is considered essential to controlling COVID-19 by influencing corresponding measures, such as physical distancing, isolation,

tracing and quarantine, as well as preventing spread from cases related to travel (Government of Canada, 2022). As of February 18, 2022, the Government of Canada has published 24 COVID-19 mathematical models to project future case estimates and scenarios. For example, the first mathematical modelling report published by the Government of Canada on April 9, 2020, developed three key scenarios: 'no control'; 'weaker controls (delay and reduce the peak)'; and 'stronger epidemic control' (Public Health Agency of Canada, 2020). Stronger epidemic controls include a high degree of physical distancing, a high proportion of cases identified and isolated, and a high proportion of contacts traced and quarantined; whereas weaker controls include a low degree of physical distancing, a low proportion of cases identified and isolated, and a low proportion of contacts traced and quarantined (Public Health Agency of Canada, 2020). This aspect of the mathematical modelling demonstrates the Government of Canada's incorporation of underlying assumptions that physical and social isolation measures will irrefutably reduce cases, thereby reducing hospitalizations and deaths. For example, the below figure (published by the Public Health Agency of Canada) describes the projected impact of each measure on cases in Canada.

FIGURE 2: MODELLED SCENARIOS SHOW IMPACT OF PUBLIC HEALTH MEASURES (APRIL 9, 2020)

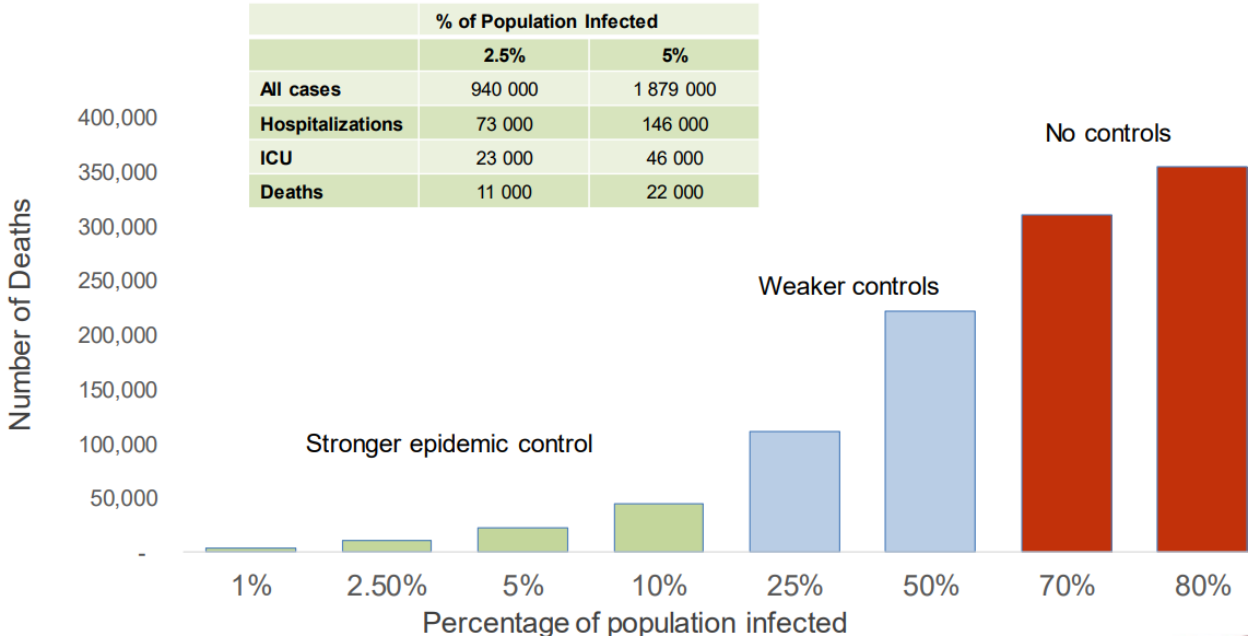


(Public Health Agency of Canada, 2020)

The figure above makes three major assumptions. First, a high degree of physical distancing, tracing, isolation, and quarantine will keep cases at a manageable level. Second, no intervention will cause an enormous spike in cases. Third, a low degree of physical distancing, isolation, and quarantine will also lead to a smaller spike, albeit smaller than no intervention. Again, this showcases the Government of Canada's underlying assumption that the NPIs described above

will reduce cases effectively. As such, the Public Health Agency of Canada also developed a corresponding figure (below) which details each of the three types of epidemic controls and their projected impacts to COVID-19 deaths.

FIGURE 3: CUMULATIVE DEATHS UNDER DIFFERENT SCENARIOS OVER THE COURSE OF THE PANDEMIC

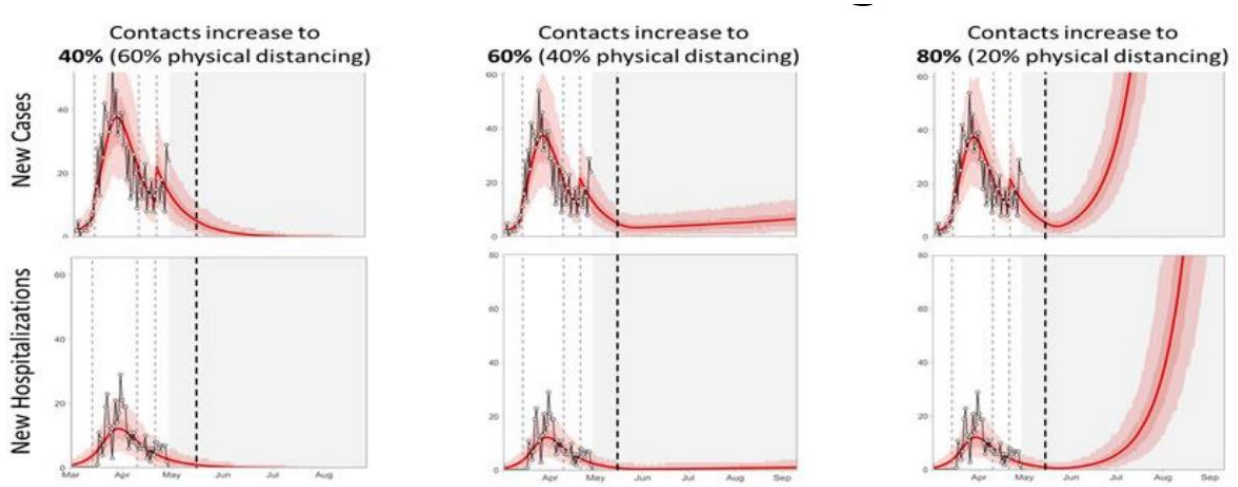


(Public Health Agency of Canada, 2020)

The above figure demonstrates the Public Health Agency of Canada's assumption that COVID-19 cases are directly linked to COVID-19 deaths. Stronger epidemic control will result in far fewer deaths, whereas no controls will result in a critical number of deaths. This mathematical modelling, at a federal level, is the crux of NPI justification as a strategy to limit or eradicate COVID-19 cases in Canada. As of February 18, 2020, the Government of Canada's COVID-19 mathematical modelling has failed to include any of the perceived, potential, or actual costs associated with NPI public policy.

The Government of BC, through the BC CDC, has also published several COVID-19 mathematical models which guide COVID-19 provincial public policy to limit the spread of the virus (BC Centre for Disease Control, 2022). Analogous to the Public Health Agency of Canada, the BC CDC provided different scenarios based on levels of government intervention. For example, BC COVID-19 mathematical modelling published on May 4, 2020, made COVID-19 case predictions based on contacts and physical distancing measures. The relationship between COVID-19 transmission and physical distancing at a high level is presented in the BC CDC figure below.

FIGURE 4: SCENARIOS WITH VARYING DEGREES OF RELAXED DISTANCING



(BC Centre for Disease Control, 2020)

As stipulated in the above scenarios, the BC CDC has also made underlying assumptions that NPIs (e.g., physical distancing) will reduce COVID-19 transmission effectively; however, none of BC CDC's mathematical models have also considered any of the perceived, potential, or actual costs associated with NPI public policy.

In response to COVID-19 mathematical modelling results, the Provincial Government of BC, through the Ministry of Health, Office of the Provincial Health Officer, has implemented approximately 190 Orders and Notices, 22 Guidance documents, and 10 Letters and Statements, for a total of 222 types of public policies as of February 18, 2022 (Government of BC, 2022). Most policies were related to physical or social distancing[6] related measures[7]. These policies will be reviewed to establish general justifications and rationale as well as any indication or considerations of the costs and benefits associated with NPI implementation.

Response Policies

At a high level, it appears each of the above policies (including letters and statements) were solely implemented to reduce cases, clusters, and outbreaks of COVID-19 in BC, thus reducing COVID-19 hospitalizations and deaths. Most recently, for example, the *Post-Secondary*

[6] As 70% of communication is non-verbal (Raymond H. , 2016), policies that require the use of PPE (e.g., masks) which limits non-verbal communication will be considered social distancing. Policies which require lockdowns, business closures, and/or stay-at-home orders, or any physical contact limitation (non-exhaustive) will be considered physical distancing.

[7] Pharmaceutical interventions and NPIs regarding COVID-19 vaccinations will be distinguished as follows: COVID-19 vaccines will be considered a pharmaceutical intervention. Proof of vaccination or any incentive to get vaccinated will be considered an NPI.

Institution Housing COVID-19 Preventive Measures Order dated February 28, 2022 stated "programs that require proof of vaccination have been shown to increase vaccination uptake in populations, thereby reducing the public health risk of SARS-CoV-2 and the burden of COVID-19 illness on the public health […] and society as a whole" (Government of BC, 2022, p. 3). Whether vaccination related or not, all policies appear to reflect the same goal, as stated above, to reduce COVID-19 cases, transmission, hospitalizations, and deaths, and more recently incentivize vaccination in order to do so.

The policies do not reference or discuss any real or perceived negative consequences associated with them; however, the policies consistently include constitutional and human rights considerations prescribed by law. To use the *Post-Secondary Institution Housing COVID-19 Preventive Measures Order* dated February 28, 2022, as an example, the Order states:

> "these rights and freedoms [under the *Charter of Rights and Freedoms*] are not absolute and are subject to such reasonable limits prescribed by law as can be demonstrably justified in a free and democratic society, which includes proportionate, precautionary and evidence-based measures, including vaccination, to prevent loss of life, serious illness and disruption of our health system and society." The Provincial Health Officer is "aware of my obligation to choose measures that limit the Charter rights and freedoms of British Columbians less intrusively, and to balance these rights and interests in a way that is consistent with the protection of public health. I have concluded that the measures which I am putting in place in this Order are proportionate, rational and tailored to address the risk, and are neither arbitrary, overbroad, nor grossly disproportionate in light of the need to protect public health at this time. In my view, any limits on constitutionally protected rights and freedoms arising from this Order, are proportionate and reasonable in the interests of protecting public health, and there are no other reasonable alternatives that would provide the same level of protection for the population" (Government of BC, 2022, p. 5)

Although the BC Provincial Health Officer has declared that BC COVID-19 policies are justified, there does not appear to be any analysis, consideration, utilization, or transparency regarding any implementation of the Oakes Test to substantiate policy constitutionality. The Oakes test is a common law test created by the Supreme Court of Canada as an outcome of *R. v. Oakes*, 1986 CanLII 46 (SCC), [1986] 1 SCR 103 to interpret the wording of section 1 of the *Canadian Charter of Rights and Freedoms* (Charter). Section 1 of the Charter states: "The *Canadian Charter of Rights and Freedoms* guarantees the rights and freedoms set out in it subject only to such reasonable limits prescribed by law as can be demonstrably justified in a free and democratic society" (Government of Canada, 1982). The terms 'demonstrably justified' and 'free and democratic society' may be difficult to determine without an informed and

comprehensive assessment, and given the language in the Order, it is not clear that the 'demonstrably justified in a free and democratic society' requirement, set out in section 1 of the Charter, has been fulfilled as the analysis has not been made publicly available, when and if the analysis has been completed. Additionally, the conclusion made in the Order: "and there are no other reasonable alternatives that would provide the same level of protection for the population", may be difficult to substantiate considering academic research articulated in the Literature Review surrounding NPI efficacy. As stated above, the Oakes Test is *the* two-prong test used to determine if a violation or limitation to rights and freedoms the Charter was designed to protect are justified by law and proportionate to the need. *R. v Oakes* (1986) articulated the test as follows:

- "First, the objective, which the measures responsible for a limit on a Charter right or freedom are designed to serve, must be 'of sufficient importance to warrant overriding a constitutionally protected right or freedom'" (para 69); and
- "Second, once a sufficiently significant objective is recognized, then the party invoking s. 1 must show that the means chosen are reasonable and demonstrably justified" (para 70).

The second prong also involves a form of a three-prong proportionality test:

- "First, the measures adopted must be carefully designed to achieve the objective in question. They must not be arbitrary, unfair or based on irrational considerations. In short, they must be rationally connected to the objective" (para 70);
- "Second, the means, even if rationally connected to the objective in this first sense, should impair 'as little as possible' the right or freedom in question" (para 70); and
- "Third, there must be a proportionality between the effects of the measures which are responsible for limiting the *Charter* right or freedom, and the objective which has been identified as of sufficient importance" (para 70) (*R. v Oakes, 1986)*

As stated above, there is no clear indication in the language of the Order to outline how proportionality was assessed, and in particular, whether or how the costs imposed by NPI policies were also considered in that analysis. A Multiple Accounts CBA would likely benefit an assessment regarding proportionality, especially if and when the costs of COVID-19 policies outweigh the costs of COVID-19 absent government intervention, or simply gauging the true severity of COVID-19 itself. This CBA would further ascertain and support a proportionality analysis in this context.

Furthermore, the Order also states "I recognize the interests protected by the Human Rights Code, and have taken these into consideration when exercising my powers" (Government of BC, 2022, p. 5).

The Government of BC has issued 13 policies specific to long-term care homes and/or seniors' assisted living residences (Government of BC, 2022). In each of the policies named *Ministry of Health – Overview of Visitors in Long-Term Care and Seniors' Assisted Living*, mental health was indicated as a policy consideration. The above policy dated February 3, 2021, described "essential visits are necessarily linked with an essential need that could not be met in the absence of the essential visit" (Government of BC, 2022, p. 2). Essential visits include six different categories, such as "visits paramount to the resident's physical care and mental well-being" (Government of BC, 2022, p. 2). This suggests the Government of BC acknowledged the negative impacts to mental well-being in this specific context, and tailored policy to meet the residents' mental health and well-being needs. The physical care and mental well-being are interpreted in the policy to include a provision of emotional support, and "visits paramount to mental well-being can include situations where a resident's mental health is acutely deteriorating and the care team and/or resident believe that a supportive visit may improve resident well-being (e.g., dementia with behavioral issues, delirium, depression, anxiety, psychosis)" (Government of BC, 2022, p. 9). That said, it seems supports related to mental well-being are contingent on the presence of an individual's mental health *acutely* deteriorating, not used as a preventative or proactive measure (Government of BC, 2022) (which seems to be out precaution not to increase COVID-19 transmission). That said, preventing COVID-19 transmission, and thereby COVID-19 cases, seems to be priority over the mental well-being of residents in long term care facilities.

Further identification or consideration of costs associated with COVID-19 policy implementation were not found.

The Government of BC's COVID-19 response policies, whether related to vaccination or not, consistently share the same wording surrounding constitutionality or human rights considerations (where prescribed by law). Based on the literature review above and the apparent failure to consider real or perceived negative consequences associated with NPI policy implementation, it would therefore be difficult to determine proportionality, reasonableness, or necessity without real consideration of costs and benefits.

Although policies overwhelmingly did not include any real or perceived costs associated with them (other than mental health considerations in Long Term Care Centers), the Government of BC did acknowledge broader mental health and financial concerns. For example, the Government of BC's *B.C.'s response to COVID-19* webpage includes a link to the province's *Virtual mental health supports* webpage (Government of BC, 2021; Government of BC, 2022). The *Virtual mental health supports* webpage includes numerous links (most of which are not related to COVID-19), including a free, phone based, short-term support counselling service named the BC COVID-19 Mental Health Network, accessible via email (Government of BC, 2021). No further detail regarding the Mental Health Network is included. *B.C.'s response to COVID-19* webpage also includes a link to business closure relief (financial support available for

businesses forced to close as a result of Provincial Health Officer orders). The link would lead the reader to the *B.C.'s Economic Plan* webpage, which provides links to resources regarding COVID-19 Closure Relief Grant (grants provided to business which closed due to Provincial Health Officer orders) (Government of BC, 2022); however, this does pose three cost considerations unmentioned. First, do the grants provide funding actually required by businesses to cover their costs? Second, would funding reach expected revenue absent closure? Third, to what extend would the Closure Relief Grant contribute to Provincial Government debt, considering the decrease in government revenue and increase in government expenditure? Lastly, the *B.C.'s response to COVID-19* webpage included a link to *COVID-19 support for individuals and families*. This webpage included links to:

- COVID-19 Paid Vacation Leave (3 hours of paid leave for vaccination);
- COVID-19 supports for youth in care and the AYA program (services for youth in government care and young adults who have 'aged out');
- Canada Worker Lockdown Benefit (the Federal Government's $300 per week benefit plan for those unable to work due to public health lockdowns and business closures);
- Canada Recover Sickness Benefit (the Federal Government's $500 per week benefit for workers who are sick or must self-isolate for COVID-19 reasons, or have underlying conditions that would make them more susceptible to COVID-19); and
- Canada Recovery Caregiving Benefit (Government of BC, 2022).

These services pose costs, similar to above, which must be considered, especially the consideration of increased government financial expenditure during a time of reduced government revenue (more detail below).

The BC CDC, HealthLinkBC, and Ministry of Mental Health and Addiction also have also provided general mental health information in the COVID-19 context, as well as connections to support (BC CDC, 2021b; HealthLinkBC, 2021; Ministry of Mental Health and Addictions, n.d.).

Although the government has recognized both mental health and financial consequences caused by COVID-19 policies, these concerns do not appear to be included in policy (other than Long Term Care Homes), nor do they appear to be factors considered in any re-opening plan; meaning these costs do not appear to be a consideration regarding policy implementation or revocation. The key considerations appear to be COVID-19 cases, hospitalizations, and deaths (see Background for more information on these metrics), at the expensive of considering anything else at all.

COVID-19 Policy Benefits in BC

Cases

According to the Provincial Health Officer, NPIs and vaccinations have both, but independently, reduced COVID-19 transmission in BC, thereby curbing the case count (Provincial Health Officer, 2022); however, considering Chapter Four: Literature Review findings, it is not necessarily clear what, if any, policy reduces or increases case counts and it is equally unclear if case counts correlate with COVID-19 hospitalizations or deaths. That said, there are a few important data to be considered.

'Cases' Considerations

As of March 4, 2020, BC has confirmed a total of 349,994 COVID-19 cases, 18,123 COVID-19 hospitalizations, and 2,903 COVID-19 deaths (Government of BC, 2022). By applying the WHO's CFR formula (see Chapter 2: Background), the BC COVID-19 CFR is 0.83% and the case-hospitalization rate is 5.18%. Hospitalization data includes admissions for people diagnosed with COVID-19 through hospital screening practices, even if admitted for irrelevant causes (which is consistent with WHO reporting guidelines described in Chapter 2: Background), and "will overestimate the number of people who are hospitalized specifically due to severe symptoms of COVID-19 infection" (BC CDC, 2022). In other words, COVID-19 hospitalizations and deaths in BC have been conflated with other causes of hospital admissions and death, resulting in an overestimation of COVID-19 severity. If BC extrapolated findings from Ontario, which described that approximately 50% of COVID-19 hospitalizations were incidental[8] (i.e., individuals who were admitted to a hospital for reasons other than COVID-19, but tested positive for COVID-19 upon arrival) (Walia, 2022), the BC CFR would likely approximate 0.42% and the case-hospitalization would approximate 3.18%. Furthermore, by applying the WHO IFR formula to the COVID-19 context in BC, and if it is true that everyone will or has been exposed to COVID-19 (Provincial Health Officer, 2021), the IFR may approximate 0.056% and the infection-hospitalization rate may approximate 0.35%.[9] Again, these projections decrease to approximately 0.028% and 0.18%, respectively, if only 50% of COVID-19 hospitalizations and deaths were *of*, not *with* COVID-19 (see Chapter 2: Background).

To reiterate information from Chapter 2: Background, "there is now clear evidence that people with pre-existing chronic conditions or compromised immune systems are at higher risk of dying of COVID-19, especially among those over the age of 80" (Statistics Canada, 2020). Of the

[8] According to Ontario Health, "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" (Ontario Health, 2022).
[9] The BC COVID-19 projected IFR and infection-hospitalization rate is based on the BC population size of 5,214,805 (Government of BC, 2021).

projected BC COVID-19 IFR of 0.028%, the next question is: who (e.g., age and comorbidities) typically comprises the 0.028%? The below table will share data which reflects and assesses, although not definitively, the severity of COVID-19 in terms of age relative to life expectancy absent COVID-19. Due to data limitations in BC and Canada, data from the UK and the US is included for reference

TABLE 5: LIFE EXPECTANCY METRICS IN CANADA, BC, UK, USA, AND THE OECD

	Age		
Metric	**Male**	**Female**	**Both**
Average Age of Life Expectancy (Canada)	80	84.1	82.1
COVID-19 Average Age of Death (Canada)	83.8		
COVID-19 Average Age of Death (BC)	84.4		
Average Age of Life Expectancy (UK)	79	82.9	80.95
COVID-19 Average Age of Death (UK)	78.7	82.5	80.4
Median Age of Life Expectancy (UK)	82.3	85.8	84.05
COVID-19 Median Age of Death (UK)	81	85	83
Health Adjusted Life Expectancy (Canada)	69.0	70.5	69.75
Life Expectancy Range (Standard Deviation) (USA)	15 years		
Age of Premature Death (Canada)	74 years or less		
Age of Premature Death (OECD)	74 years or less		
Percentage of total COVID-19 Deaths in LTC Homes (Canada)	80%		
LTC Home Average Life Expectancy (Canada)	18 months		
COVID-19-Involved Deaths reported w/ at least one other cause (Canada)	90%		

(Arya, 2020; BC CDC, 2022; Edwards, 2013; Government of Canada, 2021; O'Brien, et al., 2020; Provincial Health Officer, 2022; Public Health Agency of Canada, 2017; Statistics Canada, 2018; Statistics Canada, 2019b; Statistics Canada, 2021; Statistics Canada, 2022; UK Office for National Statistics, 2021)

Life expectancy is 82.1 years in Canada (80 for males, 84.1 for females) and 82.4 years in BC according to the latest data collected between 2015-2017 (Statistics Canada, 2019b). As of March 4, 2022, 60.8% of COVID-19 classified deaths in Canada were 80 years or older; 21.2% were 70 to 79 years; and 10.7% were 60 to 69 years (Government of Canada, 2021). Combined, 92.7% of COVID-19 classified deaths in Canada were 60 years or older. According to the Government of Canada, seniors aged 65 to 75 years account for the greatest number of deaths (Public Health Agency of Canada, 2017) absent COVID-19.

The average age of COVID-19 death in Canada, as of June 1, 2021, is 83.8 years and 84.4 in BC for both sexes (Statistics Canada, 2021); therefore, the average age of COVID-19 death is higher than average life expectancy absent COVID-19. Interestingly, Statistics Canada also stated the average age of death in Canada was 76.5 in 2019 (a significant drop in comparison to the 2015-17 data) (Statistics Canada, 2021). Statistics Canada also predicts life expectancy to drop because of COVID-19, however, it will be important for policy experts not to immediately assign

any report of excess death as a result of COVID-19 (Statistics Canada, 2021). Considering the data above, a drop in life expectancy may be attributed to other factors, such as NPIs. As it is abundantly clear now, COVID-19 policies could potentially (according to the research gathered in Chapter 4: Literature Review) cause or contribute to reductions in life expectancy (rather than COVID-19 itself); for example, COVID-19 response policies appear to have caused an increase in drug overdose and opioid overdose deaths in BC (more below). The data above also suggests that, at worst, the COVID-19 average age of death is proportionate to average life expectancy; therefore, claims that COVID-19 is reducing average life expectancy could be inaccurate as other variables are likely influencing any data or concerns regarding a decrease in average life expectancy as a result of COVID-19 (see costs below). Statistics Canada stated "COVID-19 continues to affect communities and families in Canada. In terms of lives lost, the toll of the pandemic should account for both the direct and indirect effects of the virus." (Statistics Canada, 2022); however, this articulation does not include the direct or indirect effects of COVID-19 response policies (which must not be conflated with COVID-19 itself) which may explain (fully or partly) any real or anticipated reduction of average life expectancy in Canada. There is, however, evidence that the Government of Canada may be conflating negative consequences associated with COVID-19 and the negative consequences associated with COVID-19 response policies, or even other causes of death. According to Statistics Canada, and to further validate the point made above, "the pandemic could also have indirect consequences that increase or decrease the number of deaths as a result of various factors, including delayed medical procedures, increased substance use, or declines in deaths attributable to other causes, such as influenza" (Statistics Canada, 2022). By definition, COVID-19 does not cause (for example) delayed medical procedures or an increase in substance use; however, the COVID-19 response policies do. A Multiple Accounts CBA is required to determine if the response policies (and the costs associated with them) outweigh the costs of COVID-19 if no government intervention took place.

The UK shares numerous similarities with Canada and may serve as an appropriate reference point regarding COVID-19 outcomes for comparison. In the UK, the average life expectancy is 79 years for males and 82.9 years for females, averaging 80.95 for both sexes (UK Office for National Statistics, 2021). The average age of COVID-19 death in the UK is 78.7 for males and 82.5 for females, averaging 80.4 for both sexes; whereas the median age of COVID-19 death in the UK is 81 for males and 85 for females, averaging 83 for both sexes (UK Office for National Statistics, 2021). The average age of COVID-19 death in the UK is consistent with average life expectancy.

The following data is used to further contextualize the severity of COVID-19 in terms of its impact on death statistics:

- The Health Adjusted Life Expectancy (HALE), defined as the number of years spent in good functional health, is 69 years for males and 70.5 for females (Statistics Canada, 2018).
- The standard deviation in life expectancy in the US is 15 years (Edwards, 2013). Although American life expectancy metrics may not necessarily be best extrapolated to suggest Canadian metrics, if this standard deviation is applied in Canada, the Canadian life expectancy standard deviation would range from 67.1 to 97.1.
- Both the Organisation for Economic Co-operation and Development (OECD) and the Government of Canada have set the age of premature death threshold at under 75 years (OECD, 2022; Statistics Canada, 2019b).
- Lastly, of the COVID-19-involved "deaths between March and July [of 2020], the majority (90%) had at least one other cause, condition or complication reported on the certificate", 54% were above the age of 85, and "during the first wave of the pandemic and up to the end of May, long- term care facilities and retirement homes accounted for more than 80% of all COVID-19 deaths in the country" (O'Brien, et al., 2020, p. 4). Absent COVID-19, the average life expectancy of a nursing home (i.e., LTC home) is 18 months (Arya, 2020).

Although the prevention of illness, severe disease and death in the context of COVID-19 is a worthwhile policy directive, policy makers must also remain cognizant of policies which may put the majority of the population (and especially children and youth) at risk in an attempt to protect the 'vulnerable' (i.e., individuals at average or median age of death). The above analysis attempts to contextualize the severity of COVID-19 relative to the average risk individuals face absent COVID-19. Considering the above data (e.g., average life expectancy and average age of COVID-19 death), a Multiple Accounts CBA would help policy makers determine if the risks associated with COVID-19 response policies were justified and proportionate to the risks associated with COVID-19 infection. In other words, policy makers also must ascertain, to what degree, COVID-19 itself is contributing to a situation far removed from typical life, health, and wellness absent COVID-19, and which policies are proportionate to the severity of COVID-19. According to Robinson, Sullivan & Shogren (2020), a CBA must include an analysis of the overall distribution of impacts, including the "extent to which those who are disadvantaged are disproportionately affected by both COVID-19 risks and by the economic consequences of policy actions" (Robinson, Sullivan, & Shogren, 2020). According to Lisa Robinson, a senior research scientist and deputy director of the Center for Health Decision Science at Harvard T.H Chan School of Public Health, analysts and policy makers who may compare the benefits and

costs of COVID-19 policies should examine the 'value per statistical life' (VSL)[10], which is "likely to vary depending on who is affected by the policy and by how they view the risks that they experience" (Feldscher, 2021).

COVID-19 Policy Costs in BC

According to the Government of BC and Government of Canada, the COVID-19 pandemic has proven to be a multifaceted issue, causing broad cascading – yet related – physical, mental and economic impacts even if not directly caused by COVID-19 (Government of BC , 2020) (Statistics Canada, 2022). BC CDC also stated, "measures implemented to slow the spread of COVID-19 and prevent severe outcomes and deaths also affect people's physical, mental, emotional, and spiritual health and wellness, the health care system, environment, and economy" (BC CDC, n.d.).[11] The below costs provide a brief overview of the negative consequences of COVID-19 response policies.

Economic Impacts

According to TradingEconomics.com, the Canadian "unemployment rate measures the number of people actively looking for a job as a percentage of the labour force" (Trading Economics, 2022). According to Statistics Canada (2017), the unemployment rate refers to individuals who "were without paid work or without self-employment work and were available for work and either:

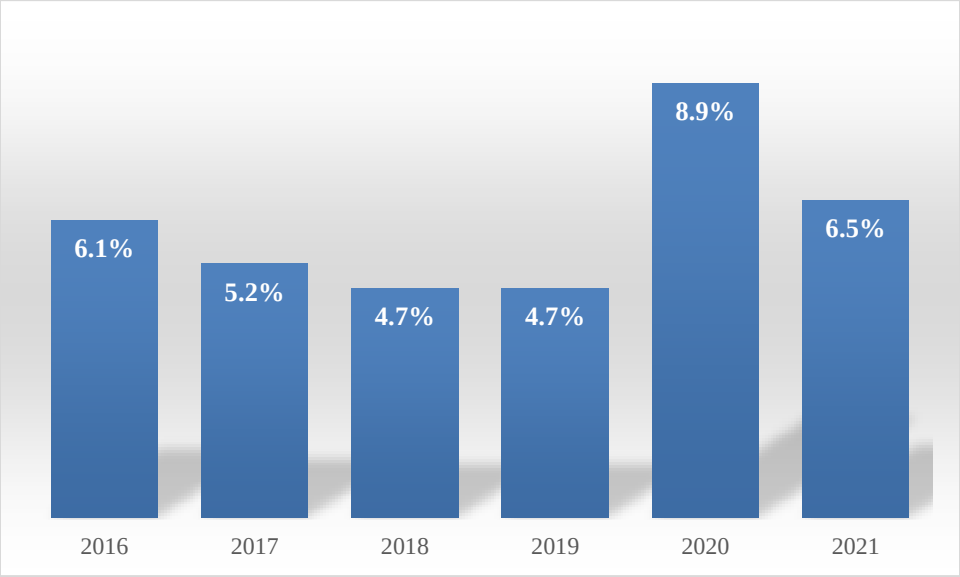
a) had actively looked for paid work in the past four weeks; or
b) were on temporary lay-off and expected to return to their job; or
c) had definite arrangements to start a new job in four weeks or less" (Statistics Canada, 2017)

[10] The VSL is "the additional cost that individuals would be willing to pay for small reductions in risks that, in the aggregate, reduce the expected number of fatalities by one. The VSL is therefore a valuation of anticipated mortality risk reductions, not the valuation of an identifiable life" (Treasury Board of Canada Secretariat, 2022). In other words, it is "local tradeoff rate between fatality risk and money. When the tradeoff values are derived from choices in market contexts the VSL serves as both a measure of the population's willingness to pay for risk reduction and the marginal cost of enhancing safety" (Kniesner & Viscusi, 2019, p. 1). VSL is crucial to consider in the context of COVID-19 policy making, as COVID-19 appears to impact individuals differently based on age and comorbidities, as per the analysis above, as do COVID-19 policies. Ultimately, considering the severity of COVID-19, VSL could (for example) more appropriately determine an individual's risk and 'willingness to pay' for a reduction of that risk depending on the individuals age and underlying health conditions. Within the COVID-19 context, the VSL will surely be different between a 25-year-old and an 85-year-old (Hammitt, 2020).

[11] BC CDC has identified population health and wellness, mental health and substance abuse, health care services, community support systems and the economy, environmental health, and Indigenous health and wellness as areas negatively impacted by COVID-19 response measures (BC CDC, n.d.).

In other words, individuals who are both unemployed and have not actively searched for work within the previous four weeks prior to Census collection would not be included in the unemployment rate. The Unemployment rate in BC since 2016[12] is displayed in the below table

TABLE 6: BC UNEMPLOYMENT RATE 2016-2021



(Statistics Canada, 2022)

Fortunately, the unemployment rate in 2021 has decreased; however, given the definition of unemployment, it is difficult to determine if those who applied or continue to receive one of the four Canada Emergency Response Benefits (CERB): Canada Response Benefit (CRB), Canada Worker Lockdown Benefit (CWLB), Canada Recovery Sickness Benefit (CRSB), Canada Recovery Caregiving Benefit (CRCB), or Employment Insurance (EI) would be included in the unemployment rate given the longevity of both programs. It is also difficult to determine how many individuals have simply given up on seeking employment following the 2020 unemployment rate increase.

Unemployment and underemployment (i.e., part time workers who may have lost full time employment due to COVID-19 response policies) poses harms to physical and mental health, and "parental unemployment and underemployment are linked to lower levels of children's educational attainment and wellbeing" (BC CDC, 2021b).

[12] The BC unemployment rate includes both sexes, aged 15 years and over.

In 2020, the Government of BC financial results had been negatively impacted, including ICBC losses and declines in tax revenue resulting in a $321M deficit as an outcome of measures to curb the spread of COVID-19 (Government of BC, 2020).

Furthermore, the Government of Canada reported a decrease in revenue of $17.7 billion "particularly due to COVID-19 shutdowns", GST credit payment, and lower crown corporation revenues (also due to COVID-19 measures) as well as a budgetary deficit of $327.7B for the 2021 fiscal year end (Government of Canada, 2022). The Government of Canada also reported an increase of program expenses (largely due to COVID-19 response measures) "by $270.1 billion, or 79.8 per cent, largely reflecting transfers to individuals, businesses, and other levels of government under the Economic Response Plan" (Government of Canada, 2022). For example, Between March 15 to October 3, 2020, the Government of Canada spent a total dollar value of $81.64B between CERB and EI, and a total of 1.2M individuals in British Columbia applied for CERB (Statistics Canada, 2021). The federal debt, as of March 31, 2021, stood at $1,048.7B in total, and the federal debt-to-GDP ratio increased from 31.2% (2019) to 47.6% (2020). For further context, the Fraser Institute (2021) stated "Since 2007/08, combined federal and provincial net debt (inflation-adjusted) has doubled from $1.0 trillion to a projected $2.0 trillion in 2020/21" and "in 2020/21, combined federal and provincial net debt is expected to equal 91.6% of the Canadian economy, up from 65.2% last year" (Fraser Institute, 2021, p. 1).

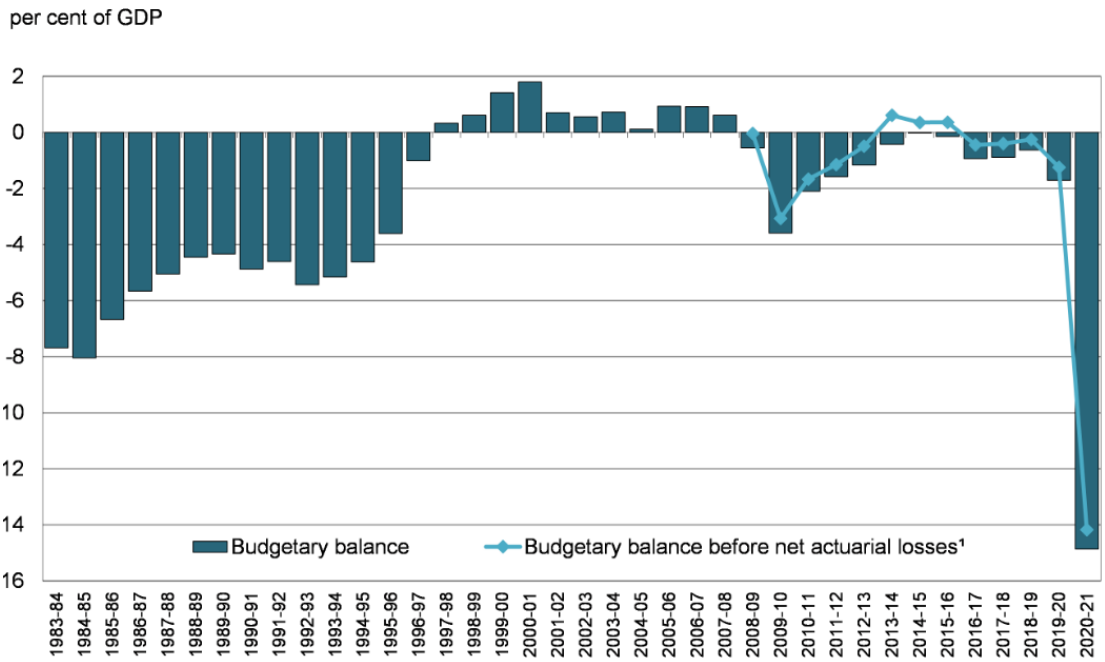
The table and figure below reflect financial and economic data produced by the Auditor General of Canada. COVID-19 response policies (e.g., Canada's Economic Response Plan) are a major contributor to the increase of debt and decrease of revenue (Government of Canada, 2022).

TABLE 7: CANADIAN FINANCIAL ESTIMATES IN BILLIONS

	2020-21	**2019-20**
Budgetary Transactions		
Revenues	316.4	334.1
Expenses	628.9	362.9
Balance (excluding net actuarial losses)	-312.4	-28.8
Balance (including net actuarial losses)	-327.7	-39.4
Financial Position		
Total Liabilities	1,652.2	1,248.6
Total Financial Assets	502.4	435.7
Net Debt	-1,149.8	-812.9
Non-Financial Assets	101.1	91.5
Federal Debt (federal, provincial/territorial, and local governments)	-1,048.7	-721.4

(Government of Canada, 2022)

FIGURE 5: FEDERAL GOVERNMENT BUDGETARY BALANCE



(Government of Canada, 2022)

COVID-19 response policies, as indicated above, have contributed to the worst budgetary balance in recorded Canadian history, and "brought about the deepest and fastest recession, worldwide, since the Great Depression" (Government of Canada, 2022). Long-term plans to address the debt problem must be developed by the provincial governments post-COVID (Fraser Institute, 2021). How both the provincial and federal deficits are managed will expose any further costs associated to the metrics above (health, wellness, economic, employment etc.) caused by COVID-19 response measures. Considering the current deficit, the Canadian Medical Association estimates "Canada's health care system will require federal funding commitments of at least $1.3 billion to return to pre-pandemic levels of patient care." (Canadian Medical Association, 2021, p. 20). Whether or not this is feasible given the current debt and inflation rates is left to be seen; however, if it is not feasible, the current debt will contribute to profound negative healthcare consequences moving forward.

<u>Opioid and Substance Abuse and Delayed or Missed Healthcare Interventions</u>

The Canadian Medical Association commissioned a report conducted by Deloitte titled *A Struggling System: Understanding the Health Care Impacts of the Pandemic*, which outlined the broader impact the COVID-19 pandemic has had on Canadians such as "delayed or missed treatments to a significant increase in the incidence of mental health and substance use disorders" (Canadian Medical Association, 2021). The report describes numerous deleterious impacts of COVID-19 measures. For example, the report shows that "delayed or missed health care services may have contributed to more than 4,000 excess deaths not related to COVID-19 infections between August and December 2020" (Canadian Medical Association, 2021).

According to the Canadian Medical Association, opioid-related deaths increased by 70% from 2019 to 2020, resulting in nearly 17 opioid-related deaths per day in 2020. In the first three months of 2021, this increased to nearly 20 deaths per day (Canadian Medical Association, 2021). The report described "substance use may have become more dangerous during the pandemic as individuals have been potentially consuming harmful substances in isolated settings more frequently, there has been less access to public health services, and the drug supply has reportedly become more toxic" (Canadian Medical Association, 2021, p. 6).

The report continued to describe impacts which seem to be otherwise unknown by the general public. For example, the Canadian Medical Association (2021) claims that although more Canadians died in 2020 than in a typical year, "the number of excess deaths was greater than can be explained by COVID-19 alone" (Canadian Medical Association, 2021, p. 9). This statement, again, highlights the need for a comprehensive assessment of both impacts of COVID-19 versus the impacts of COVID-19 policies. It is an example of the point made repeatedly in this paper that COVID-19 impacts, and COVID-19 policy impacts, must not be conflated. These are two separate sources of both costs and benefits; by conflating the two, we risk misunderstanding the true consequences of each.

In summary, the Canadian Medical Association's (2021) report revealed stark, high-level statistics related to the consequences of COVID-19 measures, including:

- More than 60,000 missed full home care assessments between March and June 2020
- Cancer screenings remained 20%-35% below pre-pandemic levels as of January 2021
- 68%-94% decrease in in-person visits for chronic disease care visits between April 2019 and April 2020
- 70% increase in opioid related deaths from 2019 to 2020
- High levels of anxiety among Canadians peaked at 27% in June 2021
- Food insecure population in Canada grew by 39% in the first two months of the pandemic
- Kids Help Phone saw an 28% increase in physical abuse calls and a 48% increase of isolation calls
- A significant procedural backlog – to the tune of 327,800 procedures – remains in Canada
- More than 4,000 excess deaths not related to COVID-19, but due to delayed care (Canadian Medical Association, 2021, pp. 3, 8, 18)

BC's Provincial Health Officer stated 2,224 lives were lost in BC to the toxic drug supply in 2021 (Government of BC, 2022); whereas 1,401 lives were lost in BC due to COVID-19 in the same year. As of April 5, 2022, a total of 3,002 COVID-19 deaths were recorded in BC (Government of BC, 2022). For context and the purpose of comparison, it is important to remain

cognizant this includes deaths with or of COVID-19, and, that the average age of COVID-19 death in Canada is 83.8 years in Canada and 84.4 years in BC (Statistics Canada, 2021).

Table 8 below provides a comparison of yearly deaths between COVID-19 and illicit toxicity deaths in BC. Figure 6 displays illicit drug toxicity deaths and death rate per 100,000 population in BC as well as a 2022 projection.

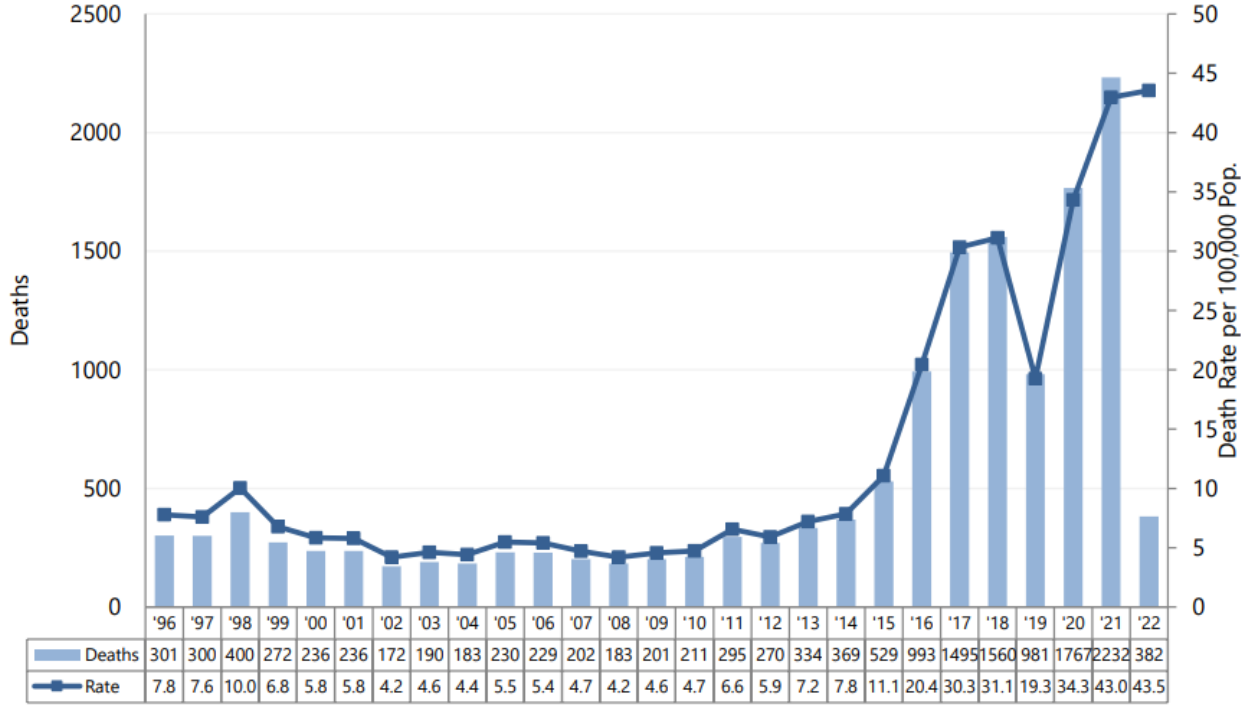
TABLE 8: COVID-19 AND ILLICIT DRUG TOXICITY DEATHS BY YEAR IN BC

Year	COVID-19 (with and of)	Illicit Drug Toxicity
2019	0	982
2020	1,075	1,767
2021	1,401	2,232
2022	526[13]	207
Total (2019-2022)	3,002	4,981
Total (2020-2021)	2,476	3,999
Total (2020-2022)	3,002	4,206
Average Age of Death	84.4	72% aged 30-59

(BC Coroners Service, 2022; Government of BC, 2022; Statistics Canada, 2021)

[13] Current COVID-19 death count (with or of) trajectory exposes the potential for the highest COVID-19 death toll by year to date in BC, despite mass vaccination efforts. According to the Provincial Health Officer, the Government of BC will be "transitioning to a new way of reporting people who've died from COVID, and its going to be looking at 30-day all-cause mortality … that means we will be over-counting people early on" (Weichel, 2022). It appears the Government of BC is reverting back to conflating COVID-19 deaths 'with or of', which may paint an inaccurate picture of COVID-19 severity moving forward. On April 7, 2022, the Provincial Health Officer made this intent clearer, by stating "in the new system, all deaths that occurred within 30 days of an individual's positive lab result will be reported, regardless of whether the underlying cause of death was determined to be COVID-19 or not. This broader definition means that some deaths will be reported that are not related to COVID-19. Knowing when a death occurred can take, on average, four to six days to enter the system" (Government of BC, 2022).

FIGURE 6: ILLICIT DRUG TOXICITY DEATHS AND DEATH RATE PER 100,000 POPULATION



	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21	'22
Deaths	301	300	400	272	236	236	172	190	183	230	229	202	183	201	211	295	270	334	369	529	993	1495	1560	981	1767	2232	382
Rate	7.8	7.6	10.0	6.8	5.8	5.8	4.2	4.6	4.4	5.5	5.4	4.7	4.2	4.6	4.7	6.6	5.9	7.2	7.8	11.1	20.4	30.3	31.1	19.3	34.3	43.0	43.5

(BC Coroners Service, 2022)

According to the BC Coroners Service (2022), COVID-19 response measures are directly responsible and continue to be the causal factor in the dramatic increase in illicit drug toxicity deaths, stating: "the average number of deaths per month more than doubled immediately after the start of COVID-19 related restrictions in March 2020 compared with the previous year" (BC Coroners Service, 2022, p. 11) as well as "following the introduction of COVID-19 restrictions in April 2020, the percentage of persons using illicit substances alone increased to 61%" (BC Coroners Service, 2022, p. 21). This statement is a powerful example of the need to carefully and systematically consider the negative impacts and costs associated with COVID-19 NPI response policies to ensure all costs of COVID-19 response policies do not outweigh the benefits. By only comparing COVID-19 and illicit drug toxicity death data in BC, COVID-19 policies *may* already have proven to be more damaging than beneficial, not only by looking at the total death counts by year, but by also considering (and placing more weight regarding severity) the average age of those who have died with or of COVID-19 versus those who have died by illicit drug toxicity.

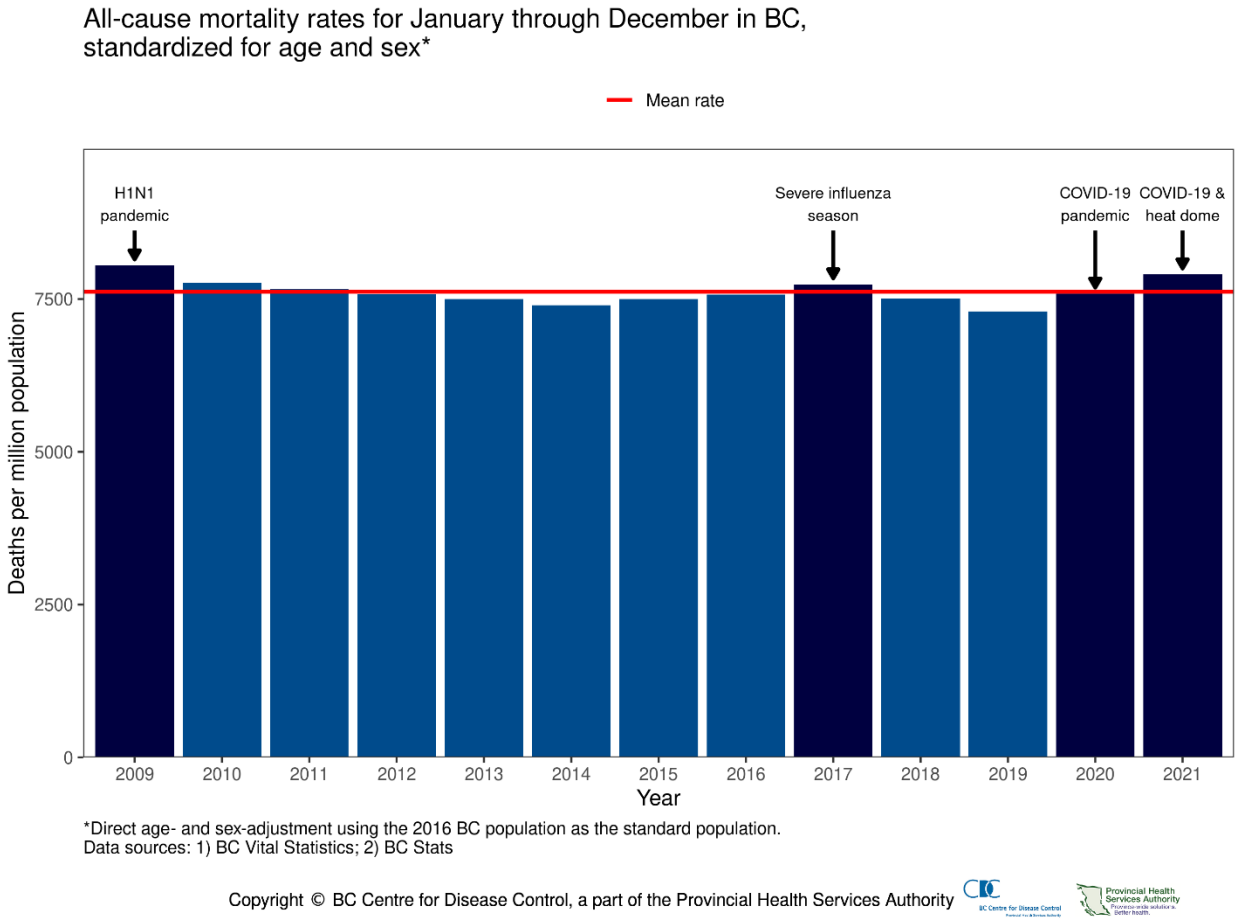
The Coroners Service further articulated that the COVID-19 pandemic and prevention measures have had a direct impact on the sharp increase in illicit drug toxicity use and death by:

- Reducing availability and accessibility of all substance use measures (e.g., harm reduction, pharmacological treatment, and community-based services);
- Reducing access to safer drug use supplies;
- Barriers to online and in-person services;

- Interrupting regular medical visits and access to medication-assisted treatment;
- Reducing access to informal supports and peer supports; and
- Increased isolation from job losses, restrictions on social gatherings and physical distancing (BC Coroners Service, 2022, p. 13).

The below table, published by BC CDC (2022) demonstrates the degree to which the COVID-19 pandemic has deviated from average expected dangers in life, as well as a broad comparison between the H1N1 pandemic in 2019 and the severe influenza season in 2017 (BC CDC, 2022).

FIGURE 7: H1N1, SEVERE INFLUENZA SEASON, AND COVID-19 COMPARISON



(BC CDC, 2022)

Considering the above table, it is very difficult to justify the need of such unprecedented response measures which may have greater costs than benefits. The above-average deaths per million in 2021 cannot easily be attributed to COVID-19, especially considering the analysis above, but rather could be caused by COVID-19 policies. Also, "standardization by age and sex allows rates in populations with different age and sex structures to be compared by taking these factors into account. An older population will have a higher overall mortality rate than a younger

population. BC's population was older in 2021 compared with 2009" (BC CDC, 2022). Again, a Multiple Accounts CBA will help determine the justification and efficacy of BC's response measures to COVID-19, as well as potentially determine if the 2020 and 2021 death counts (above) are caused by COVID-19, COVID-19 response policies, or a combination of both.

Lastly, the BC CDC has recognized numerous latent, incidental, and negative impacts caused by COVID-19 response policies. These include, but are not limited to:

- Population health and wellness
- Mental health and substance use
- Health care services
- Community support systems and the economy
- Environmental health
- Indigenous health and wellness (BC CDC, n.d.).

The factors above, and all identified throughout this report, ought to be considered, valued, monetized, and represented meaningfully and fairly in a comprehensive Multiple Accounts CBA.

Chapter 6: Findings

Introduction

Chapter 6: Findings will describe the outcomes of this research. For ease, the purpose of this research was to explore the necessity of a Multiple Accounts CBA designed to:

- Identify and compare the full costs and benefits of implementing NPIs against the full costs and benefits of response policies absent any NPI, and/or moderate government intervention; and/or
- Identify and compare the full costs and benefits of COVID-19 infection versus the costs and benefits of NPIs.

To best contextualize the above purpose, this report's research questions are as follows:

- Did BC public policy fail to account for the costs of NPIs? If so,
- What could future policy makers do differently to ensure unintended outcomes are properly identified and accounted for?

Main Themes

As discussed throughout Chapters 3: Background, 4: Literature Review, and 5: BC Case Study and Data Analysis, COVID-19 NPI response measures have been associated with both positive negative consequences internationally and domestically. More importantly, experts agree COVID-19 NPI response measures do cause or contribute to deleterious impacts (e.g., physical, social, economic etc.) (Adalja, Toner, & Inglesby, 2020; Arnold, 2020; Bae, et al., 2020; Bagus, Peña-Ramos, & Sánchez-Bayón, 2021; Bendavid, Oh, Bhattacharya, & Ioannidis, 2021; Bjørnskov, 2021; Bonal & González, 2020; Bressan, Gallo, Tirelli, Gregori, & Da Dalt, 2021; Buheji, et al., 2020; Chaudhry, Dranitsaris, Mubashir, Bartoszko, & Riazi, 2020; Christakis, Van Cleve, & Zimmerman, 2020; Coccia, 2021; De Vincentiis, Carr, Mariani, & Ferrara, 2021; Ebrahimi, Hoffart, & Johnson, 2021; Ganesan, et al., 2021; García-Esquinas, et al., 2021; Goenka, et al., 2021; Hao, et al., 2020; Hawton, et al., 2021; Huang, et al., 2021; Ioannidis J. P., 2020; Jarvis, et al., 2020; Josephson, Kilic, & Michler, 2021; Kirsch & Vitiello, 2022; Kokolakakis, Lera-Lopez, & Ramchandani, 2021; Lane, et al., 2021; Linas, et al., 202; Maringe, et al., 2020; McCrary & Sanga, 2021; McIntyre & Lee, 2020; Megarbane, B; Bourasset, F; Scherrmann, J., 2021; Milne & Xie, 2020; Muhammad & Abubakar, 2021; Mulugeta, Tadesse, Shegute, & Desta, 2021; Mutnal, et al., 2020; Peçanha, Goessler, Roschel, & Gualano, 2020; Pieh, et al., 2021; Piketty, et al., 2022; Riemann, Speck, Gerstacker, Becker, & Knopf, 2021; Saiz, et al., 2021; Segarra-Blasco, Teruel, & Cattaruzzo, 2021; Simandan, Rinner, & Capurri, 2022; Skar, Graham, & Huebner, 2021; Sjödin, Wilder-Smith, Osman, Farooq, & Rocklöv, 2020; Spiegel & Tookes, 2021; Sport England, 2020; Tanaka & Okamoto, 2021; United Nations, 2021; Vahia, Jeste, & Reynolds III, 2020; Verschuur, Koks, & Hall, 2021; Wang, et al., 2021; Wilkinson, 2022; Zhou, et al., 2021; Zweig, Zapf, Beyrer, Guha-Sapir, & Haar, 2021), but there

is (a) no clear consensus as to the extent of the negative consequences, and (b) if these consequences outweigh the natural consequences of COVID-19 itself and/or severe NPI implementation versus light NPI implementation. As such, consistent with the purpose of this report, NPI costs have been identified in BC (BC CDC, n.d.; BC Coroners Service, 2022; Canadian Medical Association, 2021; Fraser Institute, 2021; Government of BC, 2020; Government of BC, 2022; Statistics Canada, 2021; BC CDC, 2021b); however, BC public policy appears to inadequately consider and incorporate these costs into response policies, considering the language embedded in publicly available documents, (BC Centre for Disease Control, 2022; Government of BC, 2022) yet focus primarily on 'cases' as the only target and metric (BC Centre for Disease Control, 2021; Government of BC, 2021), overlooking all other metrics which impact the health and wellbeing the policies are intended to protect.

Research does suggest, however, that policy makers could benefit from weighing more importance on the costs associated with COVID-19 NPI policy implementation – In BC, this could be achievable by completing a comprehensive Multiple Accounts CBA. Two COVID-19 response measure CBAs have been completed, and both have come to similar conclusions. In summary, the CBA's have suggested that COVID-19 NPI response measures ought to be considered policy failures (Allen, 2021) and be rejected out of hand (Herby, Jonung, & Hanke, 2022).

Summary

This report's most important findings, to be further elaborated on in the next chapter, include the following:

- NPIs may not work at either eliminating or mitigating the spread of COVID-19;
- NPIs do cause harms and further implications such as, but not limited to, physical and mental health, substance abuse, economic stability and sustainability, human rights and constitutional considerations; limitations in healthcare services, reductions in community support systems, and environmental health;
- NPIs do cause harm in BC;
- NPIs may cause more harm than benefit;
- NPIs may cause more harm than COVID-19 itself;
- Publicly available policies do not seem to include language that assesses or meets constitutional requirements under s. 1 of the Charter, nor does the language appear to demonstrably justify constitutional proportionality relative to the COVID-19 threat;
- NPI efficacy is, in terms if mitigating the spread of COVID-19, questionable based on available real-world data;
- Publicly available policies and modelling appear to consider one metric: cases. This may cause policy makers to overlook costs associated with NPIs;

- An excellent tool to assess constitutional proportionality, and thereby protect human rights, while ensuring the costs of policies do not outweigh their benefits or the dangers of COVID-19 itself is to complete a Multiple Accounts CBA.

Chapter 7: Discussion and Analysis

This report has elaborated on several key considerations regarding the costs associated with NPI policy implementation, as well as further background information to contextualize the overall COVID-19 issue. Considering the information gathered throughout this report, there are key considerations and themes which could benefit from further interpretation, discussion, and analysis.

As a result of the findings in this report and subsequent analysis, it is of paramount concern the Government of BC ensure these considerations are at the forefront of future NPIs, in the COVID-19 context or otherwise, to ensure NPI costs do not outweigh their benefits and are proportionate to an overall threat.

First, as outlined in the Background, COVID-19 – perhaps – is not quite the novel virus as frequently described by health authorities. It is one of seven identified coronaviruses (four of which are endemic) (Ludwig & Zarbock, 2020; US CDC, 2020; Ye, et al., 2020) and approximately 80% similar to SARS-CoV-1 (Ludwig & Zarbock, 2020; Ye, et al., 2020). Additionally, early in the pandemic there were several articles which articulated, in a nutshell, that the worst case IFR scenario for COVID-19 was approximately 1%; however, the vast majority of individuals which make up that '1%' were the elderly (i.e., individuals at or about average life expectancy absent COVID-19) and individuals with one or more comorbidities (Cai, et al., 2020; Ioannidis J. P., 2020; Onder, Rezza, & Brusaferro, 2020; Perez-Saez, et al., 2020; Russell, et al., 2020; Stringhini, et al., 2020; World Health Organization, 2020; Wu & McGoogan, 2020). Targeting policies which only impact those most vulnerable to COVID-19 without, technically speaking, creating a new group of individuals who could be considered vulnerable to the negative consequences of NPIs may have reduced the profound number of negative outcomes associated with them (Kulldorff, Gupta, & Bhattacharya, 2020).

Second, the overall IFR of COVID-19 still appears low, even when the vulnerable population is considered (Folkhalsomyndigheten (Public Health Agency of Sweden), 2020; Ioannidis, John P. A, 2021; Perez-Saez, et al., 2020; US CDC, 2021). Coupled with inconsistent and inaccurate COVID-19 case count and death classification procedures (Onder, Rezza, & Brusaferro, 2020; Postill, et al., 2020), the potential of too high of a reliance of PCR testing (which is highly variable to testing frequency and testing sensitivity) (Jaafar, et al., 2021; LeBlanc, et al., 2020; Pollock & Lancaster, 2020; World Health Organization, 2020), and policy making based on mathematical modelling which only considers COVID-19 cases (BC Centre for Disease Control, n.d; World Health Organizations, n.d.; BC Centre for Disease Control, 2022; Government of Canada, 2022; Public Health Agency of Canada, 2020), COVID-19 severity assessment may have been inaccurate, and subsequent response policies equally so.

Third, policy-making and mathematical models which only consider cases is prone to gaps in oversight. For example, the language found within policies and cases being the only metric of concern found in mathematical models, would naturally cause all NPI costs to be overlooked. The prioritization of case counts has likely been at the expense of all NPI costs.

Fourth, it is very difficult to determine if COVID-19 solely contributed to unprecedented hospitalization rates in BC[14], beyond what hospitals have faced previously and during other pandemics (e.g., H1N1, severe influenza seasons, and SARS-CoV-1). Furthermore, it is possible that strains to BC hospital systems may have simply been results of administrative oversight. Compared globally, Canada has a relatively low number of hospital beds per capita (The World Bank, 2017-2019; World Atlas, 2020; World Health Organization, n.d.), which may put Canadians and hospital capacities at risk every year whether COVID-19 is present or not.

Fifth, as described in the Literature Review, mathematical models projected a high degree of NPI efficacy, further advocating for their implementation to mitigate or eliminate the spread of COVID-19 and subsequently reduce COVID-19 hospitalizations and deaths (Adalja, Toner, & Inglesby, 2020; Bae, et al., 2020; Huang, et al., 2021; Jarvis, et al., 2020; Lane, et al., 2021; Megarbane, B; Bourasset, F; Scherrmann, J., 2021; Milne & Xie, 2020; Mutnal, et al., 2020; Sjödin, Wilder-Smith, Osman, Farooq, & Rocklöv, 2020); however, real-world data and observation does not appear to match these projections (Arnold, 2020; Bagus, Peña-Ramos, & Sánchez-Bayón, 2021; Bonal & González, 2020; Bendavid, Oh, Bhattacharya, & Ioannidis, 2021; Bressan, Gallo, Tirelli, Gregori, & Da Dalt, 2021; Buheji, et al., 2020; Chaudhry, Dranitsaris, Mubashir, Bartoszko, & Riazi, 2020; Christakis, Van Cleve, & Zimmerman, 2020; De Vincentiis, Carr, Mariani, & Ferrara, 2021; Ebrahimi, Hoffart, & Johnson, 2021; Ganesan, et al., 2021; García-Esquinas, et al., 2021; Goenka, et al., 2021; Hao, et al., 2020; Hawton, et al., 2021; Ioannidis J. P., 2020; Josephson, Kilic, & Michler, 2021; Kirsch & Vitiello, 2022; Kokolakakis, Lera-Lopez, & Ramchandani, 2021; Linas, et al., 2021; Maringe, et al., 2020; McCrary & Sanga, 2021; McIntyre & Lee, 2020; Muhammad & Abubakar, 2021; Mulugeta, Tadesse, Shegute, & Desta, 2021; Peçanha, Goessler, Roschel, & Gualano, 2020; Pieh, et al., 2021; Piketty, et al., 2022; Riemann, Speck, Gerstacker, Becker, & Knopf, 2021; Saiz, et al., 2021; Segarra-Blasco, Teruel, & Cattaruzzo, 2021; Simandan, Rinner, & Capurri, 2022; Skar, Graham, & Huebner, 2021; Sport England, 2020; Tanaka & Okamoto, 2021; United Nations, 2021; Vahia, Jeste, & Reynolds III, 2020; Verschuur, Koks, & Hall, 2021; Wang, et al., 2021; Wilkinson, 2022; Zhou, et al., 2021; Zweig, Zapf, Beyrer, Guha-Sapir, & Haar, 2021). As such, moving forward it may be beneficial to scrap mathematical modelling as a rationale and justification for NPI implementation and substitute its use for real world data, which also

[14] A Freedom of Information request was submitted February 22, 2022, to include BC specific data relevant to the COVID-19 pandemic to include yearly hospital bed and ICU capacity and use since 2016.

includes the deleterious consequences of NPIs. As mathematical modelling is often reliant on assumptions as inputs (see The Foundation section in the Literature Review for more information), it may be largely beneficial to use two years of real-world data instead.

Sixth, logically speaking it may be erroneous and misleading to conclude that COVID-19 is solely responsible for any increase in hospitalizations and excess deaths. It is important to distinguish harms caused by COVID-19 and the harms caused by COVID-19 NPI response measures. As stated in the BC Case Study, "the average number of deaths per month more than doubled immediately after the start of COVID-19 related restrictions in March 2020 compared with the previous year" (BC Coroners Service, 2022, p. 11) as well as "following the introduction of COVID-19 restrictions in April 2020, the percentage of persons using illicit substances alone increased to 61%" (BC Coroners Service, 2022, p. 21). If COVID-19 continues to be singled out as the cause for increases in hospitalizations and deaths (and not, for example, missed cancer screenings or increases in opioid related deaths because of COVID-19 NPIs), policy makers may further risk overlooking all of the profound costs associated with NPIs, and therefore, fail to develop policies which consider them.

Seventh, if policy makers choose to continue to focus solely on cases, the definition of a case count must be consistent and accurate. As stated in the BC Case Study, the Provincial Health Officer stated the Government of BC will be "transitioning to a new way of reporting people who've died from COVID, and its going to be looking at 30-day all-cause mortality … that means we will be over-counting people early on" (Weichel, 2022) and "in the new system, all deaths that occurred within 30 days of an individual's positive lab result will be reported, regardless of whether the underlying cause of death was determined to be COVID-19 or not. This broader definition means that some deaths will be reported that are not related to COVID-19" (Government of BC, 2022). This is overwhelmingly inaccurate and misleading and prone to equally inaccurate and irrelevant response measures. For example, if such a policy was placed on a motor vehicle death count in BC, it would irrefutably and inaccurately create a deceptive spike in deaths caused by motor vehicles.

Eighth, and similarly to the first consideration, the differences between demographics most susceptible to adverse consequences of COVID-19 is largely stratified. As stated above, the elderly and individuals with one or more comorbidities are at higher risk; whereas everyone else is at a lower risk (especially as the demographic becomes younger and otherwise healthier). NPIs, however, appear to have profound negative consequences to all demographics indiscriminately (including the elderly and individuals with one or more comorbidities), and unfortunately more so the marginalized and low-socioeconomic individuals (Zweig, Zapf, Beyrer, Guha-Sapir, & Haar, 2021). This further exemplifies the importance of ensuring the costs of NPI response policies are not greater than their benefits and are proportionate to the threat of COVID-19 itself.

With these key considerations further elaborated throughout this report, policy makers must compare the costs and benefits of NPI policy implementation against policies absent NPIs or policies with minimal NPI interventions; therefore, policy makers must ensure that the wellbeing of individuals are not unnecessarily jeopardized to, perhaps ostensibly, protect the vulnerable. As stated numerous times, the Multiple Accounts CBA may be the most appropriate tool available to properly assess the costs and benefits of NPI policies which could best inform future policy making.

On March 1, 2022, the Provincial Health Officer has stated "we need to be prepared for immunity to wane again and for us to have new approaches and adapt depending on what we see come the fall" (Provincial Health Officer, 2022). What is meant by this is unclear; however, considering the BC COVID-19 IFR, hospitalization rate, and life expectancy statistics described above, the Government of BC ought to first conduct a comprehensive Multiple Accounts CBA prior to revisiting policies plagued with multifaceted, negative consequences. As of March 4, 2022, Omicron has been the most commonly detected COVID-19 variant in BC (BC CDC, 2022). Although vaccinated individuals are purported to be less likely to require hospitalization, "people can spread Omicron to others even if they have been vaccinated, especially when they have symptoms" (BC CDC, 2022). For this reason, it is entirely reasonable to assume government may, especially in the potential event a variant bypasses vaccine protection, reimplement any of the NPIs described in this report in the future.

The potential for NPI reimplementation was recently supported by additional public health messaging from BC's Provincial Health Officer. As stated above, the Government of BC is continuously monitoring the presence and spread of COVID-19, reiterating the possible need to reimplement NPIs to flatten and/or reduce the COVID-19 case count. As recently reported by local media, the Provincial Health Officer continues to anticipate another COVID-19 wave in autumn, stating "we need to be prepared that we're going to see a surge in the fall … [and] there are things that we'll have to go back to, to remember about how we can do that … I hope and I expect that we'll never have to put in orders that require people to do those things, like we did when we didn't know what was going on over the last 2.5 years. But we will rely on each other to take those measures, when we start to see things increase in transmission again." (Wong & Yuzda, 2022) This statement, in tandem with the statement in the previous paragraph, serves as a clear indication that NPIs may be reintroduced.

If NPIs are to be considered, a comprehensive assessment of their costs should be a meaningful part of the decision-making process; hence, an effective way to ensure the costs of NPI policy implementation do not outweigh their projected benefits is to complete a thorough Multiple Accounts CBA. At the very least, a Multiple Accounts CBA could help optimize NPI implementation.

Answering the Research Questions

This report's research questions are as follows:

- Did BC public policy fail to account for the costs of NPIs? If so,
- What could future policy makers do differently to ensure unintended outcomes are properly identified and accounted for?

The language within publicly available COVID-19 policies do not appear to include considerations and costs associated with the NPIs designed to reduce the transmission of COVID-19, nor do they provide thorough analysis of constitutional proportionality. As indicated above, policy makers ought to conduct a comprehensive Multiple Accounts CBA prior to implementing any further NPI focused COVID-19 response measures to ensure their costs do not outweigh their benefits

New Themes and Ideas (Unexpected Findings)

Two prior CBAs conducted to ascertain the proportionality of COVID-19 NPI response policies against the severity of COVID-19 have been completed. As stated above, the CBA's have suggested that COVID-19 NPI response measures ought to be considered policy failures (Allen, 2021) and be rejected out of hand (Herby, Jonung, & Hanke, 2022).

Summary and Revisiting the Theoretical Framework

As described in the Background in this report, a Multiple Accounts CBA seeks to overcome limitations of a traditional CBA (Shaffer, 2010). A Multiple Accounts CBA will likely best serve the needs to appropriately account for the costs and benefits of COVID-19 response measures, as it adequately includes costs not easily monetized, such as mental health, social, environmental, and potential human rights factors (Shaffer, 2010).

The findings of this report and the results of two COVID-19 CBAs suggest a Multiple Accounts CBA is needed to fully understand the consequences of COVID-19 NPI response measures relative to the threat of COVID-19 itself (Allen, 2021; Herby, Jonung, & Hanke, 2022), as well as optimize response measures if and when they are required to mitigate the costs associated with them. The following steps (informed by the outcomes of this report's research) may assist the Government of BC, should it choose to adopt this report's recommendation, in conducting a Multiple Accounts CBA for these purposes.

Step 1: The Government of BC ought to first completely distinguish deaths 'with or of' COVID-19 and remove all deaths erroneously associated or implicated COVID-19 as the cause. It will be of no benefit if deaths which were not caused by COVID-19 are included in a Multiple Accounts CBA as that data will inaccurately skew the CBA results.

Step 2: The same (regarding 'with or of' COVID-19) must be done regarding COVID-19 hospitalizations. Further analysis may be required to determine if those, especially at or above average life expectancy, Canada and OECD's Age of Premature Death, and/or individuals living with one or more comorbidities would have likely deceased absent COVID-19. These individuals ought to be weighed far less than individuals which do not fall under these categories (especially the young and healthy).

Step 3: Do not include COVID-19 cases in the CBA. Cases are highly variable and malleable to (a) testing frequency, (b) testing sensitivity, and (c) changes in policy. The risk of the case metric becoming arbitrary and irrelevant as an indicator of COVID-19 severity is far too high. As outlined in the Literature Review, cases may not serve as a reliable indicator regarding COVID-19 dangers; therefore, cases may not accurately represent any increase or decrease in COVID-19 hospitalizations or deaths.

Step 4: The costs of NPIs ought to be weighed differently against different age cohorts. As indicated in Step 2, any costs (whether COVID-19 or NPI induced), must be appropriately weighed higher for individuals who are not vulnerable to COVID-19 relative to individuals who are (who appear to be individuals at incredibly high risk absent COVID-19). It is paramount to consider the COVID-19 IFR but not to apply the IFR to all cohorts indiscriminately. The IFR is far lower for younger and healthier individuals, and that fact must be built into the Multiple Account CBA.

Step 5: Identify all costs and benefits of COVID-19. It is equally important to consider the 'benefits' of COVID-19 infection. Individuals who are infected by COVID-19 and survive will build natural immunity: a benefit which *must* be included to fully and properly assess all costs and benefits.

Step 6: Identify all costs and benefits of NPI implementation.[15] Below provides an example:

- Purported benefits: reduction of COVID-19 specific hospitalizations and deaths.
- Purported costs:
    - Physical health (e.g., any increase in negative physical health outcomes as a result of NPI implementation, especially stay-at-home orders and other physical and social distancing measures)
    - Delayed medically required interventions (e.g., cancer screenings)

[15] Lost work hours due to COVID-19 may be considered as a COVID-19 specific cost, but this may also be due to COVID-19 NPIs. If lost work hours are included in the CBA, it must be equally applied to policies which have prevented people from working even if asymptomatic and/or the virus was no longer transmissible.

- Mental health (e.g., depression among all individuals, including those most vulnerable to COVID-19)
- Suicides and thoughts of suicide
- Negative psychosocial and health behaviours (e.g., alcohol consumption, use of illicit drugs)
- Illicit drug overdoses and deaths
- Loss or reductions in income and business closures (e.g., not only business that temporarily closed, but businesses forced to shut down entirely)
- Unemployment, poverty, and income assistance rates
- Economic considerations (e.g., inflation caused by printing and spending money on all COVID-19 related expenditures, including CERB)
- Federal and Provincial budgetary considerations because of NPI implementation (e.g., reduction in tax revenues caused by business closures, increases in expenditures)
- Federal and Provincial spending on COVID-19 tools (e.g., rapid testing, PCR testing, vaccinations, contact tracing tools, COVID-19 mobile apps)
- Reduction in healthcare capacity and staff due to COVID-19 isolation and/or vaccination requirements (e.g., reduction in service deliveries in BC's healthcare centres)
- Environmental considerations (e.g., mask disposal and its impact to landfills and oceanic wellbeing)
- Potential human rights violations (e.g., stay-at-home orders and all other limitations to an individual's freedoms)
- Crime rates (e.g., incidents of domestic violence and abuse)

Step 7: Zero assumptions regarding IFR and NPI efficacy should be incorporated into the Multiple Accounts CBA. All data used in the CBA must be substantiated by real-world data. Assumptions (especially assumptions which result in theoretical counterfactuals) should no longer be used. However, if assumptions are used (although not recommended), each assumption must be transparent and made fully available to the public.

Step 8: Monetize all costs and benefits to the best possible extent. Follow Multiple Account CBA principles in the event a cost is unable to be monetized.

Step 9: Share all Multiple Account outcomes and results along with a complete methodology, list of sources, and assumptions used (if any) with the public. All information, including inputs and outputs, must be fully transparent and publicly available.

All costs and benefits must be further and fully explored prior to beginning an appropriate, all encompassing, thorough Multiple Accounts CBA. The above only provides high-level considerations as examples.

Recommendation

As evidenced by emerging literature related to COVID-19 response outcomes, it is apparent that COVID-19 policies throughout the world and in BC have proven harmful to many citizens who are neither at risk of serious illness nor death from COVID-19. Based on current findings, I therefore recommend that all COVID-19 response measures be subjected to a comprehensive Multiple Accounts CBA prior to NPI implementation to ensure that future pandemic-related policies, COVID-19 or otherwise, will help – rather than harm – the residents of BC.

Chapter 8: Conclusion

As stated in Chapter 5: BC Case Study and Data Analysis, the Canadian Medical Association (2021) claims that although more Canadians died in 2020 than in a typical year, "the number of excess deaths was greater than can be explained by COVID-19 alone" (Canadian Medical Association, 2021, p. 9). This assertion highlights the thesis statement; therefore, a need for a comprehensive assessment of both impacts of COVID-19 versus the impacts of COVID-19 policies.

The COVID-19 IFR appears low globally (Folkhalsomyndigheten (Public Health Agency of Sweden), 2020; Ioannidis, John P. A, 2021; Perez-Saez, et al., 2020; Stringhini, et al., 2020; US CDC, 2021; World Health Organization, 2020) as well as in BC (Ioannidis, John P. A, 2021). This is not to state COVID-19 does not present a hazard to human health; however, it is unclear if COVID-19 warrants drastic NPI response measures which appear to coincide with a multitude of negative consequences (e.g., psychological, economic, social, etc.) (Arnold, 2020; Bagus, Peña-Ramos, & Sánchez-Bayón, 2021; Bonal & González, 2020; Bressan, Gallo, Tirelli, Gregori, & Da Dalt, 2021; Buheji, et al., 2020; Christakis, Van Cleve, & Zimmerman, 2020; De Vincentiis, Carr, Mariani, & Ferrara, 2021; Ebrahimi, Hoffart, & Johnson, 2021; Ganesan, et al., 2021; García-Esquinas, et al., 2021; Goenka, et al., 2021; Hao, et al., 2020; Hawton, et al., 2021; Ioannidis J. P., 2020; Josephson, Kilic, & Michler, 2021; Kirsch & Vitiello, 2022; Kokolakakis, Lera-Lopez, & Ramchandani, 2021; Linas, et al., 2021; Maringe, et al., 2020; McCrary & Sanga, 2021; McIntyre & Lee, 2020; Muhammad & Abubakar, 2021; Mulugeta, Tadesse, Shegute, & Desta, 2021; Peçanha, Goessler, Roschel, & Gualano, 2020; Pieh, et al., 2021; Piketty, et al., 2022; Riemann, Speck, Gerstacker, Becker, & Knopf, 2021; Saiz, et al., 2021; Segarra-Blasco, Teruel, & Cattaruzzo, 2021; Simandan, Rinner, & Capurri, 2022; Skar, Graham, & Huebner, 2021; Sport England, 2020; Tanaka & Okamoto, 2021; United Nations, 2021; Vahia, Jeste, & Reynolds III, 2020; Verschuur, Koks, & Hall, 2021; Wang, et al., 2021; Wilkinson, 2022; Zhou, et al., 2021; Zweig, Zapf, Beyrer, Guha-Sapir, & Haar, 2021). In other words, it is difficult to determine if implemented COVID-19 response measures were proportionate to the threat of COVID-19 itself in the BC context. In fact, the Government of BC has identified numerous areas in which response measures and implemented policies have had a deleterious impact to society – many of which have disproportionality affected younger adults and certain vulnerable individuals (BC CDC, n.d.; BC Coroners Service, 2022). Overall, a review of available evidence suggests that a myriad of negative outcomes have resulted from NPI implementation in BC, and given the relatively low risk of serious illness or death from COVID-19 for the majority of the population, both the necessity and efficacy of COVID-19 response measures calls many of BC's provincial policies into question.

Strategic or Research Implications

The implications of this report highlight:

- COVID-19 NPI response measures cause negative consequences.
- A Multiple Accounts CBA would greatly benefit an assessment of NPI costs and benefits relative and proportionate of the COVID-19 threat.
- The need for costs to be accounted for in policies. NPIs *may* have greater costs than benefits.
- Future policy makers and researchers ought to thoroughly consider these consequences when determining COVID-19 NPI response measure safety and efficacy.

Limitations of Analysis and Areas for Further Research

Data quality and available is the most significant limitation of this research. Most, but not all, relevant data is available publicly at this time; therefore, data from other jurisdictions have been extrapolated to suggest findings in BC which may not necessarily be appropriately generalized. As stated earlier in this report, limitations of this research also include the novel nature of the COVID-19 pandemic leading to potential gaps in research and understanding of the virus. As data emerges, it may conflict with earlier data. Additionally, it may be difficult to determine the outcomes of a policy without considering any confounds, such as culture and public perception which may impact the willingness to accept health orders; therefore, potentially nullifying policies and reducing their efficacy.

Furthermore, this report does not include an analysis of all NPIs, nor does it include a comparative analysis between BC and other jurisdictions. Comparative analysis would provide further context to the outcomes of NPIs in BC if compared to other jurisdictions (globally and domestically) which implemented disparate or even similar policies; therefore, it may not be appropriate to extrapolate the findings in this report to generalize outcomes in other jurisdictions.

Additionally, this report does not include interviews which may have potentially provided insight from Health Canada, the BC Ministry of Health, or other relevant and key policy makers or stakeholders – insight that is not evident in or available from current literature and public documents. Interviews may have provided further context, beyond what has been made publicly available, regarding the rationale of prioritizing cases as the metric of paramount (or arguably only) concern, further insight of constitutional analysis and consideration, to what extent the costs of NPIs were considered and mitigated internally, and how and when government collaborated with external and internal stakeholders to ensure dissenting opinions and concerns were considered. As a workaround, a Freedom of Information (FOI) request was submitted February 20, 2022. The Government of BC applied a 30-day extension on April 6, 2022. As of May 28, 2022, the FOI still has not been received. Although the FOI request will likely not be ready by the time this report is finalized (and may be included as an addendum on a later date), it

includes information crucial information which would further contextualize COVID-19 and corresponding response policies in BC. The request includes:

- Yearly data of deaths caused by the following from 2016-2022:
  - Covid-19
  - Influenza
  - Pneumonia
  - Chronic Obstructive Pulmonary Disease
  - All Respiratory Diseases
  - Heart Disease
  - Stroke
  - Illicit Drug Toxicity
  - Opioid Drug Toxicity
  - Alzheimer's Disease and Dementia
  - Diabetes
  - Liver Disease
  - Parkinson's Disease
  - Kidney Disease
  - Hypertension
  - Pneumonitis due to Solids and Liquids
  - Obesity
  - Suicide

- Yearly data of the following from 2016-2022:
  - Total number of hospital beds in BC
  - Hospital bed capacity and use
  - Hospital ICU bed capacity and use.

Final Reflections

This report is not designed to critique the intentions of policy makers but inform future decision making and justify the need to conduct a full, comprehensive Multiple Accounts CBA regarding COVID-19 NPI response policies to further ensure constitutional proportionality is met, and more importantly, the human health and economic harms caused by NPI implementation do not outweigh their benefits. Considering the Government of BC's statement regarding revisiting any of these policies in the future to mitigate the spread of COVID-19 during subsequent, anticipated waves, the benefits of a Multiple Accounts CBA hold true in the COVID-19 context, as well as any other real or perceived threats and potential dangers in the future where similar policies may considered and/or implemented.

References

Adalja, A. A., Toner, E., & Inglesby, T. V. (2020). Priorities for the US health community responding to COVID-19. *JAMA, 323(14)*, 1343-1344.

Allen, D. W. (2021). *Covid Lockdown Cost/Benefits: A Critical Assessment of the Literature.* Vancouver: Simon Fraser University .

Arnold, C. (2020). The US covid pandemic has a sinister shadow—drug overdoses. *BMJ, 271(4751)*, 1-2.

Arya, A. (2020, July 16). *Palliative care has been lacking for decades in long-term care*. Retrieved from Policy Options: https://policyoptions.irpp.org/magazines/july-2020/palliative-care-has-been-lacking-for-decades-in-long-term-care/#:~:text=In%20Ontario%2C%20the%20average%20resident,in%20these%20homes%20predictably%20receive.

Bae, S. H., Shin, H., Koo, H., Lee, S. W., Yang, J. M., & Yon, D. K. (2020). Asymptomatic Transmission of SARS-CoV-2 on Evacuation Flight. *Emerging Infectious Diseases, 26(11)*, 2705-2708.

Bagus, P., Peña-Ramos, J., & Sánchez-Bayón, A. (2021). COVID-19 and the Political Economy of Mass Hysteria. *International Journal of Environmental Research and Public Health, 18(1376)*, 1-15.

BC CDC. (2021). *BC COVID-19 SPEAK Results*. Retrieved from Tableau Public: https://public.tableau.com/app/profile/bccdc/viz/BCCOVID-19SPEAKSurvey/BCCOVID-19SPEAKresults

BC CDC. (2021). *COVID-19 Survey*. Retrieved from BC CDC: http://www.bccdc.ca/health-info/diseases-conditions/covid-19/covid-19-survey

BC CDC. (2021b, December 15). *Mental well-being during COVID-19*. Retrieved from BC CDC: http://www.bccdc.ca/health-info/diseases-conditions/covid-19/about-covid-19/mental-well-being-during-covid-19

BC CDC. (2021b, September 17). *Types of tests: Viral tests can tell you if you have COVID-19 right now and are potentially infectious to others*. Retrieved from BC CDC: http://www.bccdc.ca/health-info/diseases-conditions/covid-19/testing/types-of-tests

BC CDC. (2021b, June 23). *Unemployment and Underemployment*. Retrieved from BC CDC: http://www.bccdc.ca/Health-Professionals-Site/Documents/societal_consequences/Unemployment_Underemployment.pdf

BC CDC. (2022, March 3). *BC COVID-19 Situation Report - Week 7: February 13-February 19, 2022*. Retrieved from BC CDC: http://www.bccdc.ca/Health-Info-Site/Documents/COVID_sitrep/Week_7_2022_BC_COVID-19_Situation_Report.pdf

BC CDC. (2022). *BCCDC Mortality Context App*. Retrieved from BC CDC: https://bccdc.shinyapps.io/Mortality_Context_ShinyApp/

BC CDC. (2022, March 2). *COVID-19 Variants*. Retrieved from BC CDC: http://www.bccdc.ca/health-info/diseases-conditions/covid-19/about-covid-19/variants

BC CDC. (n.d.). *Societal Consequences of COVID-19*. Retrieved from BC CDC: http://www.bccdc.ca/health-professionals/data-reports/societal-consequences-covid-19

BC CDC. (2020, May 4). *COVID-19: Going Forward*. Retrieved from BC Centre for Disease Control: https://news.gov.bc.ca/files/Covid-19_May4_PPP.pdf

BC CDC. (2021, July 16). *Self-Isolation and Self-Monitoring*. Retrieved from BC Centre for Disease Control: http://www.bccdc.ca/health-info/diseases-conditions/covid-19/self-isolation#:~:text=You%20must%20self-isolate%20when%20you%20are%20travelling%20to,for%20symptoms%20for%2014%20days%20upon%20their%20arrival.

BC CDC. (2022, January 14). *Epidemiology & Modelling Presentations*. Retrieved from BC Centre for Disease Control: http://www.bccdc.ca/health-info/diseases-conditions/covid-19/modelling-projections

BC Coroners Service. (2022, March 9). *BC Coroners Service Death Review Panel: A Review of Illicity Drug Toxicity Deaths*. Retrieved from BC Coroners Service: https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/death-review-panel/review_of_illicit_drug_toxicity_deaths_2022.pdf

BC Coroners Service. (2022, March 11). *Illicity Drug Toxicity Deaths in BC*. Retrieved from BC Coroners Services: https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/statistical/illicit-drug.pdf

Bendavid, E., Oh, C., Bhattacharya, J., & Ioannidis, J. P. (2021). Assessing mandatory stay-at-home and business closure effects on the spread of COVID-19. *European Journal of Clinical Investigation, 51(4)*, 1-9.

Bjørnskov, C. (2021). Did Lockdown Work? An Economist's Cross-Country Comparison. *CESifo Economic Studies, 67(3)*, 318-331.

Bluestone, B., Harrison, B., & Baker, L. (1981). Corporate flight: The causes and consequences of economic dislocation. *Center for Policy Alternatives*.

Bonal, X., & González, S. (2020). The impact of lockdown on the learning gap: family and school divisions in times of crisis. *International Review of Education, 66(5)*, 635-655.

Bonardi, J., Gallea, Q., Kalanoski, D., Lalive, & R. (2020). Fast and Local: How did Lockdown Policies Affect the Spread and Severity of COVID-19? *CEPR COVID Economics, 23*, 1-148.

Bouayed, J., & Bohn, T. (2021). Behavioral manipulation—key to the successful global spread of the new coronavirus SARS-CoV-2? *Journal of Medical Virology, 93(3)*, 1748-1751.

Bressan, S., Gallo, E., Tirelli, F., Gregori, D., & Da Dalt, L. (2021). Lockdown: more domestic accidents than COVID-19 in children. *Archives of disease in childhood, 106(2)*, 1-2.

Buheji, M., da Costa Cunha, K., Beka, G., Mavric, B., De Souza, Y. L., da Costa Silva, S. S., . . . Yein, T. C. (2020). The Extent of COVID-19 Pandemic Socio-Economic Impact on Global Poverty. A Global Integrative Multidisciplinary Review. *American Journal of Economics, 10(4)*, 2013-224.

Cai, Q., Huang, D., Ou, P., Yu, H., Zhu, Z., Xia, Z., . . . Chen, J. (2020). COVID-19 in a designated infectious diseases hospital outside Hubei Province, China. *Allergy, 75(7)*, 1742-1752.

Canadian Medical Association. (2021). *A struggling system: Understanding the health care impacts of the pandemic.* Ottawa: Canadian Medical Association.

Canadian Medical Association. (2021, November 30). *Excess deaths, increased mental health disorders and substance use: new CMA report highlights pandemic's broader impact*. Retrieved from Canadian Medical Association: https://www.cma.ca/news-releases-and-statements/excess-deaths-increased-mental-health-disorders-and-substance-use-new

Carson, R. B., Thomas, W. L., & Hecht, J. (2015). *Economic Issues Today: Alternative Approaches (8th Edition).* New York: Routledge.

Chappell, B. (2020, March 26). *'We Are At War,' WHO Head Says, Warning Millions Could Die From COVID-19.* Retrieved from NPR/NWPB: https://www.npr.org/sections/coronavirus-live-updates/2020/03/26/822123471/we-are-at-war-who-head-says-warning-millions-could-die-from-covid-19

Chaudhry, R., Dranitsaris, G., Mubashir, T., Bartoszko, J., & Riazi, S. (2020). A country level analysis measuring the impact of government actions, country preparedness and socioeconomic factors on COVID-19 mortality and related health outcomes. *EClinicalMedicine, 25(100464)*, 1-8.

Chin, V., Ioannidis, J. P., Tanner, M. A., & Cripps, S. (2021). Effect estimates of COVID-19 non-pharmaceutical interventions are non-robust and highly model-dependent. *Journal of Clinical Epidemiology, 136*, 96-132.

Christakis, D. A., Van Cleve, W., & Zimmerman, F. J. (2020). Estimation of US Children's Educational Attainment and Years of Life Lost Associated With Primary School Closures During the Coronavirus Disease 2019 Pandemic. *JAMA Network Open, 3(11)*, 1-12.

Chu, D. K., Akl, E. A., Duda, S., Solo, K., Yaacoub, S., Schünemann, H. J., . . . Cuello-Garcia. (2020). Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *The Lancet (British edition), 395(10242)*, 1973-1987.

Chu, D., Akl, E. A., Duda, S., Solo, K., Yaacoub, S., & Schunemann, H. J. (2020). Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *The Lancet, 395(10242)*, 1973-1987.

Coccia, M. (2021). The relation between length of lockdown, numbers of infected people and deaths of Covid-19, and economic growth of countries: Lessons learned to cope with future pandemics similar to Covid-19 and to constrain the deterioration of economic system. *Science of The Total Environment, 775(25)*, 1-10.

Das, A., Singh, P., & Bruckner, T. A. (2022). State lockdown policies, mental health symptoms, and using substances. *Addictive Behaviors, 124(107084)*, 1-9.

De Vincentiis, L., Carr, R. A., Mariani, M. P., & Ferrara, G. (2021). ancer diagnostic rates during the 2020 'lockdown', due to COVID-19 pandemic, compared with the 2018–2019: an audit study from cellular pathology. *Journal of Clinical Pathology, 74(3)*, 187-189.

Detsky, A. S., & Bogoch, I. I. (2020). COVID-19 in Canada: Experience and Response. *JAMA : The Journal of the American Medical Association, 324(8)*, 743-744.

Di Domenico, L., Pullano, G., Sabbatini, C. E., Boëlle, P., & Colizza, V. (2020). Impact of lockdown on COVID-19 epidemic in Île-de-France and possible exit strategies. *BMC Medicine, 18(240)*, 1-13.

Dr. Tedros Adhanom Ghebreyesus. (2020, July 27). *Coronavirus disease (COVID-19) pandemic: Press conferences on COVID-19*. Retrieved from World Health Organization: https://www.who.int/emergencies/diseases/novel-coronavirus-2019

Ebrahimi, O. V., Hoffart, A., & Johnson, S. U. (2021). Physical Distancing and Mental Health During the COVID-19 Pandemic: Factors Associated With Psychological Symptoms and Adherence to Pandemic Mitigation Strategies. *Clinical Psychological Science, 9(3),* 489-506.

Edwards, R. (2013). The Cost of Uncertain Life Span. *Journal of Population Economics, 26(4),* 1485-1522.

Feldscher, K. (2021, July 20). *Weighing the benefits and costs of COVID-19 restrictions*. Retrieved from Harvard School of Public Health: https://www.hsph.harvard.edu/news/features/weighing-the-benefits-and-costs-of-covid-19-restrictions/

Flaxman, S., Mishra, S., Gandy, A., Unwin, H. J., Mellan, T. A., Coupland, H., . . . Bhatt, S. (2020). Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe. *Nature (London), 584(7820),* 257-272.

Folkhalsomyndigheten (Public Health Agency of Sweden). (2020). *The infection fatality rate of COVID-19 in Stockholm – Technical report.* Retrieved from Folkhalsomyndigheten: https://www.folkhalsomyndigheten.se/contentassets/53c0dc391be54f5d959ead9131edb771/infection-fatality-rate-covid-19-stockholm-technical-report.pdf

Fraser Institute. (2021). *The Growing Debt Burden for Canadians: 2021 Edition.* Vancouver: Fraser Institute.

Friedman, J., Beletsky, L., & Schriger, D. L. (2021). Overdose-related cardiac arrests observed by emergency medical services during the US COVID-19 epidemic. *JAMA psychiatry, 78(5),* 562-564.

Ganesan, B., Al-Jumaily, A., Fong, K. N., Prasad, P., Meena, S. K., & Tong, R. K. (2021). Impact of Coronavirus Disease 2019 (COVID-19) Outbreak Quarantine, Isolation, and Lockdown Policies on Mental Health and Suicide. *Frontiers in Psychiatry, 12(565190),* 1-12.

Garcia, S., Albaghdadi, M. S., Meraj, P. M., Schmidt, C., Garberich, R., Jaffer, F. A., . . . Henry, T. (2020). Reduction in ST-segment elevation cardiac catheterization laboratory activations in the united states during COVID-19 pandemic. *Journal of the American College of Cardiology, 75(22),* 2871-2872.

García-Esquinas, E., Ortolá, R., Gine-Vázquez, I., Carnicero, J. A., Mañas, A., Lara, E., . . . Martínez-Gómez, D. (2021). Changes in Health Behaviors, Mental and Physical Health among Older Adults under Severe Lockdown Restrictions during the COVID-19 Pandemic in Spain. *International Journal of Environmental Research and Public Health, 18(13),* 1-25.

Goenka, L., Anandaradje, A., Nakka, T., Kayal, S., Dubashi, B., Chaturvedula, L., . . . Ganesan, P. (2021). The “collateral damage” of the war on COVID-19: Impact of the pandemic on the care of epithelial ovarian cancer. *edical Oncology, 38(11)*, 1-5.

Government of BC . (2020, August 31). *Public Accounts confirm economic impacts of COVID-19*. Retrieved from BC Gov News: https://news.gov.bc.ca/releases/2020FIN0048-001611

Government of BC. (2021, October). *Population Estimates*. Retrieved from Government of BC: https://www2.gov.bc.ca/gov/content/data/statistics/people-population-community/population/population-estimates

Government of BC. (2021, July 1). *Province-wide restrictions*. Retrieved from Government of BC: https://www2.gov.bc.ca/gov/content/covid-19/info/restrictions

Government of BC. (2021, August 31). *Virtual mental health supports*. Retrieved from Government of BC: https://www2.gov.bc.ca/gov/content/health/managing-your-health/mental-health-substance-use/virtual-mental-health-supports

Government of BC. (2022, April 7). *B.C. shifts to weekly COVID-19 data reporting*. Retrieved from BC Gov News: https://news.gov.bc.ca/releases/2022HLTH0116-000522

Government of BC. (2022, February 23). *B.C.'s response to COVID-19*. Retrieved from Government of BC: https://www2.gov.bc.ca/gov/content/covid-19/info/response

Government of BC. (2022, March 7). *British Columbia COVID-19 Dashboard*. Retrieved from Government of BC: https://experience.arcgis.com/experience/a6f23959a8b14bfa989e3cda29297ded

Government of BC. (2022, February 18). *COVID-19 (Novel Coronavirus)*. Retrieved from Government of BC: https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/current-health-topics/covid-19-novel-coronavirus#archived-orders

Government of BC. (2022, March 1). *COVID-19 Closure Relief Grant*. Retrieved from Government of BC: https://www2.gov.bc.ca/gov/content/covid-19/economic-recovery/closure-relief-grant

Government of BC. (2022, April 6). *COVID-19 Statistics (Thrive App)*. Retrieved from Government of BC: https://bc.thrive.health/covid19app/stats

Government of BC. (2022, January 31). *COVID-19 support for individuals and families*. Retrieved from Government of BC: https://www2.gov.bc.ca/gov/content/covid-19/info/benefits#individuals

Government of BC. (2022, February 9). *Minister's, PHO statement on lives lost to poisoned drugs in 2021*. Retrieved from BC Gov News: https://news.gov.bc.ca/releases/2022MMHA0004-000189

Government of BC. (2022, February 3). *Ministry of Health - Overview of Visitors in Long-Term Care and Seniors' Assisted Living*. Retrieved from Coronavirus COVID-19: https://www2.gov.bc.ca/assets/gov/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/covid-19/covid-19-guidance-visitors-care-assisted.pdf

Government of BC. (2022, February 18). *Post-Secondary Institution Housing COVID-19 Preventive Measures Order - February 18, 2022*. Retrieved from Order of the Provincial Health Officer: https://www2.gov.bc.ca/assets/gov/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/covid-19/covid-19-pho-order-post-secondary-institution-housing.pdf

Government of Canada. (1982). *Constitution Act, 1982: Canadian Charter of Rights and Freedoms*. Retrieved from Justice Laws Website: https://laws-lois.justice.gc.ca/eng/const/page-12.html#h-40

Government of Canada. (2020, October 7). *National polymerase chain reaction (PCR) testing indication guidance for COVID-19*. Retrieved from Government of Canada: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/guidance-documents/national-laboratory-testing-indication.html

Government of Canada. (2021, September 21). *Coronavirus disease (COVID-19): Guidance documents*. Retrieved from Government of Canada: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/guidance-documents.html

Government of Canada. (2021, October 15). *COVID-19 and deaths in older Canadians: Excess mortality and the impacts of age and comorbidity* . Retrieved from Government of Canada: https://www.canada.ca/en/public-health/services/diseases/coronavirus-disease-covid-19/epidemiological-economic-research-data/excess-mortality-impacts-age-comorbidity.html#a3

Government of Canada. (2021, October 7). *COVID-19 daily epidemiology update*. Retrieved from Government of Canada: https://health-infobase.canada.ca/covid-19/epidemiological-summary-covid-19-cases.html?stat=num&measure=deaths

Government of Canada. (2021, June 17). *COVID-19 signs, symptoms and severity of disease: A clinician guide*. Retrieved from Government of Canada: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/guidance-documents/signs-symptoms-severity.html

Government of Canada. (2021, August 20). *COVID-19: How to quarantine or isolate at home*. Retrieved from Government of Canada: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/prevention-risks/quarantine-isolate-home.html#a3

Government of Canada. (2021, June 8). *COVID-19: Provincial and territorial resources*. Retrieved from Government of Canada: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/symptoms/provincial-territorial-resources-covid-19.html

Government of Canada. (2021, August 11). *Individual and community-based measures to mitigate the spread of COVID-19 in Canada*. Retrieved from Government of Canada: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals/public-health-measures-mitigate-covid-19.html#a3

Government of Canada. (2021, July 14). *Mandatory quarantine or isolation*. Retrieved from Government of Canada: https://travel.gc.ca/travel-covid/travel-restrictions/isolation#exemptions

Government of Canada. (2021, December 10). *Mathematical modelling and COVID-19*. Retrieved from Government of Canada: https://www.canada.ca/en/public-health/services/diseases/coronavirus-disease-covid-19/epidemiological-economic-research-data/mathematical-modelling.html#w

Government of Canada. (2021, February 17). *National case definition: Coronavirus disease (COVID-19)*. Retrieved from Government of Canada: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/health-professionals/national-case-definition.html#dec

Government of Canada. (2022, March 1). *Annual Financial Report of the Government of Canada Fiscal Year 2020-2021*. Retrieved from Government of Canada: https://www.canada.ca/en/department-finance/services/publications/annual-financial-report/2021/report.html

Government of Canada. (2022, February 18). *Mathematical modelling and COVID-19*. Retrieved from Government of Canada: https://www.canada.ca/en/public-health/services/diseases/coronavirus-disease-covid-19/epidemiological-economic-research-data/mathematical-modelling.html

Günther, T., Czech-Sioli, M., Indenbirken, D., Robitaille, A., Tenhaken, P., Exner, M., . . . Brinkmann, M. M. (2020). SARS-CoV-2 outbreak investigation in a german meat processing plant. *MBO Molecular Medicine, 12(13296)*, 1-10.

Hale, T., Anania, J., Angrist, N., Boby, T., Cameron-Blake, E., Di Folco, M., . . . Zhang, Y. (2021). *Variation in government responses to COVID-19.* Oxford: University of Oxford, Blavatnik School of Government.

Hammitt, J. K. (2020). Valuing mortality risk in the time of COVID-19. *Journal of Risk and Uncertainty, 61(2)*, 129-154.

Hao, F., Tan, W., Jiang, L., Zhang, L., Zhao, X., Zou, Y., . . . Tam, W. (2020). Do psychiatric patients experience more psychiatric symptoms during COVID-19 pandemic and lockdown? A case-control study with service and research implications for immunopsychiatry. *Brain, Behavior, and Immunity, 87*, 100-106.

Hawton, K., Lascelles, K., Brand, F., Casey, D., Bale, L., Ness, J., . . . Waters, K. (2021). Self-harm and the COVID-19 pandemic: A study of factors contributing to self-harm during lockdown restrictions. *Journal of Psychiatric Research, 137*, 437-443.

HealthLinkBC. (2021, January 20). *Mental Health and COVID-19*. Retrieved from HealthLinkBC: https://www.healthlinkbc.ca/more/health-features/coronavirus-disease-covid-19/mental-health-covid

Herby, J., Jonung, L., & Hanke, S. H. (2022). A Literature Review and Meta-Analysis of the Effects of Lockdowns on COVID-19 Mortality. *Studies in Applied Economics* , 1-62.

Huang, X., Shao, X., Xing, L., Hu, Y., Sin, D. D., & Zhang, X. (2021). The impact of lockdown timing on COVID-19 transmission across US counties. *The Lancet, 38, 101035*, 1-8.

Hunter, P. (2020). The spread of the COVID-19 coronavirus: Health agencies worldwide prepare for the seemingly inevitability of the COVID-19 coronavirus becoming endemic. *EMBO Reports, 21(4)*, 1-3.

International Alliance of Physicans and Medical Scientists. (2021, September). *Physicians Declaration Global COVID Summit - Rome, Italy*. Retrieved from Doctors and Scientists Declaration: https://doctorsandscientistsdeclaration.org/

Ioannidis, J. P. (2020, March 17). *A fiasco in the making? As the coronavirus pandemic takes hold, we are making decisions without reliable data*. Retrieved from STAT: https://www.statnews.com/2020/03/17/a-fiasco-in-the-making-as-the-coronavirus-pandemic-takes-hold-we-are-making-decisions-without-reliable-data/

Ioannidis, J. P. (2020). Coronavirus disease 2019: the harms of exaggerated information and non-evidence-based measures. *European journal of clinical investigation, 50(4)*, 1-5.

Ioannidis, John P. A. (2021). *Infection fatality rate of COVID-19 inferred from seroprevalence data.* Geneva: World Health Organization. Retrieved from World Health Organization: https://www.who.int/bulletin/volumes/99/1/20-265892.pdf

Jaafar, R., Aherfi, S. W., Grimaldier, C., Van Hoang, T., Colson, P., Raoult, D., & La Scola, B. (2021). Correlation between 3790 quantitative polymerase chain Reaction–Positives samples and positive cell cultures, including 1941 severe acute respiratory syndrome coronavirus 2 isolates. *Clinical Infectious Diseases, 72(11)*, 932-933.

Jarvis, C. I., Van Zandvoort, K., Gimma, A., Prem, K., Klepac, P., Rubin, G. J., & Edmunds, W. J. (2020). Quantifying the impact of physical distance measures on the transmission of COVID-19 in the UK. *BMC Medicine, 18(124)*, 1-10.

Josephson, A., Kilic, T., & Michler, J. D. (2021). Socioeconomic impacts of COVID-19 in low-income countries. *Nature Human Behaviour, 5*, 557-565.

Kaufman, H. W., Chen, Z., Niles, J., & Fesko, Y. (2021). Changes in the Number of US Patients With Newly Identified Cancer Before COVID-19 Through the First Full Year of the Pandemic. *JAMA Network Open, 4(8)*, 1-4.

Kaur, S., Bherwani, H., Gulia, S., Vijay, R., & Kumar, R. (2021(b)). Understanding COVID-19 transmission, health impacts and mitigation: timely social distancing is the key. *Environment, Development and Sustainability, 23(5)*, 6681-6697.

Kettle, D. F. (2020). States Divided: The Implications of American Federalism for COVID-19. *Public Administration Review, 80(4)*, 595-602.

Khalid, U., Okafor, L. E., & Burzynska, K. (2021). Does the size of the tourism sector influence the economic policy response to the COVID-19 pandemic? *Current Issues in Tourism, 24(19)*, 2801-2820.

Kirsch, M., & Vitiello, D. (2022). The COVID-19 Pandemic Lowers Active Behavior of Patients with Cardiovascular Diseases, Healthy Peoples and Athletes. *International Journal of Environmental Research and Public Health, 19(3)*, 1-14.

Kniesner, T. J., & Viscusi, W. K. (2019). The Value of a Statistical Life. *Forthcoming, Oxford Research Encyclopedia of Economics and Finance, Vanderbilt Law Research Paper, 19(15)*, 1-45.

Kokolakakis, T., Lera-Lopez, F., & Ramchandani, G. (2021). Measuring the economic impact of COVID-19 on the UK's leisure and sport during the 2020 lockdown. *Sustainability, 13(13865)*, 1-15.

Kritsotakis, E. I. (2020). On the importance of population-based serological surveys of SARS-CoV-2 without overlooking their inherent uncertainties. *Public Health in Practice, 1(100013)*, 1-3.

Kucharski, A. J., Klepac, P., Conlan, A. J., Kissler, S. M., Tang, M. L., Fry, H., . . . Gibbs, H. P. (2020). Effectiveness of isolation, testing, contact tracing, and physical distancing on reducing transmission of SARS-CoV-2 in different settings: a mathematical modelling study. *The Lancet (Infectious Diseases), 20(10),* 1151-1160.

Lane, C. R., Sherry, N. L., Porter, A. F., Duchene, S., Horan, K., Andersson, P., . . . Howden, B. (2021). Genomics-informed responses in the elimination of COVID-19 in victoria, australia: An observational, genomic epidemiological study. *The Lancet. Public Health, 6(8),* 547-556.

LeBlanc, J. J., Gubbay, J. B., Li, Y. N., Arneson, S. R., Marcino, D., Charest, H., . . . McDonald, R. (2020). Real-time PCR-based SARS-CoV-2 detection in Canadian laboratories. *Journal of Clinical Virology, 128(2020),* 1-3.

Linas, B. P., Savinkina, A., Barbosa, C., Mueller, P. P., Cerdá, M., Keyes, K., & Chhatwal, J. (2021). A clash of epidemics: Impact of the COVID-19 pandemic response on opioid overdose. *Journal of Substance Abuse Treatment, 120(108158),* 1-2.

Ludwig, S., & Zarbock, A. (2020). Coronaviruses and SARS-CoV-2: A Brief Overview. *Anesthesia and Analgesia, 131(1),* 93-96.

Luo, W., Guo, W., Hu, S., Yang, M., Hu, X., & Xiong, C. (2021). Flatten the curve: Empirical evidence on how non-pharmaceutical interventions substituted pharmaceutical treatments during COVID-19 pandemic. *PloS One, 16(10),* 1-15.

Macrotrends. (2021). *Canada Life Expectancy 1950-2021*. Retrieved from Macrotrends: https://www.macrotrends.net/countries/CAN/canada/life-expectancy

Magness, P. H. (2021, April 22). *The Failure of Imperial College Modelling Is Far Worse than We Knew*. Retrieved from American Institute for Economic Research: https://www.aier.org/article/the-failure-of-imperial-college-modeling-is-far-worse-than-we-knew/

Maringe, C., Spicer, J., Morris, M., Purushotham, A., Nolte, E., Sullivan, R., . . . Aggarwal, A. (2020). The impact of the COVID-19 pandemic on cancer deaths due to delays in diagnosis in england, UK: A national, population-based, modelling study. *The Lancet Oncology, 21(8),* 1023-1034.

McCoy, L. G., Smith, J., Anchuri, K., Berry, I., Pineda, J., Harish, V., . . . Fine, B. (2020). CAN-NPI: A Curated Open Dataset of Canadian Non-Pharmaceutical Interventions in Response to the Global COVID-19 Pandemic. *medRxiv (preprint),* 1-21.

McCrary, J., & Sanga, S. (2021). The Impact of the Coronavirus Lockdown on Domestic Violence. *American Law and Economics Review, 23(1),* 137-163.

McIntyre, R. S., & Lee, Y. (2020). Projected increases in suicide in Canada as a consequence of COVID-19. *Psychiatry Research, 290(113104)*, 1-3.

Megarbane, B; Bourasset, F; Scherrmann, J. (2021). Is lockdown effective in limiting SARS-CoV-2 epidemic progression?—a cross-country comparative evaluation using epidemiokinetic tools. *Journal of General Internal Medicine, 36(3)*, 746-752.

Metcalf, C. J., Farrar, J., Cutts, F. T., Basta, N. E., Graham, A. L., Lessler, J., . . . Grenfell, B. R. (2016). Use of serological surveys to generate key insights into the changing global landscape of infectious disease. *The Lancet, 388(10045)*, 728-730.

Milne, G. J., & Xie, S. (2020). The effectiveness of social distancing in mitigating COVID-19 spread: a modelling analysis. *MedRxiv (preprint)*, 1-16.

Ministry of Mental Health and Addictions. (n.d.). *Wellbeing: COVID-19 Stress*. Retrieved from Ministry of Mental Health and Addictions: https://wellbeing.gov.bc.ca/mental-health/stress/covid-19-stress

Muhammad, D. G., & Abubakar, I. A. (2021). COVID-19 lockdown may increase cardiovascular disease risk factors. *The Egyptian Heart Journal, 73(1)*, 1-3.

Mulugeta, T., Tadesse, E., Shegute, T., & Desta, T. T. (2021). COVID-19: socio-economic impacts and challenges in the working group. *Heliyon, 7(6)*, 1-7.

Mutnal, M. B., Arroliga, A. C., Walker, K., Mohammad, A., Brigmon, M. M., Beaver, R. M., . . . Rao, A. (2020). Early trends for SARS-CoV-2 infection in central and north texas and impact on other circulating respiratory viruses. *Journal of Medical Virology, 92(10)*, 2130-2138.

National Center for Biotechnology Information. (2017, November 9). *Polymerase Chain Reaction (PCR)*. Retrieved from National Center for Biotechnology Information: https://www.ncbi.nlm.nih.gov/probe/docs/techpcr/

National Human Genome Research Institute. (2020, August 17). *Polymerase Chain Reaction (PCR) Fact Sheet*. Retrieved from National Institutes of Health: https://www.genome.gov/about-genomics/fact-sheets/Polymerase-Chain-Reaction-Fact-Sheet

Nicola, M., Sohrabi, C., Mathew, G., Kerwan, A., Al-Jabir, A., Griffin, M., . . . Agha, R. (2020). Health policy and leadership models during the COVID-19 pandemic: A review. *International Journal of Surgery, 81*, 122-129.

Nofal, A. M., Cacciotti, G., & Lee, N. (2020). Who complies with COVID-19 transmission mitigation behavioral guidelines? *PloS One, 15(10)*, 1-14.

O'Brien, K., St-Jean, M., Wood, P., Willbond, S., Phillips, O., Currie, D., & Turcotte, M. (2020). *COVID-19 death comorbidities in Canada* . Ottawa: Statistics Canada.

OECD. (2022, January). *Avoidable mortality: OECD/Eurostat lists of preventable and treatable causes of death (January 2022 version)*. Retrieved from OECD: https://www.oecd.org/health/health-systems/Avoidable-mortality-2019-Joint-OECD-Eurostat-List-preventable-treatable-causes-of-death.pdf

Oldenboom, E. R. (2005). *Costs and benefits of major sports events: A case study of Euro 2000.* Sheffield: Sheffield Hallam University.

Onder, G., Rezza, G., & Brusaferro, S. (2020). Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy. *The Journal of the American Medical Association, 323(18)*, 1775-1776.

Ontario Health. (2022, March 7). *How Ontario is responding to COVID-19*. Retrieved from Ontario Health: https://www.ontario.ca/page/how-ontario-is-responding-covid-19

Oruc, B. E., Baxter, A., Keskinocak, P., Asplund, J., & Serban, N. (2021). Homebound by COVID19: the benefits and consequences of non-pharmaceutical intervention strategies. *BMC Public Health, 21(655)*, 1-8.

Panchal, U., Salazar de Pablo, G., Franco, M., Moreno, C., Parellada, M., Arango, C., & Fusar-Poli, P. (2021). The impact of COVID-19 lockdown on child and adolescent mental health: systematic review. *European Child & Adolescent Psychiatry* , 1-27.

Park, S. W., Sun, K., Viboud, C., Grenfell, B. T., & Dushoff, J. (2020). Potential Role of Social Distancing in Mitigating Spread of Coronavirus Disease, South Korea. *Emerging infectious diseases, 26(11)*, 2697-2700.

Peçanha, T., Goessler, K. F., Roschel, H., & Gualano, B. (2020). Social isolation during the COVID-19 pandemic can increase physical inactivity and the global burden of cardiovascular disease. *American Journal of Physiology-Heart and Circulatory Physiology, 318*, 1441-1446.

Perez-Saez, J., Laver, S. A., Kaiser, L., Regard, S., Delaporte, E., Guessous, I., . . . Azman, A. S. (2020). Serology-informed estimates of SARS-CoV-2 infection fatality risk in Geneva, Switzerland. *The Lancet Infectious Diseases, 21(4)*, 69-70.

Pieh, C., Budimir, S., Delgadillo, J., Barkham, M., Fontaine, J. R., & Probst, T. (2021). Mental health during COVID-19 lockdown in the United Kingdom. *Psychosomatic medicine, 83(4)*, 328-337.

Piketty, J., Carbonnel, M., Murtada, R., Revaux, A., Asmar, J., Favre-Inhofer, A., & Ayoubi, J. (2022). Collateral damage of COVID-19 pandemic: The impact on a gynecologic surgery department. *Journal of Gynecology Obstetrics and Human Reproduction, 51(102255)*, 1-7.

Pollock, A. K., & Lancaster, J. (2020). Asymptomatic transmission of covid-19. *BMJ, 371(4851)*, 1-2.

Postill, G., Murray, R., Wilton, A., Wells, R., Sirbu, R., Daley, M., & Rosella, L. (2020). An analysis of mortality in Ontario using cremation data: Rise in cremations during the COVID-19 pandemic. *medRxiv preprint*, 1-15.

Provincial Health Officer. (2021, December 21). *'Everybody's going to be exposed': Dr. Bonnie Henry on COVID-19 in B.C.* Retrieved from YouTube: https://www.youtube.com/watch?v=_Vbhej9Pmdk

Provincial Health Officer. (2022, March 1). *COVID-19 Update for March 1, 2022*. Retrieved from YouTube: https://www.youtube.com/watch?v=HW3fr_bv-zU

Public Health Agency of Canada. (2017). Reducing premature mortality among young and middle-aged adults. *HPCDP, 37(3) Volume 37-3, March 2017*, 3. Retrieved from Government of Canada.

Public Health Agency of Canada. (2020, April 9). *COVID-19 in Canada: Using data and modelling to inform public health action*. Retrieved from Government of Canada: https://www.canada.ca/content/dam/phac-aspc/documents/services/diseases/2019-novel-coronavirus-infection/using-data-modelling-inform-eng.pdf

Public Health Agency of Canada. (2020). Modelling scenarios of the epidemic of COVID-19 in Canada. *Artificial intelligence in publich health, 46(6)*, 198-204.

Public Health Ontario. (2020, December 9). *COVID-19 Infection Fatality Rates Reported in Two Studies by Ioannidis et al.* Retrieved from Public Health Ontario: https://www.publichealthontario.ca/-/media/documents/ncov/research/2020/12/synopsis-ioannidis-studies-covid-19-infection-fatality-rates.pdf?la=en

Raymond, H. (2016). The Art of Nonverbal Communication in Practice. *The Hearing Journal, 69(5)*, 22-24.

Raymond, L., Daniel, K., & Hennes, E. (2021). Norm-Based Governance for a New Era: Collective Action in the Face of Hyper-Politicization [Manuscript Submitted for Publication]. *Preprint (Purdue University)*, 1-27.

Riemann, S., Speck, I., Gerstacker, K., Becker, C., & Knopf, A. (2021). Collateral damage of the COVID-19 pandemic: An alarming decline in critical procedures in otorhinolaryngology in a german university hospital. *European Archives of Oto-Rhino-Laryngology, 278(9),* 3417-3423.

Robertson, A., & Shaw, S. (2004). *Use of the Multiple Accounts Analysis Process for Sustainability Optimization.* Vancouver: Robertson Geoconsultants Inc.

Robinson, L. A., Sullivan, R., & Shogren, J. F. (2020). Do the Benefits of COVID-19 Policies Exceed the Costs? Exploring Uncertainties in the Age–VSL Relationship. *Risk Analysis, 41(5),* 761-770.

Rosenbaum, J., Lucas, N., Zandrow, G., Satz, W. A., Isenberg, D., D'Orazio, J., . . . Schreyer, K. E. (2021). Impact of a shelter-in-place order during the COVID-19 pandemic on the incidence of opioid overdoses. *The American Journal of Emergency Medicine, 41,* 51-54.

Roy, J., Jain, R., Golamari, R., Vunnam, R., & Sahu, N. (2020). COVID-19 in the geriatric population. *International Journal of Geriatric Psychiatry, 35(12),* 1437-1441.

Russell, T. W., Hellewell, J., Jarvis, C. I., van Zandvoort, K., Abbott, S., Ratnayake, R., . . . Kucharski, A. J. (2020). Estimating the infection and case fatality ratio for coronavirus disease (COVID-19) using age-adjusted data from the outbreak on the Diamond Princess cruise ship, February 2020. *Eurosurveillance, 25(12),* 1-5.

R. v. Oakes, 1986 CanLII 46 (SCC), [1986] 1 SCR 103

Ryu, S., Ali, S. T., Jang, C., Kim, B., & Cowling, B. J. (2020). Effect of Nonpharmaceutical Interventions on Transmission of Severe Acute Respiratory Syndrome Coronavirus 2, South Korea, 2020. *Emerging Infectious Diseases, 26(10),* 2406-2410.

Saiz, J., González-Sanguino, C., Ausín, B., Castellanos, M. Á., Abad, A., Salazar, M., & Muñoz, M. (2021). The Role of the Sense of Belonging During the Alarm Situation and Return to the New Normality of the 2020 Coronavirus Pandemic (COVID-19) in Spain. *Psychological Studies, 66(3),* 326-336.

Sakarneh, M. A. (2021). The impact of COVID-19 and lockdown on families of students with special education needs. *Cypriot Journal of Educational Sciences, 16(3),* 1010-1020.

Segarra-Blasco, A., Teruel, M., & Cattaruzzo, S. (2021). The economic reaction to non-pharmaceutical interventions during Covid-19. *Economic Analysis and Policy, 72,* 592-608.

Shaffer, M. (2010). *Multiple Account Benefit-Cost Analysis: A Practical Guide for the Systematic Evaluation of Project and Policy Alternatives.* Toronto: University of Toronto Press, Scholarly Publishing Division.

Shuja, K. H., Aqeel, S. M., Khan, E. A., & Abbas, J. (2020). Letter to highlight the effects of isolation on elderly during COVID-19 outbreak. *International Journal of Geriatric Psychiatry, 35(12)*, 1477-1478.

Simandan, D., Rinner, C., & Capurri, V. (2022). Confronting the rise of authoritarianism during the COVID-19 pandemic should be a priority for critical geographers and social scientists. *ACME: An International Journal for Critical Geographies*, 1-31.

Simon Fraser University. (2013). *What Is Mathematical Modeling?* Retrieved from Simon Fraser University: https://www.sfu.ca/~vdabbagh/Chap1-modeling.pdf

Simon Fraser University. (n.d.). *Faculty and Associates*. Retrieved from Simon Fraser University: School of Public Policy: https://www.sfu.ca/mpp/faculty-associates/marvin-shaffer.html

Sjödin, H., Wilder-Smith, A., Osman, S., Farooq, Z., & Rocklöv, J. (2020). Only strict quarantine measures can curb the coronavirus disease (COVID-19) outbreak in Italy, 2020. *Euro Surveillance: European Communicable Disease Bulletin, 25(13)*, 1-6.

Skar, G. B., Graham, S., & Huebner, A. (2021). Learning Loss During the COVID-19 Pandemic and the Impact of Emergency Remote Instruction on First Grade Students' Writing: A Natrual Experiment. *Journal of Educational Psychology*, 1-15.

Spiegel, M., & Tookes, H. (2021). Article Navigation. *The Review of Financial Studies, 24(11)*, 5266-5308.

Sport England. (2020). *Active Lives Adult Survey May 2019-20 Report.* London: Sport England.

Stanford University. (n.d.). *Profiles: John P.A. Ioannidis*. Retrieved from Stanford University : https://profiles.stanford.edu/john-ioannidis

Statistics Canada. (2017, May 3). *Dictionary, Census of Population, 2016: Unemployed*. Retrieved from Statistics Canada: https://www12.statcan.gc.ca/census-recensement/2016/ref/dict/pop124-eng.cfm

Statistics Canada. (2018, April 18). *Health Reports: Health-adjusted life expectancy in Canada*. Retrieved from Statistics Canada: https://www150.statcan.gc.ca/n1/pub/82-003-x/2018004/article/54950-eng.htm

Statistics Canada. (2019, May 30). *Life expectancy, at birth and at age 65, by sex, three-year average, Canada, provinces, territories, health regions and peer groups*. Retrieved from Statistics Canada: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310038901

Statistics Canada. (2019b, September 5). *Premature and potentially avoidable mortality, Canada, provinces and territories*. Retrieved from Statistics Canada: https://open.canada.ca/data/en/dataset/91c3412c-f835-454a-8966-00f3830d31c9

Statistics Canada. (2020, November 16). *COVID-19 death comorbidities in Canada*. Retrieved from Statistics Canada: https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00087-eng.htm

Statistics Canada. (2021, February 16). *Canada Emergency Response Benefit and EI statistics*. Retrieved from Statistics Canada: https://www.canada.ca/en/services/benefits/ei/claims-report.html

Statistics Canada. (2021, June 1). *Reductions in life expectancy directly associated with COVID-19 in 2020*. Retrieved from Statistics Canada: https://www150.statcan.gc.ca/n1/pub/91f0015m/91f0015m2021002-eng.htm

Statistics Canada. (2022, March 30). *Provisional deaths and excess mortality in Canada dashboard*. Retrieved from Statistics Canada: https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021028-eng.htm

Statistics Canada. (2022, January 7). *Unemployment rate, participation rate and employment rate by educational attainment, annual*. Retrieved from Statistics Canada: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410002001&pickMembers%5B0%5D=1.11&pickMembers%5B1%5D=2.8&pickMembers%5B2%5D=4.1&pickMembers%5B3%5D=5.1&cubeTimeFrame.startYear=2016&cubeTimeFrame.endYear=2021&referencePeriods=20160101%2C20210101

Stijelja, S., & Mishara, B. (2020). COVID-19 and Psychological Distress-Changes in Internet Searches for Mental Health Issues in New York During the Pandemic. *JAMA Intern Med, 180(12)*, 1703-1706.

Stringhini, S., Wisniak, A., Piumatti, G., Azman, A. S., Lauer, S. A., Baysson, H., . . . Eckerle, I. (2020). Seroprevalence of anti-SARS-CoV-2 IgG antibodies in Geneva, Switzerland (SEROCoV-POP): a population-based study. *The Lancet, 396(10247)*, 313-319.

Sud, A., Jones, M. E., Broggio, J., Loveday, C., Torr, B., Garrett, A., . . . Lyratzopoulos, G. (2020). Collateral damage: The impact on outcomes from cancer surgery of the COVID-19 pandemic. *Annals of Oncology, 31(8)*, 1065-1074.

Tanaka, T., & Okamoto, S. (2021). Increase in suicide following an initial decline during the COVID-19 pandemic in Japan. *Nature human behaviour, 5*, 229-238.

The World Bank. (2017-2019). *DataBank - World Development Indicators (Hospital beds (per 1,000 people))*. Retrieved from The World Bank: https://databank.worldbank.org/reports.aspx?source=2&series=SH.MED.BEDS.ZS&country=

The World Bank. (n.d.). *Hospital beds (per 1,000 people)*. Retrieved from The World Bank.

Thomson, S., & Ip, E. C. (2020). COVID-19 emergency measures and the impending authoritarian pandemic. *Journal of Law and the Biosciences, 7(1)*, 1-33.

Thu, T. P., Ngoc, P. N., Hai, N. M., & Tuan, L. A. (2020). Effect of the social distancing measures on the spread of COVID-19 in 10 highly infected countries. *Science of the Total Environment, 742(140430)*, 1-7.

Trading Economics. (2022, February). *Canada Unemployment Rate*. Retrieved from Trading Economics: https://tradingeconomics.com/canada/unemployment-rate#:~:text=In%20Canada%2C%20the%20unemployment%20rate%20measures%20the%20number,job%20as%20a%20percentage%20of%20the%20labour%20force.

Treasury Board of Canada Secretariat. (2022, March 29). *Policy on Cost-Benefit Analysis*. Retrieved from Government of Canada: https://www.canada.ca/en/government/system/laws/developing-improving-federal-regulations/requirements-developing-managing-reviewing-regulations/guidelines-tools/policy-cost-benefit-analysis.html

Turcotte-Tremblay, A.-M. G., & Ridde, V. (2021). The unintended consequences of COVID-19 mitigation measures matter: practical guidance for investigating them. *BMC Medical Research Methodology, 21(28)*, 1-17.

UK House of Commons. (2021). *Coronavirus: lessons learned to date. Sixth REport of the Health and Social Care Committee and Third Report of the Science and Technology Committee of Session 2021-22.* London: UK House of Commons.

UK Office for National Statistics. (2021, January 11). *Average age of those who had died with COVID-19*. Retrieved from UK Office for National Statistics: https://www.ons.gov.uk/aboutus/transparencyandgovernance/freedomofinformationfoi/averageageofthosewhohaddiedwithcovid19

UK Office for National Statistics. (2021, September 23). *National life tables - life expectancy in the UK: 2018 to 2020*. Retrieved from UK Office for National Statistics: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/bulletins/nationallifetablesunitedkingdom/2018to2020

Ullrich, A., Schranz, M., Rexroth, U., Hamouda, O., Schaade, L., Diercke, M., & Boender, T. S. (2021). Impact of the COVID-19 pandemic and associated non-pharmaceutical interventions on other notifiable infectious diseases in germany: An analysis of national surveillance data during week 1–2016 – week 32–2020. *The Lancet Regional Health - Europe, 6(100103)*, 1-9.

United Nations. (2020). *COVID-19 and maritime transport: Impact and responses.* Geneva: United Nations Conference on Trade and Development (UNCTAD).

United Nations. (2021). *Key Statistics and Trends in International Trade 2020.* Geneva: United Nations Conference on Trade and Development (UNCTAD).

US CDC. (2020, February 15). *Human Coronavirus Types*. Retrieved from US CDC: https://www.cdc.gov/coronavirus/types.html

US CDC. (2020). Impact of the COVID-19 Pandemic on Emergency Department Visits - United States, January 1, 2019-May 30, 2020. *Morbidity and Mortality Weekly Report, 69(23)*, 699-704.

US CDC. (2020). Mental Health, Substance Use, and Suicidal Ideation During the COVID-19 Pandemic - United States, June 24-30, 2020. *Morbidity and Mortality Weekly Report, 69(32)*, 1049-1057.

US CDC. (2020). Mental Health-Related Emergency Department Visits Among Children Aged <18 Years During the COVID-19 Pandemic - United States, January 1-October 17, 2020. *Morbidity and Mortality Weekly Report, 69(45)*, 1675-1680.

US CDC. (2020, April 27). *Nonpharmaceutical Interventions (NPIs)*. Retrieved from US CDC: https://www.cdc.gov/nonpharmaceutical-interventions/index.html

US CDC. (2021, March 19). *COVID-19 Pandemic Planning Scenarios*. Retrieved from US CDC: https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html

Vahia, I. V., Jeste, D. V., & Reynolds III, C. F. (2020). Older Adults and the Mental Health Effects of COVID-19. *JAMA, 324(22)*, 2253-2254.

van den Berg, P., Schechter-Perkins, E. M., Jack, R. S., Epshtein, I., Nelson, R., Oster, E., & Branch-Elliman, W. (2021). Effectiveness of three versus six feet of physical distancing for controlling spread of COVID-19 among primary and secondary students and staff: A retrospective, state-wide cohort study. *Clinical Infectious Diseases,* 1-25.

Verschuur, J., Koks, E. E., & Hall, J. W. (2021). Global economic impacts of COVID-19 lockdown measures stand out in high-frequency shipping data. *PloS one, 16(4)*, 1-16.

Walia, A. (2022, January 5). *Ontario (Canada) Admits 50% of "COVID" Hospitalizations Not From COVID, Death Count May Also Be Misleading*. Retrieved from The Pulse: 2022

Wang, Y., Shi, L., Que, J., Lu, Q., Liu, L., Lu, Z., . . . Shi, J. (2021). The impact of quarantine on mental health status among general population in China during the COVID-19 pandemic. *Molecular psychiatry, 26*, 4813-4822.

Wang, Y., Wang, Y., Chen, Y., & Qin, Q. (2020). Unique epidemiological and clinical features of the emerging 2019 novel coronavirus pneumonia (COVID-19) implicate special control measures. *Journal of Medical Virology, 92(6)*, 568-576.

Weichel, A. (2022, April 5). *COVID-19 death 'over-counting' expected as B.C. switches reporting systems*. Retrieved from CTV News: https://bc.ctvnews.ca/covid-19-death-over-counting-expected-as-b-c-switches-reporting-systems-1.5849813

Wilkinson, E. (2022). COVID-19 pandemic to lead to thousands of additional UK lung cancer deaths. *The Lancet Oncology, 23(1)*, 1.

Winter, J., Bailey, M., Galley, E., Joseph, C., & Shaffer, B. (2021). *A Multiple Account Benefit-Cost Analysis of Coal Mining in Alberta.* Calgary: University of Calgary: The School of Public Policy Publications.

Wiseman, S. M., Crump, R. T., & Sutherland, J. M. (2020). Surgical wait list management in canada during a pandemic: Many challenges ahead. *Canadian Journal of Surgery, 63(3)*, 226-228.

Woolf, S. H., Chapman, D. A., Sabo, R. T., Weinberger, D. M., Hill, L., & Taylor, D. D. (2020). Excess deaths from COVID-19 and other causes, March-July 2020. *The Journal of the American Medical Association, 324(15)*, 1562-1564.

World Atlas. (2020, March 30). *Countries With The Most Hospital Beds Per Capita*. Retrieved from World Atlas: https://www.worldatlas.com/articles/countries-with-the-most-hospital-beds-per-capita.html

World Doctors Alliance. (2020, June 25). *Open Letter to all the Citizens of the World and All the Governments of the World*. Retrieved from World Doctors Alliance: https://worlddoctorsalliance.com/

World Health Organization. (2020, November 2020). *A look inside laboratories responding to COVID-19*. Retrieved from World Health Organization: https://www.who.int/news-room/feature-stories/detail/a-look-inside-laboratories-responding-to-covid-19

World Health Organization. (2020, August 4). *Estimating mortality from COVID-19*. Retrieved from World Health Organization: https://www.who.int/news-room/commentaries/detail/estimating-mortality-from-covid-19

World Health Organization. (2020, April 20). *International Guidelines for Certification and Classification (Coding) of COVID-19 as Cause of Death*. Retrieved from World Health Organization: https://cdn.who.int/media/docs/default-source/classification/icd/covid-19/guidelines-cause-of-death-covid-19-20200420-en.pdf?sfvrsn=35fdd864_2

World Health Organization. (2020, December 14). *WHO Information Notice for IVD Users: Nucleic acid testing (NAT) technologies that use real-time polymerase chain reaction (RT-PCR) for detection of SARS-CoV-2*. Retrieved from World Health Organization: https://web.archive.org/web/20210120083427/https:/www.who.int/news/item/14-12-2020-who-information-notice-for-ivd-users

World Health Organization. (2021). *WHO-convened Global Study of Origins of SARS-CoV-2: China Part - Joint WHO-China Study Team report.* Geneva: World Health Organization.

World Health Organization. (2021b). *Considerations for implementing and adjusting public health and social measures in the context of COVID-19.* Geneva: World Health Organization.

World Health Organization. (n.d.). *Coronavirus disease (COVID-19)*. Retrieved from World Health Organization: https://www.who.int/health-topics/coronavirus#tab=tab_1

World Health Organization. (n.d.). *Hospital beds (per 10 000 population)*. Retrieved from World Health Organization: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/hospital-beds-(per-10-000-population)

Worldometer. (2021, December 5). *Australia*. Retrieved from Worldometer: https://www.worldometers.info/coronavirus/country/australia/

Worldometer. (2022, January 1). *Sweden*. Retrieved from Worldometer: https://www.worldometers.info/coronavirus/country/sweden/

Wu, Z., & McGoogan, J. M. (2020). 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. *Journal of the American Medical Association, 323(13)*, 1239-1242.

Yan, B., Zhang, X., Wu, L., Zhu, H., & Chen, B. (2020). Why Do Countries Respond Differently to COVID-19? A Comparative Study of Sweden, China, France, and Japan. *The American Review of Public Administration, 50(6-7)*, 762-769.

Ye, Z.-W., Yuan, S., Yuen, K.-S., Fung, S.-Y., Chan, C.-P., & Jin, D.-Y. (2020). Zoonotic origins of human coronaviruses. *International Journal of Biological Science, 16(10)*, 1686-1697.

Zhou, Z., Jiao, B., Lu, P., Tan, X., Wang, D., Xu, X., . . . Wang, S. (2021). Collateral Damage or Benefit? The Impacts of COVID-19 Induced Lockdown and Mandatory Screening Policy on Lung Surgery: Evidence from Wuhan. *Huazhong University of Science and Technology, Wuhan, Hubei, China (Preprint)*, 1-34.

Zweig, S., Zapf, A. J., Beyrer, C., Guha-Sapir, D., & Haar, R. J. (2021). Ensuring Rights while Protecting Health: The Importance of Using a Human Rights Approach in Implementing Public Health Responses to COVID-19. *Health and Human Rights, 23(2)*, 173-86.