COVID Model Projections

March 17, 2022

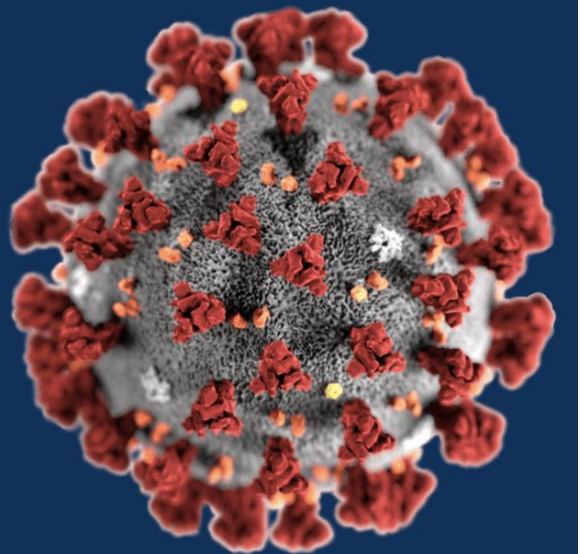
BC COVID-19 Modelling Group

@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

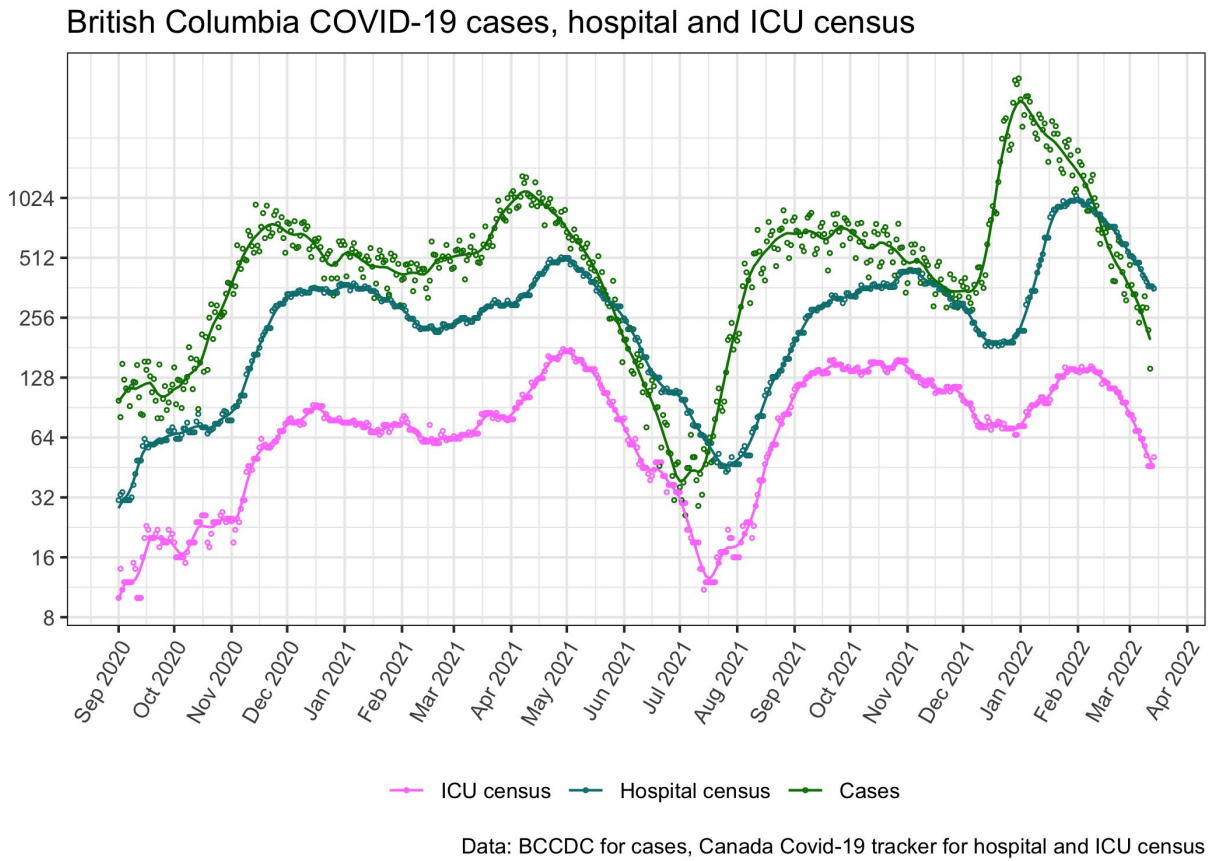
Omicron in BC: The fall of BA.1 and the rise of BA.2

- Cases among those aged 70+ are down by a factor of 3.4-fold from the Omicron peak.
- The number of patients in hospital and those requiring ICU care are both down 2.9-fold from the Omicron peak.
- Omicron sub-variant BA.2 continues to spread in BC, however, with selection favouring BA.2 by s = 9% per day in BC relative to BA.1. **Given recent rates of spread, BA.2 now comprises the majority of new cases in BC (>50%).**
- The drop in cases from the Omicron peak is driven mainly by declines in BA.1. The number of **BA.2 cases has been slowly rising** (using cases among 70+ to gauge infection rates).

Risks are likely modest over the next month

- The major short-term risks are the rise in the more-transmissible BA.2 variant, the relaxation of most mandated health measures, and the waning of immunity provided by boosters, especially those boosted >3 months ago.
- These risks are partially offset, however, by the extensive immunity present in BC, with high numbers doubly vaccinated, high uptake of boosters, and recent infection.

Hospital trends in BC



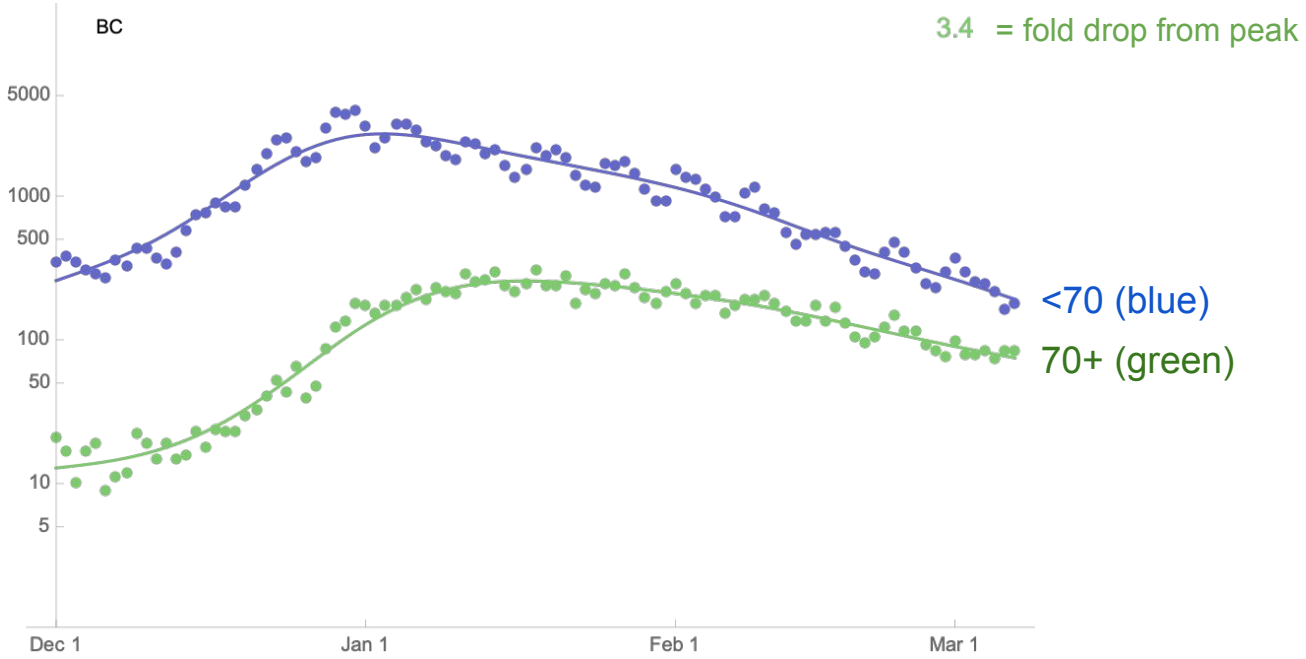
The number of people in hospital and in ICU has declined 2.9-fold since the Omicron peak.

Source (J. von Bergmann) Case data from BC COVID-19 Database (http://www.bccdc.ca/health-info/diseases-conditions/covid-19/data). STL trend lines on log scale.

Case counts among those 70+: British Columbia

→ Cases (green) among the 70+ age group are **declining significantly in BC***, having dropped more than 3-fold from the Omicron peak.

Reported cases have dropped much more steeply in younger age groups (blue; 17-fold decline from peak), due to changes in testing priorities.



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.

Age-corrected case counts: Health Authority

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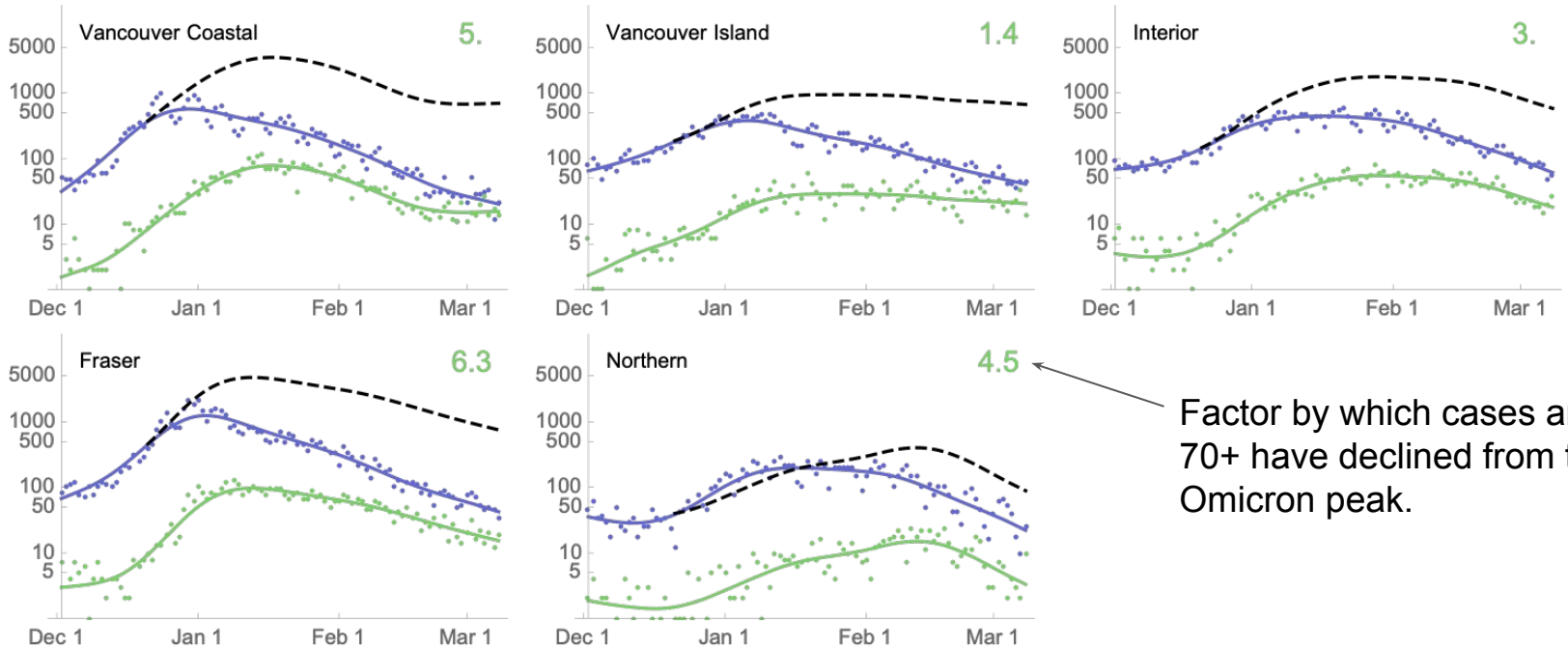


Corrected total
<70 (blue)
70+ (green)

Factor by which cases among 70+ have declined from the Omicron peak.

→ All Health Authority show declines or stable numbers of cases among people aged 70+, although some HA, like Vancouver Island, have not yet declined substantially.

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.

While cases have declined, BC still faces an uncertain COVID-19 future over the next month:

- Spread of BA.2 sub-lineage of Omicron (slides 8-10)
- Waning of boosters, especially among the most susceptible (slide 11-12)
- Relaxation of measures leading to a rising transmission rate (slide 13)

→ A model including these effects predicts only modest rises in cases over the next month (slide 14)

The COVID-19 trajectory in BC over the next month depends strongly on how fast waning occurs and whether people continue to abide by safety measures, even if they are no longer required (e.g., masking, limiting large gatherings in crowded and poorly ventilated spaces).

Risk of BA.2 spread

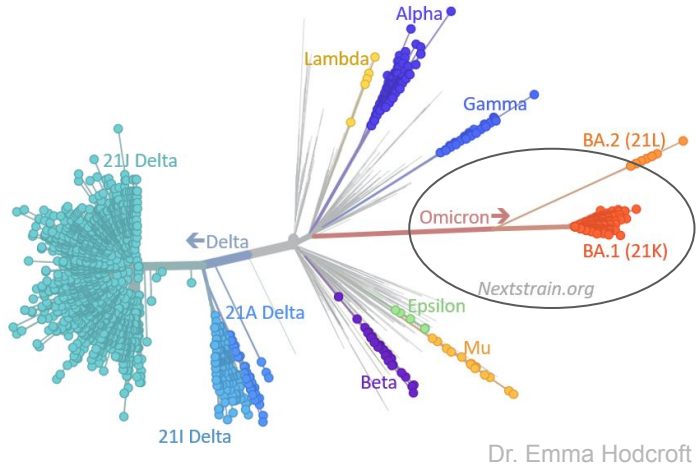
GISAID data shared by Public Health labs across Canada allow us to track the spread of Omicron sublineages over time.

→ BA.1.1 (dark red) is spreading slightly faster than BA.1, rising in frequency at a rate of *s* = 3.3% per day.

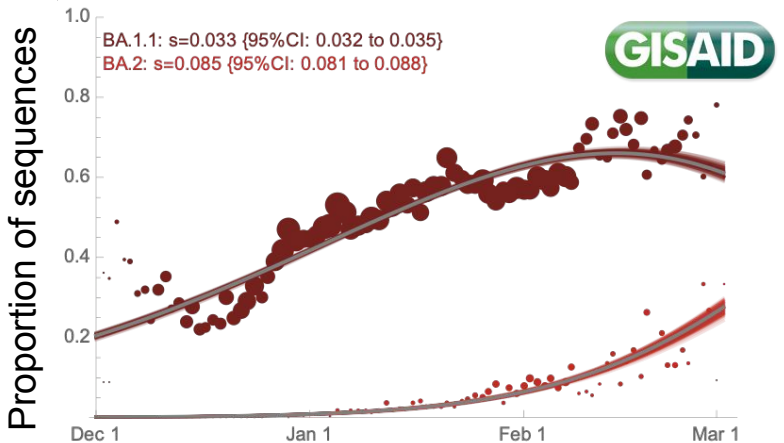
→ BA.2 (light red) is spreading much faster than BA.1, rising in frequency at a rate of *s* = 8.5% per day. At this rate, BA.2 is now expected to be at ~50% frequency in Canada.

What does this imply for case numbers?

Are any of the Omicron sublineages rising in case numbers, not just frequency, in BC?



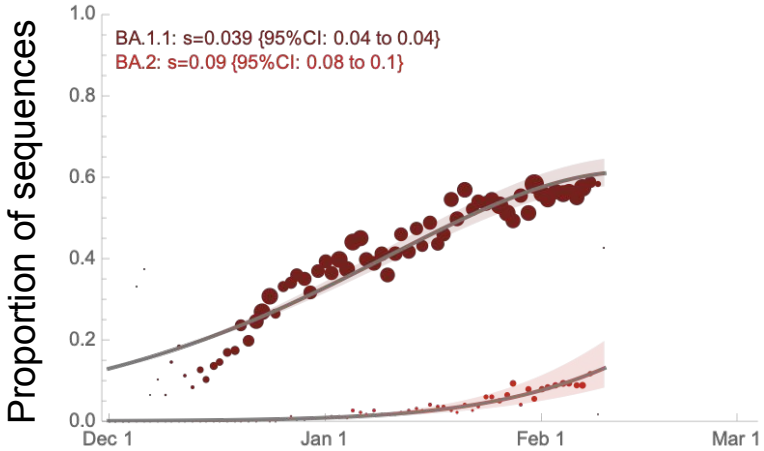
Dr. Emma Hodcroft



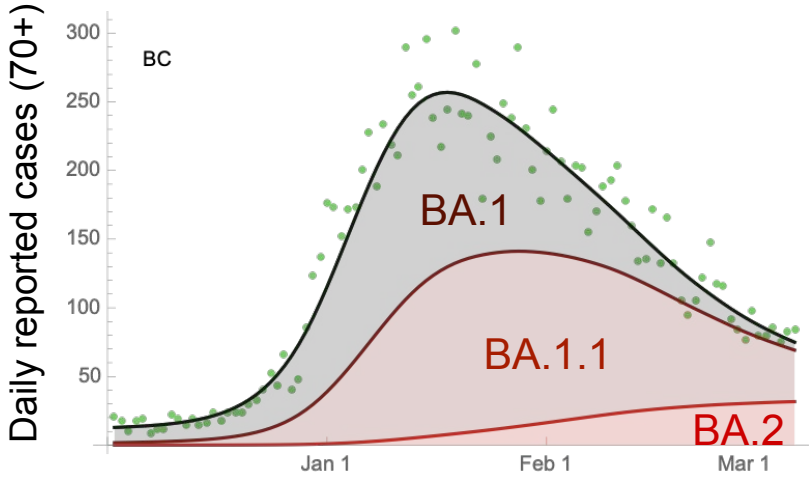
Source (S. Otto) Canadian sequences were downloaded from GISAID for BA.1, BA.1.1, and BA.2 on March 15, 2022 (Alberta sequences were removed as AB first identifies variants and preferentially sequences BA.2). A model of selection was fit to the numbers of each type using maximum likelihood based on a trinomial distribution given the expected frequencies on each day. Hessian matrix used to obtain confidence intervals.

Case counts among those 70+: British Columbia

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.



→ While the numbers of BA.1 (daily growth rate r = –9%) and BA.1.1 (r = –5%) are declining, **the estimated numbers of BA.2 are slowly rising (r = +0.4%) in British Columbia.**

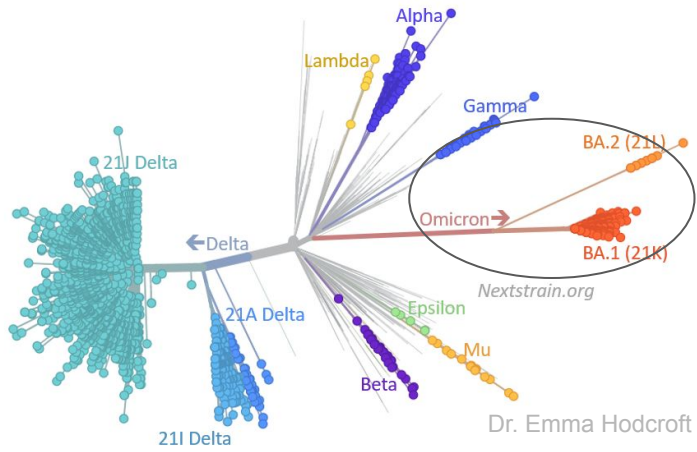
Source (S. Otto) Canadian sequences were downloaded from GISAID for BA.1, BA.1.1, and BA.2. A model of selection was fit to the numbers of each type using maximum likelihood based on a trinomial distribution given the expected frequencies on each day. Hessian matrix used to obtain confidence intervals.

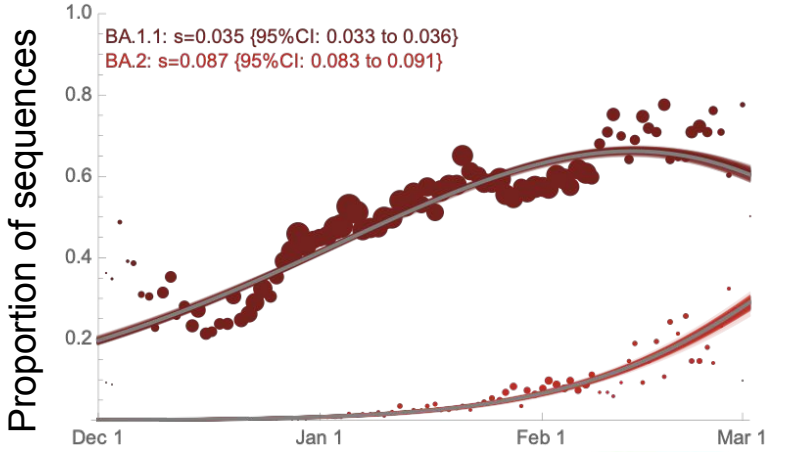
Risk of BA.2 spread

Combining case rates among those 70+ in age (more consistently tested) with models of selection allows us to estimate the **numbers** of each Omicron sublineage.

- Both BA.1 and BA.1.1 are declining in absolute numbers, although the frequency of BA.1.1 is rising relative to BA.1
- **BA.2 is, however, rising in both frequency and in numbers, both in BC and Ontario (Appendix).**
- Although the growth rates per day are currently small (*r* = +0.4-0.5% per day), waning immunity (especially in those over 70) and the relaxation of many Public Health measures coinciding with BA.2 rising numbers poses a risk of another Omicron wave.

Other Provinces besides ON and BC have too few cases (e.g., Atlantic provinces) or too few genomic sequences in GISAID to conduct similar analyses.





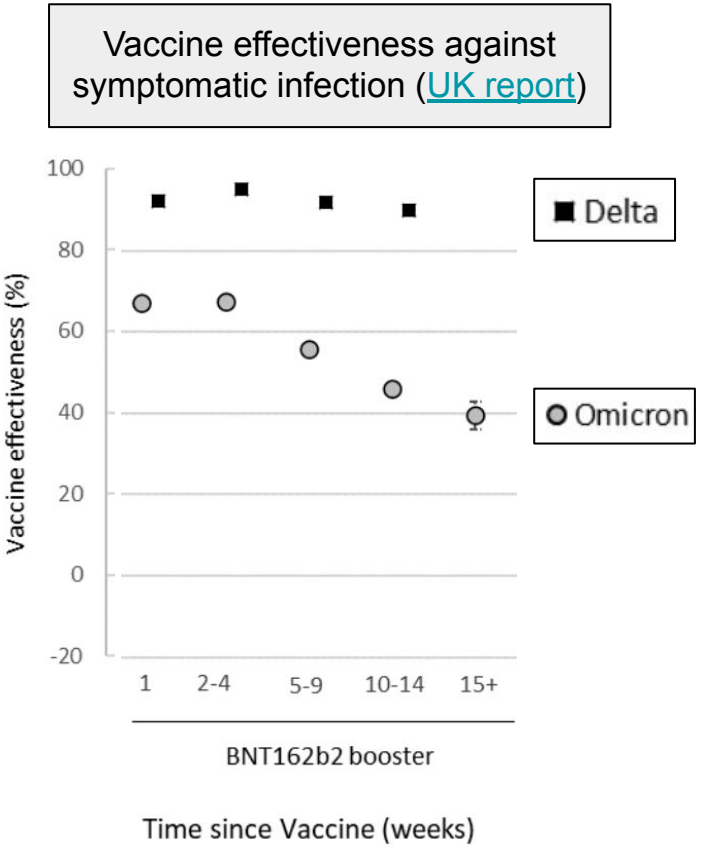
Risks of waning

Recent data in BC indicate that vaccination (two-dose or boosted) reduces a person's risk of hospitalization five-fold (BC Gov News).

With the highly divergent Omicron variant, **boosters** have substantially increased immunity, raising antibody levels and protecting against infection and severe outcomes.

The protective effect of boosters* wanes over time, however, as antibody levels fall.

- UK reports a decline in vaccine effectiveness (VE) against symptomatic infection from 70% to 40%, following >15 weeks since the booster (figure)
- The same UK report found that VE against hospitalisation rose to ~90% following boosting but dropped to ~75% in 10-14 weeks following boosting
- A US CDC report similarly found VE against hospitalization dropped from 91% <2 months after a booster to 78% >4 months



These studies find that boosters provide ~10-fold protection against hospitalization, compared to unvaccinated individuals, but this drops to 4-5-fold after 3 to 4 months since boosting.

* Reporting mRNA (primarily Pfizer) data

Risks of waning

As a consequence of this waning, the risk of hospitalization for a boosted individuals rises by a factor of two over the course of 3-4 months.

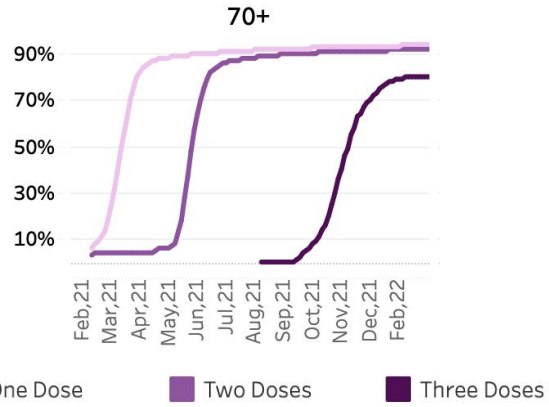
Many people in BC, especially those most susceptible to severe health impacts of COVID-19, received boosters more than 3 months ago and are now experiencing declining levels of protection.

For example, while 80% of people over aged 70 in BC have received boosters, half of these boosters occured before November 30 and 7/8 were before December 31, 2021 (BCCDC; figure).

The option of a fourth dose, 3-4 months following a third booster dose, would reduce hospitalization risks for those most susceptible to severe COVID-19 reactions*.

These boosters help fight against Omicron, despite the extensive genetic changes in this variant.

Vaccination levels in BC among those 70+ in age



* Canada's National Advisory Committee on Immunization (NACI) recommends a fourth dose for those who are immunocompromised. Ontario Health recommends a fourth dose to long-term care home residents, three months after their third booster. should receive a fourth dose of the COVID-19 vaccine

Risks of relaxing measures

It is challenging to predict the effects of relaxing mandatory public health measures in BC, because the impact depends on how much **individuals continue to practice these measures, such as mask wearing**.

The evidence is strong that well fitting and high quality masks substantially reduce the risk of spread of COVID-19:

- A randomized-trial study in Bangladesh compared symptomatic seroprevalence in those receiving masks and mask education relative to controls, finding an 11.6% reduction in COVID symptoms and a 9.5% reduction in seropositivity for COVID-19.
- A 2020 study comparing states with mask mandates to those without found that mask mandates were associated with a reduction in daily growth rates by $r = 2\%$ three weeks after the mandate, leading to an estimated 200,000 averted cases by May 2020.
- A 2021 evidence review compiled a variety of evidence that masks reduce transmission and can have a substantial impact lowering the reproductive number, R_t, of the virus, including a study that estimated a US GDP benefit of 1 trillion dollars if a nationwide mask mandate were implemented in the United States, due to averted infections and fatalities.
- A 2021 analysis of the effectiveness of different measures found that 'Wearing a mask' was one of the measures that had an important and significant impact reducing R_t, (ΔR_t, between −0.018 and –0.12).

> "COVID-19 spreads primarily through respiratory droplets exhaled when infected people breathe, talk, cough, sneeze, or sing. Most of these droplets are smaller than 10μmin diameter, often referred to as aerosols… Community mask wearing substantially reduces transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)"
>
> – Brooks and Butler 2021

Modelling risks: a relatively small second Omicon surge

We consider a 9% per day BA.2 advantage together with an uncertain increase in transmission due to relaxing public health measures (15% in blue or 30% in orange)

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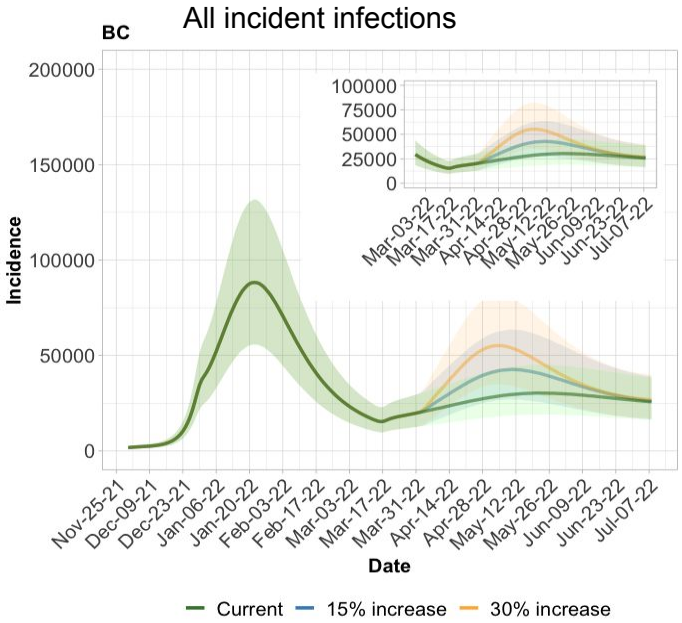
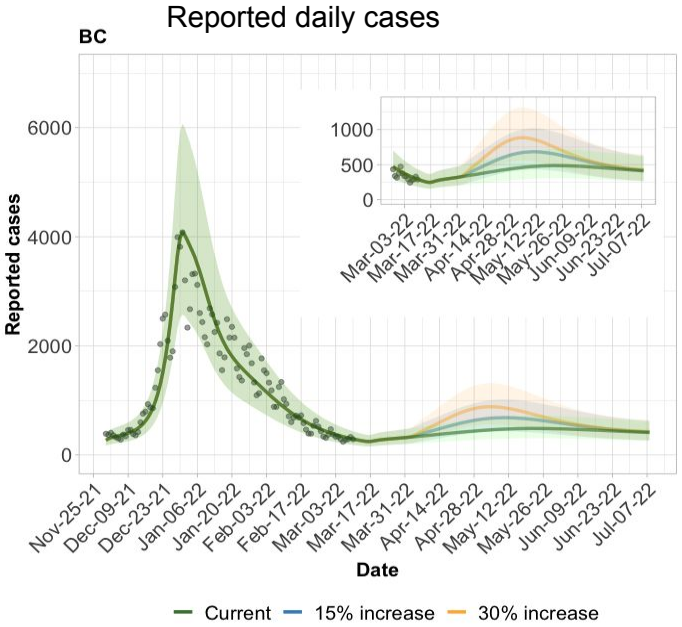
Results suggest a considerable wave in the worst case scenario, but still a much smaller secondary wave than the primary Omicron wave in January.

Source (SFU MAGPIE group; C. Colijn). Omicron transmissibility estimated with data. Booster efficacy 70% against infection, waning with an average 4 month period (back to the protection of two-dose vaccination).
We use reported daily cases, under the assumption that testing was maintained in those aged 70+, but that overall testing also declined to well below 2021 levels in late December 2021.





Creating safer spaces

With Canada having moved away from mask requirements and other mandated safety measures, there is a need to create safer indoor spaces, especially for those at higher risk. **Innovative solutions are needed to create safe options for all,** including safer options for essential transportation and shopping**.**

Investment in improved ventilation reduces the risk of transmission, and we applaud moves to improve ventilation standards (e.g., recent funding by BC to upgrade HVAC systems in schools).

Meanwhile, air quality can be assessed using simple CO_2 sensors. Because crowded spaces with little air turnover accumulate higher CO_2 concentrations, sensors allow people to **choose safer businesses**:

- Venues in Japan provide public access to CO_2 data (photo)
- Belgium is requiring publicly visible CO_2 sensors in restaurants
- Quebec and England are installing CO_2 sensors in classrooms

Other groups, including one in Manitoba, share lists of businesses that continue to require masks, providing safer options for their customers.

→ Let us know of innovations providing safer spaces in BC!

Key messages

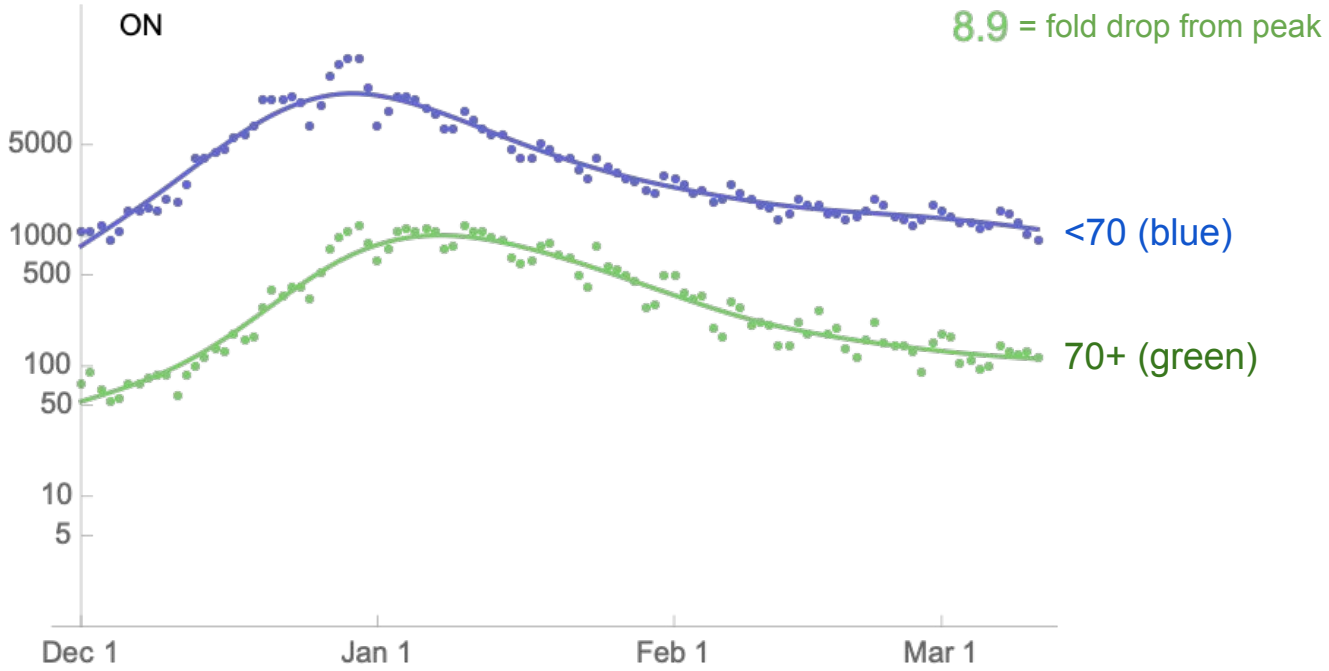
State of the Omicron wave in BC:

- BA.1 is fast declining in BC, but the Omicron wave is increasingly dominated by BA.2.
- The number of **BA.2 has, however, been slowly rising**.
- While the COVID-19 situation is good and improving, BC faces a number of short-term risks:
  - Further rise in BA.2
  - Removal of mandated protective measures, such as mask requirements
  - Waning of immunity, especially among those who are most susceptible and were boosted early
- Modelling suggests, however, that given current high levels of immunity, **rises in cases should be moderate** over the short term.
- Everybody in BC should continue to have **safe access to essential services**, such as transportation and groceries, especially while Omicron remains prevalent.

APPENDIX: Case counts among those 70+ in Ontario

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

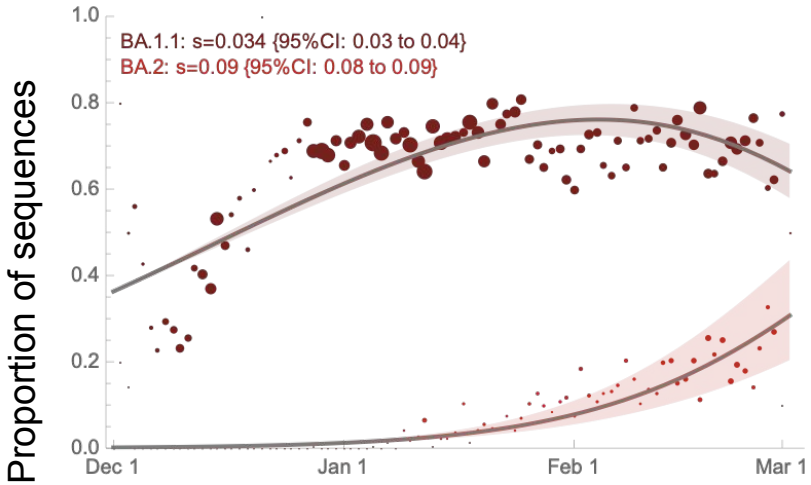
→ Cases (green) among the 70+ age group are **declining significantly in ON***, having dropped 9-fold from the Omicron peak.



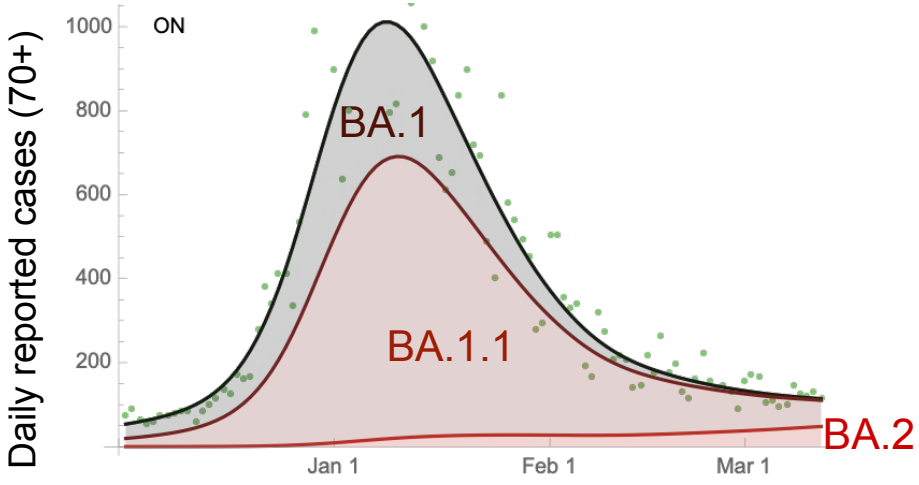
Source (S. Otto) New cases per day in 10-year age groups were downloaded from the Ontario Data Catalogue ("Accurate_Episode_Date"), trimming the last four days (incomplete). Cubic spline fits to log-case data were obtained (curves) for those 70+ (green) or <70 (blue). *Linear regression through log case counts among 70+ from last 14 days of data.

Case counts among those 70+: Ontario

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



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



→ While the numbers of BA.1 (daily growth rate r = –7%) and BA.1.1 (r = –3%) are declining, **the estimated numbers of BA.2 are slowly rising (r = +2%) in Ontario.**

Source (S. Otto) Canadian sequences were downloaded from GISAID for BA.1, BA.1.1, and BA.2 on March 15. A model of selection was fit to numbers of each type using maximum likelihood for a trinomial distribution given expected frequencies on each day. Hessian matrix used to obtain confidence intervals.