Coronavirus disease (COVID-19)

Priority strategies to optimize testing and quarantine at Canada's borders

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Executive summary

In November 2020, the Minister of Health established the COVID-19 Testing and Screening Expert Advisory Panel. The Panel provides evidence-informed advice to the federal government on science and policy related to existing and innovative approaches to testing and screening.

The Panel has issued 3 reports since January 2021. This fourth report provides recommendations for land and air border measures. The Panel did not include marine border measures in its scope of analysis or recommendations.

Border measures help to reduce risk. They're designed to:

- reduce mortality and morbidity from COVID-19 by limiting the introduction of SARS-CoV-2 and emerging variants of concern (VoCs) into Canada
- maintain essential supply chains and services and ensure that travel restrictions are not excessive to public health needs
- use surveillance of SARS-CoV-2 and VoCs at the borders for all types of travellers to inform ongoing measures

The advice in this report may require revision both due to rapidly evolving evidence and the continued evolution of the pandemic. The Panel is providing this advice as a third wave of COVID-19 is occurring in much of the country. As such, the report assumes that the current federal recommendations against non-essential travel will remain in force. The Panel emphasizes the need for Canadians, including vaccinated travellers, to follow public health requirements such as physical distancing and mask wearing. The Panel also emphasizes that all individuals with symptoms of COVID-19 should be tested using a PCR test. Finally, the Panel notes that the role of border measures is to mitigate risk, recognizing that it's impossible to eliminate risk completely given the need to maintain essential supply chains and services.

Our recommendations apply to people entering Canada from other countries. Whether vaccinated or not, travellers entering other countries may be subject to different quarantine and testing requirements. Similarly, while the Panel recommends consistency across the country, we recognize that those entering Canada may face additional requirements or restrictions in some provinces or territories.

The Panel considered 3 broad principles in developing its recommendations:

1. Border measures must evolve to reflect the experience gained and the global situation regarding VoCs and vaccination
    - The Government of Canada should continue to screen positive cases among international travellers for VoCs.
    - Additional short-term measures may be necessary as and when emerging VoCs are identified in Canada or internationally.
    - The Government of Canada have procedures in place to ensure that all travellers submit required tests and that all positive results are immediately communicated to the appropriate local health authority.
2. Border measures must be simple, easy to understand, equitable and consider both benefits and harms
    - The current requirement for all air travellers to quarantine in government-authorized accommodations should be discontinued. However, travellers subject to quarantine must provide a suitable quarantine plan for approval and then adhere to this plan. If the traveller does not have a suitable quarantine plan, they should be required to adhere to an alternative one (for example, in designated quarantine facilities).

- Testing requirements that vary by country of origin should not be implemented for travellers entering Canada except under unique circumstances. Increased monitoring of quarantine compliance should be considered for travellers arriving from countries with new variants of concern.
- As much as possible, land and air border measures should be consistent.
- There is no substantial incremental value in additional testing for people travelling to other Canadian destinations once they have arrived at their first port of entry in Canada, considering they will be going through other testing points.

3. Changes to border measures should be implemented in stages
    - Implementation of new border measures should be phased in, as the implementation process, including enforcement, may take time to put in place.
    - The federal government should continue to use the ArriveCAN app for traveller information reporting. The government should also review/approve quarantine plans for all arriving travellers at both land and air borders, including screening for symptoms for all travellers.
    - There should be a system in place to validate proof of vaccination for arriving travellers as soon as possible.

The Panel identified 5 distinct groups of travellers:

- non-exempt who are not vaccinated
- partially vaccinated (received the first dose of a 2-dose series, are within the recommended maximum interval period between doses and 14 days have passed since the first dose)
- fully vaccinated (14 days have passed since the final dose)
- non-exempt with proof of previous infection
- exempt as defined by the Government of Canada, such as essential workers

Along with recommending that all travellers follow public health requirements (including physical distancing, mask wearing), the Panel offers the following recommendations for each type of traveller:

- For unvaccinated non-exempt travellers:
    - pre-departure polymerase chain reaction (PCR) test within 72 hours of departure or an authorized rapid antigen test within 24 hours of departure
    - PCR test on arrival at the border testing station or the quarantine location (for land border crossing, a home-sampling kit may be used)
    - travellers with a negative PCR test result taken at day 7 of quarantine to be permitted to leave quarantine, those with a positive result to isolate according to public health guidance and those who do not take a day 7 test to complete 14 days of quarantine
- For partially vaccinated non-exempt travellers:
    - pre-departure PCR test within 72 hours of departure or an authorized rapid antigen test within 24 hours of departure
    - PCR test on arrival at the border testing station or the quarantine location (for land border crossing, a home-sampling kit may be used)
    - travellers with a negative PCR test taken on arrival to be permitted to leave quarantine and those with a positive result to isolate according to public health guidance
- For fully vaccinated non-exempt travellers:
    - acceptable proof, as defined by the Government of Canada, of authorized vaccination and that sufficient time has passed after the final dose in the vaccine series
    - no pre-departure test, quarantine requirement or day 7 test
    - for surveillance purposes, PCR test on arrival at the border testing station (for land border crossing, a home-sampling kit may be used)

- For travellers with proof of previously resolved infection (more than 14 days but less than 180 days before the travel day):
    - acceptable proof, as defined by the Government of Canada, of infection within this time period
    - PCR test on arrival at the border testing station or the quarantine location (for land border crossing, a home-sampling kit may be used)
    - travellers with a negative PCR test taken on arrival to be permitted to leave quarantine and those with a positive result to continue to isolate according to public health guidance.
- For all exempt travellers:
    - voluntary arrival testing using lab-based PCR or rapid tests with sample collection completed away from the border (ideally implemented to allow for robust surveillance, to provide information on further potential recommendations for this group)

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The Expert Advisory Panel and reports

Mandate of the Panel

The COVID-19 Testing and Screening Expert Advisory Panel aims to provide timely and relevant guidance to the Minister of Health on COVID-19 testing and screening.

The Panel's mandate is to complement, not replace, evolving regulatory and clinical guidance on testing and screening. Our reports reflect federal, provincial and territorial needs, as all governments seek opportunities to integrate new technologies and approaches into their COVID-19 response plans.

Plan for reports

The focus of the first Panel report included 4 immediate actions to optimize testing and screening:

1. optimize diagnostic capacity with lab-based PCR testing
2. accelerate the use of rapid tests, primarily for screening
3. address equity considerations for testing and screening programs
4. improve communications strategies to enhance testing and screening uptake

The second report focused on testing and screening strategies in the long-term care sector. The third report provided a perspective on how the recommendations from the first report can be applied to schools. This fourth report focuses on testing and quarantine measures for Canada's borders.

Consultation

The Panel consulted with more than 60 health, public policy, border and transportation experts, as well as other industry stakeholders who are impacted by the COVID-19 border measures. The Panel will continue to consult with a variety of stakeholders as we prepare further reports.

Guiding principles

Public health initiatives should minimize unintended harm, promote equity and increase transparency and accountability. Panel discussions and engagement with stakeholders highlighted a number of key principles to consider in its guidance, including equity, feasibility and acceptability. The Panel applied these principles in framing its guidance.

This report contains the Panel's independent advice and recommendations, which were based on available information at the time of writing the report. The Panel examined scientific journal articles, modeling studies, news articles and data from the Public Health Agency of Canada to inform its recommendations.

Terms

Some of the terms used in the report may not be familiar to all readers. Key terms used in this report include:

- **Vaccinated:** People who have received both doses of a 2-dose authorized vaccine or 1 dose of a single-dose authorized vaccine and 14 days have passed since the final dose.
- **Partially vaccinated:** People who received the first dose of a 2-dose authorized vaccine at least 14 days ago and are within the recommended maximum interval period between doses.

- **Unvaccinated:** People who have not received a dose of a COVID-19 vaccine or those with a single dose of a 2-dose COVID-19 vaccine and the recommended maximum 2-dose interval period has passed

Acknowledgements

The Panel expresses its appreciation to the ex officio members of the Panel and to officials at Health Canada who have been working tirelessly to support the Panel. The Panel also acknowledges the contributions of the "shadow panel" on testing and screening, a group of students and young scientists who provided expert research and analytical assistance. Shadow panel members include Rahul Arora, Matthew Downer, Jane Cooper, Michael Liu, Jason Morgenstern, Netra Unni Rajesh, Sara Rotenberg and Tingting Yan.

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Objectives of border measures

Border measures serve to reduce risk but not eliminate it through measures, including testing and quarantine, which are intended to:

- reduce mortality and morbidity from COVID-19 by limiting the introduction of SARS-CoV-2 and its VoCs into Canada
- maintain essential supply chains and services and ensure that travel restrictions are not excessive, while continuing to protect the public
- use surveillance testing of SARS-CoV-2 and VoCs at the borders for travellers, including voluntary testing of exempt travellers, to inform ongoing measures

This report presents the Panel's advice to the Minister of Health on border measures to be considered in relation to the Order in Council *Minimizing the Risk of Exposure to COVID-19 in Canada Order (Quarantine, Isolation and Other Obligations)*.

Background

Canada's border measures are informed by obligations under the International Health Regulations (IHR). The IHR is an instrument of international law that is legally binding on 196 countries to limit the spread of health risks while preventing unwarranted travel and trade restrictions. Recognizing the IHR, Canada cannot impose health-related travel restrictions except in situations of public health emergencies (such as COVID-19). When doing so, Canada must recognize the rights of travellers concerning treatment of personal data, informed consent and non-discrimination.

Like most countries, Canada has implemented measures and placed restrictions on entry and re-entry at border crossings during the pandemic, including mandatory quarantine. These are designed to:

- reduce the importation and subsequent spread of SARS-CoV-2
- decrease the volume of international travel to and from Canada

For example, international travel to and from the country declined from 96.8 million travellers in 2019 to 25.9 million in 2020. The number of travellers entering Canada decreased by over 90% from December 2019 to December 2020.

Border measures became more stringent in 2021 to further limit the importation of SARS-CoV-2 and to create a testing and sequencing perimeter to better respond to variants of concern (VoCs). These measures (see Annex A) included requiring:

- a negative SARS-CoV-2 PCR test before and/or on arrival to Canada
- a brief quarantine at a hotel or another approved location such as a traveller's home
- another test before the end of the quarantine period

There was a decrease of 41% in the rate of imported cases of COVID-19 from early January (152 cases per 100,000 arrivals) to early March (90 cases per 100,000 arrivals). In February, Canada further required air travellers to quarantine in government-authorized accommodations while awaiting arrival test results.

From February 21 to March 24, 1.3% of non-exempt travellers tested positive on arrival and 1% tested positive on day 10. However, there is not enough information to understand how many chains of transmission were initiated by these travellers and what contribution travel makes to the overall burden of disease in Canada at this time.

Some travellers are exempt from COVID-19 testing and quarantine measures because they provide essential services (see Annex B). Additional measures for this group could impose undue hardship and adversely impact essential services. From December 2020 to March 2021, most travellers (88% to 93%) entering Canada by land were exempt from testing and quarantine requirements (for example, truck drivers and health care workers). During this period, those entering Canada by air were primarily non-exempt travellers (65% to 86%) and were required to follow testing and quarantine requirements.

In Canada, all positive samples identified through border measures are sent for genetic sequencing to confirm and identify any VoCs. From February 22, 2021, to March 25, 2021, there were 171 VoC cases confirmed (161 cases of B1.1.7 and 10 cases of B1.351) by sequencing of positive tests from travellers (14% of total positive cases identified). This may be an underestimate given the delay to complete sequencing.

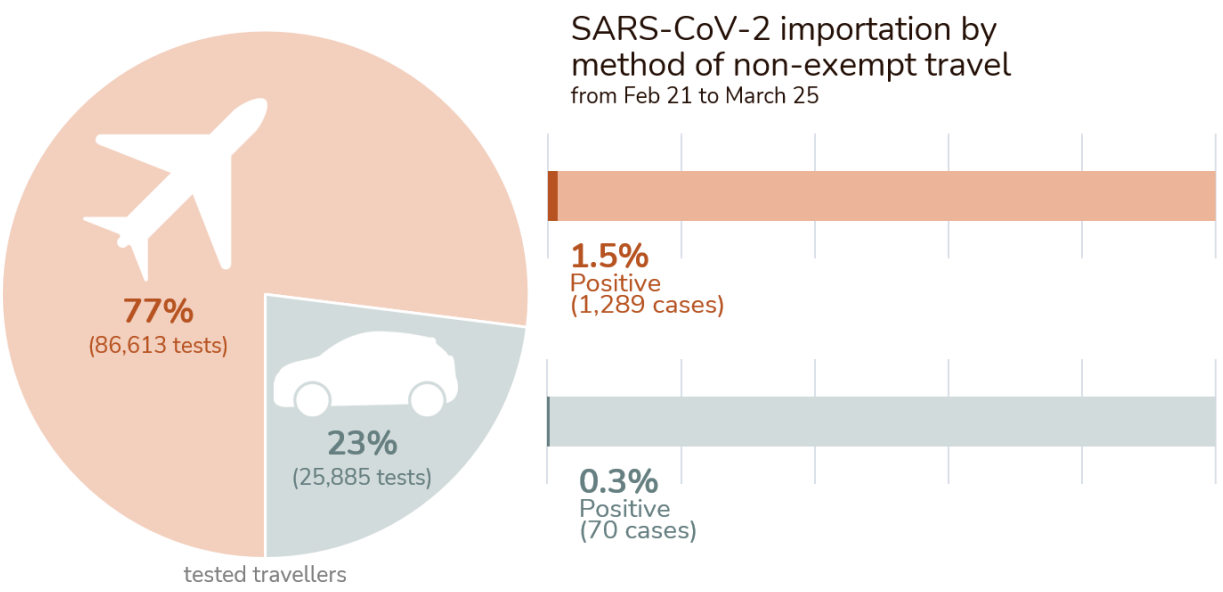

Figure 1: SARS-CoV-2 importation by method of non-exempt travel

Canada's current border measures aim to reduce the importation and further spread of SARS-CoV-2, including VoCs. Previous border measures were insufficient to prevent the importation of the B.1.1.7 VoC, which is now the dominant strain in Ontario and British Columbia. As well, P.1 is gaining ground in British Columbia. It is important to note that by the time a variant is identified as being "of concern," it is highly likely to be present in many countries around the world. Therefore, excessive or 'targeted' focus on travellers arriving from a single country is likely to provide a false sense of reassurance and not materially impact the presence of a VoC in Canada.

The Panel notes that the necessary testing capacity and recommendations will depend on the number of travellers and the global and domestic epidemiological situation as borders begin to reopen. Similarly, the COVID-19 situation is one of evolving risk and border measures are put in place to mitigate that risk. A regularly updated risk assessment is critical to understanding the risk factors, as well as the impact of border measures.

Border measures also come at a cost to the economy and to the movement of Canadians. For example, airlines are reporting operating at significantly lower capacity compared to the previous year. As the roll-out of vaccination programs advances domestically and internationally, the volume of travel will likely increase. A new balance will need to be found with modified testing and quarantine requirements. However, some border measures are likely to be required for the foreseeable future.

Evidence

The Panel's recommendations for border measures are based on data from the scientific literature and the Public Health Agency of Canada and experiences to date, including modelling studies, observational studies and pilots. As new evidence on vaccination, VoCs, border measures and other aspects of SARS-CoV-2 emerges, it will be important to ensure that:

- the goal of limiting the importation of SARS-CoV-2 and its VoCs is maintained and
- the guidance in this report is reviewed and updated accordingly

The key elements of the Panel recommendations related to border measures are pre-departure testing, arrival testing, quarantine and quarantine exit testing.

Pre-departure and arrival testing

Modelling shows that both pre-departure and arrival testing are likely to reduce importation of SARS-CoV-2, and both types of testing are more effective when used together.[1, 2] Pre-departure testing can reduce the number of actively infectious individuals who arrive in Canada, and the risk of transmission is further reduced when testing is done close to departure time (24 to 48 hours before).[3, 4, 5, 6]

From a logistics perspective, pre-departure testing is also less likely to result in delays at the border. Some modelling studies suggest that pre-departure rapid antigen tests (RATs) conducted close to departure (24 hours or less) may be as effective at identifying positive cases as PCR tests collected within 72 hours before departure (assuming 80% to 95% sensitivity of the RAT).[7, 8] However, estimates of the sensitivity of RATs in asymptomatic people vary (45% to 91%).[9, 10, 11, 12] When modeled with lower sensitivity, RATs for pre-departure testing are not as effective as PCR testing when conducted within 72 hours before departure. Therefore, there remains some uncertainty regarding the effectiveness of RATs used as pre-departure tests.

For pre-departure tests, some countries (for example, US, Haiti, Jamaica, Germany, Switzerland, Italy) will accept RATs in lieu of PCR tests.[13, 14, 15, 16, 17, 18] The Netherlands will accept RATs taken within 24 hours of departure, in addition to a PCR test taken within 72 hours of departure. Iceland does not accept RATs for pre-departure testing. Some hotels have also reportedly started offering on-site rapid tests to help with the travel testing requirement.

Two Canadian airport pilot studies and the Public Health Agency of Canada (PHAC) have collected data on the arrival test positivity rate. The Alberta border testing pilot, which began November 2, 2020, tested 50,929 non-exempt travellers, of which 1.37% had a positive test result upon arrival. The McMaster HealthLabs study found that 1% of those tested on arrival were positive for COVID-19. The Alberta pilot found that the proportion of air-travellers who tested positive within 14 days (2.2%) did not differ greatly compared to land travellers (1.9%).

While these positivity rates may seem low, it's important to consider that these individuals were not tested because they had symptoms or were close contacts of individuals with COVID-19. In this context, test positivity rates of 1% to 2% support the importance of arrival testing as a means of reducing transmission, especially potential transmission of VoCs.

PHAC data from arrival tests at both land and air borders conducted between February 22 and March 24, 2021, found an overall arrival test positivity of 1.3%. Air travellers had an arrival test positivity rate of 1.5% while land travellers had an arrival test positivity rate of 0.3%.

Testing to exit quarantine

Modelling studies indicate that a 7-day quarantine with a test at the end of the quarantine period may be similarly effective to a 14-day quarantine without testing.[19, 20, 21] In terms of 'real-world' evidence, the McMaster HealthLabs study found that 94% of all cases were detected by the day 7 test.

Quarantine exit testing becomes more important when compliance with quarantine is low. Depending on the level of compliance, a 7-day quarantine with testing may be more effective than a 14-day quarantine without testing.[22, 23] While a mandatory three-day initial quarantine in government-authorized accommodations obviously improves compliance during those 3 days, the level of compliance after is uncertain. Requiring a test at day 7 of quarantine to facilitate exit may prove to be an incentive and thus increase compliance, resulting in more robust surveillance.

Considerable effort is being made to ensure quarantine is observed. The federal government made 1.48 million calls between April 2020 and March 2021. Canada also deployed local police or security contractors to do site visits for 121,617 quarantined travellers between January 29 and March 25, 2021. Continued efforts to monitor and, if needed, improve adherence to quarantine are warranted.

Currently, travellers are required to be tested on day 10 of their 14-day quarantine. Internal data from PHAC suggests there are fewer day 10 tests completed compared to number of arrival tests. For example, air travellers submitted 31,616 arrival samples for testing from February 22 to March 6, 2021. However, only 21,100 samples for day 10 quarantine exit tests had been received by March 20.

Last, it is possible that new variants that have a longer incubation period may emerge. In this case, the length of quarantine and timing of exit tests will both need to be revised.

International examples
United Kingdom: The United Kingdom has implemented a phased testing exit strategy for international arrivals. Passengers must complete a passenger locator form with a travel plan and have proof of a negative PCR test within 72 hours of departure. They undergo additional testing on days 2 and 8 at their own cost and can leave quarantine once the day 8 test confirms a negative result. There is also an early release program in certain regions of England, where travellers may pay for a private, government-authorized PCR test on day 5 and leave with a confirmed negative result. Passengers cannot travel to the United Kingdom if they have been through a country on the banned travel list unless they are British, Irish or have the right to live in the United Kingdom. If returning from a country on this list, the traveller must quarantine for 10 days in a government-authorized accommodation. **Germany:** Travel to Germany is banned from countries where there is high prevalence of variants of concern, except for citizens/residents, connecting travellers or other special cases. For the European Union, Schengen and other low-risk countries, travellers must register their plans online and follow all testing and quarantine regulations. Travellers from high-risk areas must have a negative test 48 hours before entry. While quarantine protocols are determined by local Länders (states), in general travellers from high-risk areas must be tested before or immediately after entering the country and then self-isolate for 10 days. In some Länders, travellers can leave quarantine after 5 days, following a negative test result.

Mandatory quarantine approaches

Canada's current quarantine policy requires a mandatory 3-day quarantine in a government-authorized accommodation on arrival for non-exempt air travellers. This policy was designed to maximize compliance for the first 3 days of the required 14-day quarantine. It also ensures that some imported cases of COVID are identified

and managed before the traveller moves into the community. Non-exempt travellers entering by land are not required to quarantine in a government-authorized accommodation. Australia, which has a COVID-19 elimination strategy, requires all travellers to quarantine for 14 days in government-authorized accommodations to reduce the secondary transmission of COVID-19 into the community.

While likely improving quarantine compliance in Canada for the short term, there are several issues related to mandatory government-authorized accommodation worthy of consideration. First, some travellers are choosing to pay a fine of up to $3,000 rather than staying in a government-authorized accommodation or a designated quarantine facility. These travellers may or may not be adhering to quarantine. Second, there are significant administrative costs and resources devoted to managing hotel quarantine that cannot be used for other issues related to the pandemic response. Third, travellers face an added cost (up to $2000 CAD per person), time commitment and a burden to book government-authorized accommodation. Fourth, due to the costs and the reality that land and air border measures do not currently align (land travellers are not required to undergo mandatory hotel quarantine), some travellers are landing at U.S. airports and crossing into Canada by land. Fifth, hotel quarantine of up to 3 days is inconsistent with the incubation period of SARS-CoV-2.

The costs and hardships from lengthier mandatory quarantine in government-authorized accommodations may be acceptable in countries such as New Zealand and Australia that are pursuing an elimination strategy. Nevertheless, the Panel noted that despite strict health measures, there have been reports of hotel quarantine workers testing positive for SARS-CoV-2 in both Australia and New Zealand.

In Canada, the current approach to mandatory hotel quarantine:

- is not applied equally to land and air travellers
- is expensive to administer
- provides opportunities for travellers to bypass by paying a fine
- is inconsistent with the incubation period of the virus

Government-authorized accommodations also require participating hotels to implement strict public health measures to ensure employees and visitors are not infected during their visit. This includes ensuring employees are adequately protected and undergo frequent screening tests to minimize the risk of infection and further community transmission.

International example
Singapore: Non-citizens require pre-clearance to travel into Singapore at least 2 weeks before travel. All travellers must complete a Stay Home Notice, although the length (7 days or 14 days) and location of quarantine depends on the person's travel history and entry status. Travellers also require a PCR test within 72 hours of departure and upon arrival (at their own cost). People who have travelled to a select few countries (Australia, Brunei Darussalam, Mainland China, New Zealand and Taiwan) are allowed to leave as soon as the on-arrival PCR test is confirmed as negative. Singapore's strategy has been largely successful in limiting the number of imported cases.

In addition, currently in Canada, some jurisdictions require that travellers self-isolate in a separate dwelling from those in the household who have not travelled.[24, 25] If this is not possible, the entire household must self-isolate.

Given the current Canadian context, the Panel recommends a strong focus on adherence to quarantine rather than modifying the hotel quarantine program to become more like those in place in New Zealand and Australia. Research indicates that emphasizing quarantine as a social norm increases the perceived benefits of quarantine as well as compliance with quarantine. Recent research also indicates that specific supports related to financial support, temporary accommodation if necessary, clear communication, effective contact tracing and routine

monitoring would help to increase compliance (as opposed to enforcing a specific quarantine location).[26, 27] The Panel also noted that quarantine is being used to good effect in Atlantic Canada.

Exempt travelers

In Canada, some travellers are exempt from border measures (see Annex B), which is similar to other countries such as the United States. In Canada, due to a dramatic decrease in non-exempt travel, exempt travellers currently make up a large proportion of current travellers. For instance, between March 10 and 16, 2021, exempt travellers comprised 31% of all international air arrivals and 93% of land arrivals.

The Alberta pilot study, and Ontario and New Brunswick voluntary truck drivers pilot projects are the main sources of evidence of COVID-19 testing regarding exempt workers in Canada:

- Preliminary results from the Alberta pilot study included 1,010 exempt travellers arriving by air and 144 arriving by land from November to December 2020 with a test positivity rate of 2.5% and 1.4%, respectively.
- In the Ontario Voluntary Truck Drivers Pilot Project, 918 exempt cross-border truck drivers were tested from July to September 2020, finding zero cases.
- In the New Brunswick Truck Driver Pilot Project, 1,199 truck drivers were tested from May to August 2020, also finding zero cases.

In the Alberta pilot study, it's difficult to determine whether the test positivity found in exempt workers is due to their status, the type of border crossing or the country of origin (mostly the United States). The results from all 3 studies appear to be at odds. However, they were conducted over different timeframes and with different epidemiology. The truck driver pilots were undertaken in the late spring and summer, when the incidence of COVID-19 was much lower in Canada and the US, than over the winter. It's also possible that there are provincial differences in the risk of infection for exempt workers. The results of these pilots raise the question as to whether some measures should also apply to exempt workers.

Stakeholder groups representing exempt travellers, with whom the Panel consulted, indicated that if testing requirements are imposed on essential workers based on the rationale that they are a higher-risk group, they should also be prioritized for vaccination.

Canadian example
British Columbia: For agricultural temporary foreign workers, the British Columbia government is funding quarantine at government-funded hotels. It's also funding cost for food service, laundry services, interpretation and translation services, health screening and other necessary services. This program appears to have been successful. All 64 COVID-19 positive cases were detected in 4,997 workers from April and December 31, 2020. Everyone recovered under the care and supervision of the program, with no known transmission into the community.

Onward travellers

"Onward travellers" are those who arrive from an international airport and board an airplane, train or bus to their final location. According to internal PHAC modeling, there is a negligible marginal benefit to additional testing for onward travellers with a RAT when a pre-departure PCR test has been conducted. If there's a 1.2% positivity rate among travellers, adding an antigen test will detect only another 9 cases for every 10,000 travellers, because most cases will already have been detected by PCR. As well, this approach requires a significant increase in testing capacity at airports, which could result in crowded conditions during peak travel times and thus lead to increased

risk of transmission. Traveller test registration, swabbing, wait times, recording and referral times would result in a wait of up to 45 minutes.

International example
Iceland: In Iceland, travellers must present a negative PCR test within 72 hours of departure. If passengers are connecting, the 72 hours are counted from when the passenger boards their first flight. They are asked for proof of boarding and the test result.

Vaccinated travellers

As of March 2021, COVID-19 vaccine efficacy data are only available for a few months following vaccination. For 2-dose COVID-19 vaccines, the highest efficacy is seen after 2 doses. Currently, authorized vaccines in Canada are moderately to highly efficacious in preventing symptomatic COVID-19 and highly efficacious in preventing severe disease. Many experts have expressed views that vaccination is very likely to reduce the risk of infection and transmission of SARS-CoV-2. Evidence to support this view is starting to accumulate.

Clinical trials and real-world effectiveness studies have demonstrated that all COVID-19 vaccines available in Canada are effective against SARS-CoV-2 infection and highly effective against severe disease.[28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39] There is also evidence that people with a previous infection have reduced risk of re-infection, at least temporarily.[40, 41, 42, 43] Randomized controlled trials and observational studies suggest that COVID-19 vaccination reduces viral load, which has been linked to reduced transmission in a small observational study.[44, 45, 46] A cohort study reported a 54% reduction in the hazard of documented COVID-19 infection among the household members of health care workers who had received their full vaccine regimen. Furthermore, there's also evidence that vaccination prevents asymptomatic disease.[47, 48, 49] Overall, these studies suggest that vaccination reduces the risk of transmission of COVID-19.

There is also uncertainty about the effectiveness, duration of protection and reduction in transmission risk after a single dose of 2-dose vaccines. Re-analysis of phase 3 trial data for the Pfizer-BioNTech and Moderna vaccines suggested efficacies of 89% and 95%, respectively, about 2 weeks after the first dose.[50, 51, 52] Since then, real-world studies have found single-dose effectiveness ranging from 46% to 80% against SARS-CoV-2 infection and symptomatic infection.[53, 54, 55, 56, 57, 58] Some of this variability may be due to differences in the time elapsed since the dose.[59, 60]

A study from the U.S. Centers for Disease Control and Prevention (CDC) shows that both 1 and 2 doses of the authorized 2-dose mRNA COVID-19 vaccines provided early, substantial protection against infection for health care personnel, first responders and other frontline essential workers. Another observational study reported that first dose effectiveness in adults ages 70 and older plateaued 28 to 34 days after the first dose, at 60% to 70%. There have also been reports of reduced viral load in those infected after receiving only one dose. Finally, a 30% reduction in hazard of documented COVID-19 infection was reported among household members of health care workers who had been vaccinated. Of these, 78.3% had only received 1 dose.

While more evidence is needed, a single dose of a 2-dose vaccine appears to confer substantial protection in most recipients for some period of time. In most recipients, the second dose of a 2-dose vaccine likely confers some additional protection and extends the duration of protection.

People previously infected with SARS-CoV-2 have been found to have persistent neutralizing antibodies and immune memory for 5 to 8 months after infection.[61, 62] Observational studies have found that those with evidence of previous infection were 81% to 100% less likely to have future infections, at least within 5 to 7 months following infection.[63, 64, 65, 66, 67] Outbreak and close contact investigations have also found that those with previous infections

were strongly protected against re-infection.[68, 69] Together, this suggests a protective effect against future infection in those with a previous infection.

No direct evidence about transmission risk in people with previous infections was found. Updated guidance from the CDC states that people previously infected with COVID-19 within 3 months of travel are not required to undergo pre-departure testing.

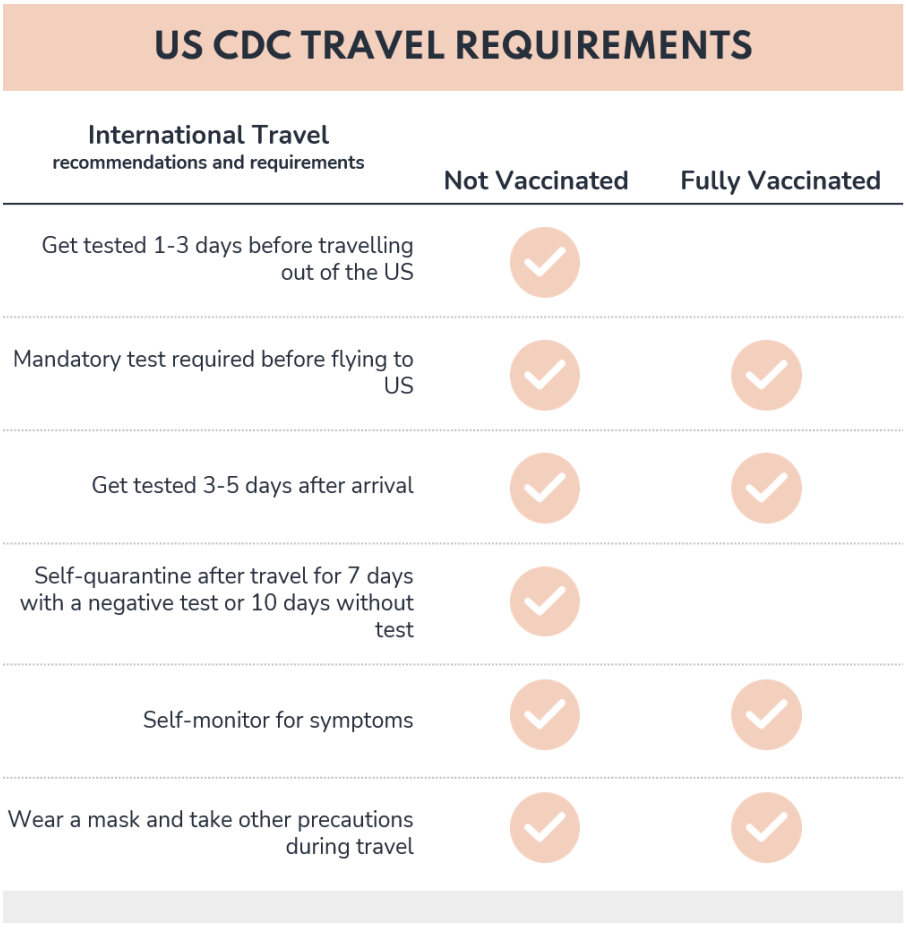

Figure 2: CDC and international travel during COVID-19

Overall, travellers who have been vaccinated or previously infected likely pose a lower risk of importation and transmission of SARS-CoV-2. However, some COVID-19 vaccines may have reduced effectiveness against existing and emerging VoCs.[70, 71, 72, 73, 74, 75, 76] Therefore, border measures for vaccinated travellers need to be evaluated carefully as new evidence continues to emerge. The approach taken towards testing and quarantine for vaccinated travellers must weigh the evidence on potentially reduced overall infection and transmission risk against the burden of mandatory testing and quarantine requirements on people.

Some countries have opted to reduce or eliminate quarantine requirements for fully vaccinated people (14 days after the second vaccine dose). Greece, Poland, Mumbai and some US states (Massachusetts and Vermont) have removed travel quarantine requirements, while Thailand has opted to reduce travel quarantine from 14 to 7 days.[77, 78, 79, 80, 81, 82] Belize has eliminated testing requirements for travellers who are fully vaccinated. Iceland will waive requirements for negative PCR tests, border screening and quarantine for anyone who provides

documentation that they have been fully vaccinated. The European Union is proposing a Digital Green Certificate, which will provide information on whether a traveller has been vaccinated, has recovered from COVID-19, and if not, the result of their COVID-19 tests.

Some countries are taking more conservative approaches. China will still require quarantine and testing of travellers, irrespective of vaccination status. Australia still requires 14-day mandatory quarantines for those outside of the safe zone (New Zealand), but will waive requirements of pre-departure tests for fully vaccinated people.

The CDC recently released updated recommendations for vaccinated travellers noting that they are less likely to get and spread COVID-19. The CDC does recommend that vaccinated travellers continue to follow its recommendations for safe travel including, for example, wearing a mask and washing hands often. The CDC recommends that both vaccinated and unvaccinated travellers present a negative COVID test taken no more than 3 days pre-departure as well as a test 3 to 5 days after arrival. There is no quarantine required for vaccinated travellers arriving in the US. A summary of the updated guidance from the CDC is included in Figure 2.

Recommendations

Our recommendations for testing related to travel at land and air border crossings and quarantine, are based on the evidence available to us when this report was written. As additional data and evidence become available, these recommendations may need to be revisited.

The Panel considered 3 broad principles in developing its recommendations.

Border measures must evolve to reflect the experience gained and the global situation regarding VoCs and vaccination

VoCs will affect the stringency of measures needed at the border. For existing and new SARS-CoV-2 variants, clear evidence may arise of significantly decreased vaccine effectiveness, evasion of test detection, reduced susceptibility to therapeutics and/or more severe disease. Arrival testing of vaccinated travellers is an important component of surveillance for variants with reduced vaccine effectiveness. Finally, emerging evidence on the effectiveness of COVID-19 vaccines in reducing transmission, including across different vaccine types and with 1 or 2 doses, will need to be considered when the recommendations are revisited.

The Panel recommends that the Government of Canada continue screening positive cases in international travellers for VoCs. This screening will provide a surveillance tool to monitor for novel or emerging VoCs. **Additional short-term measures may be necessary as and when new emerging VoCs are identified in Canada or internationally.** These should be similar to what has been done at the border at various points throughout the pandemic. This approach can help to reduce the risks of importation of a new or emerging VoCs into Canada. It also allows time to adjust testing and quarantine measures on a general basis, recognizing that by the time a VoC is detected in Canada, it is likely present in many countries.

The Panel recommends that the Government of Canada have procedures in place to ensure that all travellers submit required tests and that all positive results are immediately communicated to the appropriate local public health authority.

Border measures must be simple, easy to understand, equitable and consider both benefits and harms

Canadians are more likely to adhere to border restrictions if they are clear, understandable, equitable and if they avoid creating unreasonable delays and imposing unreasonable costs.

The Panel recommends that land and air border measures should be consistent as much as possible. The Panel's approach aims to promote the public good by recommending border measures that reduce the risk from SARS-CoV-2 and its VoCs, while also not imposing excessive burdens on travellers, particularly exempt travellers.

The Panel recommends that the requirement for all air travellers to quarantine in government-authorized accommodations be discontinued. However, travellers subject to quarantine must provide a suitable quarantine plan for approval and adhere to this plan. The Panel recommends that the government continue to ensure that those who do not have a suitable quarantine plan be required to adhere to an alternative one (for example, in designated quarantine facilities). The country is in the third wave of COVID-19. This must be taken into consideration when phasing out current border measures such as government-authorized accommodations.

The global nature of travel and human mobility means that country-specific travel restrictions are likely to be of limited value. This is partially because travellers are able to circumvent such restrictions. As well, by the time such restrictions are implemented, the relevant variant will likely have already spread to other countries. Therefore, the **Panel does not recommend implementation of country-specific testing or quarantine requirements at this time, except under unique circumstances. Increased monitoring of quarantine compliance should be considered for travellers arriving from countries with new variants of concern.**

Rapid antigen tests were considered for onward travellers arriving by air as a means of quickly determining if they were potentially positive. However, **the Panel does not currently see substantial incremental value in testing onward travellers at airports considering the other testing points throughout the traveller's journey.** If onward travellers are transiting to an international flight, no arrival testing is required in Canada. If they are transiting to a domestic flight or other transport, a PCR test is required on arrival.

Changes to border measures should be implemented in a phased approach

The Panel heard from industry associations, unions and individual organizations (for example, airlines and airports) on the importance of measures that can be phased in. Enough advance notice should be given to allow Canadians and industry to prepare and plan accordingly. Future changes to border measures (for example, easing of measures as vaccination becomes widespread) should be similarly phased. **The Panel recommends phased implementation of new border measures and consideration for the implementation process, including enforcement, which for some new measures, may take more time to implement.**

The Panel proposes a number of immediate measures for unvaccinated, partially vaccinated, vaccinated, previously infected and exempt travellers (see Table 1). These recommendations will need monitoring and adjusting as additional data and evidence continues to come in.

The Panel recommends the Government of Canada continue to use the ArriveCAN app to manage traveller information reporting. The Panel also recommend that quarantine plans be reviewed and approved for travellers arriving at both land and air borders, including symptom screening for all travellers. The Panel also acknowledges that there will be a number of considerations regarding vaccine "certification." A system to validate proof of vaccination for arriving travellers should be made available as soon as possible.

The Panel proposes a focus on emerging evidence in the ongoing implementation and revision of border measures for vaccinated travellers:

- effectiveness of vaccines in reducing COVID-19 transmission
- effectiveness of vaccines against VoCs and the prevention of their transmission
- effectiveness for "partially" vaccinated travellers (those who have received 1 dose of a 2-dose vaccine)
- SARS-CoV-2 and VoC importation among vaccinated travellers using border surveillance data

The Panel notes that while an evolution towards a consistent approach is recommended, travellers may be required to follow additional provincial and territorial requirements or restrictions. For example, Nova Scotia currently requires travellers outside of the Atlantic bubble (New Brunswick, PEI, Nova Scotia, Newfoundland and Labrador) to self-isolate for 14 days when arriving in or returning to Nova Scotia.

In designing and deploying border measures that are intended to minimize risks, adherence to public health measures during the continued roll-out of vaccines remains critical. The unintended consequences, including impacts on compliance, associated with lower stringency measures for those already vaccinated must also be considered, as vaccination prioritization strategies may cause age-based differences in the ability to travel at the

moment. **The Panel recommends that all travellers follow requirements from public health authorities (including physical distancing, mask wearing).**

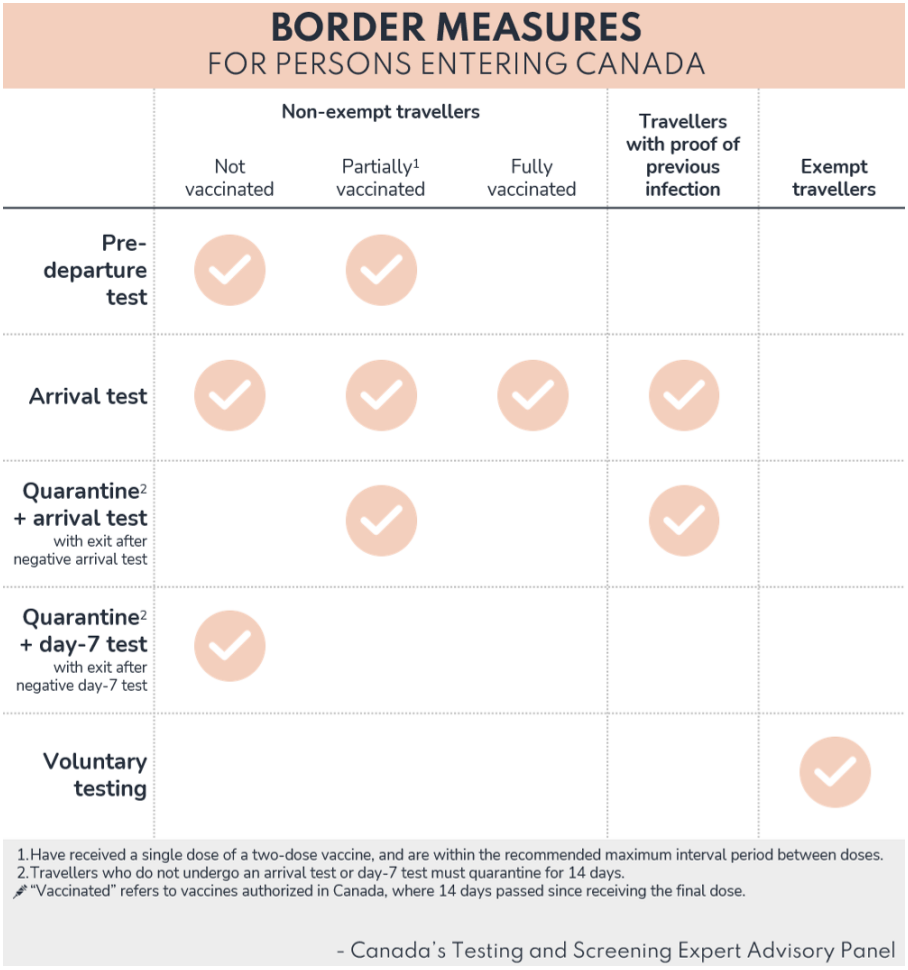

Figure 3: Summary of border measure recommendations

Table 1: Key air and land border measure recommendations for persons entering Canada

Group	Proposed measures
Unvaccinated non-exempt traveller	**Summary of evidence** • Pre-departure testing can reduce the number of actively infectious individuals at borders and is most effective shortly before departure. PCR testing within 72 hours of departure or a rapid antigen test (RAT) within 24 hours of departure may be equally effective. • Arrival testing is more effective than pre-departure testing but both tests are more effective than either alone. • A 7-day quarantine with a day 7 test may be similarly effective to a 14-day quarantine alone. A Canadian airport pilot project found that 94% of all detected cases were found at the day 7 test.

- Canadian airport pilot studies indicate that secondary contacts are the same between those in quarantine and exempt travellers, which highlights the importance of quarantine for the whole household.

Implementation

1. **Pre-departure** test may be a PCR test within 72 hours of departure or a RAT (authorized test) conducted within 24 hours of departure.
2. **On arrival PCR test** for air travellers upon entering Canada at the border testing station or designated quarantine facility. For land travel, the PCR test may occur off-site using a take-home sampling kit.
3. **Quarantine at approved place of quarantine or designated quarantine facility**.
    - Household members must quarantine with the traveller if isolation is not possible within the home. Alternatively, travellers can go to a designated quarantine facility.
4. **Day 7 PCR test** and then leave upon receipt of a negative test. A traveller with a positive test result will be required to isolate based on public health guidance. Those who do not complete the day 7 test must quarantine for 14 days in total.

Partially vaccinated non-exempt travellers (received a single dose of a 2-dose vaccine within the maximum recommended 2-dose interval period)

Summary of evidence

- Emerging evidence suggests that a single dose of the 2-dose vaccines available in Canada is effective against lab-confirmed COVID-19 and severe disease for a substantial period of time in most individuals.

Implementation

1. **Provide acceptable evidence/proof**, as defined by the Government of Canada, of receipt of single dose of a 2-dose series of an authorized vaccine and sufficient time has passed for an immune response to occur. Partially vaccinated travellers who are outside the maximum recommended 2-dose interval period are considered unvaccinated.
2. **Pre-departure** test may be a PCR test within 72 hours of departure or a RAT (authorized test) conducted within 24 hours of departure.
3. **On arrival PCR test** for air travellers upon entering Canada at the border testing station or designated quarantine facility. For land travel, the PCR test may occur off-site using a take-home sampling kit.
4. **Quarantine** at home until receiving a negative arrival test.
    - Household members must quarantine with the traveller if isolation is not possible within the home. Otherwise, travellers can go to a designated quarantine facility.

Fully vaccinated non-exempt travellers

Summary of evidence

- Evidence indicates that COVID-19 vaccines available in Canada are effective against lab-confirmed COVID-19 and severe disease.
- Emerging evidence suggests that COVID-19 vaccination may reduce asymptomatic infection and transmission.

- Uncertainty on whether some COVID-19 vaccines will have reduced protective effects against certain variants of concern.

Implementation

The Panel understands that there are implementation considerations that will influence timing of changes to vaccinated travellers.

1. **Provide acceptable evidence/proof**, as defined by the Government of Canada, of receipt of an authorized vaccination and sufficient time has passed after the final dose in vaccine series
2. **Eliminate** pre-departure test for travellers entering Canada and day 10 testing
3. For surveillance purposes, administer **PCR test on arrival**
4. **Self-monitoring for symptoms and no quarantine required unless the on-arrival PCR test confirms a positive result**
5. Airports/airlines use **different streams** to separate vaccinated, partially vaccinated and unvaccinated travellers.

Travellers with proof of previous infection in last 14 to 180 days

Summary of evidence

- Emerging evidence suggests that previous infection within 5 to 7 months protects against lab-confirmed COVID-19 and severe disease.

Implementation

1. **Provide acceptable evidence/proof**, as defined by the Government of Canada, of infection more than 14 days but less than 180 days before the day of travel
2. **On arrival PCR test** for air travellers upon entering Canada at the border testing station or designated quarantine facility. For land travel, the PCR test may occur off-site using a take-home test kit.
3. **Quarantine** at home until receiving a negative arrival test
    - Household members must quarantine with the traveller if isolation is not possible within the home. Otherwise, travellers can go to a designated quarantine facility.

Exempt travellers

Summary of evidence

- Between March 10 and 16, 2021, exempt travellers comprised 31% of all international air arrivals and 93% of land arrivals.
- In December 2020, preliminary results from a Canadian pilot study found that 2.8 exempt workers for every 100 exempt workers at land and air borders tested positive for COVID-19.
- Two other Canadian pilots found zero cases among exempt travellers crossing by land.

Implementation

1. **Voluntary testing** on arrival for exempt travellers with lab-based PCR or rapid test
    - Take-home sampling kit and/or scale up pharmacy capacity

- Self-monitoring for symptoms and no quarantine required unless the test is positive

Note: The voluntary arrival testing program should provide useful information on further potential recommendations for this group.

Implementation considerations

Surveillance system characteristics

Ongoing evidence review and communication between Canada and its international partners will be essential in maintaining a strong border testing program. Federal and provincial/territorial public health authorities should collaborate closely to identify details of the travel history of positive travellers, particularly those with VoCs. This will help to identify and adapt to new variants and vaccine effectiveness in a timely fashion.

Efforts to keep lab test and sequencing turnaround times as rapid as possible and consistent with national and provincial standards should be ongoing. This will maximize the timeliness of surveillance testing information and allow public health case and contact management to respond rapidly.

Voluntary testing in exempt travellers is mainly for surveillance purposes. It also may provide information that informs further recommendations for exempt travellers.

Border logistics

Despite dramatic decreases in traveller volumes as a result of the pandemic (up to 90% reductions from pre-pandemic travel), some airports and land borders may not be able to manage additional on-site COVID-19 testing. An increase in travel will impact the number of people congregating in an airport. If travel increases in the coming months, it will pose a greater burden on arrival testing and lab capacity, particularly for unvaccinated non-exempt travellers. Similarly, even if only a small number of travellers are infected with SARS-CoV-2 and initiate new chains of transmission, the absolute number of new chains of transmission will increase as the number of unvaccinated non-exempt travellers increases. Managing the increased number of travellers on arrival is best solved through frequent review of data and continuous improvement in the nature and application of border measures. These measures must be responsive to and anticipate changes in risk based on evolving evidence.

Larger airports are experts in logistics and should be able to scale up to accommodate larger volumes. However, they will need advance notice to prepare. The more advance the notice, the more prepared they will be. Smaller airports may face more challenges. It will be important that all logistical elements, including adequate resources and scaling, are in place to ensure safe and effective movement of travellers, as well as effective communications about testing and quarantine.

Land border crossings will need to be reviewed to ensure they can scale up to effectively manage higher volumes and testing requirements, even if only to provide ‘take-home’ sampling kits.

Quarantine and testing capacity

Changes in border measures over the coming months will eventually lead to an increase in the number of travellers entering and departing the country. Implementation of ongoing arrival and day 7 testing of travellers will require additional capacity to support testing processes, telephone support and quarantine compliance verification.

New testing tools

As new testing tools become available, Canada should explore how they can be used to improve border measures. For example, rapid tests that also screen for VoCs could increase the speed of testing as well as the speed for managing cases and contact tracing. Similarly, emerging evidence on the effectiveness of unsupervised home

sampling could help relieve current logistical constraints. If adopted, further consideration is required to ensure appropriate reporting to relevant public health authorities. As well, implementation of new testing tools will require guidance to assist border agents will require support whenever new testing tools are implemented.

Digital technology

Data collection and management provides decision-makers with the necessary timely information needed to respond during the pandemic. Data on the vaccinated population and the presence of VoCs can inform future border measures. ArriveCAN is an important first step in the adoption of digital technology. However, maximizing further use of existing and rapidly evolving digital technology to support border measures is also key (for example, use of artificial intelligence in Greece).

The Panel strongly encourages further exploration of digital technology that can be used to gather data for vaccinated populations and to improve quarantine effectiveness and compliance.

Communication

Along with border measures, travellers' actions (for example, compliance with measures) once they enter Canada will be a key contributor to minimizing the risk of secondary transmission of SARS-CoV-2.

The Panel recommends providing simple and clear information to travellers at the border about what they need to do and about their risk of infecting others while in quarantine. Communicating this information will help travellers make decisions to minimize the risk they may pose to others.

Further evolution of border measures

As new evidence about vaccination and variants of concern emerges, border measures will need to evolve. The Panel offers the following criteria that may be used to decide when to reduce border measures:

- there's a high vaccination rate, particularly in high-risk settings and populations at high risk of mortality and morbidity (for example, older than 50)
- evidence supports herd immunity: the risk associated with specific recognized VoCs has been considered and found acceptable (for example, vaccines have been shown to be effective for recognized VoCs)
- surveillance capacity is maintained among travellers for existing and new VoCs across traveller groups

Conclusion

Border measures are essential to reduce the importation of SARS-CoV-2 and variants of concern into Canada. As vaccines continue to roll out in Canada and internationally, it is an opportune time to examine how border measures can be adjusted to continue to mitigate pandemic risks through testing and surveillance. Managing a border is inherently complex but the measures in place must be easy to understand, equitable, feasible and consider both benefits and harms. The proposed approach is evidence-informed and reflects the global situation on SARS-CoV-2, VoCs and vaccine effectiveness.

The Panel identified 5 distinct groups of travellers for its border recommendations (unvaccinated, partially vaccinated, fully vaccinated, previously infected and exempt travellers).

We present our recommendations to the Minister of Health for consideration in developing the federal government's approach to future border measures during the pandemic. Any changes to border measures will likely need to be phased in to give enough time to adjust processes, logistics and communications.

Annex A: Summary of current border measures for persons entering Canada

Table A-1: Border measures for persons entering Canada as of April 2021

Current measures	Land	Air
ArriveCan completion	Required	Required
Pre-departure testing	Ages 5+ must provide proof of a negative COVID-19 molecular test taken up to 72 hours before arrival in Canada (must be taken in US)	Ages 5+ must provide proof of a negative COVID-19 molecular test taken up to 72 hours before their departure
Arrival testing	Take a molecular test for COVID-19 on arrival	Molecular test before departure from the airport
Follow-up testing	Take an additional PCR test at day 10 of their 14-day quarantine (provided with test kit and instructions at border)	Take an additional PCR test on day 10 of the mandatory quarantine (provided with test kit and instructions before leaving airport)
Quarantine	Mandatory 14-day quarantine with check-ins from public health authorities	Mandatory 14-day quarantine including up to 3-day hotel quarantine at their cost upon arrival until negative COVID-19 test is received

Note: marine entry is restricted at this time

Annex B: Exempt travelers

Travellers may be **exempt** from quarantine, pre-entry testing and/or arrival testing. Many of those who are exempt from either testing or quarantine are exempt for **essential** reasons. However, those exempt from federal quarantine or testing must still adhere to provincial and territorial restrictions.

Table B-1: Summary of border measure exemptions

Quarantine exemptions	Pre-testing exemptions	Arrival testing exemptions
Those exempt from quarantine include those who: • Provide essential services • Maintain the flow of essential goods or people • Are receiving medical care within 36 hours of entering Canada • Regularly cross the border to work • Live in integrated trans-border communities Essential reasons for quarantine exemption include: • Those in the medical and health care field • Essential work as defined under Emergency Orders (includes persons in the trade or transportation sector, emergency service providers and technicians or specialists who support critical infrastructure) • Those within trans-border, remote cross-border or geographically restricted communities • Cross-border students and people driving them • Cross-border custody arrangements • Other special circumstances	Those exempt from pre-entry tests include those who: • Have a resolved COVID-19 infection (positive COVID-19 test taken between 14 and 90 days before travel) • Are children under 5 years of age • Are transiting through Canada • Are receiving medical treatments • Require medical evacuation • Essential work as defined under Emergency Orders (includes persons in the trade or transportation sector, emergency service providers, and technicians or specialists who support critical infrastructure) • Other special circumstances	Those exempt from arrival testing include those who: • Have a resolved COVID-19 infection (positive COVID-19 test taken between 14 and 90 days before travel) • Are children under 5 years of age • Have diplomatic, official, and courtesy visas • Require medical evacuation • Are traveling for national interest reasons as determined by the Minister of Health • Are exempt from quarantine requirements

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