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CONNAISSANCES SCIENTIFIQUES - COVID-19

## **COMMENTARY**

### Covid-19 mitigation strategies and considerations

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## Executive summary

Canada and the world are at a critical stage with the Covid-19 pandemic. As the situation evolves, there is a need for a clear set of considerations and principles to inform decision-making. The mitigation strategies and considerations presented in this commentary aim to inform discussions around a balance between controlling the virus (and its negative health consequences) and reducing the economic implications of the pandemic.

As governments are planning for the gradual return to usual activities, approaches should be based on a clear set of goals and objectives. *Control*, or mitigation, of the effects of Covid-19 is the presently achievable goal (vs. eradication or elimination) given that Covid-19 is likely to become an endemic disease – one which continues to circulate indefinitely. As per lessons from previous pandemic situations, government decision-making should be guided by principles that include collaboration, evidence-informed decision-making, proportionality, and flexibility, to minimize serious illness and overall deaths, and to minimize societal disruption resulting from the pandemic. Furthermore, attention to frameworks for ethical decision-making and equity considerations are critical in planning and implementation of interventions.

Canada has now greatly accelerated its pace of vaccination, although risks remain with respect to supply chains, uptake and emerging variants of concern. While achieving high levels of vaccine coverage is essential, the focus for those leading the pandemic response strategy must remain on the control of transmission of disease and on decision-making about reopening that is based on disease transmission metrics, rather than arbitrary levels of vaccination or fixed dates.

Canada is making progress with its immunization program, but the variants have contributed to a large third wave in many parts of the country. Measured approaches are necessary to control this wave and to avert future waves. It is important to find ways to maintain public confidence to ensure support for the necessary public health measures to control the spread of disease, maximize confidence in the vaccines, and achieve maximal uptake. Clear, consistent, coordinated, and timely communications are critical in achieving these aims.

To conclude, as national governments are planning a path forward, clear and timely guidance is required not only for the provinces and territories, but also to provide Canadians with ‘hope’ that we will gradually return to some level of normalcy. There are several areas for which clear national guidance could be of value:

1. A risk-based framework to guide reopening of services based on local epidemiology and vaccine coverage. The framework should focus on disease transmission, and public health and health system capacity indicators to guide reopening rather than simply measures of vaccination coverage or fixed dates.
2. Recommendations on the appropriate use of documentation, i.e. certification of vaccination, and whether proof of vaccination should be mandatory in some settings.
3. A border strategy that combines testing and quarantine of appropriate duration based on risk to ensure protection from the importation of virus variants while still facilitating travel.
4. Assessment of key learnings from behavioural science disciplines to support messaging and communications to ensure public acceptance of public health measures when necessary and when vaccines are offered.

## Introduction

The unparalleled Covid-19 pandemic continues to create health, psychosocial, and economic burdens in Canada and worldwide. Covid-19 struck at a time of significant global connectedness and availability of advanced research and technology. While experience from past pandemics provided some guidance for actions, the scientific evidence in these instances was different and less helpful as a basis for many of the decisions to be made in the current context given that SARS-CoV-2 is a new virus. Unsurprisingly, since governments around the world responded to urgent challenges amidst uncertain and shifting evidence, the responses have been inconsistent and have evolved as new findings emerge. This is magnified in Canada given the distribution of constitutional powers between the federal and provincial/territorial governments. As a result, the variable and constant changes over time have led to public confusion, fatigue, frustration, and concern. These challenges are further augmented by the continued evolution of the virus and the identification of variants of concern, some of which are more transmissible, have a higher mortality rate, and threaten vaccine escape.

It is remarkable (and a testament to an outpouring of global collaborative scientific effort) that less than a year after Covid-19 was declared a global pandemic, vaccines have been developed, tested, vetted, and distributed in record time. But, given that there has been no previous experience with the use of vaccines for coronavirus' and they are using new platforms for delivery, significant uncertainties remain. To date, Health Canada has authorized four (or technically five) vaccines: Moderna, Pfizer-BioNTech, AstraZeneca (and a Serum Institute of India version), and Janssen (1). These authorized vaccines all follow a two-dose schedule except for Janssen. All Canadians who wish to get vaccinated can do so in a tiered and orderly fashion determined by the provinces and territories, starting with priority groups based on recommendations from the National Advisory Committee on Immunization (NACI). Given the significant differences in population characteristics and disease epidemiology across the country, the sequencing of priority groups has not been the same across Canadian jurisdictions – leading to some degree of perceived inconsistency and resulting public confusion. Canada has also faced challenges with securing adequate supply of vaccines given limited domestic biomanufacturing capacity. Not unexpected, vaccine hesitancy is a significant concern, and the identification of safety signals with the AstraZeneca and Janssen vaccines has magnified attention on this issue.

At the time of writing, vaccine rollout, supply, and distribution ramp-up is underway and decision-makers are starting to consider the appropriate path forward to ease current public health restrictions while minimizing the risk of subsequent resurgence of the virus. This is particularly important as Canada pursues a *first-dose-fast* strategy with extended dose intervals given that there is a short supply in order to meet the goal of vaccinating as many people as quickly as possible. As a result, there will be an extended period with most of the population partially vaccinated and awaiting their second dose.

The purpose of this commentary is to provide key considerations for a pathway to easing public health restrictions safely, mitigating the negative consequences of Covid-19, and a return to some normalcy. These considerations are based on existing frameworks from other jurisdictions, previous knowledge around infectious disease principles, and the current state of the evidence and pandemic situation. As the situation evolves in Canada and abroad, it is important to note that the uncertainties may also evolve, reinforcing the need for a clear set of considerations and principles to inform decision-making. There continues to be a focus on levels of vaccination needed to achieve herd immunity, with the expectation that things will go back to 'normal' at that point. This may be an elusive goal given the proportion of the population that may choose not to be vaccinated, the global situation and the emergence of variants. It is essential that the focus remain on control of transmission of disease, with vaccination as one of the many tools available for that purpose, and that decisions about reopening be based on disease transmission metrics, rather than arbitrary levels of vaccination or fixed dates.

## The importance of setting objectives

As governments are planning for the gradual return to usual activities, approaches should be based on a clear set of goals and objectives. This commentary highlights key principles, tools, considerations, and current uncertainties that relate to optimizing the application of public health measures.

### Eradication, elimination, or mitigation: goals for infectious disease control

There are three broad potential goals for infectious disease control: eradication, elimination, or mitigation/control. *Eradication* refers to new cases of an infectious agent being prevented globally. To date, this has only been achieved for smallpox and rinderpest (although virus samples do remain in a few restricted laboratory environments) (2). Eradication strategies entail identification of technically feasible interventions that are tested and considered effective (2). *Elimination* is the control of the agent with no new cases in a specific region of the world. This has been achieved for several infectious diseases such as polio and measles. SARS-CoV-2 elimination, not mitigation, creates the best outcomes for health, the economy, and restoring civil liberties the soonest, given stricter but shorter lockdown measures (3). While elimination of SARS-CoV2 has been a strategy adopted by some countries (e.g., New Zealand, Australia, Iceland, Japan, and South Korea) and regions (e.g., Canada's Atlantic provinces), it is too early to tell whether this has been achieved, given that twenty-four months disease free in a region is generally accepted as a minimum standard to achieve elimination (2). The SARS-CoV2 virus has an animal reservoir and is spreading in humans in many regions of the world. Therefore, while eradication or elimination may be worthy aspirational goals, achievement of either goal is unlikely to be feasible.

*Control*, or mitigation, of the effects of Covid-19 is the presently achievable goal as we are faced with Covid-19 likely becoming an endemic disease – one which continues to circulate indefinitely. To date, control has relied primarily on public health measures and treatment of disease; the arrival of vaccines provides a powerful additional control mechanism to prevent the disease, and to reduce its severity. The continued development of therapeutics and effective management of longer-term sequelae will be another important tool to minimize the effects of disease in those who are infected, and potentially as a preventive tool for chemoprophylaxis. In the past, infectious diseases that have become endemic have been effectively mitigated through combinations of public health measures, preventive agents, and treatments.

However, at this time, the control strategies, which mitigate the person-to-person transmission (e.g., as measured by case incidence) and impact of Covid-19 disease have been largely non-pharmaceutical. These include, but are not limited to, closure of nonessential business, mask wearing, physical distancing, restrictions on social/large gatherings, stay-at-home orders, travel advisories and restrictions, contact tracing, testing, support, and quarantine policies. These strategies have a continuum from relatively strict (as in many parts of Canada and Europe), to much looser (as in many parts of the United States of America – or US). The degree of control measures imposed is driven by the level of risk tolerance within a jurisdiction, and the balance placed between minimizing the direct health consequences of the disease, and the degree of societal and economic disruption that might be tolerated. With the knowledge that has been accumulated over the past year, it is possible to focus public health measures more specifically on settings and populations that have the greatest risk of disease. For example, targeted closures of businesses experiencing outbreaks as opposed to blanket lockdowns can be considered. There is also greater knowledge to apply in essential workplaces which cannot be closed, such as appropriate use of personal protective equipment, ventilation, physical distancing, and appropriate supports for those that get Covid-19 or are exposed to cases (e.g., isolation facilities, paid sick days). Such focused approaches to controlling spread of disease require significant support for core public health activities such as testing and contact tracing. However, there is also a complex interplay between science, politics, and the development of policy in light of completing objectives that impact the degree of control measures.

Currently, there is much debate on the potential use of proof of vaccination, for example, vaccine certificates, as another tool to ease restrictions, including for international travel. For example, the International Air Transport Association (IATA) is developing a travel pass. [The IATA Travel Pass](#) is a mobile application for travelers to store and manage certifications for Covid-19 tests or vaccines. Such a tool has significant ethical, privacy, logistic and equity considerations which need to be quickly examined before they are broadly deployed. There is also an urgent need to consider whether proof of vaccination will be required in settings such as health care facilities, schools, or post-secondary institutions.

Key outcomes

The key outcomes that have been considered nationally, tracked, and measured to varying degrees have been Covid-19 outcomes, broader health outcomes, and social and economic outcomes (table 1). In addition to direct impacts of Covid-19 on morbidity/mortality and health care capacity, the impact of public health measures on non-Covid health consequences should be considered. This includes assessing the impact on mental health, other chronic and acute health conditions (such as delays in routine and urgent care drug and alcohol use, child welfare and development, family violence, and interruption of other vaccine and drug delivery). These are also known as collateral outcomes and unintended consequences related to the overall response to the Covid-19 pandemic. The overall strength of our society and economy must also be monitored. Stricter control measures can have more dramatic consequences for society (e.g., the impact of school closures on children as well as their parents/guardians who are either working/not working and home schooling). Stricter control measures will also rely on greater financial supports such as wage subsidies. Therefore, the ability to continue to maintain such interventions is necessary for such measures.

Table 1: Key outcomes and indicators

Outcome	Example indicators
COVID-19: morbidity and mortality; health care capacity and utilization	<ul style="list-style-type: none"> <li>• Number of cases and deaths from Covid-19.</li> <li>• Excess deaths due to Covid.</li> <li>• Number of hospitalizations.</li> <li>• Long-term consequences from Covid-19.</li> <li>• Potentially avoidable mortality and potential years of life lost (4).</li> <li>• Proportion of ICU beds occupied (4).</li> <li>• Proportion of medical ventilators used (4).</li> <li>• Total number of emergency room visits (4).</li> <li>• Proportion of hospital beds occupied by Covid-19 patients (4).</li> </ul>
Examples of non-Covid health consequences	<ul style="list-style-type: none"> <li>• Suicide and overdose rates.</li> <li>• Perceived mental health (5).</li> <li>• Mental health illness hospitalization rate (5).</li> <li>• Cancelled or delayed medical, surgical, routine, and preventative care interventions.</li> <li>• Drug, alcohol use and drug overdoses.</li> <li>• Changes in health behaviours (e.g., sleep, physical activity, nutrition).</li> <li>• Family and domestic violence.</li> <li>• Reduced access to health and social services.</li> </ul>
Social and economic impacts	<ul style="list-style-type: none"> <li>• Unemployment rates (5).</li> <li>• Housing affordability (5).</li> <li>• Low-income rates (5).</li> <li>• High school and post-secondary graduates (5).</li> <li>• Delay in new health care professionals due to delayed training.</li> </ul>

	<ul style="list-style-type: none"> <li>• Child development and learning.</li> <li>• Consumer sales.</li> <li>• Imports and exports of goods.</li> </ul>
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### **Textbox:** Covid-19 epidemiology indicators

It is desirable to have a clear, consistent set of indicators and metrics for monitoring the impact of control measures and as thresholds for action at municipal, provincial and federal levels. Even with the deployment of vaccines, the key consideration for decision-making will be indicators of disease spread and public health and health system capacity.

#### **Epidemiology indicators**

- *Case counts and case rates* (speed and direction). This includes the degree of community spread, the presence of variants of concern among positive cases, and whether most new cases can be traced to previously confirmed cases. As a greater proportion of the population is vaccinated case counts on their own may be a less meaningful indicator of status of the outbreak than hospitalization or mortality indicators.
- *Reproductive number ( $R_0$ )*.
- *Number of tests and test positivity*.
- *Access to rapid testing and contact tracing*.
- *Percent of confirmed (genomic sequencing) cases and type of variants of concern*.
- *Vaccine breakthrough cases* (percent in relation to fully vaccinated individuals).
- *Hospitalization and ICU/ventilator capacity*.
- *Number of deaths*.
- *Vaccination rates, single and two doses (as applicable)*.

### Examples of strategic approaches

#### *Strict approaches*

The 'Canadian Shield' approach, designed by the COVID Strategic Choices Group, is an example of a strategy to strictly control Covid-19. It is intended to protect Canadians and the economy from the consequences of Covid-19 through a near-zero Covid plan that aims at zero community transmission similar to strategies successfully used for many months in Atlantic and Northern Canada (6). There are three key actions for building this shield (6):

- "Sustain an effective lockdown until Covid cases are low enough that testing, tracing and isolation can work effectively".
- "Relax restrictions only to the extent that new Covid cases continue a steady decline of 17% -25% per week. In the fight against Covid, if you are not winning (i.e., new cases are not going steadily down) you are losing. Any new increases will likely lead to a 3rd set of lockdowns in the spring".
- "Proactively assist the individuals, businesses and communities most affected by these policies".

#### *Less strict approaches*

Harvard Global Health Institute's framework for policy makers and the public was an example of a less strict control framework that balances societal reopening with Covid-19 control measures (6). It recommends that jurisdictions make a choice between mitigation or suppression – an effort to get to zero or near zero case incidence. To get to the latter, the framework indicates that there will need to be: 1)

resources for testing, tracing, and supporting isolation; 2) protecting the vulnerable; and 3) treating the ill. The authors recommended key metrics with thresholds for different levels of action and reopening of services at different levels of disease transmission (7). To restore the economy without subsequent lockdowns, it was recommended to choose the suppression strategy. Although this framework was released in mid-2020, and is centered around the first wave, such a framework could be tailored to the current Covid-19 situation. The colour-coded levels of reopening put forward by several Canadian jurisdictions are variations of such approaches. However, these approaches are challenging to maintain unless there is good quality and timely data to inform appropriate and urgent action when required.

Throughout the pandemic, the *timing of implementation* for particular measures and approaches has been critical. This has been demonstrated through experience of European countries – those that implemented stringent policies by spring 2020, tended to report fewer deaths due to Covid-19 by June 2020 (8). The earlier control policies are implemented, the less strain there seems to be on the health care systems with some evidence of quicker economic recovery as observed in several Asian countries, Australia, and New Zealand.

## Principles

The 2018 Canadian Pandemic Influenza Plan provides a set of principles (listed below) to guide decision-making including collaboration, evidence-informed decision-making, proportionality, and flexibility. The overall purpose of this guidance is twofold: to minimize serious illness and overall deaths, and to minimize societal disruption resulting from the pandemic (9).

- *Collaboration.* All levels of government and health care stakeholders need to work in partnership to produce an effective and coordinated response.
- *Evidence-informed decision-making.* Decisions should be based on the latest and best available evidence to the extent possible and adjust as the science evolves. Other factors can also enter into decision-making, such as legal and institutional constraints, values, costs, and availability of resources.
- *Proportionality.* The response to a pandemic should be appropriate to the level of the threat.
- *Flexibility.* Actions taken should be tailored to the situation and subject to change as new information becomes available. The pan-Canadian approach should be consistent, although patterns of spread may mean that regional and local jurisdictions will require flexibility in terms of the scale and timing of their response.

In addition to these main guiding principles, the 2018 plan for Canadian pandemic planning and response activities are also guided by:

- *A precautionary approach.* This approach is particularly applicable in the early stages of a pandemic when evidence-informed decision-making is not possible due to lack of data and the uncertainty of an evolving event. This means taking timely and reasonable preventive action, proportional to the threat and its health consequences and evidence-informed to the extent possible (9).
- *The use of established practices and systems to the extent possible.* Avoid trying to implement new ways to do things during an emergency (9).
- *Ethical decision-making.* Ethical principles and societal values should be explicit and embedded in all decision-making, including the processes used to reach decisions. The plan notes that good decision-making processes include:
  - openness and transparency – the process is open for scrutiny, and information about the basis for decisions and when, and by whom, they were made is publicly accessible;
  - accountability – being answerable for decisions;

- inclusiveness – stakeholders are consulted, and views, and any disproportionate impact on particular groups, are considered; and
- reasonableness – decisions should not be arbitrary but rather be rational, proportional to the threat, evidence-informed, and practical (9).

The Plan did not consider equity directly, although it is implicit in the ethical principles. The experience of the past year has demonstrated that certain populations are disproportionately affected by Covid-19 and the public health measures. Equity considerations are critical, particularly with the vaccine roll-out.

## Key considerations

Figure 1 illustrates the pressures that will continue to drive cases up or down. We discuss several of these in turn.

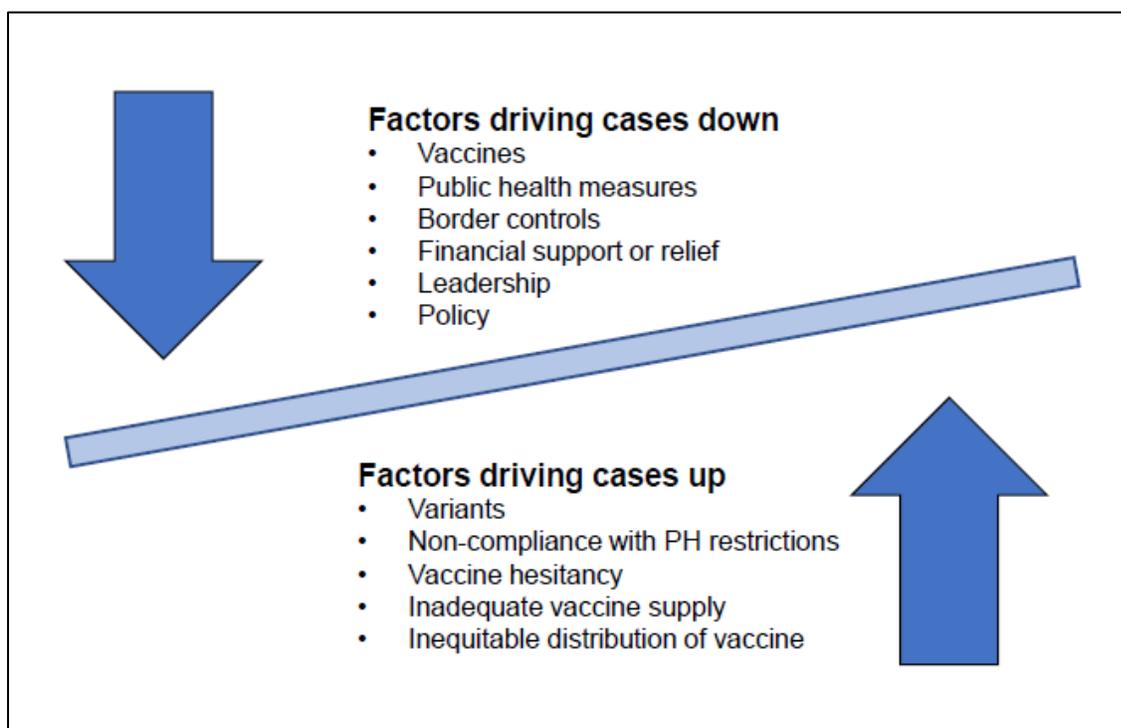


Figure 1: Pressures driving Covid-19 cases up or down.

### Immunization impact.

Immunization program milestones can be used to help guide reopening strategies. The NACI guidance outlines Canadian priority populations for immunization. As jurisdictions complete each vaccination stage, relaxation of restrictions could be considered if Covid-19 cases are adequately controlled. Recently, the Public Health Agency of Canada's modeling suggested if we can get to a higher number of Canadians (target number being 75%) getting their first dose by mid-June, we may see some loosening of public health restrictions this summer. While we can hope Canadian adults who wish to get vaccinated will have access to the vaccine by the end of summer of 2021, this may come with challenges. It is important to note that a global program will likely take several years, and current projections suggest that booster shots or shots tailored to new variants may need to be required. Accordingly, some measures, such as those related to travel, will likely need to be in place for some time to come.

It is also unclear when children will be vaccinated, but there is hope that teenagers may be vaccinated by fall 2021. Recently, Pfizer BioNTech (or Pfizer) SE have started recruiting children less than 12 years old into a Phase 1/2/3 vaccine trail (10). In its March 31st media release, Pfizer announced positive results for Covid-19 vaccine in adolescents between the ages of 12 to 15 years (11) and Health Canada has approved its use in this age group. Moderna has commenced their Phase 2/3 trail of their mRNA Covid-19 vaccine candidate in adolescents ages 12 to less than 18 years (12). Parental hesitancy to vaccinate their children is affected by experiences, emotions, ways of thinking, informational sources, peers/family, risk perceptions, and trust. If there is vaccine hesitancy among parents, and they choose not to get vaccinated, it is likely that they will also choose not to vaccinate their children. Communication strategies to curb parental hesitancy, and other hesitant subgroups should be considered and implemented to increase vaccination rates and limit the spread of Covid-19 and variants (13).

Furthermore, there is still considerable research required to inform what control measures may be required after the Canadian population is immunized. For example, the degree and duration of immunity, and particularly the protection against variants of concern, still needs to be evaluated. As most Canadian jurisdictions pursue a *first-dose-fast* strategy, there will also be a period of several months when most of the population has been partially immunized. Relaxation of public health measures during this time will need to be based on indicators of community transmission, and carefully monitored. There is also ongoing research on what might constitute an optimal plan for providing booster vaccines – considering whether it is effective to use different combinations of the approved Covid-19 vaccines for first and second doses. Currently the Oxford Vaccine Group is leading the “COM-COV1” (Comparing Covid-19 Vaccine Schedule Combinations) trial studying combinations Pfizer BioNTech BNT162b2, AstraZeneca ChadOx1 nCoV-19. The COM-COV2 study broadened the combinations to: 1) AstraZeneca with either AstraZeneca or Moderna, or Novavax; 2) Pfizer with either Pfizer, Moderna or Novavax (14). A Canadian study on this subject is in the process of being launched.

Factors that could delay timelines to reach full immunization coverage resulting in herd immunity include unexpected safety issues emerging with early vaccines, significant manufacturing or supply-chain delays, continued slow adoption, issues with effectiveness of the vaccines in reducing transmission, emergence of variants of concern that the vaccines do not protect against, or a shorter-than-anticipated duration of vaccine-conferred immunity (15). Anecdotally, there are some indications that Canadians may or may not keep their second vaccine appointment, and that they do not believe getting the second shot would be worth their while. This may further cause delays in meeting immunization targets. Governments need to give the public the tools to make informed decisions and to put risk into context.

Vaccine hesitancy among health care workers and the general public may also delay timelines to reach full immunization coverage, especially if hesitancy is a longer-term trend. Sudden changes to vaccine recommendations may further cause hesitancy among the general public and health care workers. For example, the numerous changes to NACI’s recommendations on the age groups that can use the AstraZeneca vaccine and the association to rare cases of serious blood clots are adding to hesitancy in some populations. Anecdotally, there have been reports that younger people are willing to get the AstraZeneca shot, despite these changes in recommendations. An important determinant of increased vaccine hesitancy may be the overwhelming number of negative messages, even from credible sources, and the very little positive messaging around vaccine uptake. There needs to be effective and positive communications around vaccines, including how vaccine uptake is related to loosening public health restrictions. One consideration is to put together an agency, or gather community trusted communicators and influencers, that disseminate appropriate messaging to those that are vaccine hesitant, especially in settings with low vaccine uptake.

With respect to health care workers, a recent commentary emphasizes the importance of paying attention to details and remaining careful during discussions around vaccines, regardless of whether these conversations occur with individuals or the public (16). Tips to provide to health care workers and trainees to address concerns regarding vaccines include tailoring messaging to the target audience, using

tactful communication, having prior knowledge of common concerns and misinformation about vaccine, and refreshing knowledge on the necessity for vaccines, the mechanisms and safety of vaccine options (16).

Vaccine uptake across the population and in specific sub-groups will be critical to monitor. If certain groups choose not to get vaccinated, there may remain risk of disease in some pockets of the population. The level of coverage of the vaccine will influence the ability to reopen different sectors. There needs to be close monitoring of coverage levels in communities and workplaces with higher levels of community transmission, so-called 'hot-spots'. Without special attention, coverage is likely to be higher in more well-to-do neighbourhoods that also have lower levels of transmission, as recently shown in Ontario (17).

#### Continued evolution of SARS-CoV-2.

SARS-CoV-2 is likely to remain an endemic disease, at least in the medium term, according to an increasing scientific consensus (15). Even with control in the human population it is likely that Covid-19 will eventually become an endemic disease through animal reservoirs. For example, minks were shown to act as a reservoir given they were infected following exposure to Covid-19 positive humans (18). Further, ongoing laboratory research suggests that other animals including cats, dogs, ferrets, fruit bats, hamsters, and tree shrews can also become infected and spread Covid-19 to other animals within the same species (18). The virus may act similarly to the seasonal influenza virus with new variants every year, and likely require regular booster vaccinations.

#### Spread of variants of concern.

The threat of variants is causing concern among the scientific community and decision-makers. There are a number of variants of concern (e.g., B.1.351, P.1., B.1.1.7, and B.1.617) and reported in several countries around the world including Canada (19). Most recently, the B.1617 variant, originating in India, is concerning, given the recent surge in cases and deaths in India attributed to this variant, and limited medical supplies. There are concerns that the emergence of more-infectious SARS-CoV-2 variants increases the risk of not achieving herd immunity (20). Of particular concern is that variants are more contagious, can lead to more serious illness, and could potentially reduce the effectiveness of vaccines, resulting in diminished public health gains to date. However, the greatest concern, and the area that requires most attention, is to monitor for variants that evade currently available vaccines, known as vaccine escape. Such a variant would have devastating consequences and require rapid development and deployment of vaccines targeted to it.

#### The ability to implement appropriate control measures.

Until vaccines are able to bring transmission under control, the core public health measures will need to be continued (see appendix). There is ongoing need for the test, trace, isolate and support strategy (21). Technologies such as rapid tests may facilitate reopening of certain types of services, keeping in mind the potential limitations of these technologies and their subsequent impacts (i.e., the low sensitivity of the rapid tests currently available).

Travel restrictions and border closures are essential to control and prevent spread of more transmissible variants. Over the past year, Canada has bounced from approach to approach with respect to border closures and continues to be largely reactive. A coherent border strategy that combines a rigorous testing regime with enforced quarantines of appropriate durations for those who present risk should be developed.

An important consideration is that the hardest prevention measure is not allowing people to see family and friends. When deciding which public health measures to keep in place and others to lift, the decision should balance the benefits and harms, and consider that there is an entire generation who will have lifelong consequences due to the pandemic. One approach is to start with reopening schools,

colleges, and universities, and limit activities such as large sporting and entertainment events. Allowing outdoor activities, such as fitness or restaurant patios should be prioritized over indoor activities.

#### Public acceptance.

Given the prolonged nature of the pandemic, public acceptance for control measures is critical and the degree of strictness should be informed by the likelihood of compliance. For example, greater compliance with a slightly less strict measure may be better than poor compliance with a stricter measure. Similarly, public acceptance of vaccines will be critical and should be closely monitored.

#### *Considerations regarding population willingness to support and adhere to controlled measures.*

As the pandemic continues into its second year, there are clear signs that the population is increasingly frustrated with the ongoing control measures and may be less likely to adhere with recommendations. Stricter control measures, which may have been effective in earlier stages of the pandemic, may be less likely to be accepted. For example, mandatory mask mandates resulted in significant levels of adherence in public settings, as opposed to voluntary recommendations (19). However, this has also resulted in significant backlash in some settings. Depending on the setting, continued use of mandatory approaches may be met with greater resistance.

Approaches to increase vaccine confidence should be based on well-understood behavioral science research. Such critical communications, especially in high infection areas where there tends to be vaccine hesitancy, should be tailor to subgroups/local contexts and should be empathetic (21). For example, behavioural science sheds light on the barriers and incentives to adopting protective behaviours, such as wearing masks and keeping a physical distance, in different contexts and sub-populations. Effective communication and messaging strategies should follow evidenced-based elements/principles including the dos and don'ts around trust and credibility, empathy, autonomy and empowerment, values, emotions and stories, public involvement, speed, audience segmentation, and institutionalization (22).

#### Considering fiscal capacity for continued control measures

Governments during the pandemic have faced the difficult task of balancing the harms to health and the harms to the economy, subject to political constraints, and have adopted a variety of strategies, often depending on their particular context.

One recent comparative study of 16 countries (which did not include Canada) undertook an analysis of the three interconnected systems (public health, the economy and politics) (23). They argue that the difference among countries in context had a big effect on outcomes, and that the pandemic tended to exacerbate existing weaknesses in any of these systems. Outcomes were worse where public health infrastructure was weak, where there was significant economic inequality prior to the pandemic, and where there was political alienation (a lack of trust in government). They provide three archetypical examples of responses termed control (Taiwan), consensus (Germany) and chaos (United States): see Table 2 (23). Since the paper was published in January, vaccine availability in countries with significant domestic production such as the US and United Kingdom (UK) has somewhat changed the dynamic but as recent experience suggests for India, this is not always a panacea.

Table 2: Classifying countries - three examples from Jasanoff et al, 2021 (23).

	<b>Control (Taiwan)</b>	<b>Consensus (Germany)</b>	<b>Chaos (United States)</b>
<b>Health</b>	Uncontested public health sovereignty Learning from SARS and H1N1	Negotiated public health sovereignty National research & advisory system Corporatist medicine	Contested public health sovereignty Competing political and biomedical subject
<b>Economy</b>	Minimal restriction No lockdown Negative effects mainly from networked economy	System stabilization Job protection Learning from 2008	Market stimulus Direct cash relief Controversial bailouts
<b>Politics</b>	Statist approach High public approval of Covid response Victory for incumbent party in local election	Corporatist approach Committed to risk aversion and stability	Pluralist with high polarization Distrust in expertise Conflict between center and states

Canada falls in this typology somewhere between Europe (the German case) and the US. Federal countries face additional challenges, and Australia is one of the few federal examples which managed to pull together a unified response, pulling together a “wartime” National Cabinet of heads of all states/territories, which may have facilitated a coordinated response that contributed to the low number of deaths.

The economic impact on Canada, although severe, was not as dire as initially predicted. Early models projected unemployment peaking at 22.5% (23) and a loss of Gross Domestic Product (GDP) of 10% by summer of 2020, compared to its February 2019 level (24).

The 2021 federal budget did not propose major new tax increases, but proposed continued spending on recovery, extending the various temporary support programs, and proposing a major investment in social infrastructure for childcare, as well as other measures aimed at young people, low wage workers, digital transformation, and the green economy. Paid sick leave, advocated by many public health professionals, has been implemented in a mixed manner by the federal, provincial and territorial governments.

It is important to note that continued public health measures will require support for individuals and businesses that are affected. Governmental support is especially important to help mitigate the potential financial impacts of policies on businesses such as Section 22 Class Order to close workplaces to manage the chains of Covid-19 transmission as recently adopted by two public health units in Ontario (Toronto and Peel) (24).

### Unintended consequences on the health care system

The health care system will need to adapt to provide support and resources for individuals with long-term effects of being infected with Covid-19, and potential consequences of the vaccines. There are significant backlogs of medical and surgical procedures which will take months, if not years to address. Unfortunately, it is also likely that there will be significant consequences as a result of these delays. For example, individuals with cancer may present with more advanced disease. There are many physical and mental health consequences from both Covid-19 and the impact of the public health measures that will need to be addressed by the health care system.

Compounding these challenges are indications that there may be a shortage of health care workers in the future due to resignations and early retirement. At the same time, some health professionals in training will have entry to practice delayed as a result of their programs or certification processes having been disrupted as a consequence of the pandemic.

### Risk tolerance of those in the sector.

There may be different levels of risk tolerance across sectors. Some sectors may be prepared to tolerate a higher level of risk in order to reopen. However, reopening of that sector may have an impact on others with lower risk tolerance. Therefore, the overall impact needs to be weighed and not be focused solely on a specific sector.

### Canada and its global interdependence.

Canada is closely integrated with the North American market as well as globally. Like many other countries, its path forward is dependent on other key players in the Covid-19 response with respect to vaccine delivery, trade arrangements, and travel. Even as the Canadian population is more fully immunized the need for border control measures, such as surveillance for variants of concern will remain necessary.

### Research & evaluation.

The Covid-19 pandemic has highlighted the limitations to current practices with regards to data collection and sharing across Canada and abroad. There is a need for better surveillance systems, methodological standards for data collection and sharing, and coordinated research efforts nationally and internationally, that reaches beyond the pandemic.

## **Example roadmap**

- The UK's roadmap suggests four steps to be reached in progression to inform the easing of restrictions (for particular jurisdictions): 1) the continued success of the vaccine deployment program; 2) evidence showing that vaccines are sufficiently reducing hospitalizations and deaths among those vaccinated; 3) infection rates do not risk a surge in hospitalizations; and 4) assessment of risk of severe health outcomes or deaths is not changed by new variants of concern (25). Each step will last a duration of five weeks, and there will be an assessment before proceeding to the next step.
  - The UK's roadmap considers taking a highly precautionary approach to address outbreaks caused by unmanageable spread of variants of concern that pose a risk on vaccination progress, considers supporting individuals, businesses and the most vulnerable, and considers more opportunities for visitations among family and friends (25).

- The US CDC’s guidance considers lifting social restrictions in the US as they continue to vaccinate their population. Those who are fully vaccinated can gather indoors with other fully vaccinated people and unvaccinated people of any age that are at low-risk of serious outcomes without wearing a mask or staying 6 feet apart (26). Vaccinated people can also gather or conduct activities outdoors without a mask, unless in crowded settings (26). Further, vaccinated people do not require to get tested when traveling within the US. Those who do not live in group settings may refrain from typical quarantine and testing if no symptoms present after exposure to Covid-19, and get tested only if experiencing Covid-19 symptoms (26).

**Case study: Israel’s vaccine rollout & reopening approach**

<p>Vaccine rollout</p>	<p>Israel’s approach to vaccine rollout is centered on speed, prioritization, modifications to vaccine transport, storage and distributions, efficient communication strategies, various vaccination centers to improve access, a centralized organization to schedule appointments, and involving community health care workers (21). As outlined by the Ontario COVID-19 Science Advisory Table, Ontario and likely many other provinces and territories in Canada, could adopt or adapt such an approach.</p>
<p>Reopening</p>	<p>Israel’s three phase approach to reopening consists of a traffic light system (green, yellow, orange) and is mainly guided by vaccination rates or thresholds with requirements to continue two-meter physical distancing and wearing a mask, and proof of vaccination or a “Green Pass” (see below) for entrance into certain settings. Some thresholds include reopening school grades 7-10 when the level of immunization is 70% or above in those aged 50+, and entrance into coffee shops, restaurants and bars will require a green pass and allow 75% occupancy and at most 100 people indoors, outside 100 people, and maintaining two meters between tables (27).</p> <p><u>Vaccine certificate or Green Pass</u></p> <ul style="list-style-type: none"> <li>• Green pass: a certification that allows people who are fully vaccinated (i.e., those who received two doses, and a week has passed since the second dose) or those with proof of recovery from Covid-19, to enter specific establishments (27).</li> <li>• Ensuring accessibility of these certificates is an important consideration, and differences in local contexts should be kept in mind. Israel’s Green Pass can be issued through a mobile app, their ministry of health website, or by phone. They also can be issued in four languages: Hebrew, Arabic, Russian, and English (27).</li> </ul> <p>One of the first institutions to reopen are schools, starting with younger children first, older children who live in areas with high vaccination rates second, and last to reopen are universities and colleges in the third phase. In the second and third phase, certain institutions, for example, gyms, swimming pools, sports events, cafes, restaurants, banquet halls, and hotels require a “Green Pass”. Despite increased vaccination and proof of it, restrictions remain on gathering capacity, and legal requirement for physical distancing and mask wearing (27).</p>

**Conclusion**

The mitigation strategies and considerations presented in this commentary aim to inform discussions related to balancing concern for control of the virus and the concern for the economic implications of the pandemic. Canada and the world are at a critical stage with the Covid-19 pandemic.

While a few countries have managed to achieve higher levels of immunization coverage, they are still exposed to the risks of variants of concern. Canada is making progress with its immunization program, but the variants have driven a large third wave in many parts of the country. Measured approaches are necessary to control this wave and to avert future waves. Maintaining public confidence is essential in order to ensure support for the public health measures that are necessary to control the spread of disease, and to maximize confidence in the vaccines and achieve maximal uptake. Clear, consistent, coordinated, and timely communications will continue to be required. There are several areas for which clear national guidance could be of value:

1. A risk-based framework to guide reopening of services based on local epidemiology and vaccine coverage. The framework should focus on disease transmission, and public health and health system capacity indicators to guide reopening rather than measures of vaccination coverage or fixed dates.
2. Recommendations on appropriate use for certification of vaccination and whether proof of vaccination should be mandatory in some settings.
3. A border strategy that combines testing and quarantine of appropriate duration based on risk to ensure protection from importation of virus variants while facilitating travel.
4. Assessment of key learnings from behavioural science disciplines to support messaging and communications to ensure public acceptance of public health measures when necessary and vaccines when offered.

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## APPENDIX

### Tools for controlling disease

The evidence base for control measures for COVID-19 has improved considerably during the past year. Below is a list of these control measures, including a summary of the supporting research evidence

#### *Case-based tools*

- Testing – diagnostic and surveillance.
- Tracing – forward and backward individual tracing, and digital tools.
- Isolation and support.
- Surveillance and epidemiology.

#### *Population-based tools*

##### **Non-pharmaceutical interventions and tools to control the pandemic:**

- Hand hygiene.
- Respiratory etiquette (28).
- Face masks (28). The type and quality of face masks worn are important for controlling spread and transmission of Covid-19. A rapid review found that non-medical masks were more effective for source control compared to the protection of uninfected individuals. There was also a synergist effect when masks were worn by both infected and uninfected individuals (29). Three characteristics were identified as determinants of non-medical mask efficacy: filtration efficiency, breathability, and fit. Multiple layers of high-quality fabrics improved filtration efficiency, decreased the risk of spreading or being exposed to the virus, but reduced breathability with each added layer (29). Not recommended were vacuum cleaner bags, loosely folded and fitted face masks, bandana-style face masks, single layered neck gaiters, respirators with an exhalation valve given that there were drawbacks regarding safety, effectiveness of protection, and effectiveness of source control (29). Further, it is not recommended to wear face shields alone in replacement of face masks given that there is limited evidence regarding their effectiveness when worn alone. Those that choose to wear face shields only based on situational factors, should adjust by emphasizing hand hygiene, respiratory etiquette, and physical distancing (30).
- Symptom screening.
- Physical distancing.
- Gathering limits. Risk of transmission during gatherings was found to be directly related to the size of the gathering (31). There are some types of gatherings that are less risky which include gathering of small close community networks in comparison to a mix of different networks. Events that involve random mixing of social networks, including the use of public transit, restaurants/bars, and sporting events posed a higher risk of transmission (31).
- Suspension of events (sports entertainment, religious).
- Closure of non-essential business (retail, restaurants, bars, and clubs). Closures and reopening businesses should be done strategically (32). It is recommended that restrictions should be targeted to prioritize saving lives, ensuring equity, and preserving societal values (32).
- Surface and object cleaning (28).
- Increasing ventilation (28).
- Voluntary isolation at home of sick individuals with uncomplicated illness (28).
- School measures (e.g. stricter exclusion policies for ill children, increasing desk spacing, reducing mixing between classes, and staggering recesses and lunchbreaks) are conditionally recommended, with gradation of interventions based on severity (28).
- Workplace measures (e.g. encouraging teleworking from home, staggering shifts, and loosening policies for sick leave and paid leave) (28).
- Avoid crowding (28).
- Travel advice (28).
- Internal (within country) travel restrictions (28).

**Medical counter measures**

- Dexamethasone (33).
- Remdesivir (34).
- Bamlanivimab (34)
- Hydroxychloroquine prophylaxis does not have an important effect on hospital admission and mortality, probably increases adverse effects, and probably does not have an important effect on laboratory-confirmed SARS-CoV-2 infection (35).
- There is also high uncertainty as to whether ivermectin combined with iota-carrageenan and ivermectin alone reduces the risk of SARS-CoV-2 infection (35).

**Protection for individuals in high-risk work settings**

- Risks are unevenly distributed to those who work in high-risk settings and essential services. Therefore, providing adequate protection for these workers should be a priority (32). Providing this support requires collective action by employers, workers, and governments (32).

**School and daycare closures**

The Lancet Covid-19 Commission identified 6 priority areas or mitigation strategies for safe work, school, and travel environments, and identified keeping schools open as a priority (32). They attest that schools should be treated as essential institutions and provided the necessary support to remain open (32). Schools play an important role in the development of children and youth and provide benefits both intellectually and socially. Long-term school closures can lead to educational gaps, further perpetuate inequities, and can negatively affect psychosocial wellbeing (36). The CDC suggests that mitigation strategies for schools through grades K-12 include the following:

- Universal and correct use of masks by all students, teachers, and staff (37).
- Physical distancing of at least 6 feet should be maximized and use cohorting or podding to minimize exposure (37).
- Handwashing and respiratory etiquette (37).
- Cleaning and maintaining healthy facilities (37).
- Contact tracing in combination with isolation and quarantine, in collaboration with the health department (37).
- Diagnostic testing to any student, teacher or staff member who exhibits symptoms of Covid-19 at school (37).
- Screening testing to identify cases without or prior to the development of symptoms (37).
- Vaccinating teachers, and staff, and in communities as soon as possible (37).

**Travel restrictions**

- Border closures.
- Flight suspension.
- Testing & Quarantine. Examples of implementation measures for travel include, early and effective pre-flight screening and testing, and post-flight quarantine and isolation to reduce the spread of Covid-19 (32). Evidence from quantitative models suggests that testing and quarantine strategies for community contacts and travellers are similar when considering testing at quarantine lengths greater than one week (38). For strategies less than one week, test and quarantine strategies are less effective in the community because case contacts may be early in their incubation period and test results would have a high false negative rate. This is less of an issue for travellers that may be at any point in their infection, but there is still a risk of releasing travellers early in their incubation period (38).
- Proof of immunization.

**Vaccine certification**

- Standardized and central recording of vaccination status should be considered given the prospect of requiring this information for international travel.
- There are mixed perspectives on whether such requirements should be in place for domestic activities as visiting a family member in a long-term care home, or for events with larger crowds.

- Such certification may also be required for some categories of employment.
- Vaccine or immunization certification (i.e., a scannable bar code or a quick response code on a smartphone) may soon be required to provide proof of immunization to SARS-CoV-2 in certain contexts, and for international travel (39).
- Wilson and Flood (2021) suggest that Canadian provincial and territorial governments “should ensure their ability to issue a cryptographically signed digital vaccination record from a government repository to operationalize immunization passports that meet national standards and aligns with international initiatives” (39).
- Such tools may lead to equity, privacy, and coercion problems if there is limited access to vaccines and technology, and if a standard vaccination record is not implemented (39).