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.

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

https://bccovid-19group.ca
Overview

No conclusive evidence of a turnaround in the second Omicron wave (BA.2) in BC

- Reported cases, cases among those aged 70+, hospitalization data, Facebook/UMD survey data and wastewater data together suggest no turnaround yet in COVID-19 infections in BC.

- Omicron sub-variant BA.2 continues to rise in frequency among viral samples taken 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 drive an increase in hospitalizations to the same extent as the BA.1 wave.

- The expected turnaround will be driven by building immunity (unlike previous behaviour-driven turnarounds) and uncertainty in projections comes from uncertainty in that immunity. This uncertainty can be decreased by up-to-date and accurate (hospital) data which is in short supply currently.
Hospital trends in BC

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

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.

As seen recently in Ontario, interpreting wastewater data is tricky and not always accurate.

Source (J. Bergmann) Data from Metro Vancouver’s Testing for the COVID-19 Virus in Wastewater
Survey of COVID-19 trends in Metro Vancouver

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*.

Source (J. Bergmann) Data from COVID-19 Trends and Impact survey.
As official COVID-19 data in BC becomes less available we consider alternative data sources to measure the impact on the pandemic in BC. Excess mortality is one such metric.

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

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

Without a baseline of the variation in the signal, it is still unclear whether BC is doing well or poorly on this metric.
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.

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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).

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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).

Source (S. Otto) New cases per day in 10-year age groups were downloaded from the BCCDC COVID-19 data portal. Cubic spline fits to log-case data were obtained (curves) for those 70+ (green) or <70 (blue). *Linear regression through log case counts among 70+ from last 14 days of data.
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 BA1 in BC.

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

→ 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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Daily growth rates

BC
- BA.1*
- BA.1.1
- BA.2

\[ r = 3.6\% \]
\( (19 \text{ day doubling}) \)

Alberta
- BA.1 & BA.1.1*
- BA.2

\[ r = 1.6\% \]
\( (42 \text{ day doubling}) \)

Ontario
- BA.1*
- BA.1.1
- BA.2

\[ r = 1.9\% \]
\( (36 \text{ day doubling}) \)

Quebec
- BA.1*
- BA.1.1
- BA.2

\[ r = -1.5\% \]

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.

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.
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.
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.
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§.

Source (S. Otto) New cases per day in 10-year age groups were downloaded from the BCCDC 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.

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

State of the Omicron wave in BC:

- BA.2 is now dominant in BC and across Canada.
- The BA.2 wave does not appear to have peaked yet but there is indication that it could be smaller than the first wave based on growing immunity in the population.
- This is supported by various sources of data including age-corrected case counts and Alberta hospital data which has allowed for more reliable projections.
- The story in BC may differ depending on uncertainties in the growth of immunity in the population that cannot be narrowed using local case and hospitalization data.