COVID Model Projections

September 1, 2021

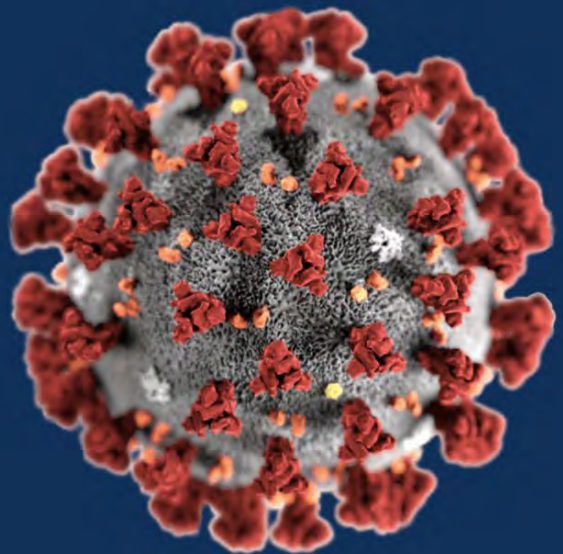
BC COVID-19 Modelling Group

@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

Contributors to report
Eric Cytrynbaum (UBC, co-editor)
Sarah Otto (UBC, co-editor)
Dean Karlen (UVic and TRIUMF)
Caroline Colijn (SFU)
Jens von Bergmann (MountainMath)
Rob James (evidently.ca)
James Colliander (UBC and PIMS)
Daniel McDonald (UBC)
Paul Tupper (SFU)
Daniel Coombs (UBC)
Elisha Are (SFU)
Bryn Wiley (UBC)

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

BC: A transition period with growth continuing, but slower

Overall summary

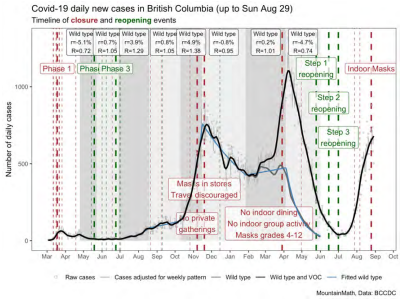
- Mandates and public response to rising case numbers have slowed the spread of COVID-19. The Interior, with the earliest restrictions, shows the strongest slow down.
- In BC, cases are now growing at only 2% each day (corresponding to a doubling time of 40 days if this growth rate continues)
- The BC-wide mask mandate will likely reduce growth rates further in the coming weeks.
- We'll get the most bang-for-the-buck from having vaccine passports if people get vaccinated as **early as possible**, both protecting them from severe cases but also reducing transmission to others.
- The number of patients in hospital has risen exponentially over the past month. Of these patients, an increasing fraction are needing ICU care.
- Vaccines are showing high effectiveness in BC across age groups, reducing cases 12-fold and hospitalization rates 29-fold once fully vaccinated (age-corrected analysis).

Current state of COVID-19 in BC

Public health measures introduced in the Interior Health Authority have substantially reduced the growth rate of COVID-19*.

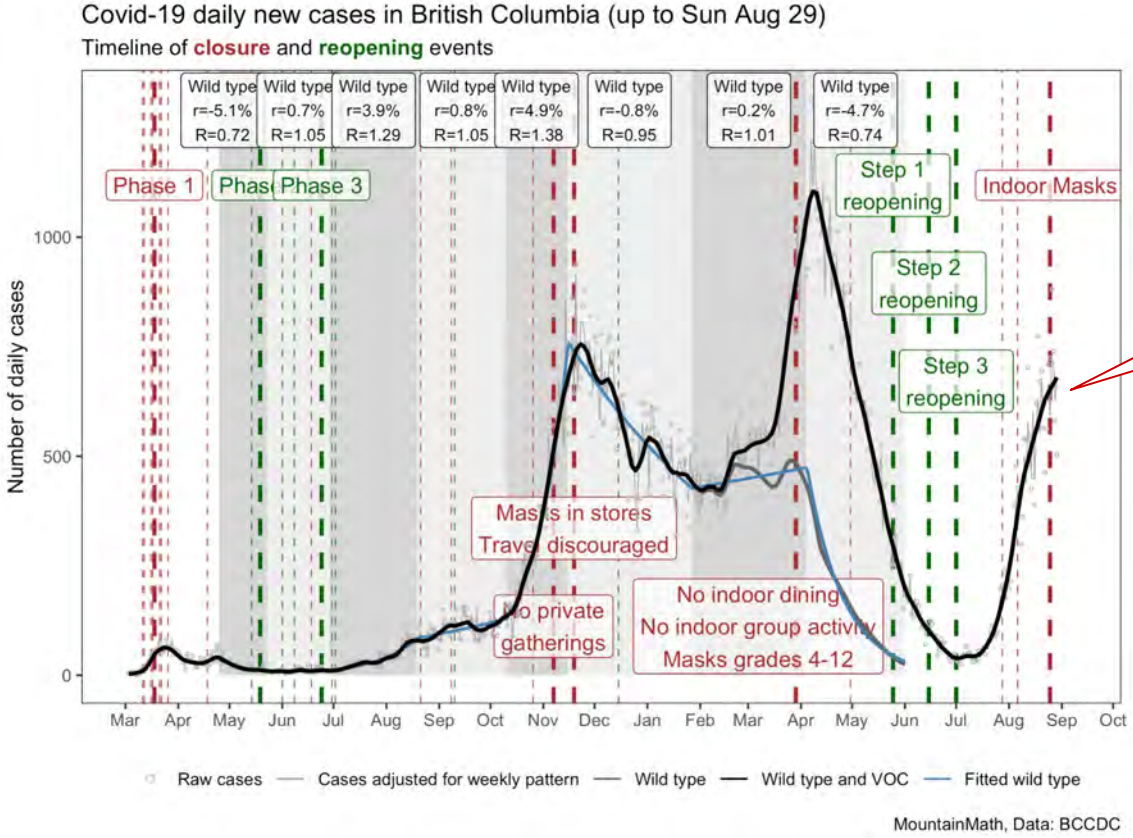
Growth rates are beginning to slow in the other Health Authorities.

Growth rates across BC are expected to reduce further in the weeks ahead with the BC-wide mask mandate (effective August 25) and launch of a vaccine passport (partial vaccination required September 11; full vaccination October 24).



*Central Okanagan – July 29: masks, August 6: restrictions on group gatherings; Interior – August 21: masks; August 23: some restrictions on group gatherings. BC – August 25 mask mandate; vaccine passport to come into effect on September 13 (first dose) and October 24 (second dose)

State of the COVID-19 Pandemic in BC



After a period of rapid growth, case growth rates are slowing.

A slight slow down is visible following public health orders in the Interior*. BC-wide restrictions have not yet had time to have a visible impact.

COVID-19 continues to spread, but now more slowly, in BC.

Source (J. von Bergmann) Case data from BC COVID-19 Database (http://www.bccdc.ca/health-info/diseases-conditions/covid-19/data). Vertical lines give dates of public health measures (major as thick lines, minor as thin lines). Grey dots are raw case counts, grey lines is cases abused for weekly pattern, black STL trend line and blue fitted periods of constant exponential growth. *Central Okanagan – July 29: masks, August 6: restrictions on group gatherings; Interior – August 21: masks; August 23: some restrictions on group gatherings. BC – August 25 mask mandate; vaccine passport to come into effect on September 13 (first dose) and October 24 (second dose)

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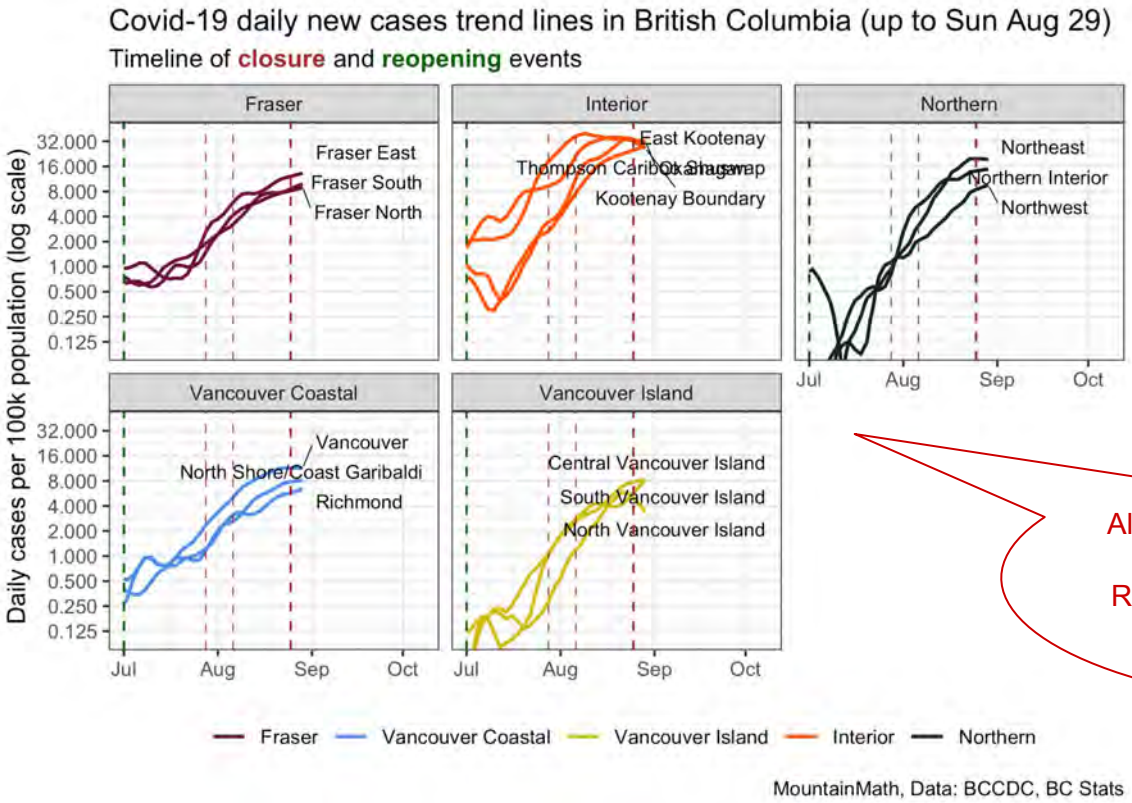
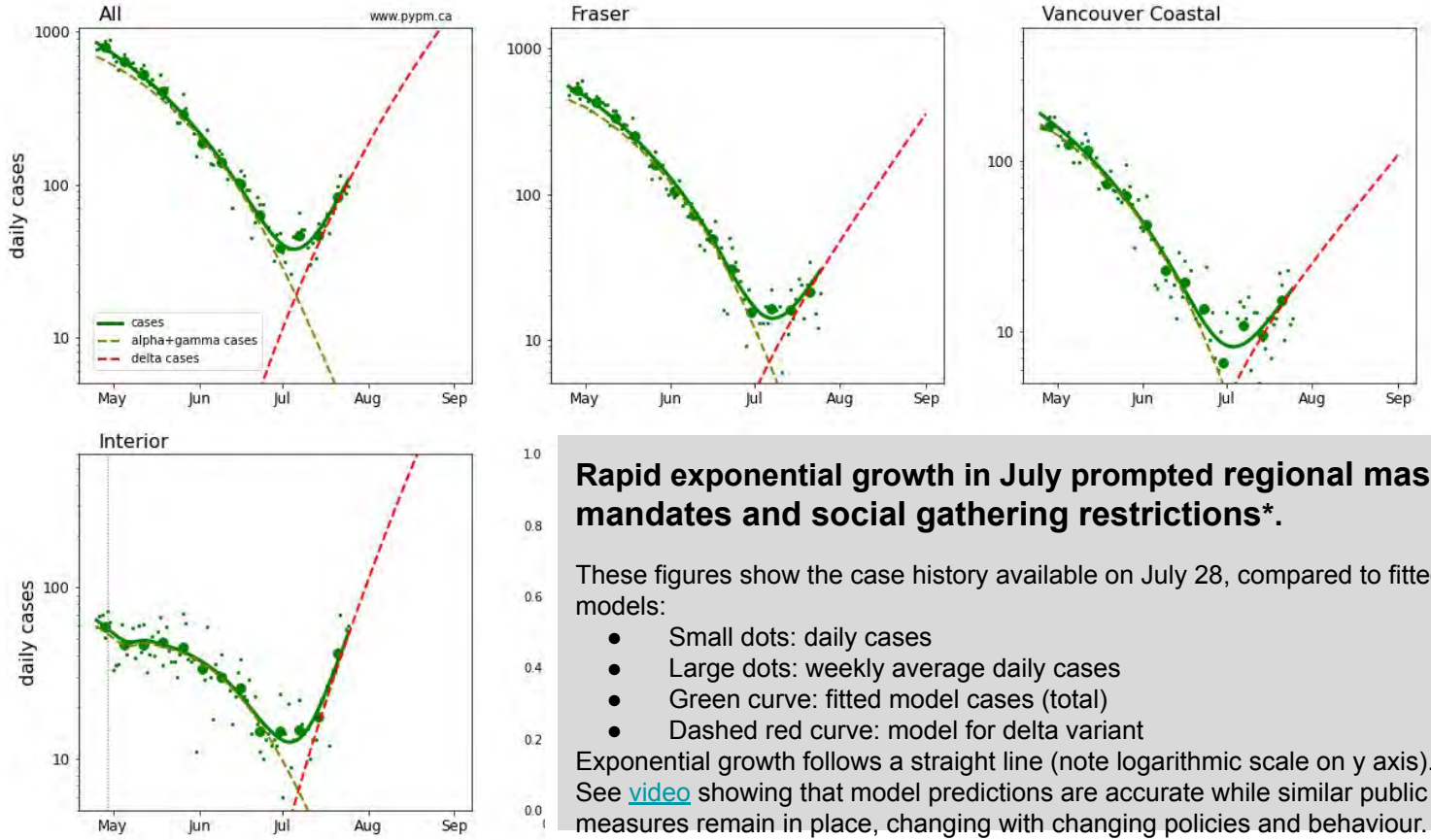


All Health Service Delivery Areas have exhibited similar case growth rates.
Regions in the Interior, including the Okanagan, have slowed substantially in growth.

Source (J. von Bergmann) Case data from BC COVID-19 Database (http://www.bccdc.ca/health-info/diseases-conditions/covid-19/data). Vertical lines give dates of public health measures (major as thick lines, minor as thin lines). STL trend lines on log scale.

Model fits to BC data (July 28 report)



Rapid exponential growth in July prompted regional mask mandates and social gathering restrictions*.

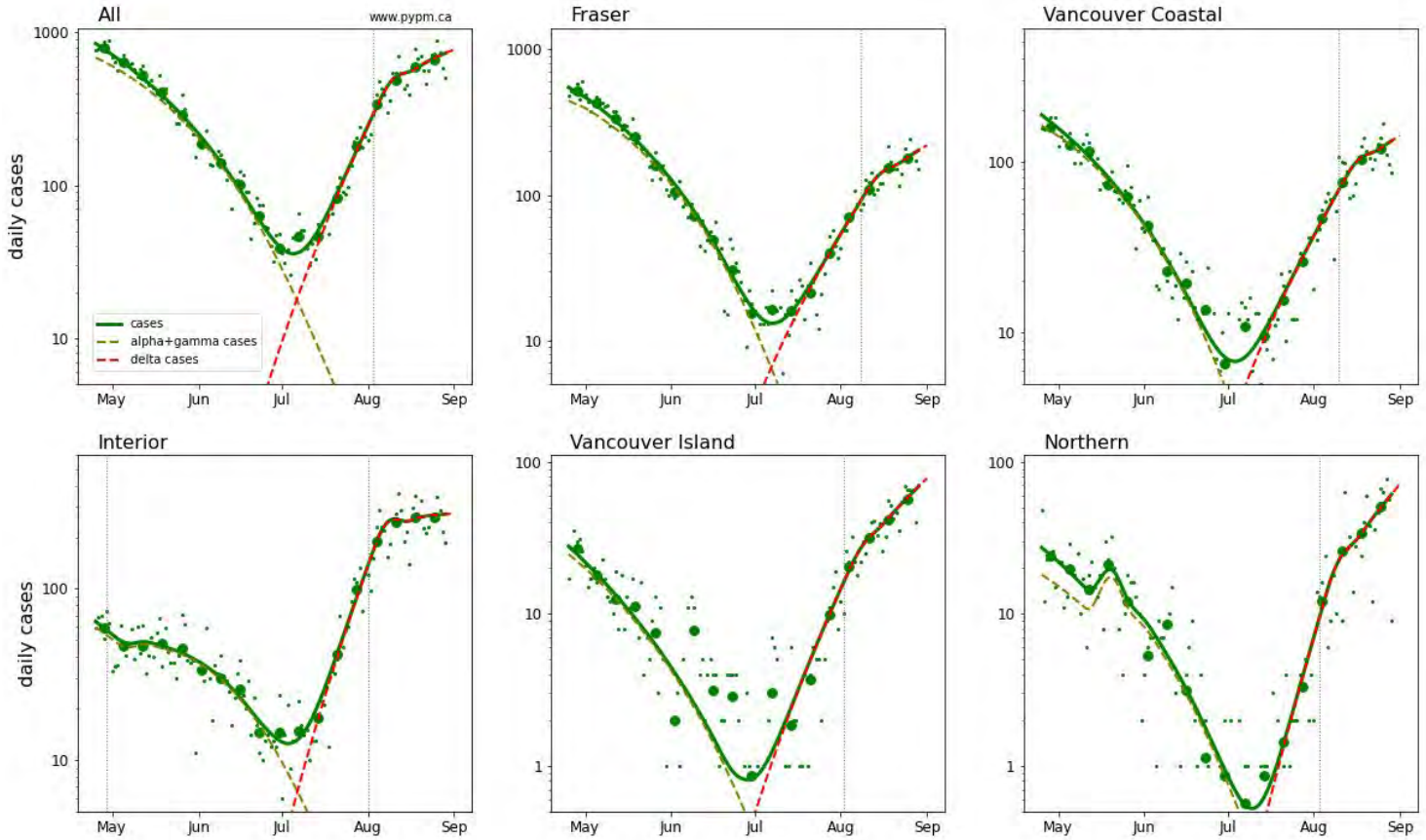
These figures show the case history available on July 28, compared to fitted models:

- Small dots: daily cases
- Large dots: weekly average daily cases
- Green curve: fitted model cases (total)
- Dashed red curve: model for delta variant

Exponential growth follows a straight line (note logarithmic scale on y axis).
See video showing that model predictions are accurate while similar public health measures remain in place, changing with changing policies and behaviour.

Source (D. Karlen). See www.pypm.ca. These models have no age structure. Fits include past vaccination schedule. *Central Okanagan – July 29: masks, August 6: restrictions on group gatherings; Interior – August 21: masks; August 23: some restrictions on group gatherings. BC – August 25 mask mandate; vaccine passport to come into effect on September 13 (first dose) and October 24 (second dose)

Model fits to BC data (August 30)



Recent measures and the public's response have nearly stopped growth in the Interior and have significantly slowed growth in all other regions.

Source (D. Karlen). See www.pypm.ca. These models have no age structure. Fits include past vaccination schedule. Overall growth in BC is currently at 1.8% per day (corresponding to a 40 day doubling time if this rate were to continue), but rates are currently in transition due to recent mandates in BC.

Will recent BC-wide mandates reverse growth?

The BC-wide mask mandate became effective August 25th. Will this be enough?

We do not yet know. Growth rates have begun to slow, but we need about 2 weeks of case data after a shift in restrictions to estimate growth with any confidence.

The following considerations suggest that the BC mask mandate may just stop growth, but a shift to more indoor activities may counteract that:

- The Interior continues to exhibit growth, at a slower rate, despite a mask mandate in the Central Okanagan (effective July 29) and in the Interior (effective August 21st).
- A 2020 study comparing states in the USA found that mask mandates reduced the daily growth rate by ~2% per day, which would flatten the current growth in BC.
- In October 2020, growth rates increased significantly as activities moved indoors.

A BC mask mandate could make a bigger difference, however, if more people wear masks (higher adherence) and if we use better masks (higher efficacy). [Reviewed here]

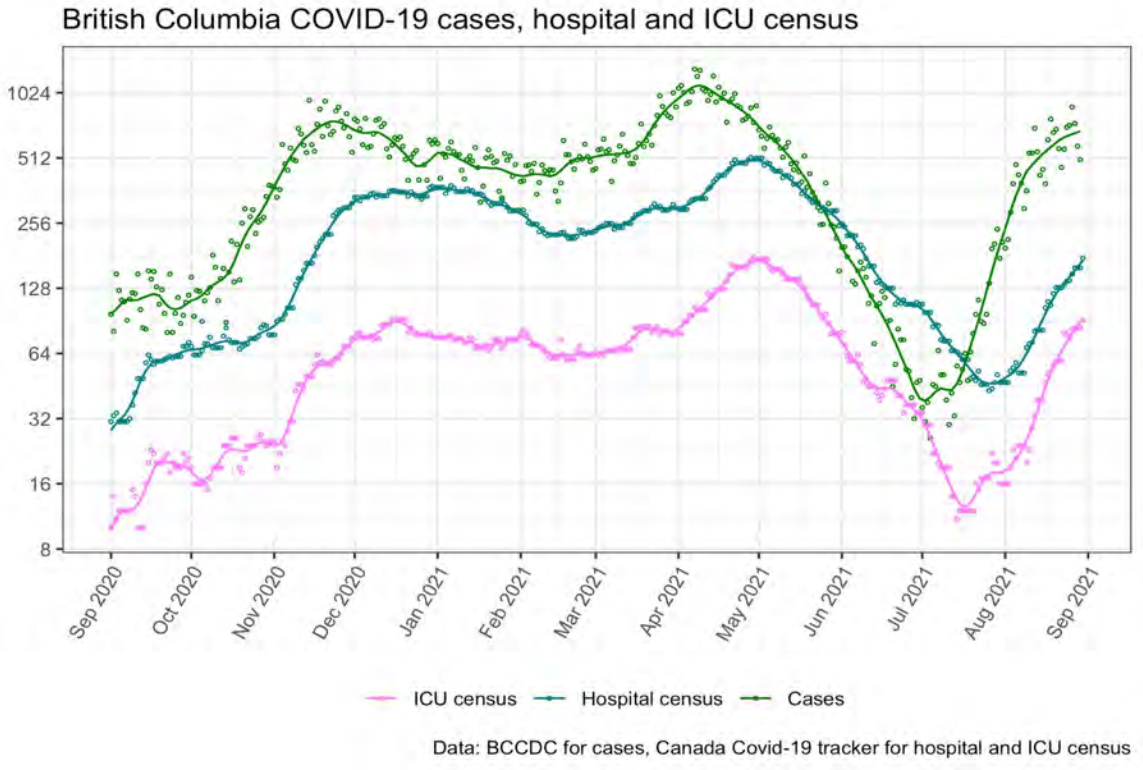
Impact on Health Care

The rising number of cases is creating an increasing health impact in British Columbia, with increasing numbers of patients in hospital and in ICU.

Recently, more patients in hospital are requiring ICU, possibly due to the observed rise in severity due to Delta seen in other jurisdictions.

Hospital and ICU occupancy over time

Hospitalization and ICU occupancy continue to rise, tracking the rise in COVID-19 cases, with a slight delay as symptoms develop.



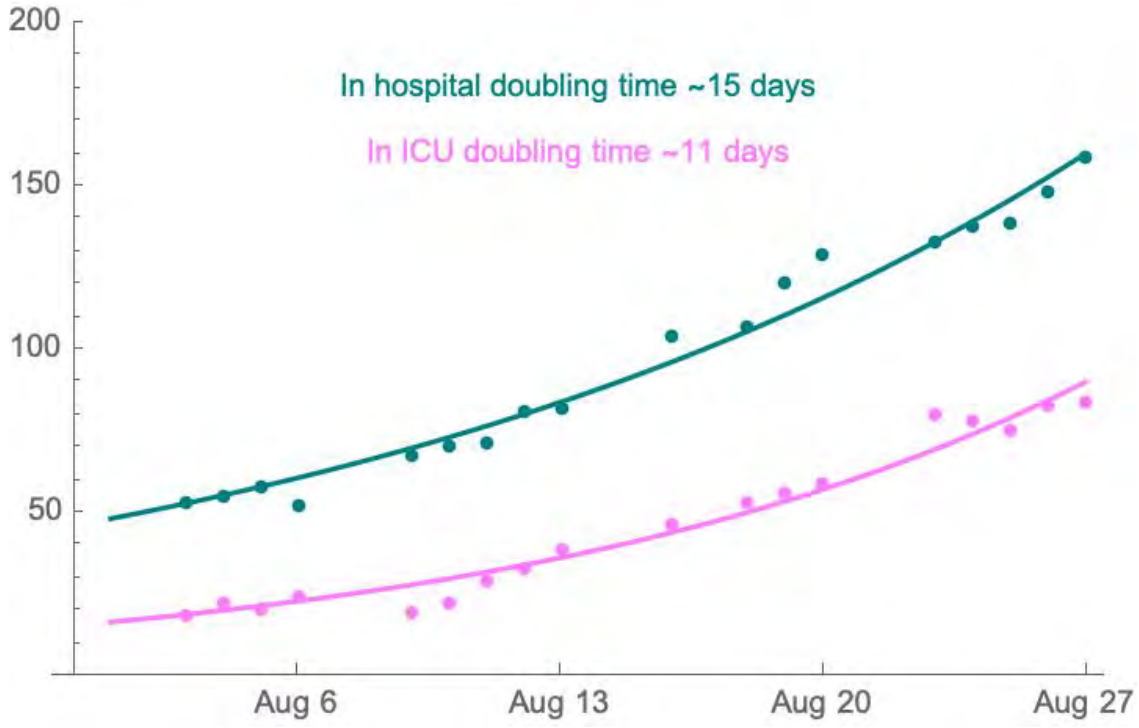
Source (J. von Bergmann) Case data from BC COVID-19 Database (http://www.bccdc.ca/health-info/diseases-conditions/covid-19/data). STL trend lines on log scale.

Hospital and ICU occupancy over time

Both hospital and ICU occupancy have risen exponentially through August.

The number of patients in ICU has grown faster than those in hospital (daily growth rates of 0.065 versus 0.046).

Although many factors may contribute, the Delta variant that now predominates (98% of BC cases) has been found to be more severe in other jurisdictions*, which may explain the faster growth in cases needing ICU care.



Source (S. Otto) Case data from BC COVID-19 Database (http://www.bccdc.ca/health-info/diseases-conditions/covid-19/data). Curves show an exponential model fit.
*Singapore study found that Delta was 4.9 times more likely to lead to an oxygen requirement, ICU admission, or death among unvaccinated hospitalized patients; see overview of Delta severity in CBC article.

Hospital and ICU occupancy over time

Of those patients in hospital, the fraction in ICU has thus recently increased.

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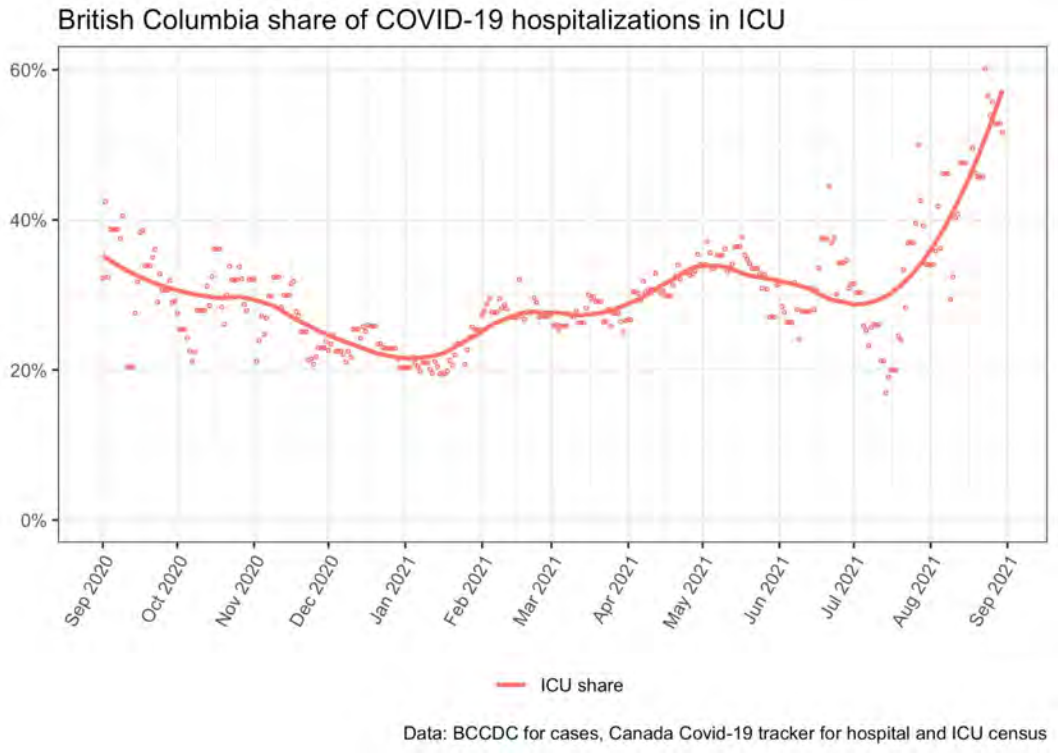
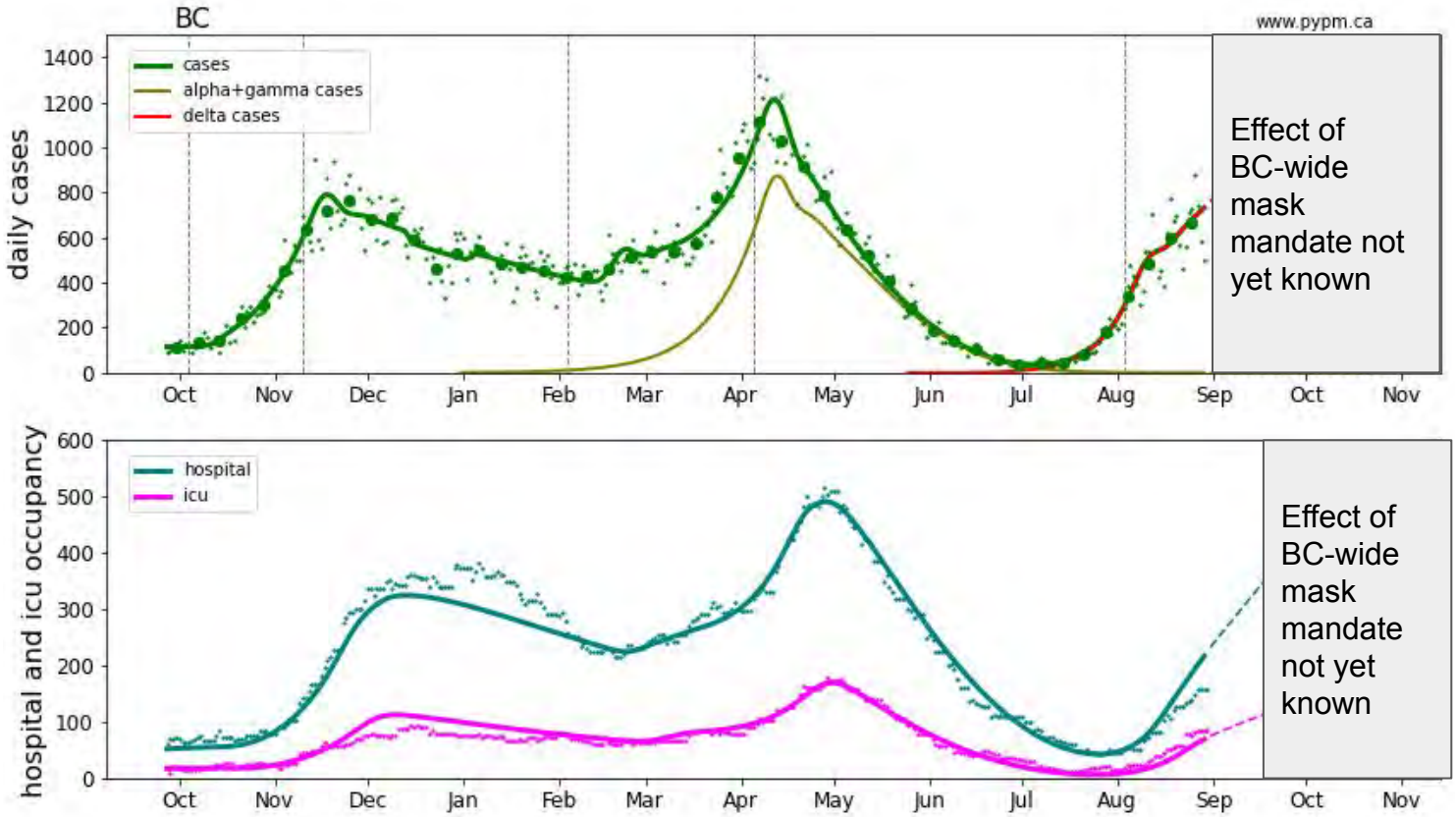


Source (J. von Bergmann) Case data from BC COVID-19 Database (http://www.bccdc.ca/health-info/diseases-conditions/covid-19/data). STL trend lines on linear scale. *Singapore study found that Delta was 4.9 times more likely to lead to an oxygen requirement, ICU admission, or death among unvaccinated hospitalized patients; see overview of Delta severity in CBC article.

Estimating demands on health care



The COVID-19 pandemic is tracked using positive tests (cases), yielding an infection model (green curve).

The infection model projects hospital occupancy well.

Recent hospital occupancy is lower than projected, while ICU occupancy is higher.

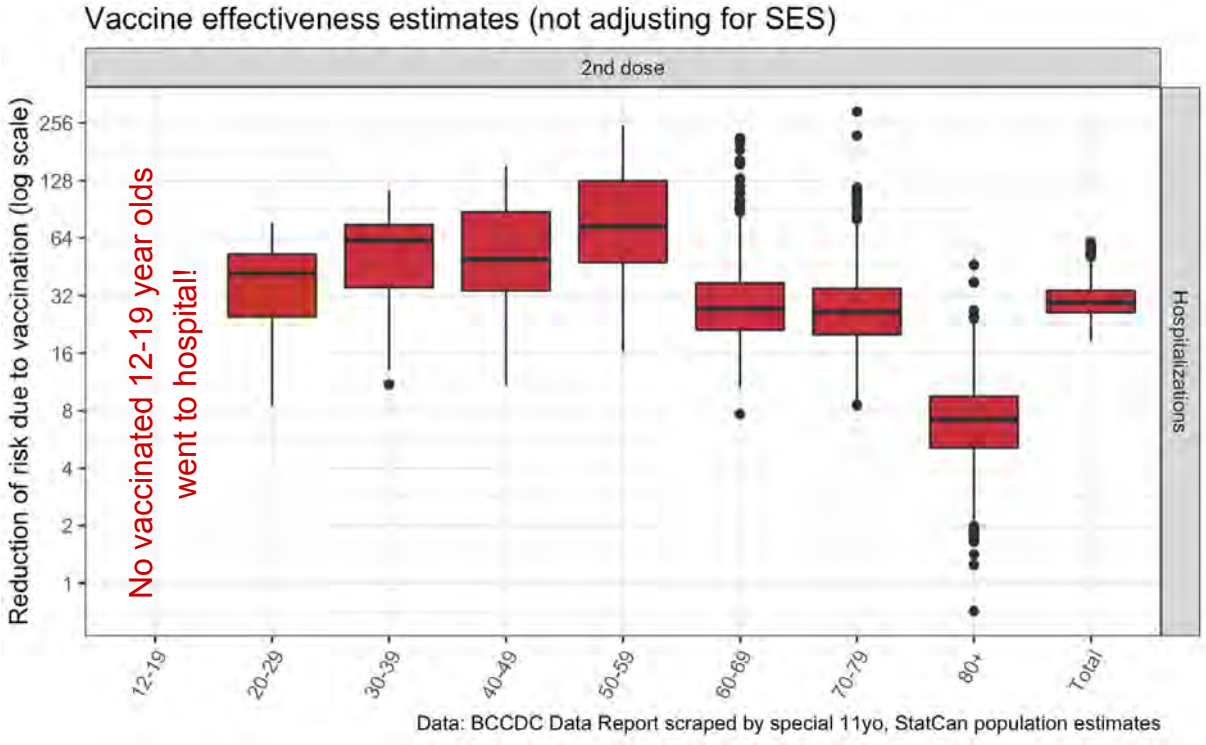
Source (D. Karlen). See www.pypm.ca. These models have no age structure. Fits include past vaccination schedule.

Vaccines protect against COVID cases and hospitalization

People who are fully vaccinated are on average 29 times less likely to require hospitalization.

Vaccine protection is even stronger for younger adults.

Importantly, while this analysis corrects for age class, it does not account for socio-economic status and other important correlates of risk.



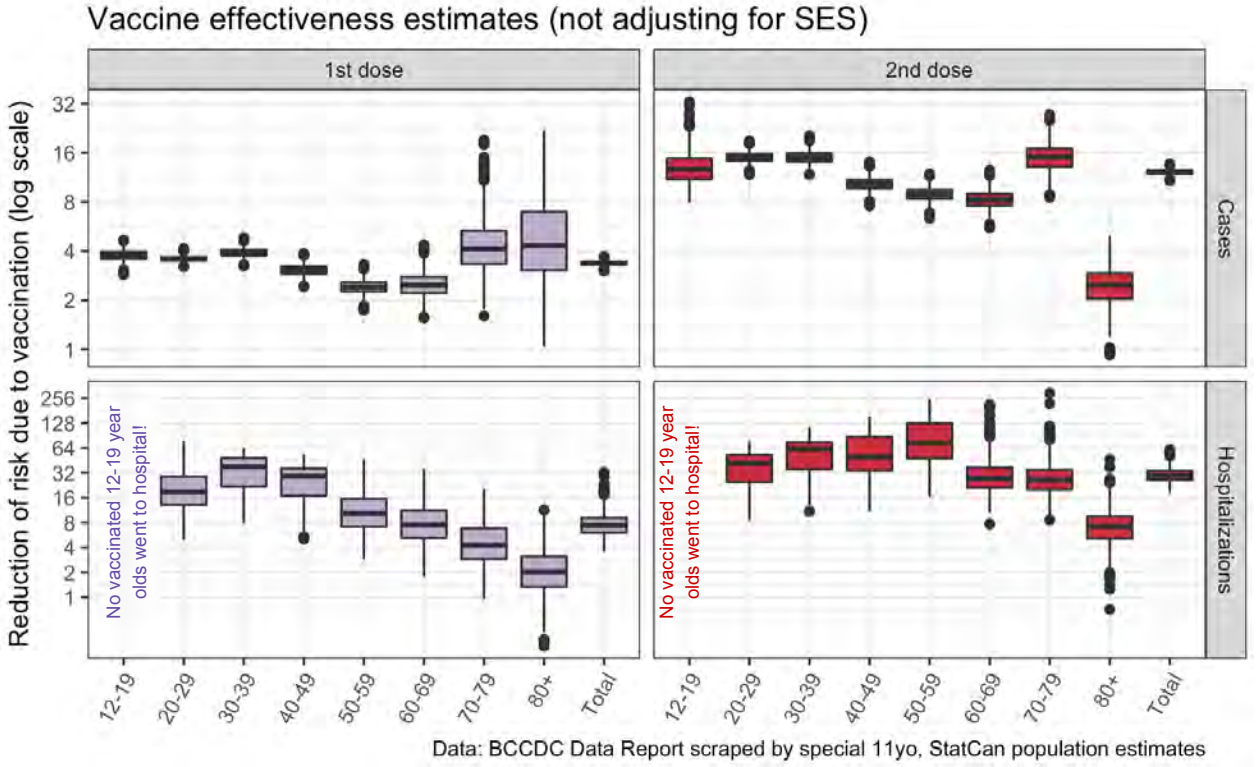
Source (J. von Bergmann) Data from BC Data Summary (August 19) summarizing health outcomes by vaccination status and age from July 17-August 17. Bootstrap sampling conducted to give the 25-75% quantile (boxes), with whiskers spanning 2.5-97.5% of samples. See details in blog.

Vaccines protect against COVID cases and hospitalization

Vaccines protect less against getting a case of COVID (top) or hospitalization (bottom) after only one dose (left).

Getting a second dose boosts protection substantially across all age classes (right).

The most elderly members of BC remain most vulnerable, but they are still 12 times less likely to be hospitalized if fully vaccinated.



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Vaccination rates

The recent announcement of a vaccine passport required to access many non-essential services in British Columbia has led to an uptick in first dose vaccinations, rising in the last week from 3702 daily (August 17-23) to 6839 daily (August 24-30).

Nevertheless, this is a small fraction of the 733,000 eligible people who are unvaccinated (August 30th).

While first dose vaccinations are not required until September 13, getting vaccinated as soon as possible will have a greater impact on the pandemic and help to avert stricter social mandates:

- **The earlier people get vaccinated, the earlier they are personally protected.** Our immune system response matures over time, rising substantially only after ~3 weeks.
- **The earlier people get vaccinated, the less likely they will infect others.** The sooner we get vaccinated, the sooner we can protect those around us, reducing transmission rates.

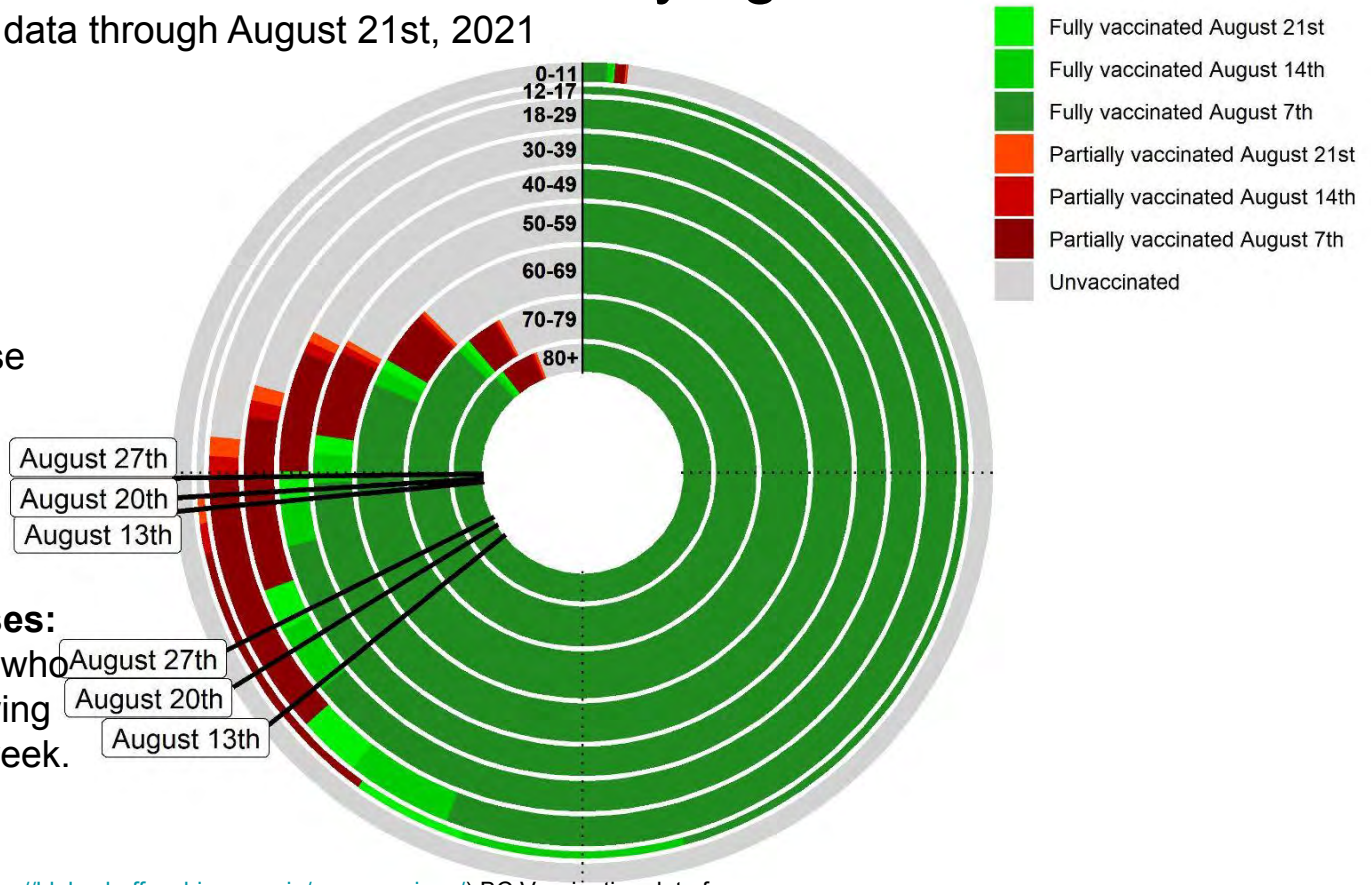
In order to substantially lower the large rise in cases and hospital demand projected in October (see August 18th report), we encourage unvaccinated individuals to get vaccinated as early as possible.

Closing the circle: Vaccination status by age

August 28th update includes data through August 21st, 2021

Slow progress on 1st doses:
The fraction of BC's entire population with at least one dose has sped up, but only slightly, rising ~0.9% per week.

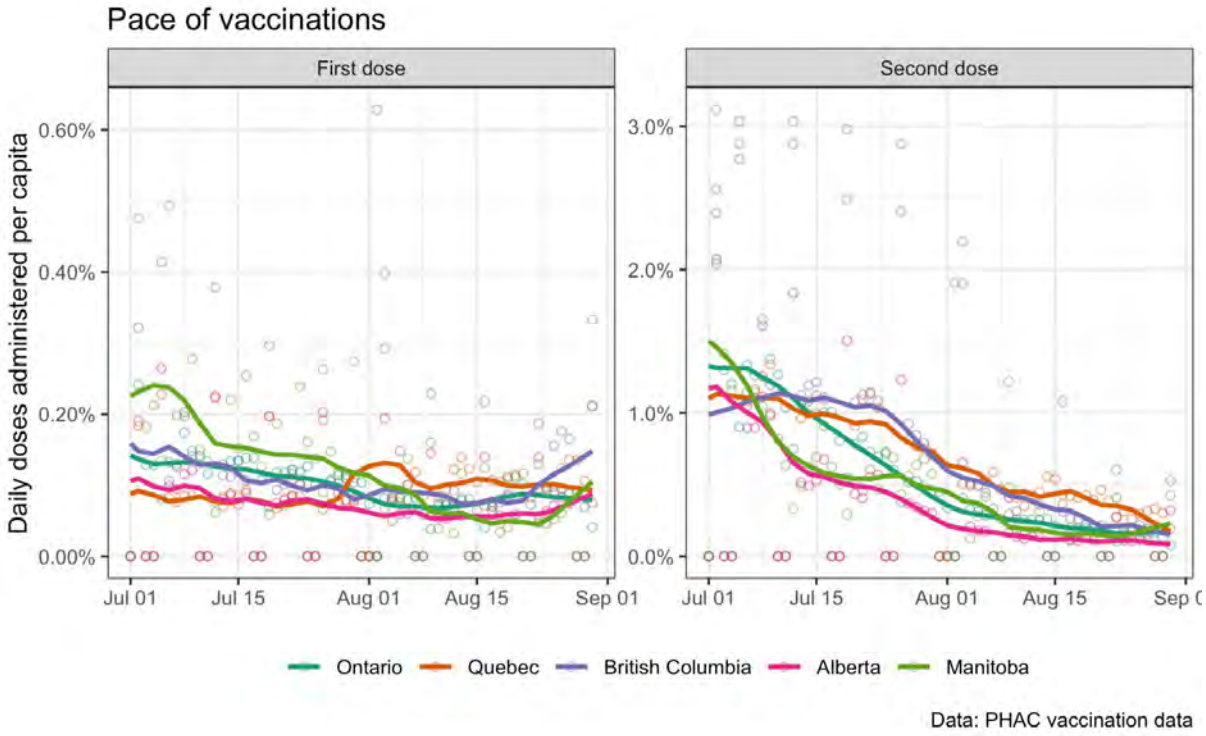
Slowing progress on 2nd doses:
The fraction of BC's population who are fully vaccinated shows slowing growth, now rising ~1.5% per week.



Source (B. Wiley). Design by Blake Shaffer (https://blakeshaffer.shinyapps.io/app_vaccines/) BC Vaccination data from https://health-infobase.canada.ca/covid-19/vaccination-coverage/, with area of each circle segment proportional to BC's population in that age class. BC 2021 Population projections for vaccination percentages from BC Stats: https://www2.gov.bc.ca/gov/content/data/statistics/people-population-community/population/population-projections

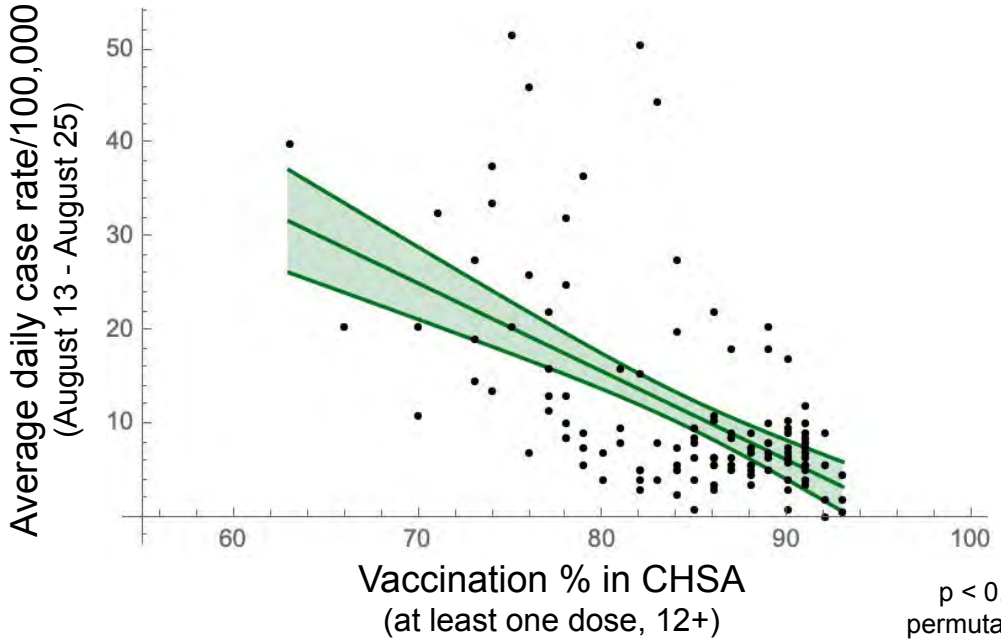
Vaccination progress

Vaccine passports announced in BC (August 23) and in Quebec (July 8) have been followed by a slight rise in first dose vaccinations.



Vaccination helps

We continue to see a major effect of vaccination levels across Community Health Service Areas (CHSA). For the most recent two-weeks of cases, communities with 70% of eligible people vaccinated have **four** times more COVID-19 cases than those with 90% vaccination.



$p < 0.0001$
permutation test

Vaccines protect, even against Delta, e.g., these studies from the UK:

- 8.3-fold lower infection rates[a]
- 2.6-fold lower chance of hospitalization if infected[b]

⟶ Vaccination double protects

Source (S. Otto). BCCDC data portal's surveillance dashboard data; see maps for regions that would most benefit from community vaccination drives (accessed August 30, 2021).
[a] Lopez-Bernal (2021) NEJM. [b] Sheikh et al. (2021) Lancet

http://www.getvaccinated.gov.bc.ca

Alberta and Saskatchewan

Like BC, Alberta and Saskatchewan have experienced

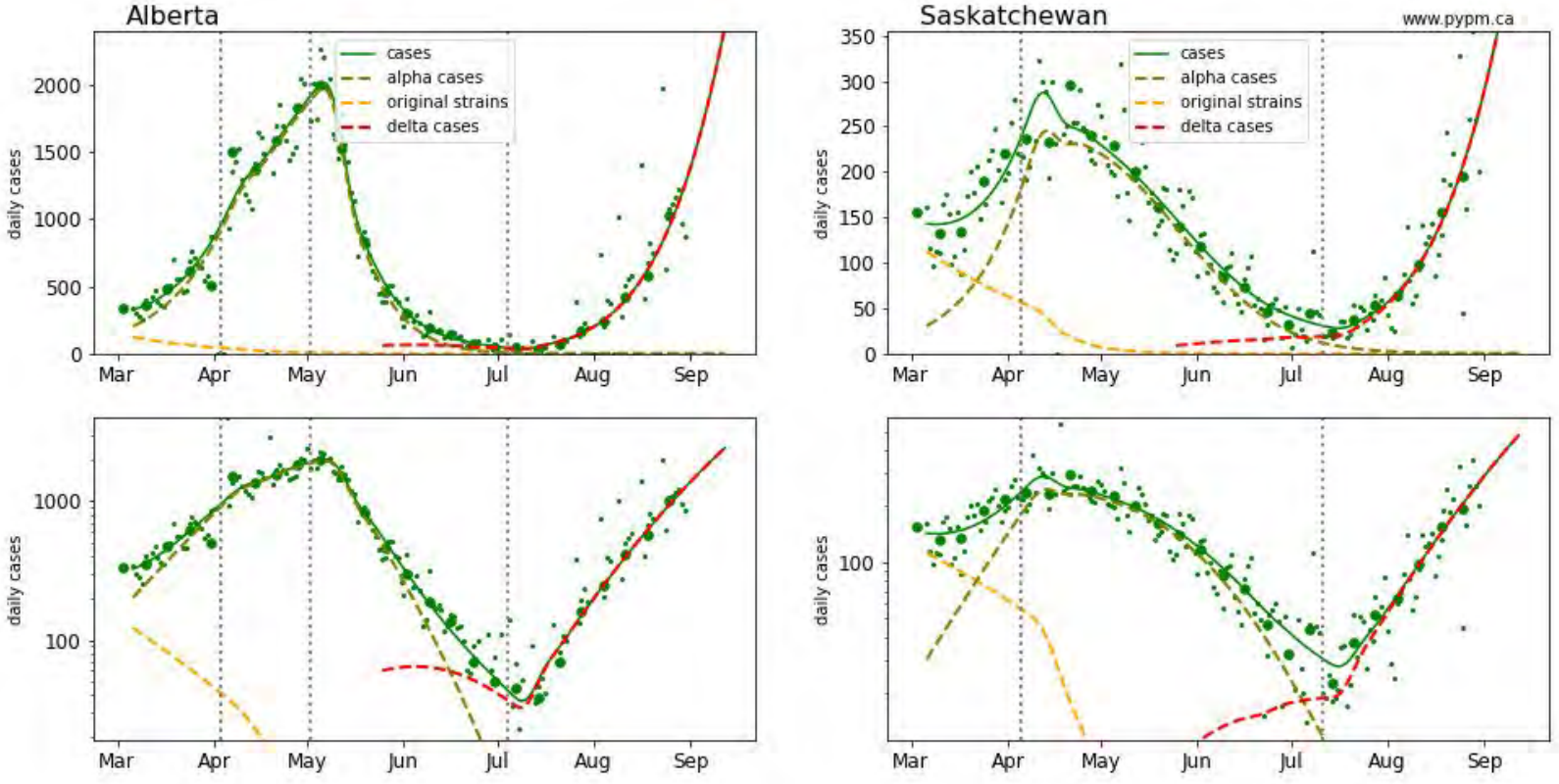
- rapid growth in delta infections starting in July
- growth in COVID hospital and ICU occupancy consistent with expectations given the rise in cases

The next slides show the recent case and hospital occupancy, and projections for the following scenarios:

- No action
- Rapid expansion of vaccination
- Measures taken to reduce transmission and rapid expansion of vaccination

To reduce the burden on health care systems, measures to reduce transmission are necessary, in addition to expanded vaccination.

Alberta and Saskatchewan case history

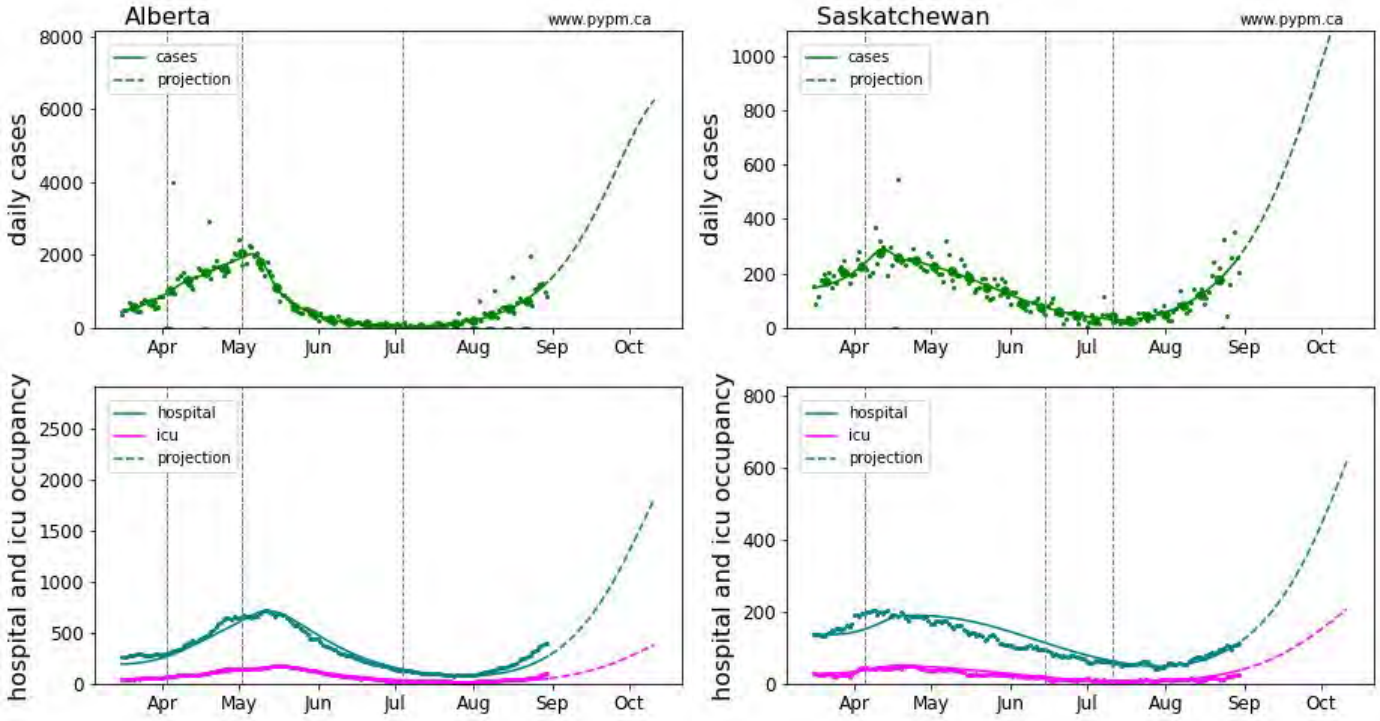


Growth pattern similar to that observed in BC before mandates.

Sustained growth since mid-July, now at 6% (5%) per day for AB (SK).

Source (D. Karlen). See www.pypm.ca. These models have no age structure. Fits include past vaccination schedule.

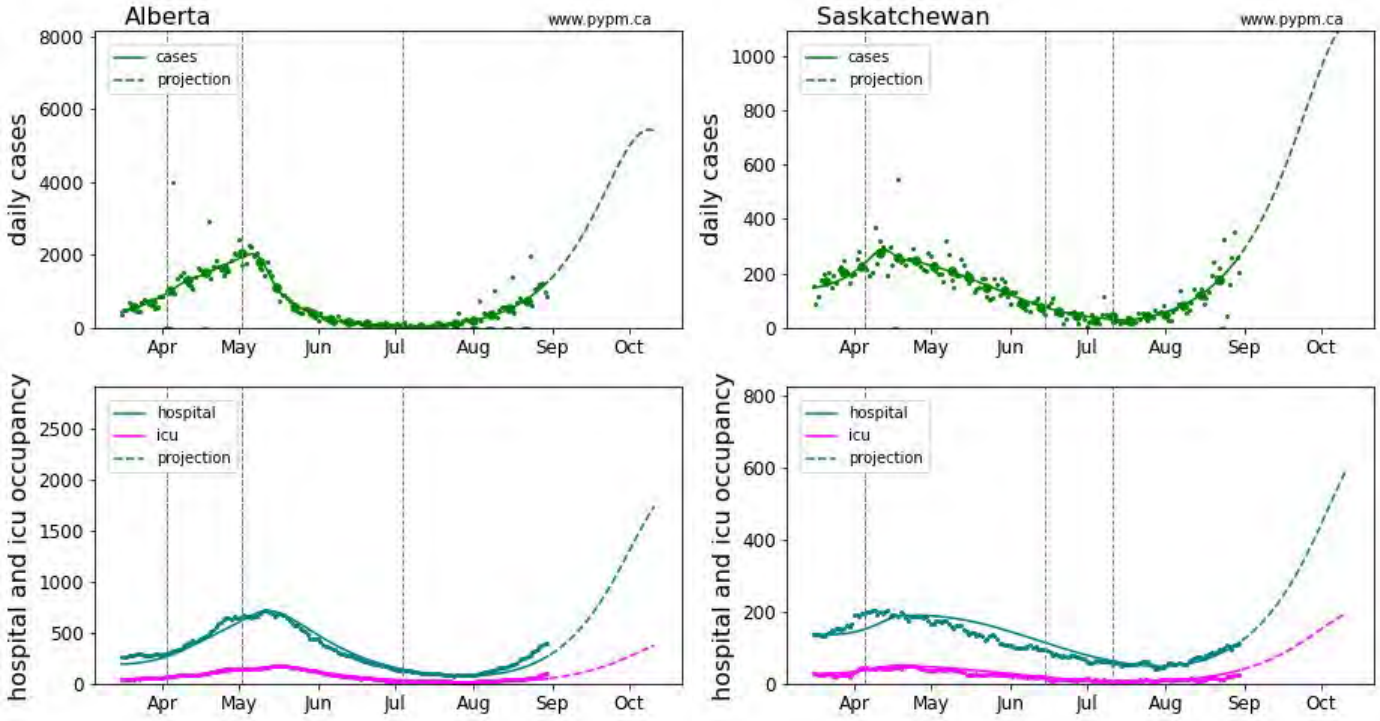
AB, SK projections for no-action



If no action is taken, COVID hospitalizations would far exceed previous records.

Source (D. Karlen). See www.pypm.ca. These models have no age structure. Fits include past vaccination schedule.

AB, SK projections: rapid vaccination expansion



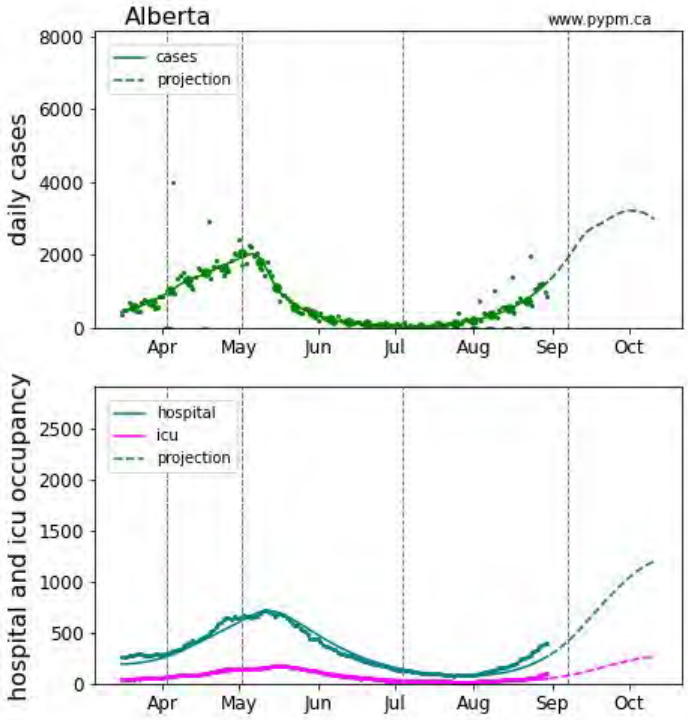
Rapid expansion of first-dose vaccinations:

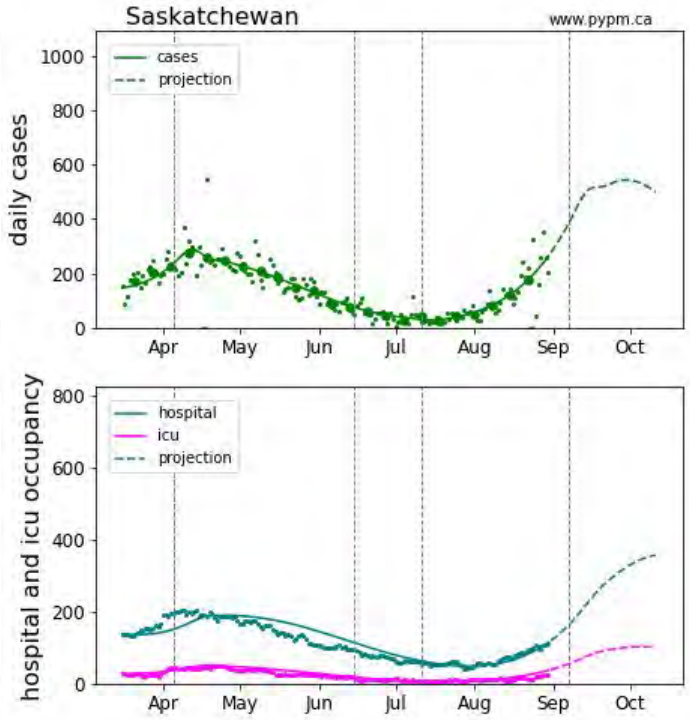
- AB: 20k/day,
- SK: 5k/day

not sufficient to avert crisis, since immunity takes time to acquire.

Source (D. Karlen). See www.pypm.ca. These models have no age structure. Fits include past vaccination schedule. Assumes expansion begins week of Sept 7.

AB, SK projections: measures and expanded vaccination



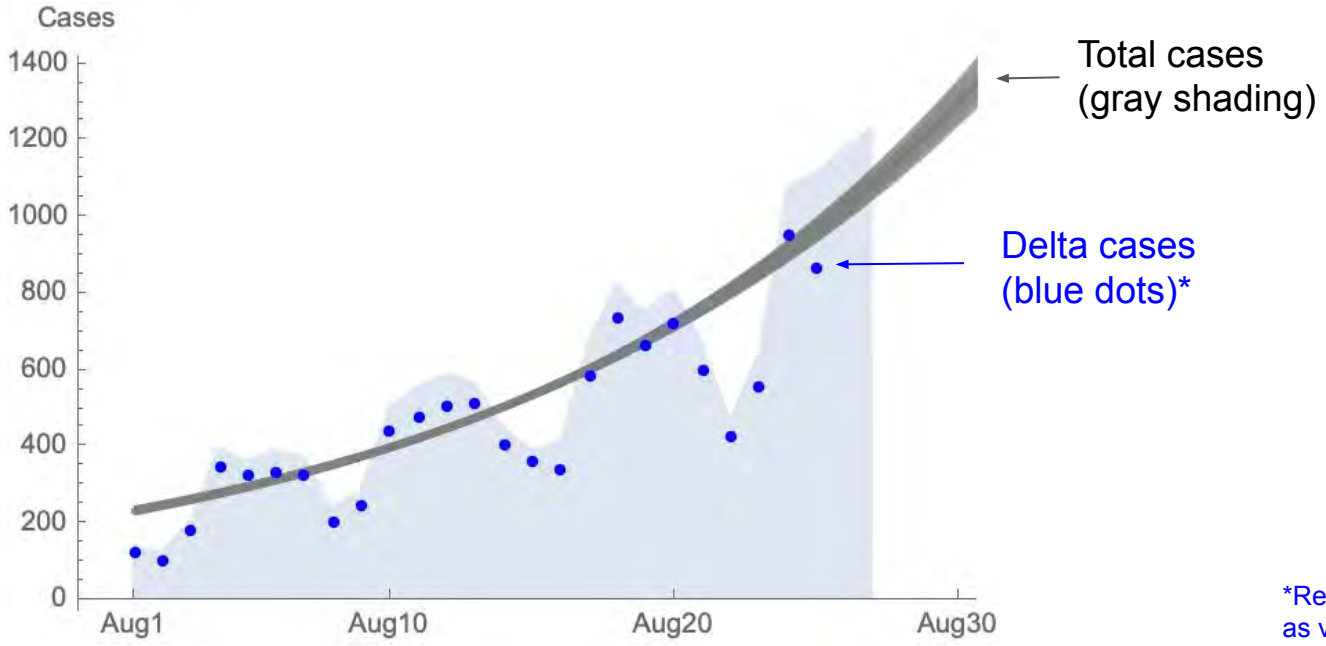


Measures to reduce transmission and to expand vaccination are necessary to reduce the demand on the health care systems.

Source (D. Karlen). See www.pypm.ca. These models have no age structure. Fits include past vaccination schedule. Assumes changes occur on week of Sept 7.

Alberta cases are rising exponentially

Delta cases now predominate in Alberta (blue dots), underlying the rise in overall cases (grey).
Toal case number has been growing at a daily rate of ~0.06 (doubling time ~12 days).



*Recent Delta numbers are underestimated, as variants are still being typed.

Data from source file https://www.alberta.ca/stats/covid-19-alberta-statistics.htm#variants-of-concern (accessed August 30, using data through August 27).

Final words

The Delta wave of COVID-19 infections is in transition in British Columbia.

Measures taken in the Interior have nearly stopped the growth in cases there.

In the other regions, growth rates have begun to slow.

With the mask mandate expanded to all of BC and schools reopening, transmission rates are currently changing. Stay tuned for the next report to capture those changes.

Hospital capacity may soon be exceeded in neighbouring provinces if action is not taken soon.

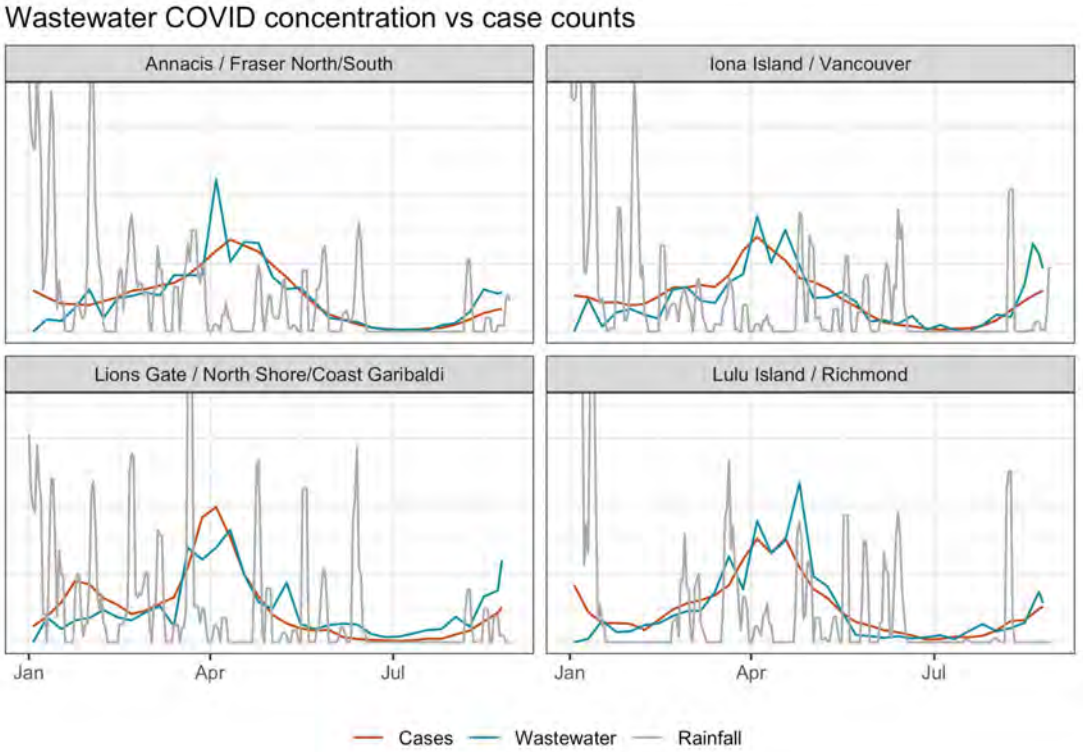
Appendix

COVID-19 prevalence: Cases and wastewater

Wastewater is being monitored for COVID-19 viral concentration in Metro Vancouver.

Wastewater trends (blue) have largely matched case numbers (red) in 2021.

Comparing these trends will allow us to detect major changes in the fraction of infections that remain undetected and to identify when COVID-19 appears in an area without cases.



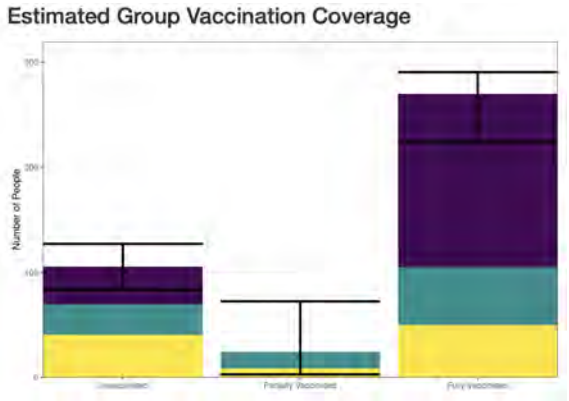
Source (J. von Bergmann) Case data from BC COVID-19 Database (http://www.bccdc.ca/health-info/diseases-conditions/covid-19/data). Wastewater data from Metro Vancouver (http://www.metrovancouver.org/services/liquid-waste/environmental-management/covid-19-wastewater/Pages/default.aspx). Wastewater viral concentration (blue), cases in the local health region (red), and rainfall (grey) are drawn with the same average height, showing relative changes only.

Reminder: New app projecting vaccination status

Vaccination rates are changing globally, making it challenging for universities, festivals, trade shows, conferences, or other organizations who might want to quantify how at-risk their participants are for COVID-19 infection.

We have created a browser app to estimate the numbers of unvaccinated, partially vaccinated, and fully vaccinated people in a group at a future date, based on data from around the world on vaccination rates by location and age group.

While most accurate over short time frames, this app provides event organizers a clearer picture of the susceptibility of their participants to COVID-19.



Source (B. Wiley)