

# COVID Model Projections

April 27, 2022

[BC COVID-19 Modelling Group](#)

[@bcCOVID19group](#)



# About BC COVID-19 Modelling Group

The BC COVID-19 Modelling Group works on rapid response modelling of the COVID-19 pandemic, with a special focus on British Columbia and Canada.

The interdisciplinary group, working independently from Government, includes experts in epidemiology, mathematics, and data analysis from UBC, SFU, UVic, and the private sector, with support from the Pacific Institute for the Mathematical Sciences.



<https://bccovid-19group.ca>

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*Independent and freely offered advice,  
using a diversity of modelling approaches.*

# Overview

## **The second Omicron wave (BA.2) continues to rise in BC**

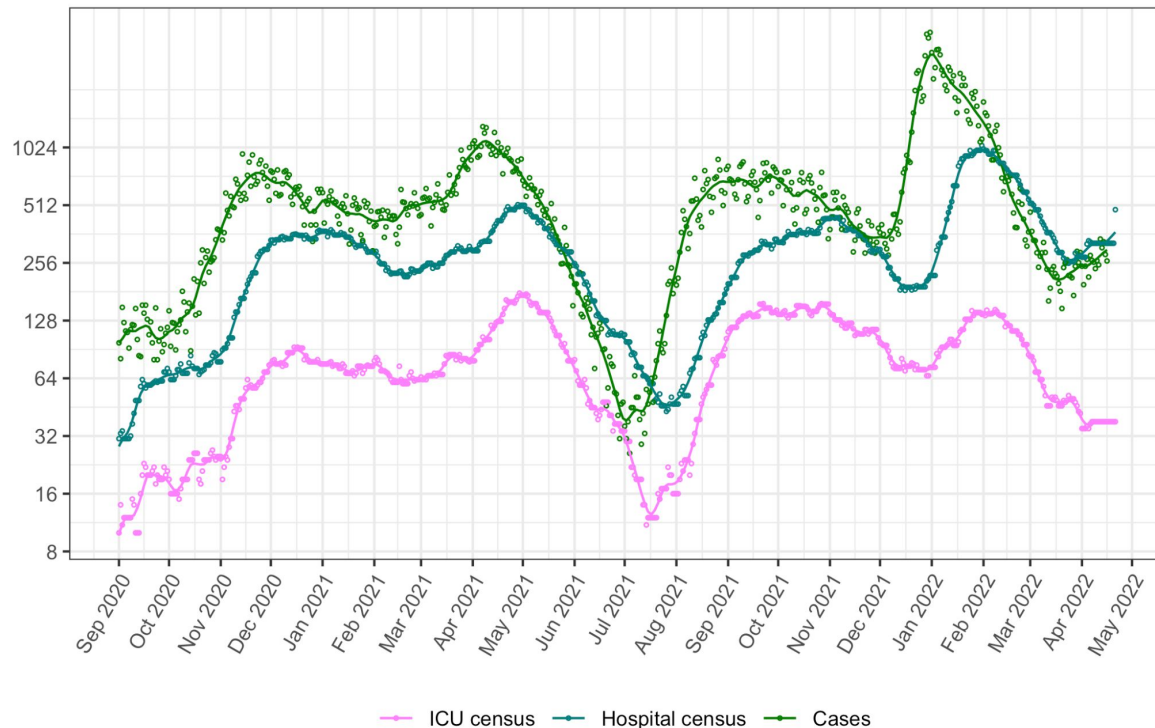
- Reported cases, cases among those aged 70+, hospitalization data, Facebook/UMD survey data and wastewater data all suggest an ongoing rise in COVID-19 infections in BC.
- Omicron sub-variant BA.2 continues to rise in frequency across Canada. Although no new genomic data is available for BC, it is likely that the BA.2 frequency is well over 80% in BC.
- Several provinces are ahead of BC in this wave and their data as well as less reliable local data suggest (with some uncertainty) that the BA.2 wave in BC will not be as bad as the BA.1 wave.

## **Risks of a second Omicron wave are hard to gauge**

- The first line of immune protection from antibodies rises with boosters, as well as following infection, but the extent of this protection wanes over time, making it challenging to know how protected BC is during this second Omicron wave.
- The most vulnerable and the most exposed (e.g., health care workers) were boosted first and so now face the lowest level of protection as we enter the second Omicron wave.

# Hospital trends in BC

British Columbia COVID-19 cases, hospital and ICU census



Data: BCCDC for cases, Canada Covid-19 tracker for hospital and ICU census

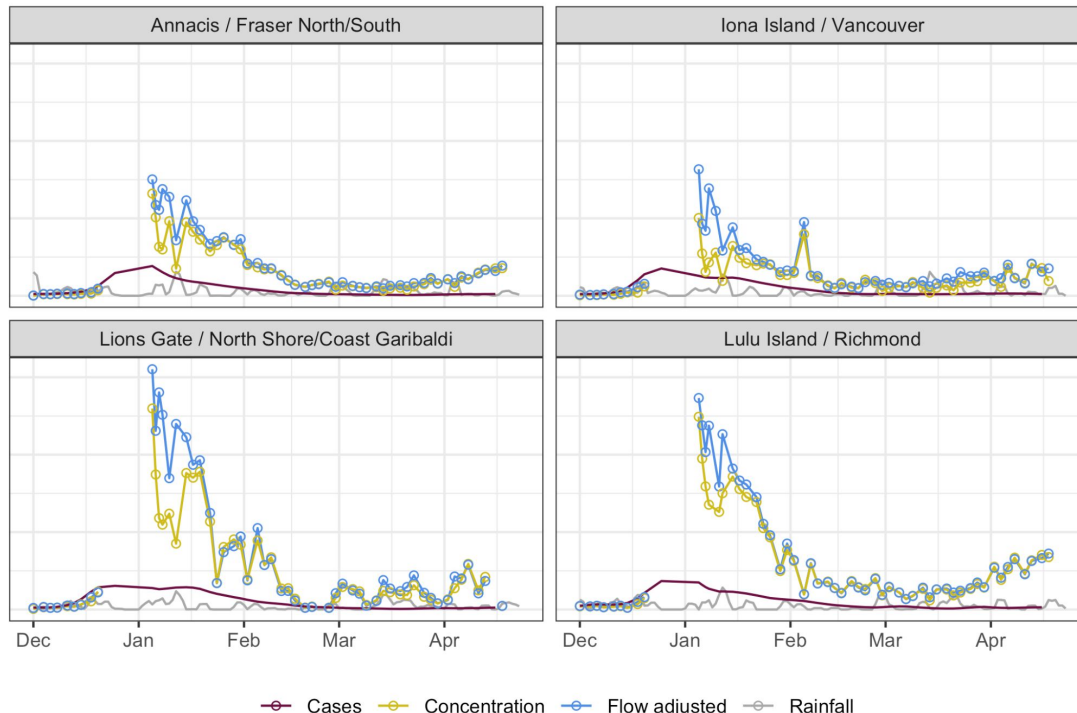
The numbers of **reported cases** and people in **hospital** (but not **ICU**) are showing upward trends in BC.

# Wastewater trends in Metro Vancouver

Recent wastewater COVID concentration vs case counts

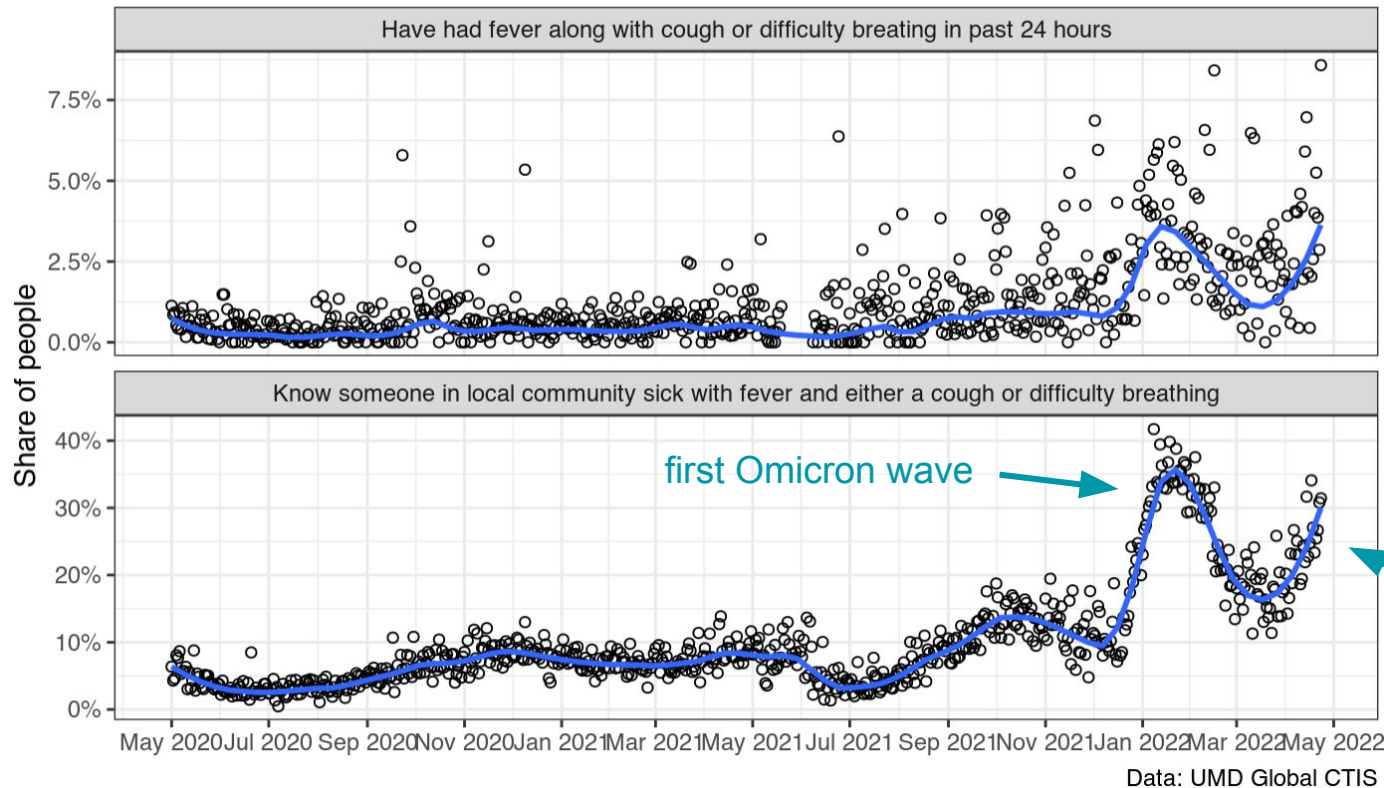
Clear trends in wastewater signals are difficult to discern, with some regions showing an uptick.

Increasing collection frequency, expanding coverage, reducing data lag, and adding covariates to help with modelling are important steps toward an alternative surveillance program based on wastewater.



# Wastewater trends in Metro Vancouver

## UMD CTIS Survey for British Columbia

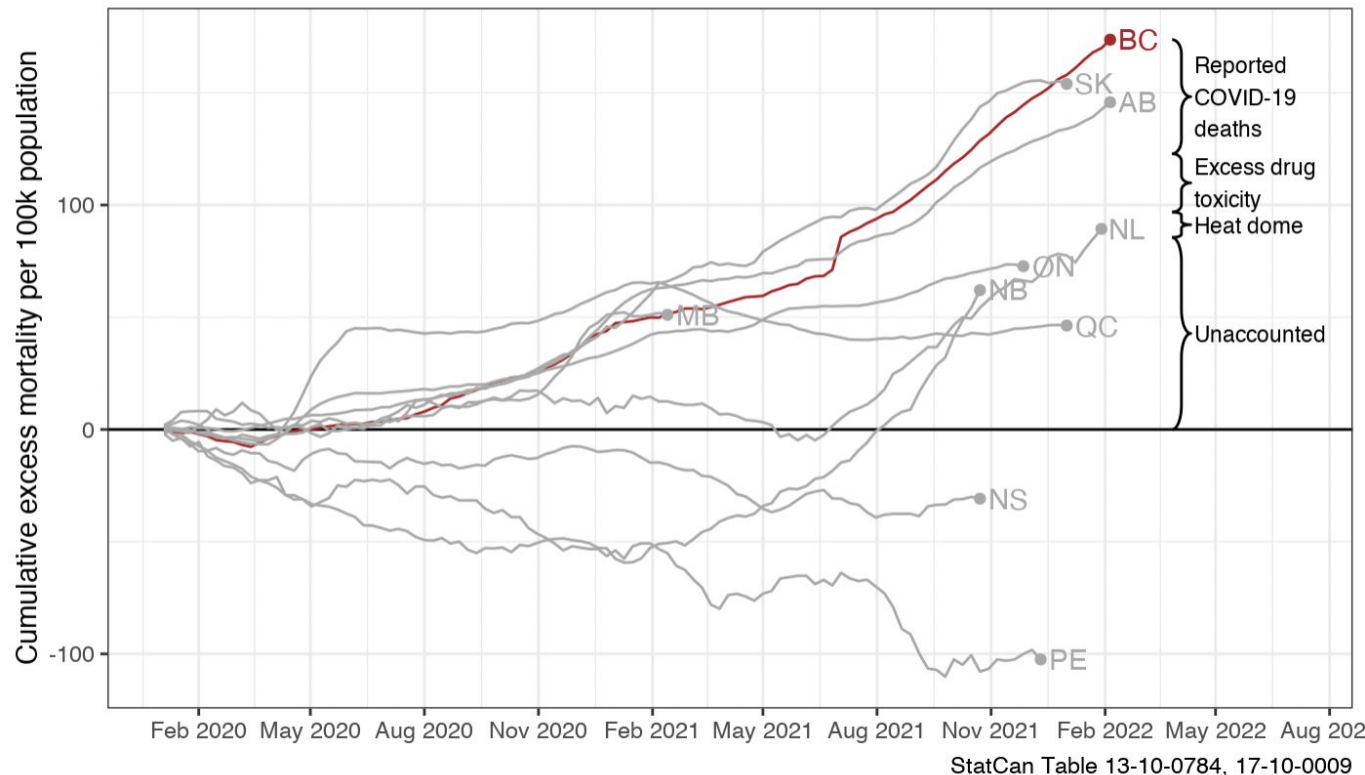


The [COVID-19 Trends and Impact survey](#), in collaboration with Facebook, shows signatures of high numbers of people who are currently infected (top) or know of someone infected (bottom) with COVID-19\*.

second Omicron wave

# Excess mortality

Cumulative excess mortality per 100k population since January 1, 2020



As official COVID-19 data in BC becomes less available it is important to consider alternative data sources to measure the impact on the lives of BC residents. Excess mortality is one such metric.

It accounts for all cause mortality in excess of expected deaths.

Half of BC's excess mortality since the start of the pandemic is accounted for in official statistics.

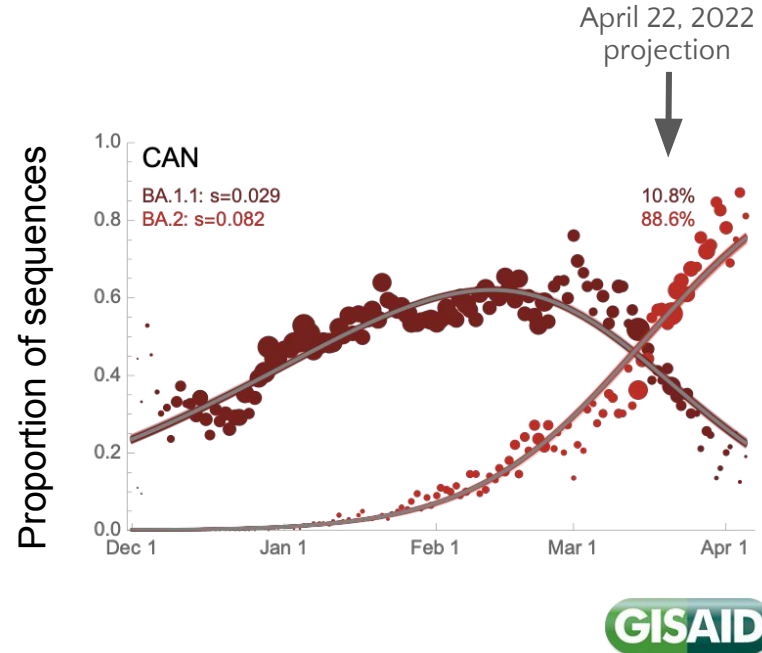


# Spread of Omicron sub-lineages in Canada

Data shared by Public Health labs across Canada allow us to track the spread of Omicron sub-lineages over time.

→ BA.1.1 is spreading slightly faster than BA.1 at a rate of  $s=3\%$  per day (dark red).

→ BA.2 is spreading much faster than BA.1 at a rate of  $s=8\%$  per day (this is similar to selective spread of Alpha).  
Proportion of BA.2 cases estimated this week at **89%**.



**How does this vary across Canada?**

**What does this imply for case numbers?**

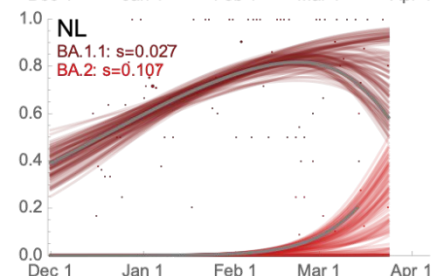
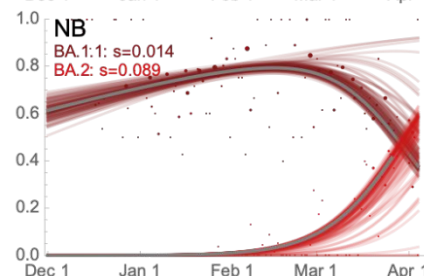
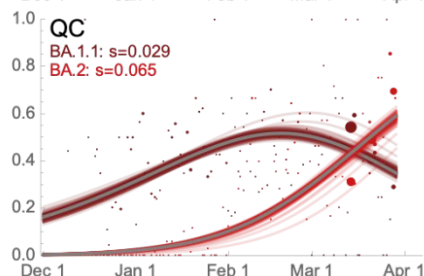
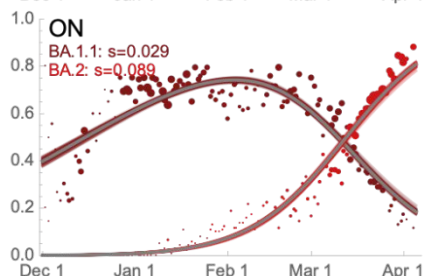
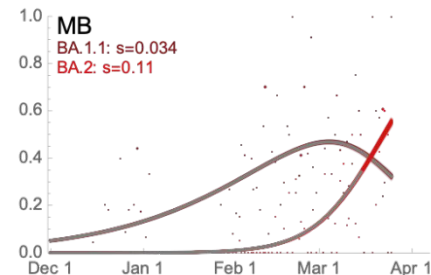
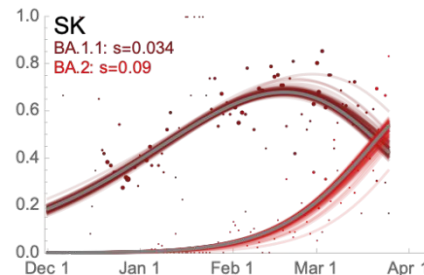
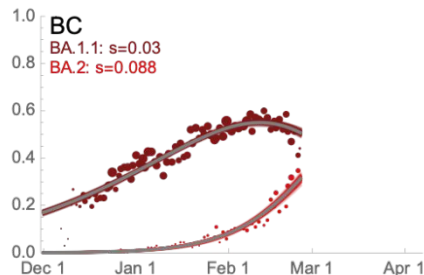
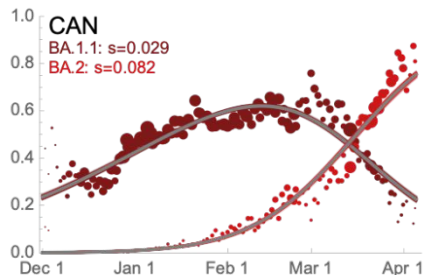
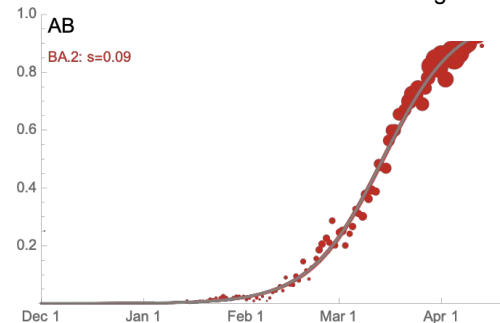
**Source (S. Otto)** Canadian sequences were downloaded from GISAID for BA.1, BA.1.1, and BA.2 (Alberta sequences were removed as AB first identifies variants and preferentially sequences BA.2). A model of selection was fit to the numbers of each type using maximum likelihood based on a trinomial distribution given the expected frequencies on each day. Hessian matrix used to show plausible trajectories, accounting for uncertainty in the parameters.



# Spread of Omicron sub-lineages in Canada

BA.2 is expected to have reached a frequency of >80% today, showing a similar selective advantage, in all provinces analysed.

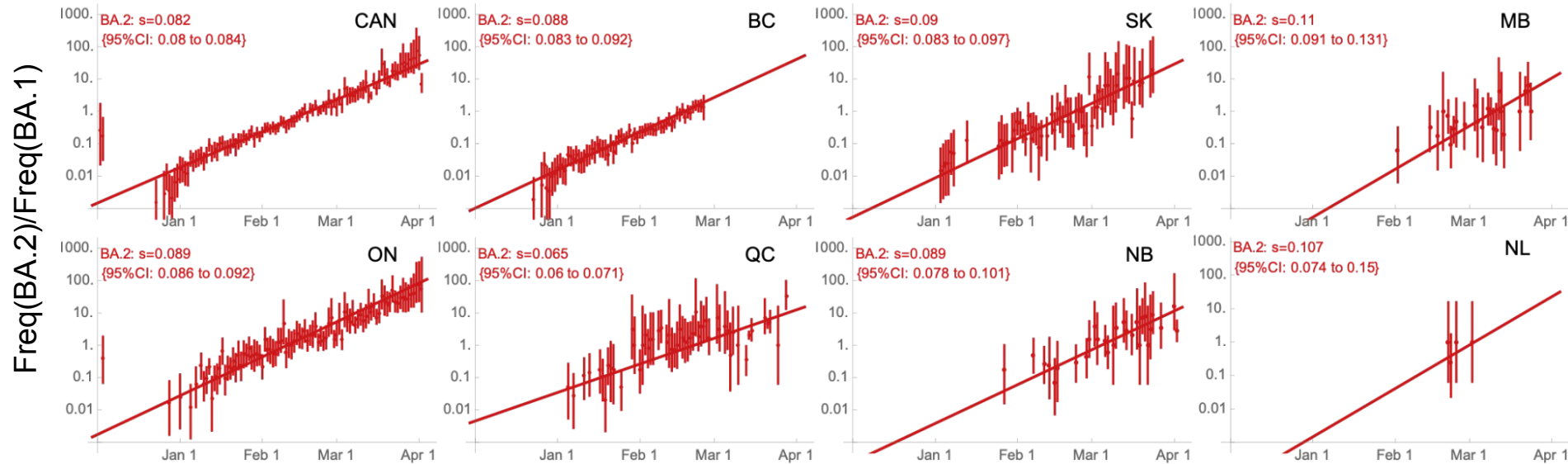
Alberta analysed separately  
(based on PCR typing)



**Source (S. Otto)** Canadian sequences were downloaded from GISAID for BA.1, BA.1.1, and BA.2 (Alberta sequences were removed as AB first identifies variants and preferentially sequences BA.2). A model of selection was fit to the numbers of each type using maximum likelihood based on a trinomial distribution given the expected frequencies on each day. Hessian matrix used to illustrate plausible trajectories, accounting for uncertainty in the parameters. Alberta data obtained based on [PCR typing](#).

# Spread of Omicron sub-lineages in Canada

The same data, plotted on a log-scale as the frequency of BA.2 versus BA.1, shows a linear rise with a slope equal to the strength of selection. **The strength of selection favoring BA.2 has remained constant** (no appreciable change in slope).

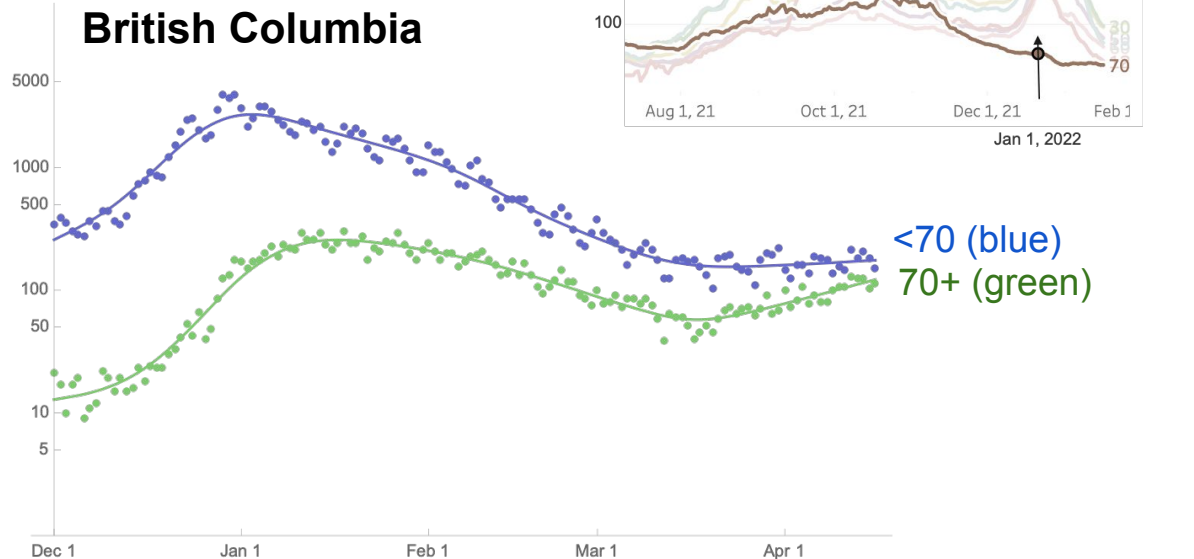


**Source (S. Otto)** Canadian sequences were downloaded from GISAID for BA.1, BA.1.1, and BA.2 (Alberta sequences were removed as AB first identifies variants and preferentially sequences BA.2). A model of selection was fit to the numbers of each type using maximum likelihood based on a trinomial distribution given the expected frequencies on each day. Profile likelihood used to obtain 95% confidence intervals. Alberta data obtained based on [PCR typing](#).

# What does this imply for case numbers?

We'll use case numbers observed in individuals aged 70+, who have been more consistently tested.

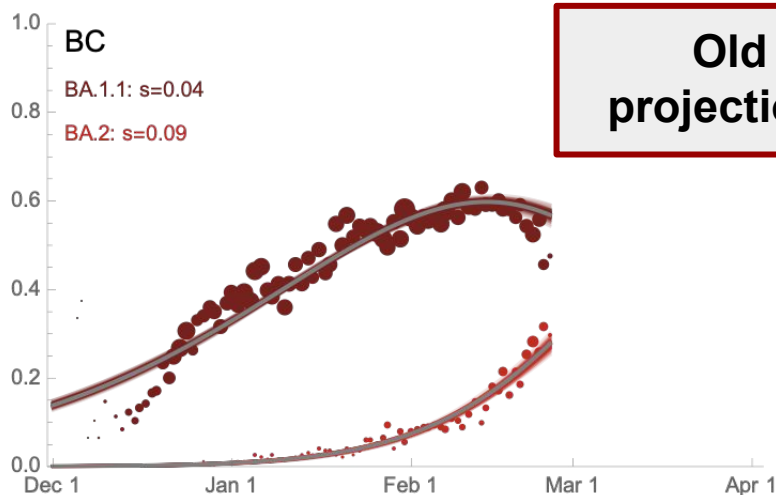
Cases among the 70+ age group continue to rise **significantly\*** (see Health Authority data in Appendix).



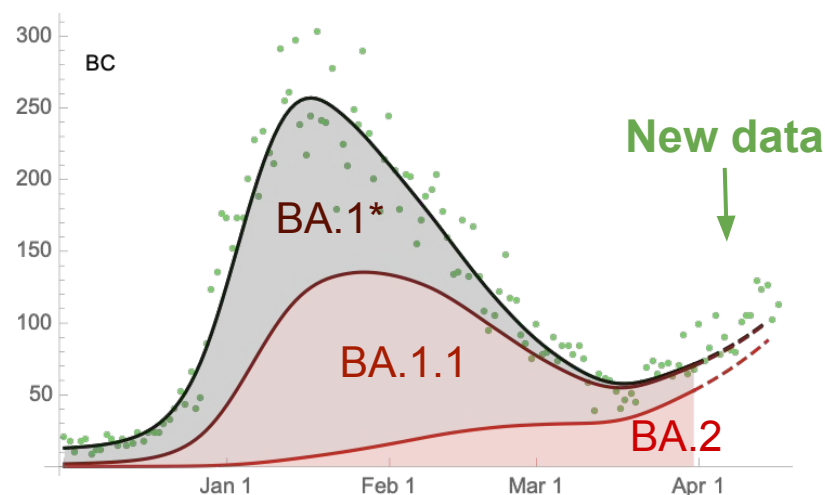
# What does this imply for case numbers?

Fitting models of selection allows us to estimate rate of spread of BA.1.1 and BA.2, relative to BA.1 in BC.

Multiplying by the # of cases in those over 70 allows us to **estimate** growth in numbers of each Omicron sublineage.



Old  
projections

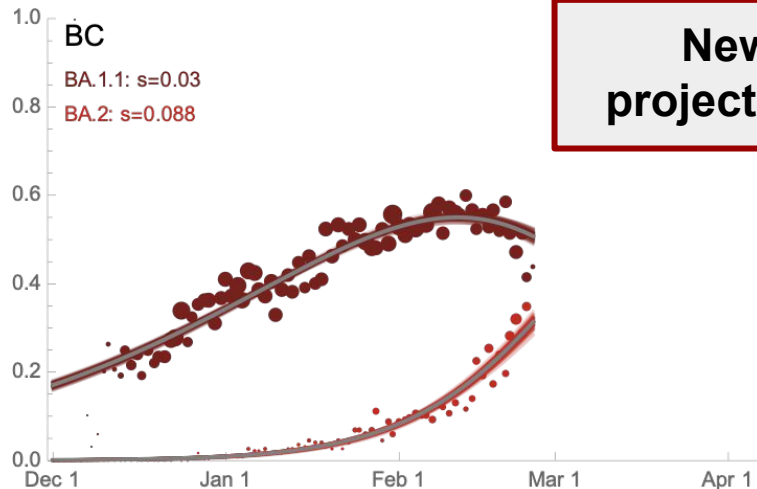


→ Here we add the last three weeks of data to previous projections, showing excellent fit to the projected rise in case numbers among 70+ due to spread of BA.2

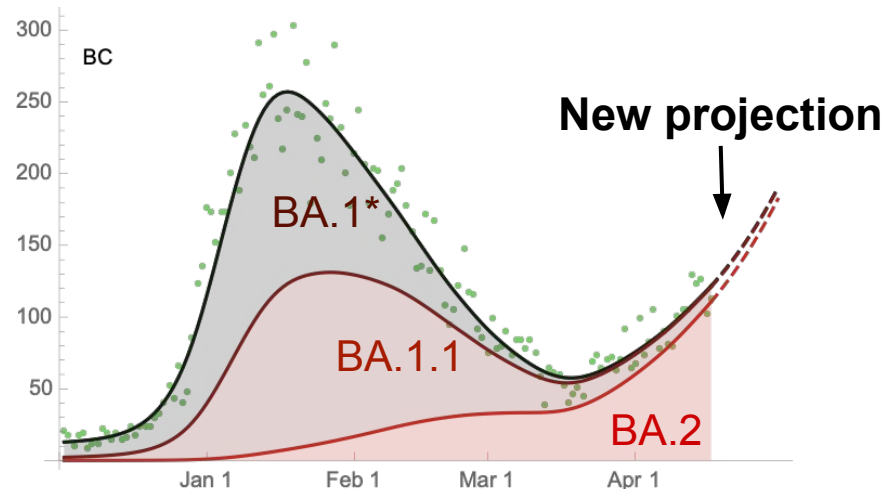
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Multiplying by the **# of cases in those over 70** allows us to **estimate** growth in numbers of each Omicron sublineage.

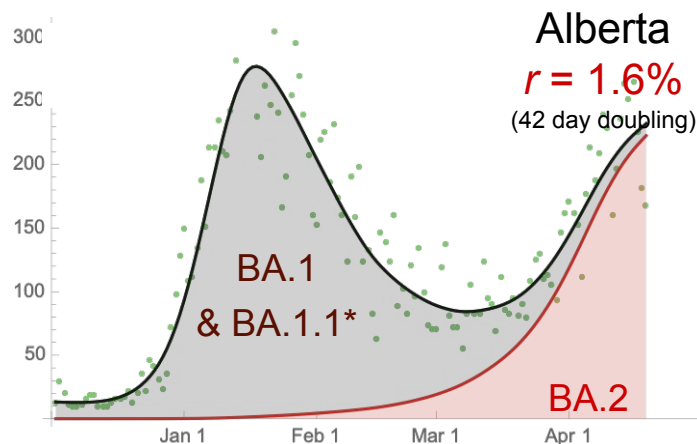
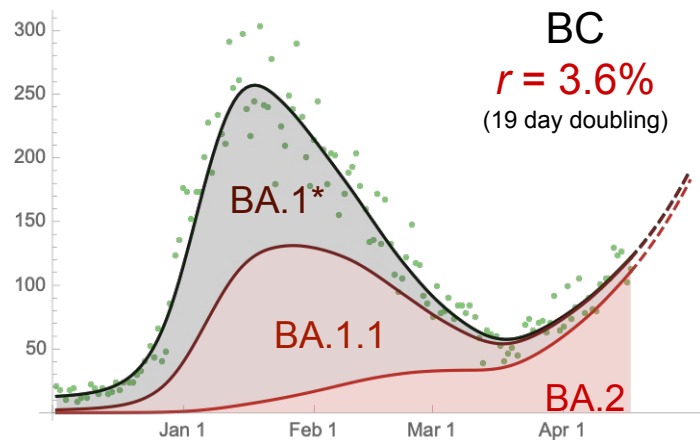


**New  
projections**

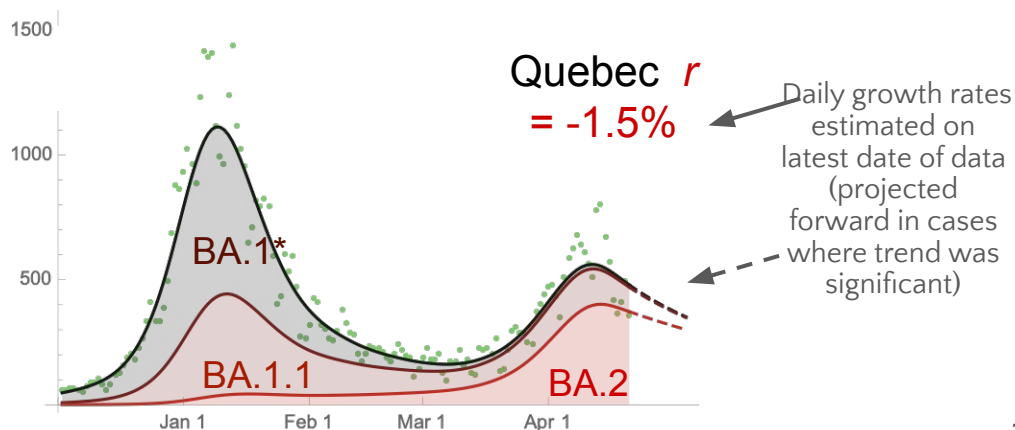
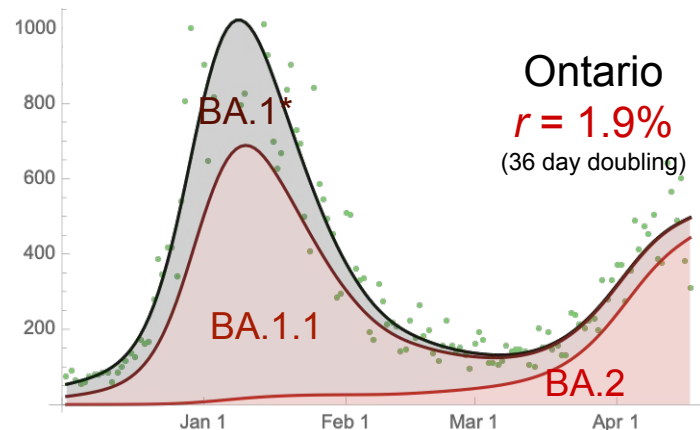


→ Updating the projection, we see a continued increase in cases.

# Daily growth rates



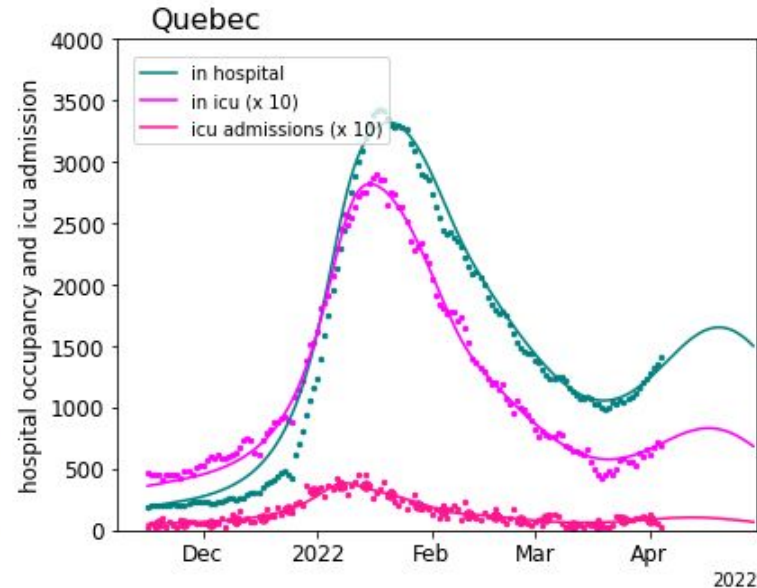
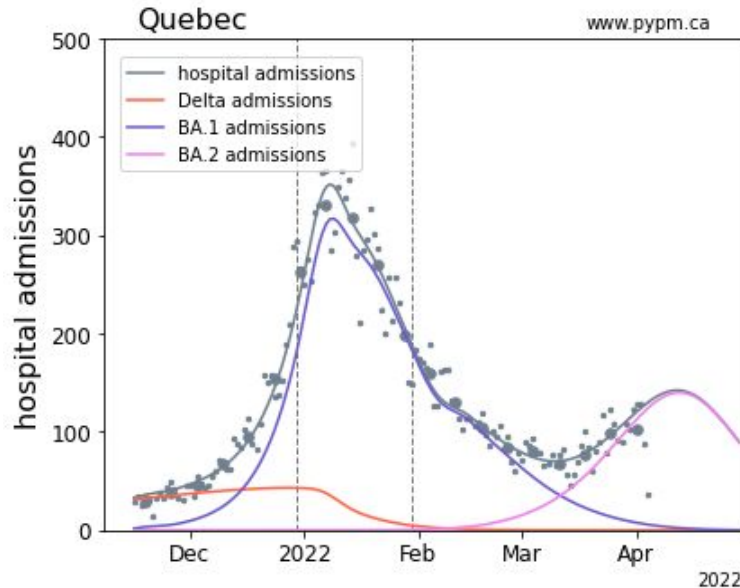
BA.2 wave appears to have peaked in QC and nearly so in AB & ON, but not yet in BC.



\*Grey includes other variants.

# April 6 hospital projection for Quebec (from our last report)

- In place of case data, hospital admission data are used to define the infection model.
- The immunity model is not well established. As a result, **projections are very uncertain**.

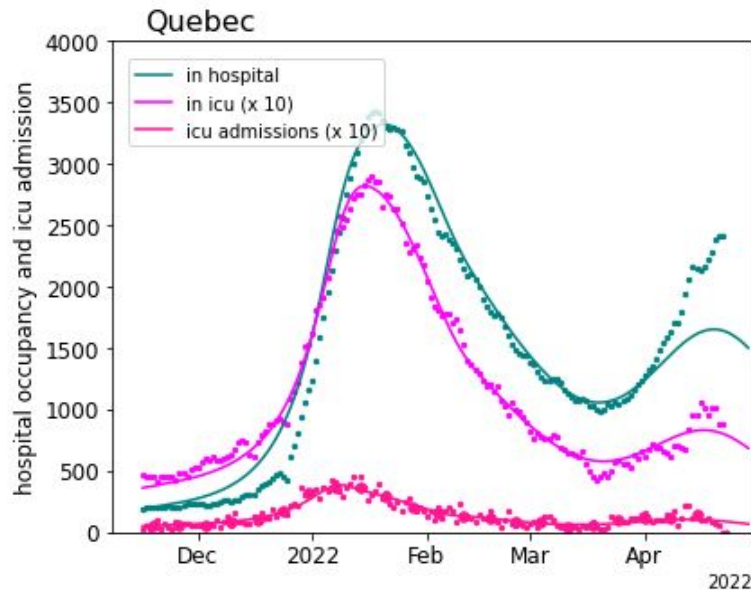
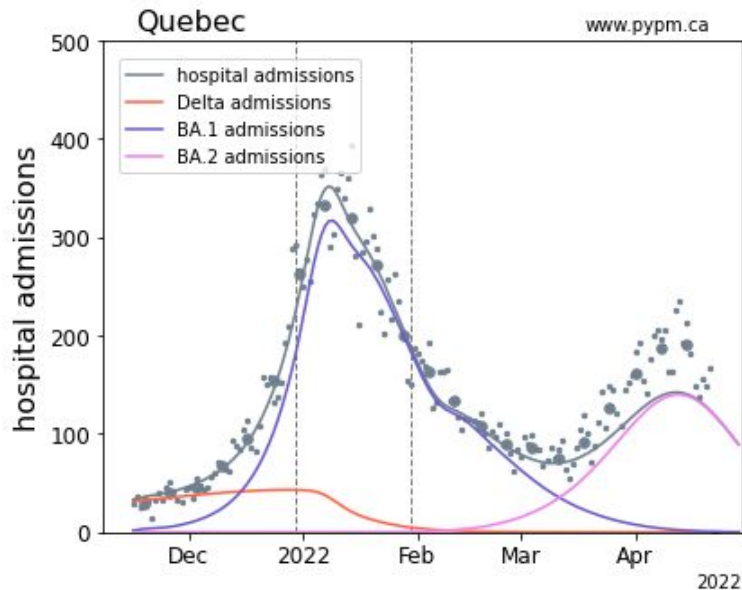


**Source (D. Karlen)** As in previous reports, the model has no age structure. Two Omicron strains are included (BA.1 includes BA.1.1) with both evading 80% of natural immunity from previous strains and 80% of 2 dose vaccinations. Booster doses are assumed to provide 80% effectiveness against infection. Omicron infections are assumed to produce symptoms with a probability of 60% of that for previous strains. The probability that symptoms lead to hospitalization is 35% of that for previous strains. Vertical lines show fitted dates for transmission rate changes. The larger dots show weekly averages.

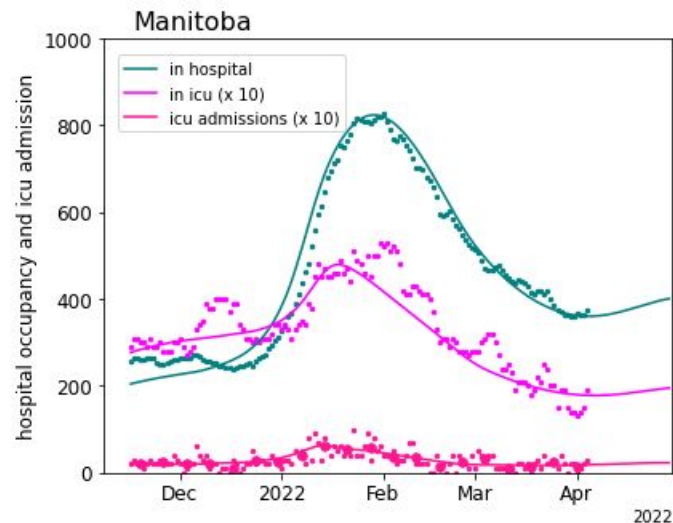
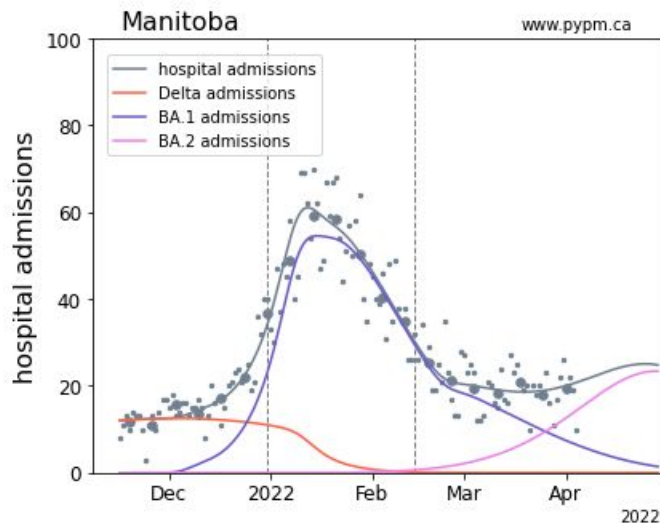
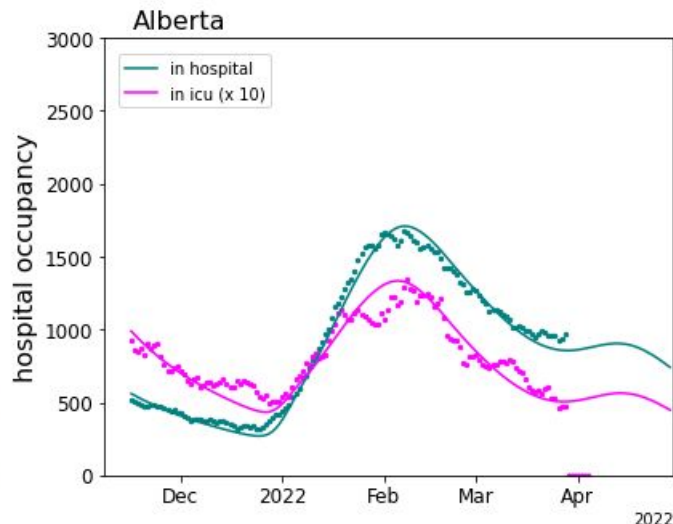
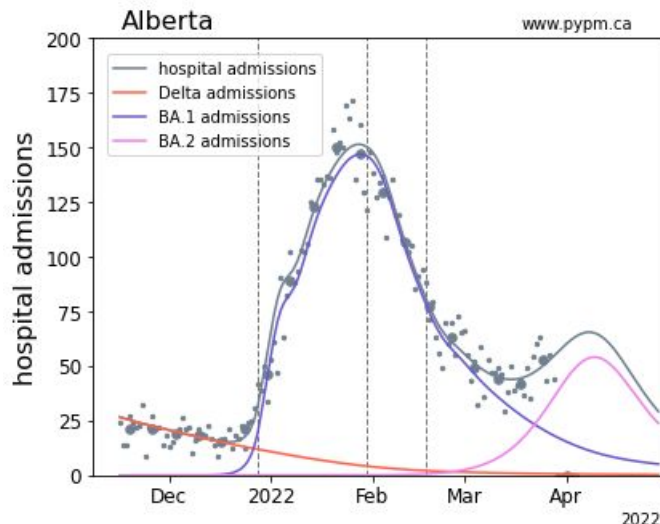


# April 6 hospital projection for Quebec (with data update)

- Previously reported hospital admissions revised upward by Quebec. Undercounting of hospital admissions (a three week delay in reporting admissions) led to an underestimated growth rate for BA.2
- If current data also undercount recent hospital admissions, the situation in Quebec is unclear

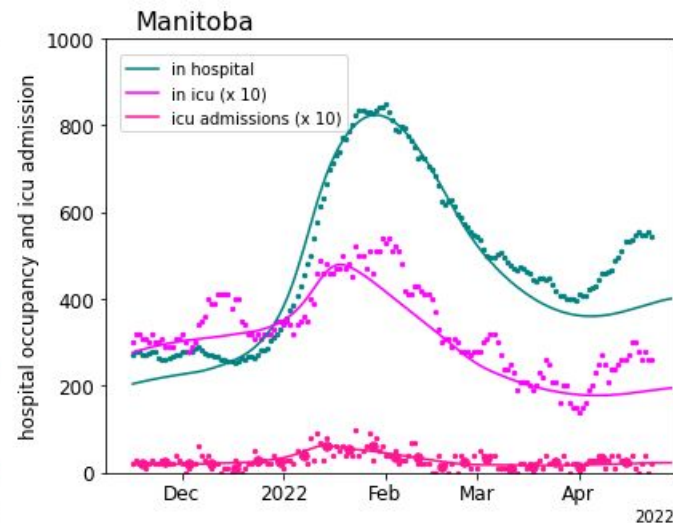
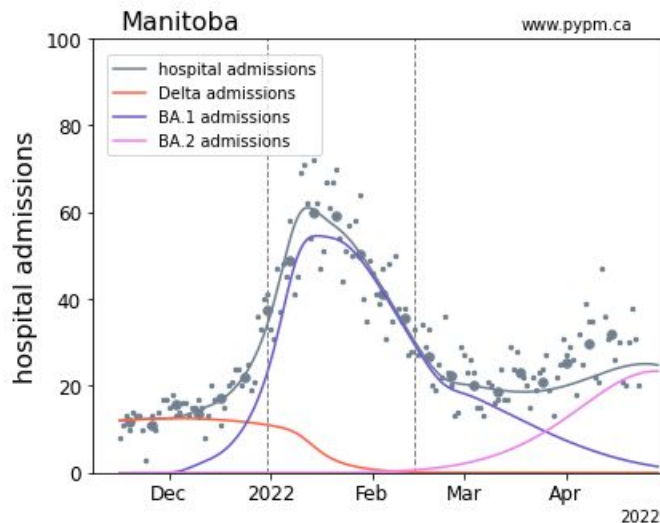
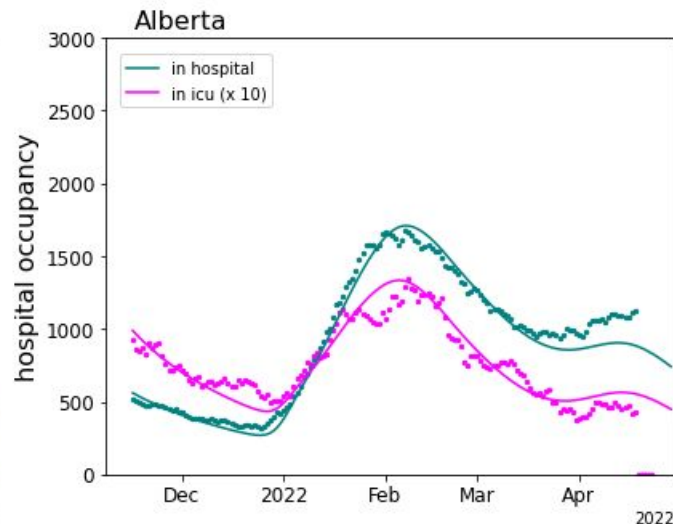
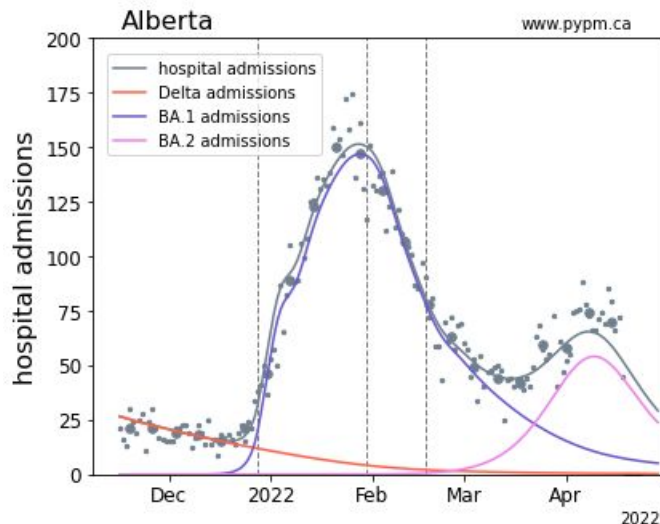


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## April 6 Projections (from our last report)

While these projections suggest that BA.2 might produce a smaller wave, that depends crucially on the level of immunity building up in the population.



## April 6 Projections (with data update)

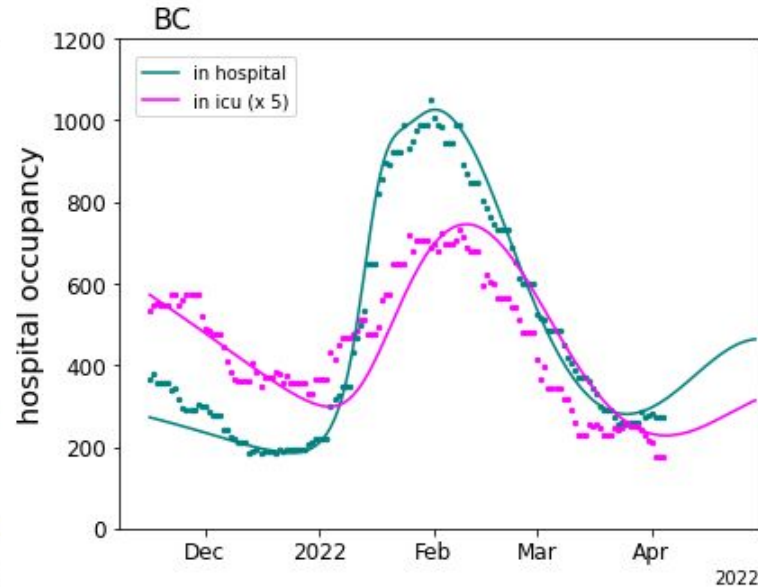
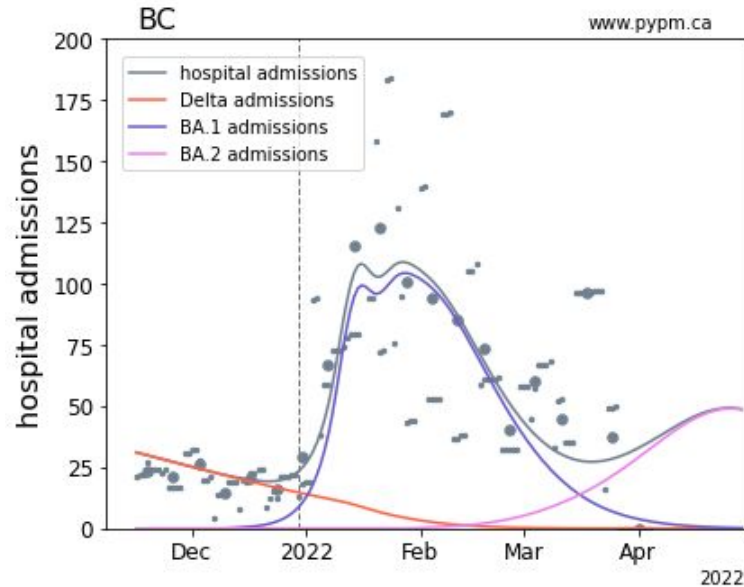
Hospital admission data from Alberta have less reporting delay than Quebec.

A turnover in Alberta hospital admission rates, as predicted from growing population immunity, appears to be consistent with recent data.

An important check of the immunity model.

# BC hospital data issue (from our last report)

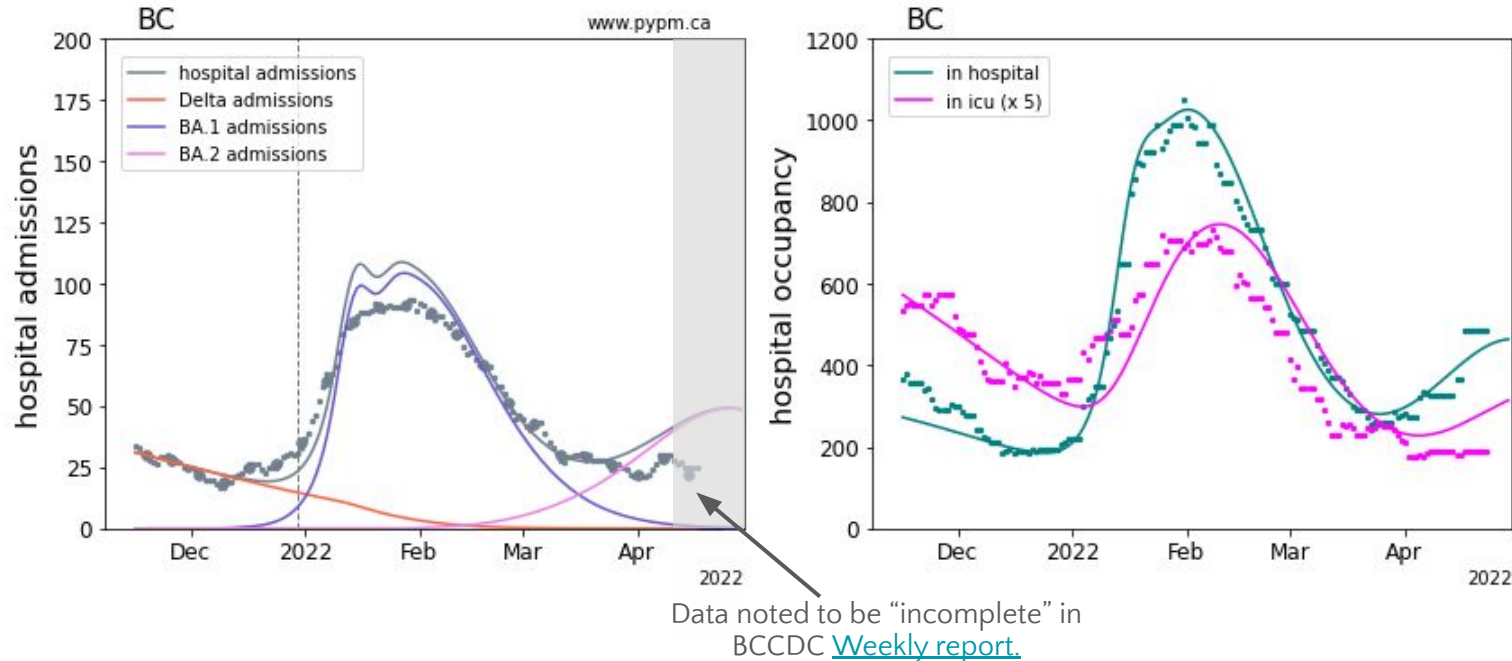
- Poor quality hospital admission data\*: large variance



\* Based on the change in reported total number of COVID cases ever in hospital ([BCCDC Dashboard](#)), which is updated irregularly across Health Authorities, leading to large under- and over-estimation of new admissions by day.

# April 6 projection compared to new data source

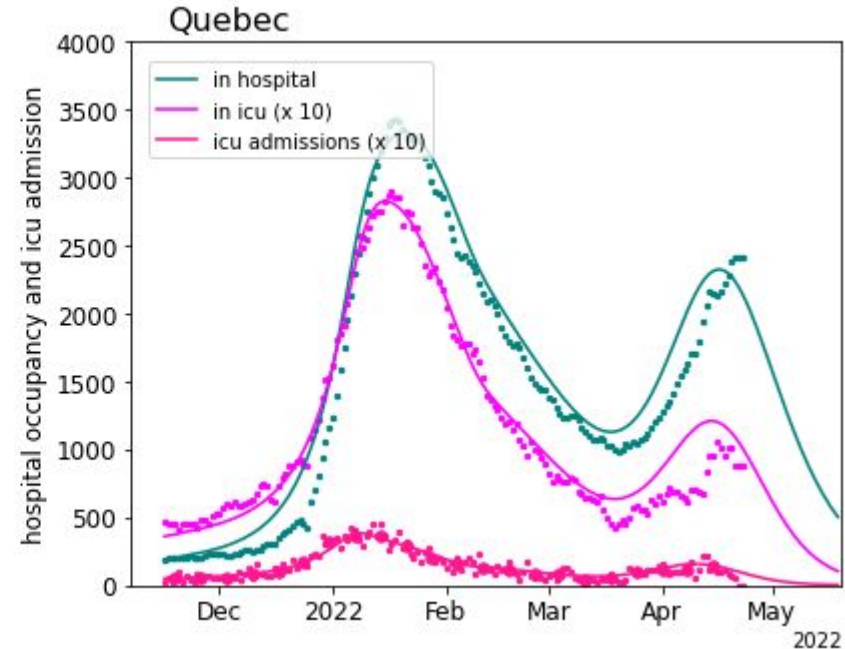
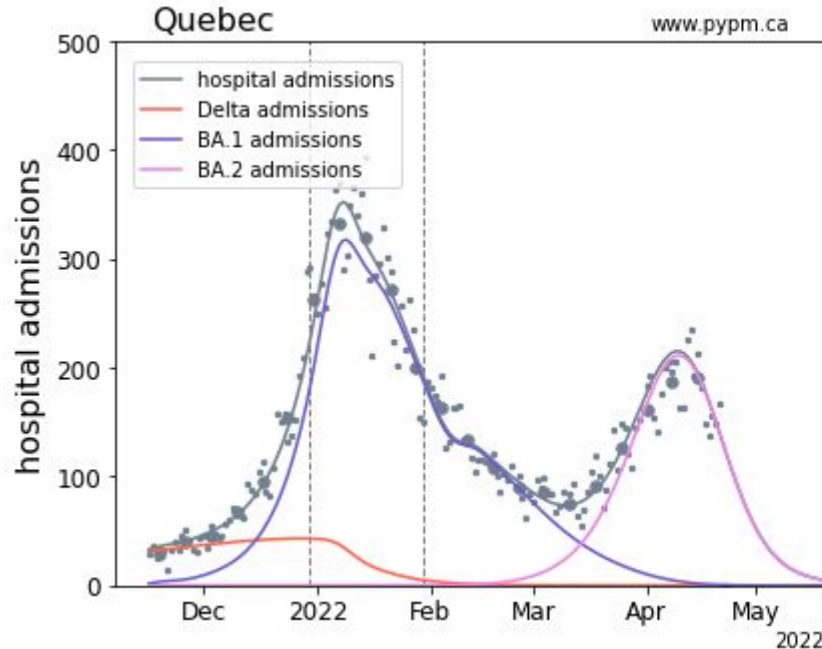
- Hospital admission data\* derived from BCCDC graphs showing reduction in risk of hospitalization by vaccination. Variance is artificially reduced in the process.



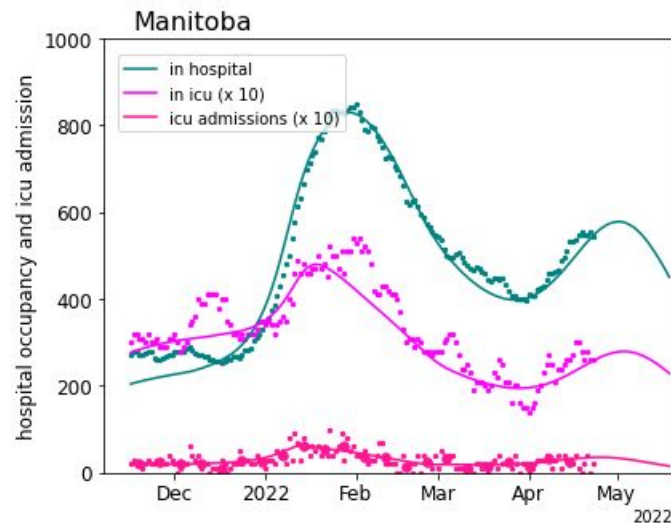
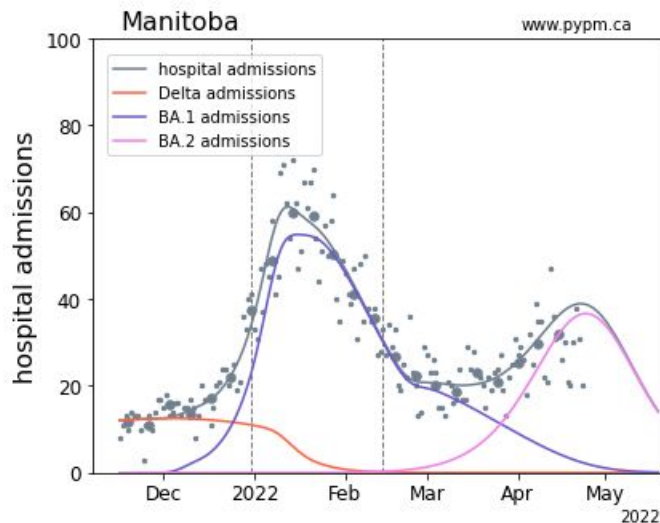
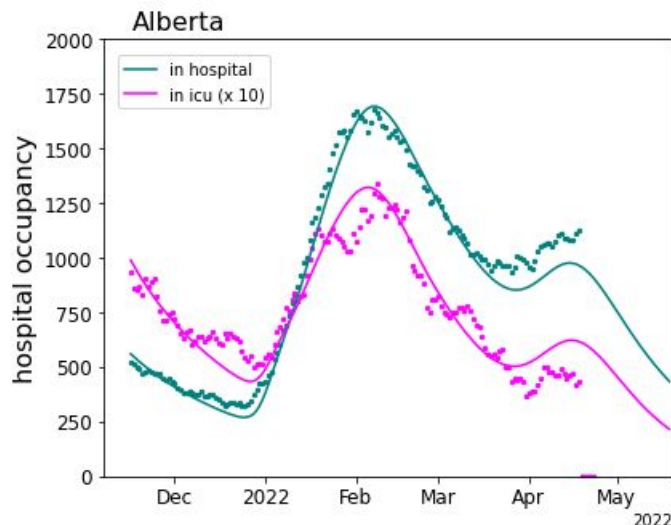
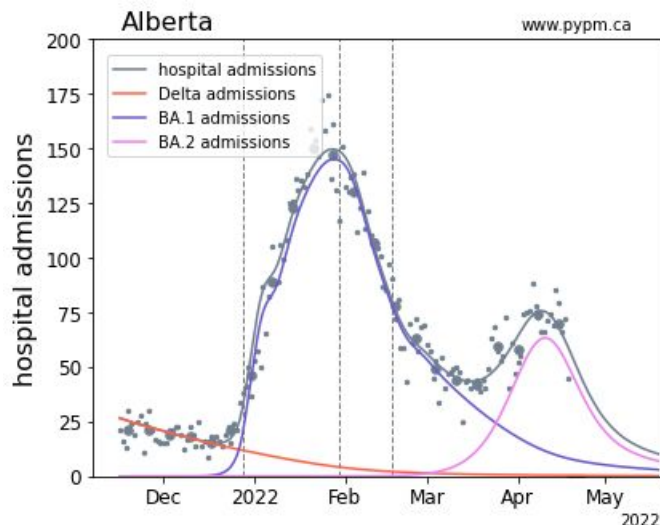
\* Based on daily hospital admissions reported on the BCCDC COVID-19 [Surveillance Dashboard](#) ("Outcomes by Vax 2"), averaging over the fraction of vaccinated and unvaccinated individuals from [COVID-19 vaccination in Canada](#) (the small fraction of partially vaccinated individuals were excluded).



# Updated hospital projections



**Source (D. Karlen)** These updated projections have adjustments for transmission parameters to better match the data. Immunity model parameters are not modified from the previous projections (April 6 report). For some provinces, the most recent hospital admission data are not used in the fit, to account for possible lag in reporting. The severity of BA.2 is assumed to be the same as BA.1.

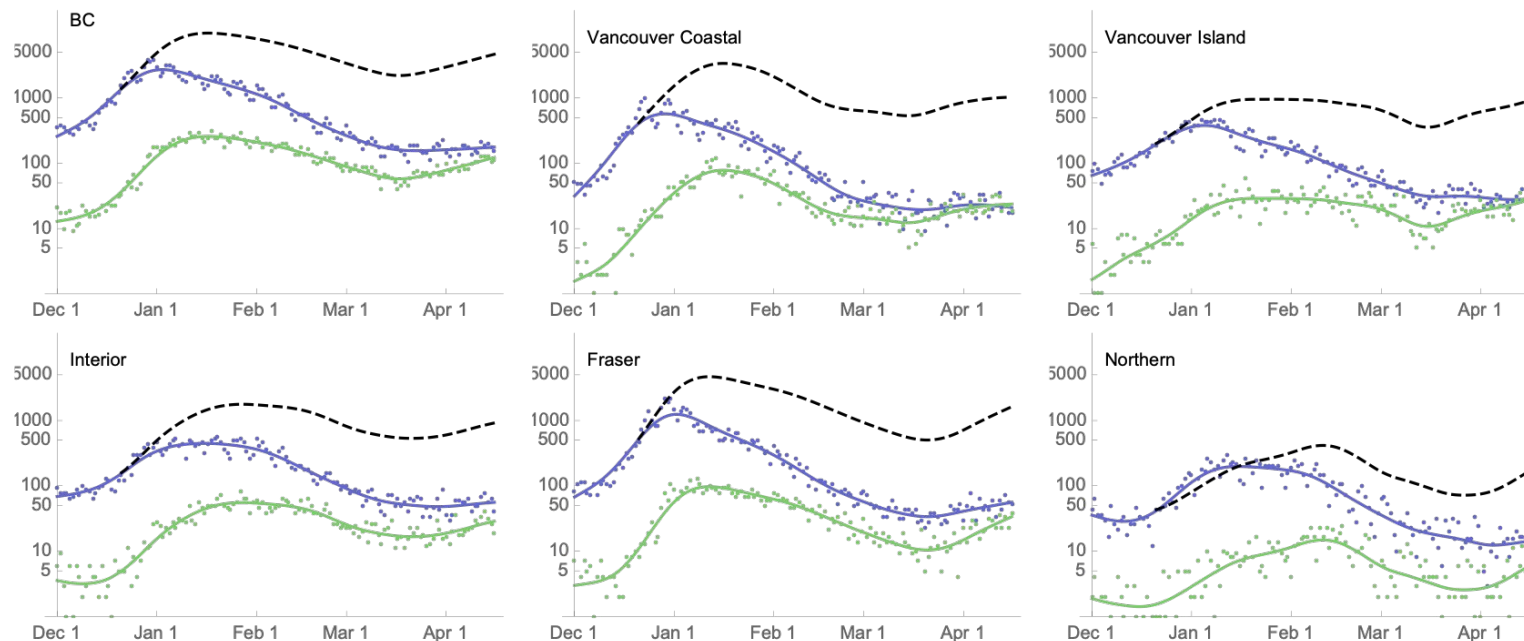


## Updated Projections

Should turnovers not occur as predicted, the immunity model parameters will need to be adjusted in the future.



# BC: Age-corrected case counts



Corrected<sup>§</sup> total

<70 (blue)  
70+ (green)

§ Correction assumes testing is consistent in 70+ and % of infections in this age class has been stable.

→ Cases among those aged 70+ (green) continue to rise significantly\* in BC. Black curves provide a rough guide of total cases, had testing continued in all age groups<sup>§</sup>.

**Source (S. Otto)** New cases per day in 10-year age groups were downloaded from the [BCCDC COVID-19 data portal](https://www.bccdc.ca/covid-19/data-portal). Cubic spline fits to log-case data were obtained (curve) and estimates for those <70 obtained by applying the fits for those 70+, shifted up to match the projection for that age class on 21 December 2022 when testing limits were initially reached in many parts of the province. \*Linear regression through log case counts among 70+ from last 14 days of data.

# Assessing your personal risk

Personal risk is the product of **risk of exposure** and **risk of outcome** if exposed. To assess personal risk we need to know both.

## Risk of exposure

- How prevalent is COVID-19 in your community? What personal precautions are you and those around you taking? What infrastructural precautions exist in the places you spend time?
- Information on the community level of covid transmission has become largely unavailable in BC.
- Information about infrastructural precautions (e.g. levels of ventilation, proxy data like CO2 readings) is sparse and there is no concerted effort to improve ventilation or make proxy data available. This is in contrast with efforts made to increase sanitation/ hand washing/ plexiglass barriers earlier in the pandemic.

## Risk of (severe) outcome

Risk of severe outcome depends on personal characteristics, and is difficult to assess. Some risks are still poorly quantified and incompletely understood (e.g. long covid).

# Key messages

## State of the Omicron wave in BC:

- The BA.2 wave continues to rise (reported cases among 70+, number of people in hospital).
- BC faces the same uncertainties regarding this wave:
  - Unknown number of recent infections – **uncertain immunity**
  - Unknown strength and time frame of waning of Omicron-based immunity – **uncertain immunity**
  - Unknown risks of severe and long-term COVID, especially with different individual histories of vaccination, infections, and risk factors – **uncertain severity**
  - Unknown responses to lifting of public health measures – **uncertain contact rates**
  - Changing and inconsistent data streams – **uncertain infection rates**
- Data and modelling of other provinces with generally similar trends suggests that the BA.2 wave may not be as large as the BA.1 wave. However, this projection is sensitive to several of the uncertainties listed above.