

# COVID Model Projections

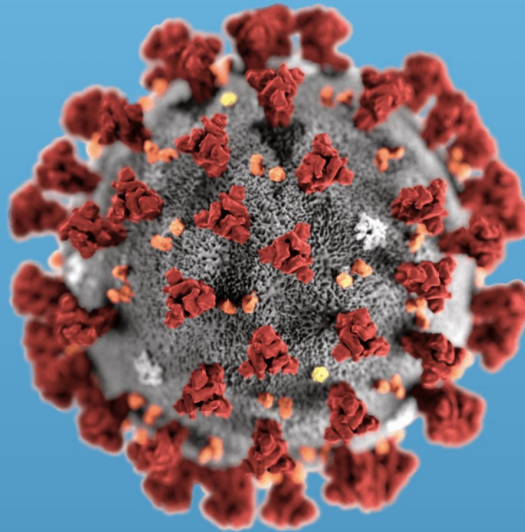
August 18, 2021

[BC COVID-19 Modelling Group](#)

# 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 was convened by [Caroline Colijn](#) (SFU) and [Dan Coombs](#) (UBC) 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.*

# BC: The rising Delta wave

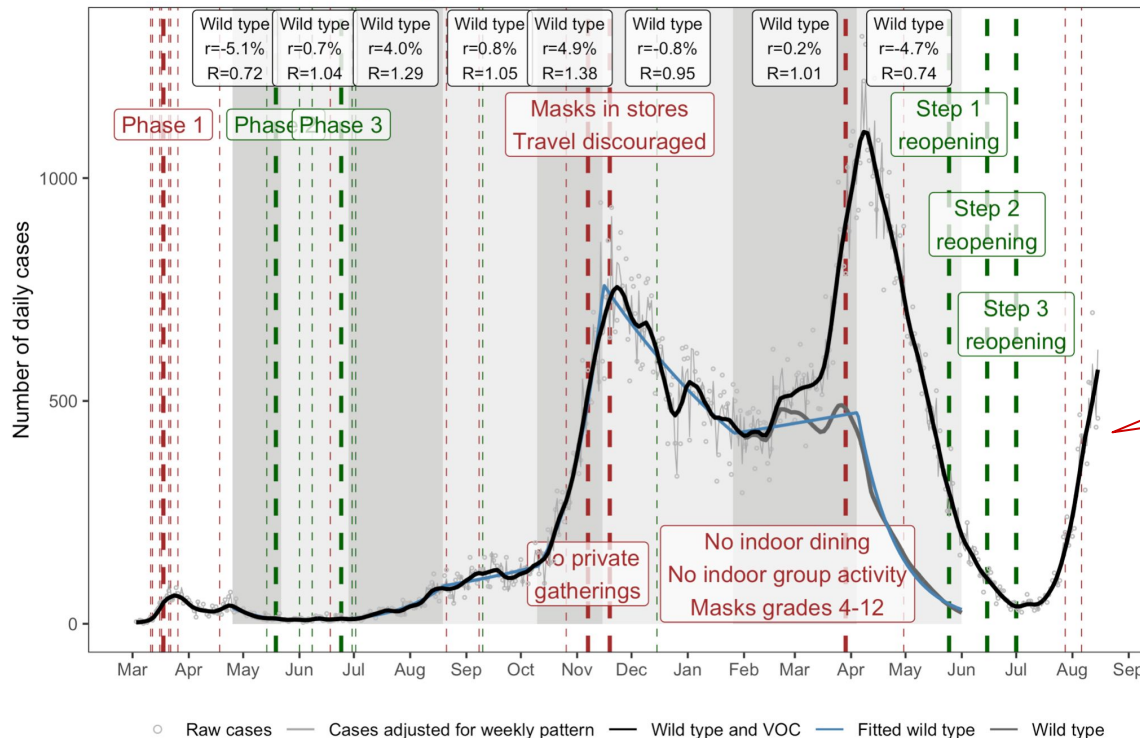
## Key messages

- For nearly five weeks, infections throughout BC have been growing exponentially, doubling about every 9 days (growing 8% each day).
- The growth is observed in all Health Authorities and Health Service Delivery Areas.
  - Community Health Service Areas with 70% vaccination have five-fold higher case counts than those with 90% vaccination among those eligible.
- Hospitalization and ICU occupancy will soon rapidly increase.
  - Hospitalization and ICU demand are not “decoupled” from case numbers.
  - Fraction of cases leading to hospitalization has not declined in BC in 2021.
- Children will be disproportionately affected during this wave.
  - Children under 10 are 9% of the population, but 36% of the unvaccinated population.
- It is urgent that action be taken to reduce transmission and expand vaccination coverage, in order to avoid overwhelming BC’s medical system.

# State of the COVID-19 Pandemic in BC

Covid-19 daily new cases in British Columbia (up to Sun Aug 15)

Timeline of **closure** and **reopening** events



MountainMath, Data: BCCDC

Cases are showing strong and sustained growth after Step 2 & 3 reopening.

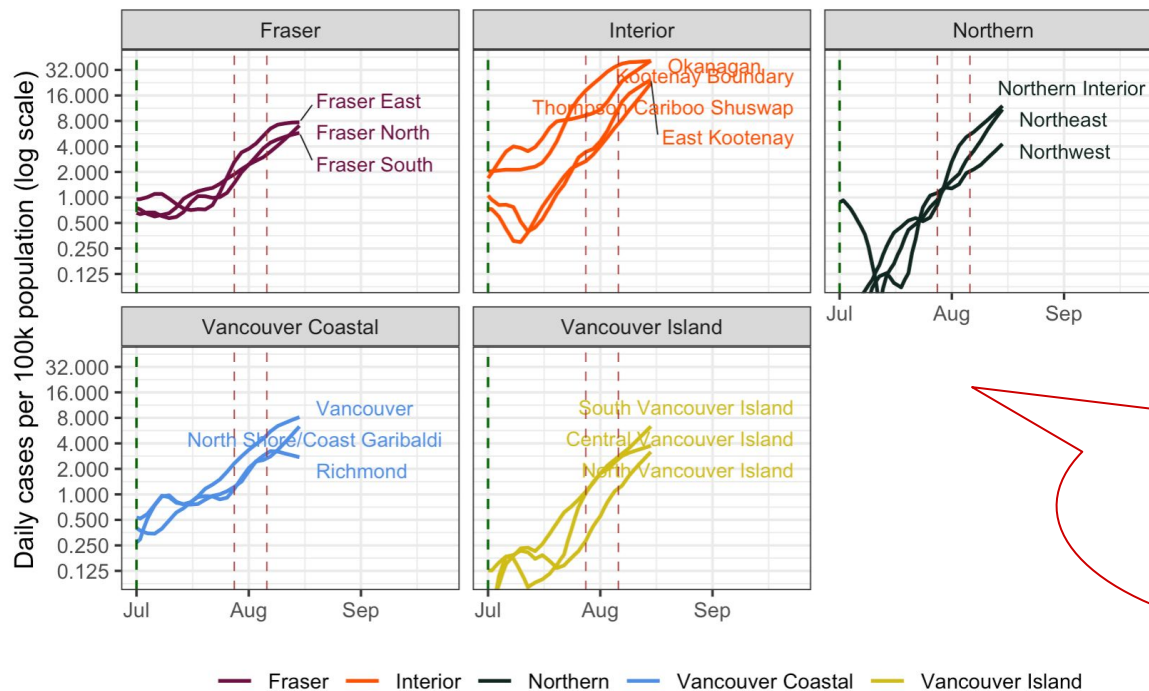
**COVID-19 is now spreading rapidly in BC, echoing growth of Delta in other regions.**

**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.

# State of the COVID-19 Pandemic in BC

Covid-19 daily new cases trend lines in British Columbia (up to Sun Aug 15)

Timeline of **closure** and **reopening** events



All Health Service Delivery Areas have exhibited similar case growth rates. Some regions, including Okanagan Health, are now showing signs of flattening.

MountainMath, Data: BCCDC, BC Stats

**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.

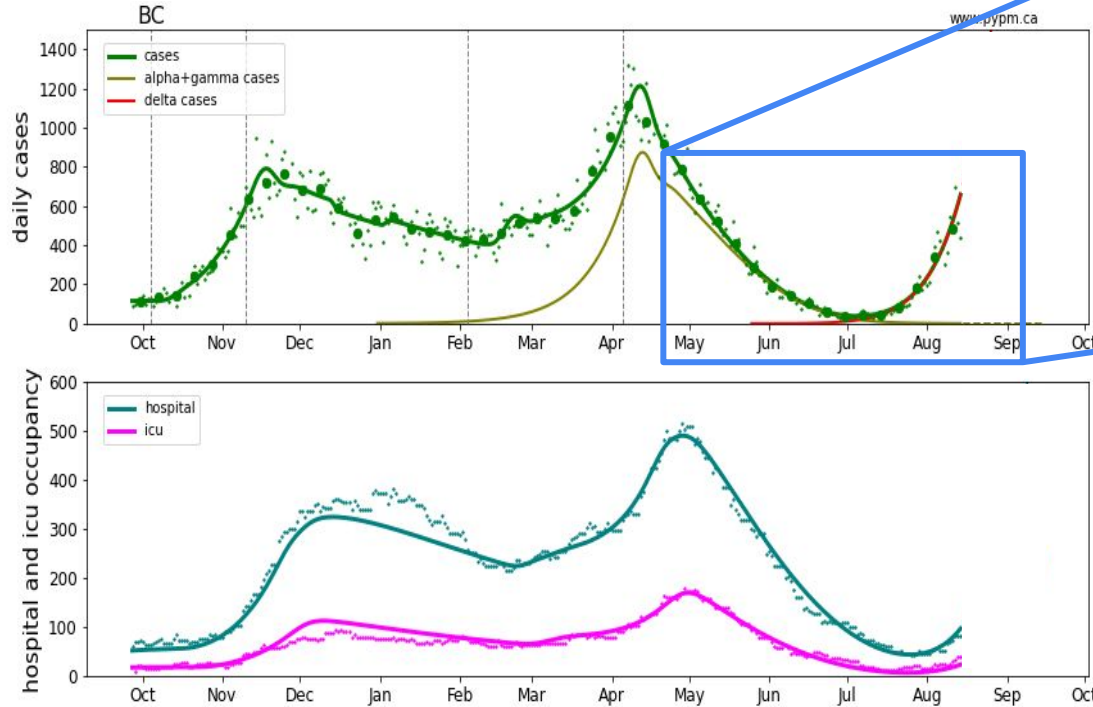
# Modelling growth of delta variant infections in BC

The growth of delta infections in each Health Authority has followed the trend lines first estimated in late July.

The rapid rate of growth (roughly 8% per day) has been steady each week since, following the pattern that occurs when there is community transmission.

Cases will soon exceed record levels.

# Recent fits to case and hospital data



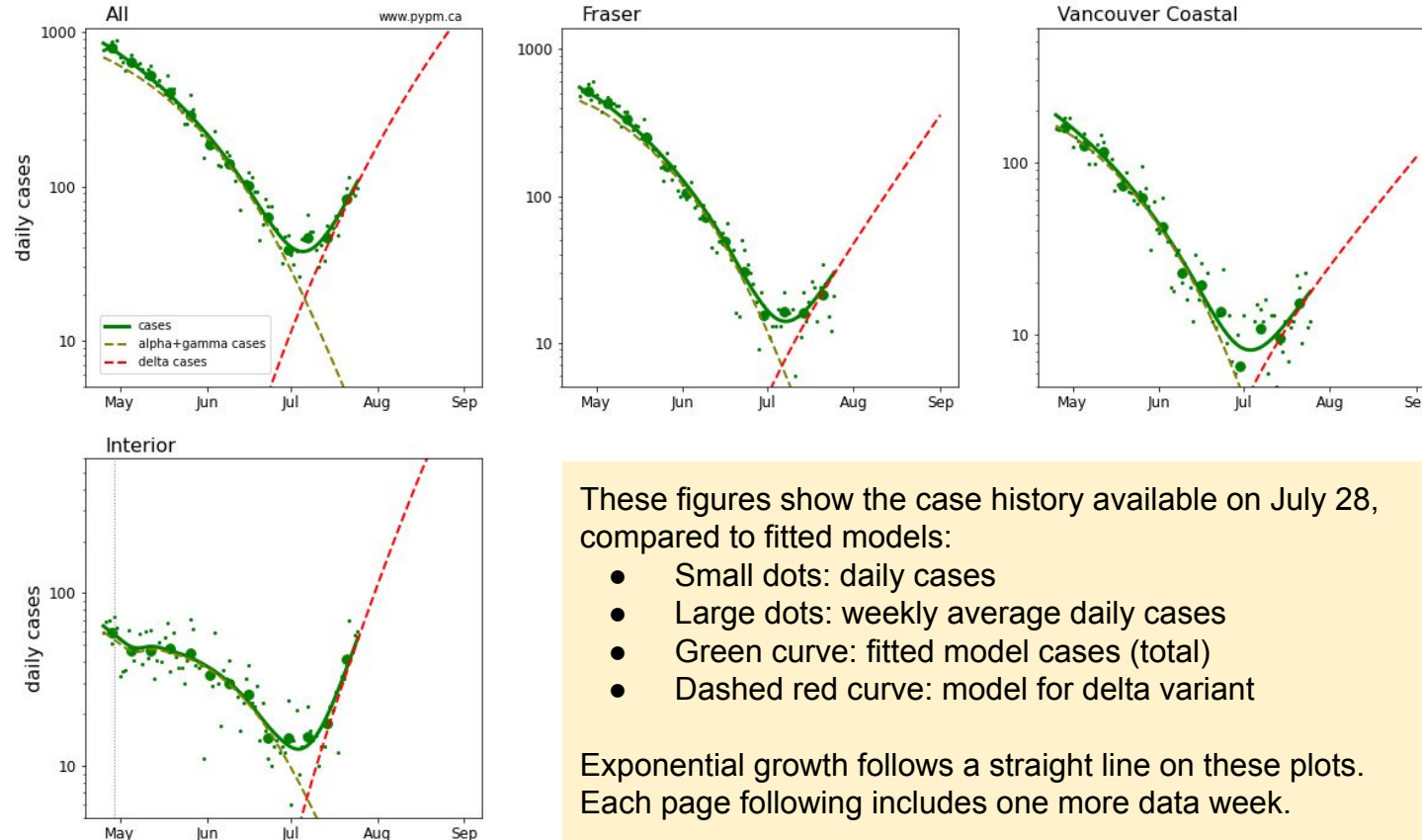
Zoom of  
data on  
log scale

Growing and declining COVID infection rates are monitored by positive tests (cases), yielding an infection model (green curve).

The infection model (curves) reproduces hospital and ICU occupancy data (points).

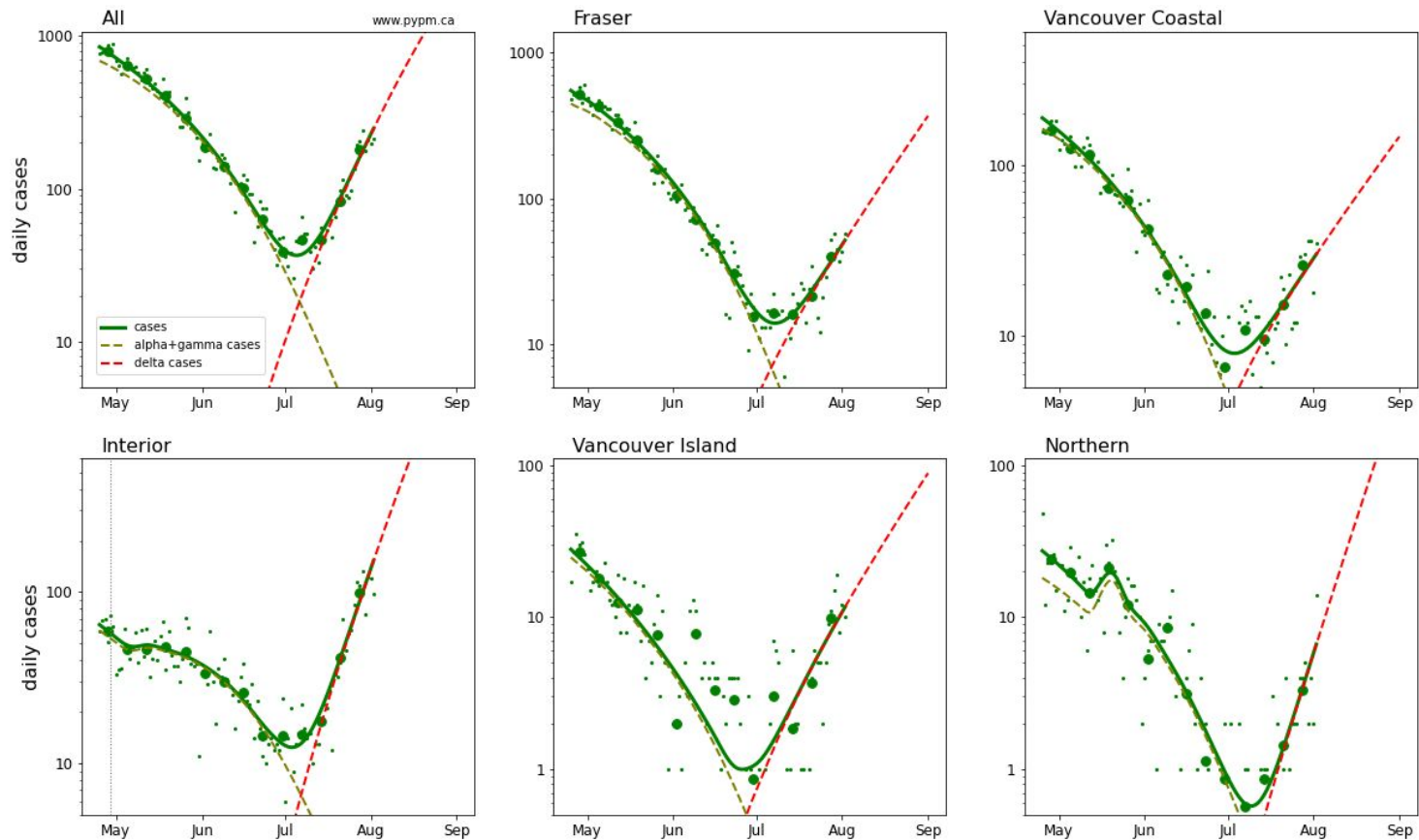
How good is the model at projecting? ...

# Model fits to BC data (July 28 report)



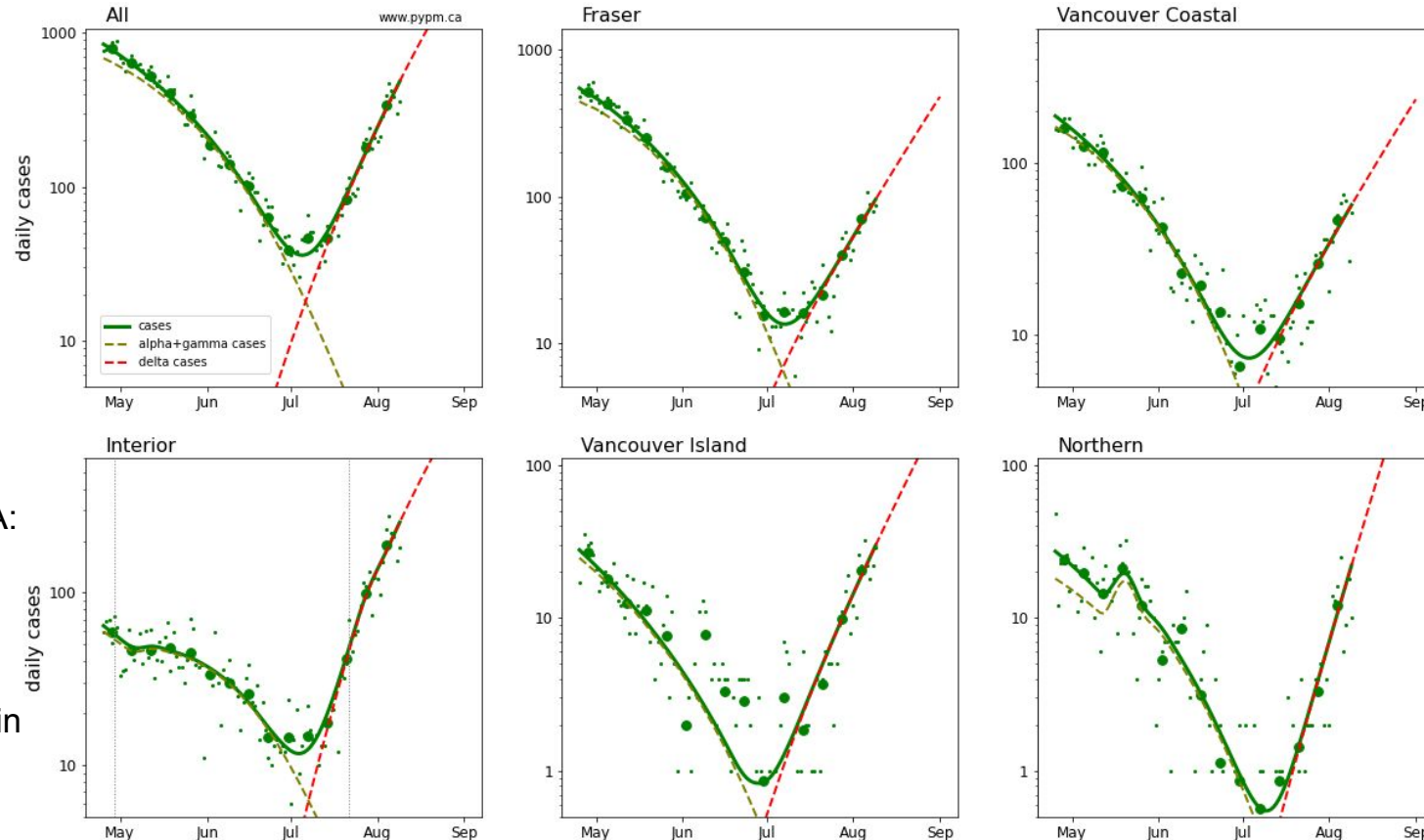


# Model fits to BC data (August 3 update)



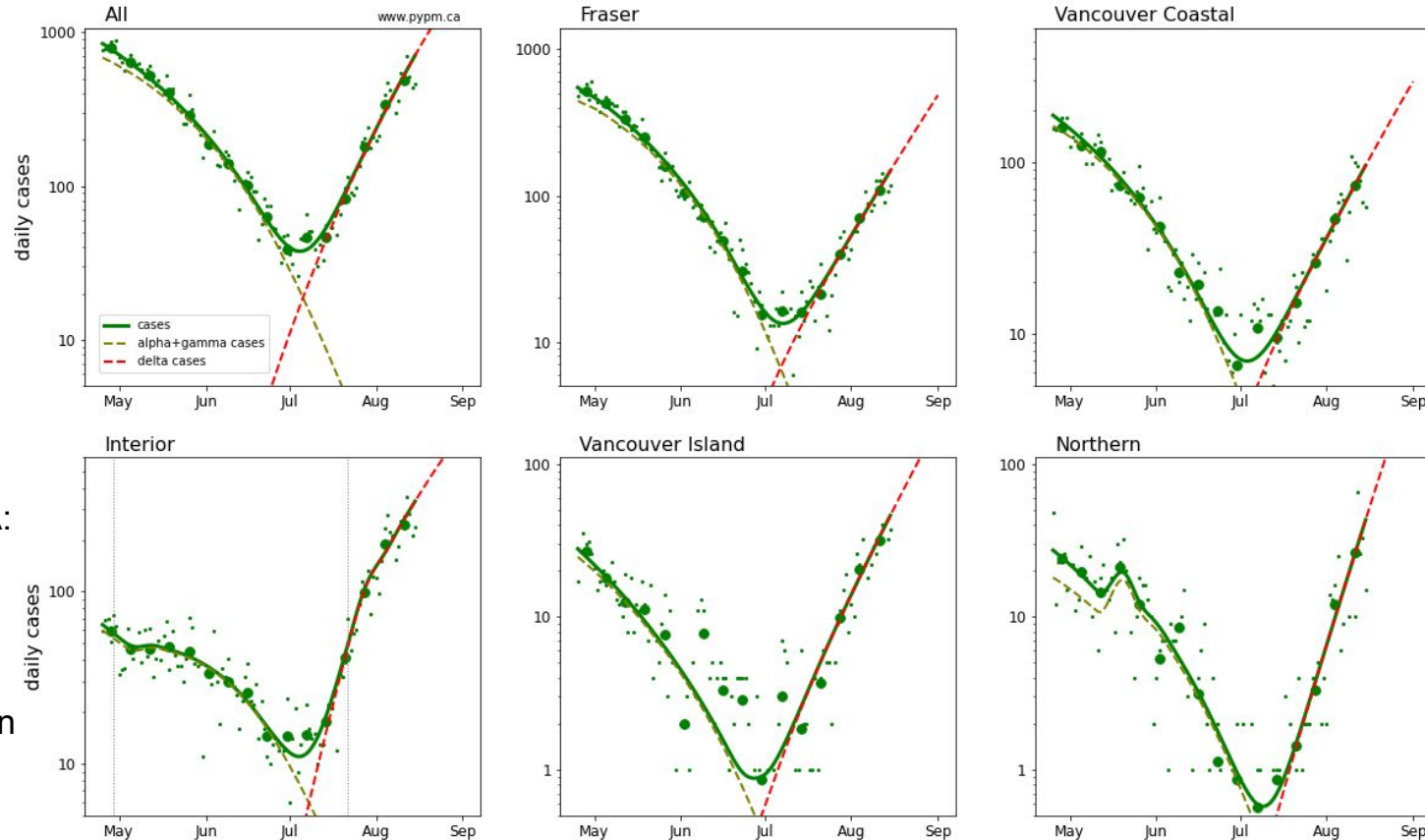
Source (D. Karlen). See [www.pypm.ca](http://www.pypm.ca). These models have no age structure. Fits include past vaccination schedule.

# Model fits to BC data (August 10 update)



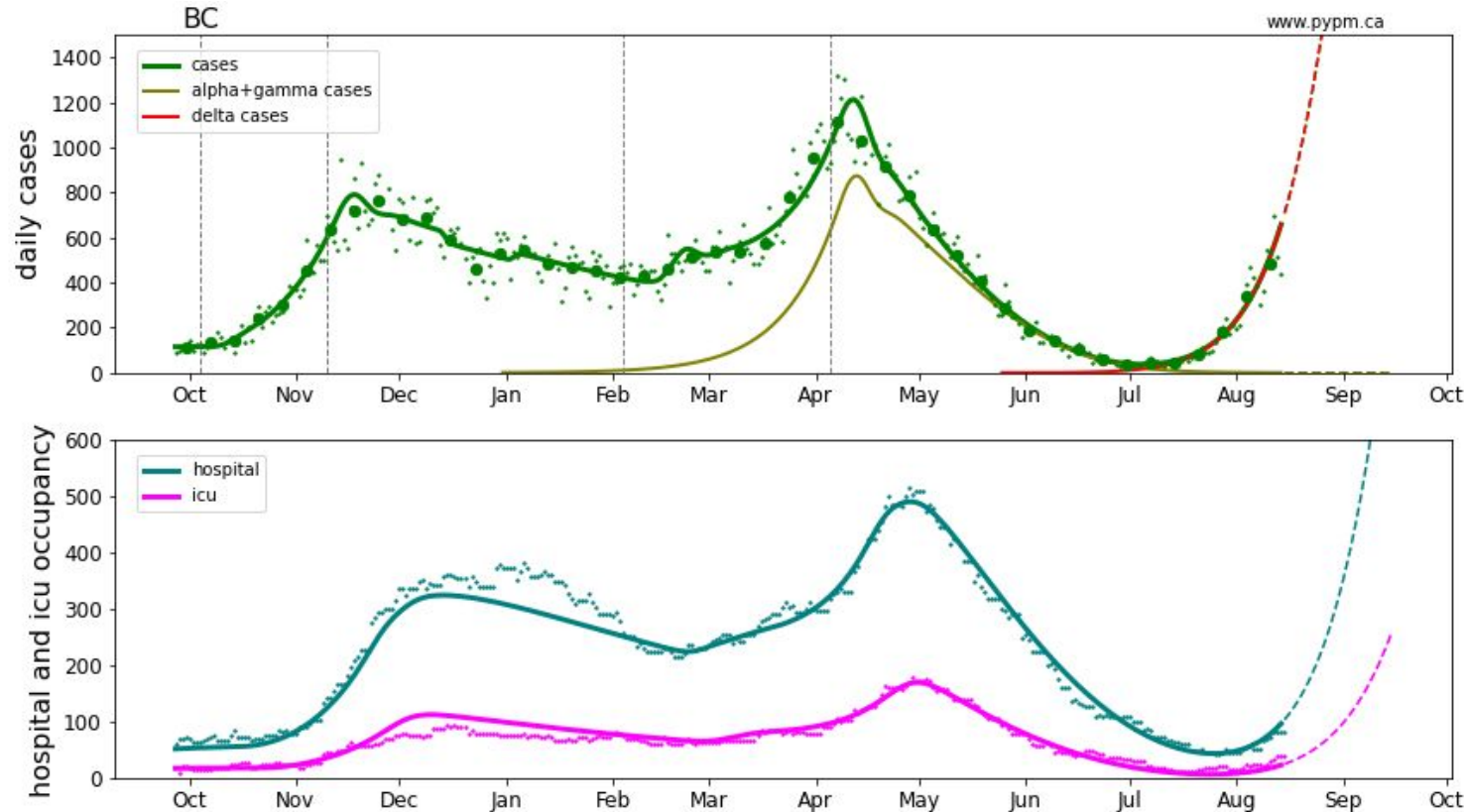
Interior HA:  
measures  
brought in  
in late July:  
small  
reduction in  
growth

# Model fits to BC data (August 16)



Interior HA:  
measures  
brought in  
late July:  
small  
reduction in  
growth

# Impact of continued growth on health care



Growing and declining COVID infection rates are monitored by positive tests (cases), yielding an infection model (green curve).

The infection model (curves) reproduces hospital and ICU occupancy data (points).

We can therefore estimate future occupancy.

# Is hospitalization ‘decoupling’ from cases?

We examine data to check whether our high rates of vaccination are causing the fraction of cases leading to hospitalization to decline significantly (“decouple”), which would help avert a health care crisis, despite the rapid growth in cases.

The next slides show that BC data are not consistent with this hypothesis.

# Hospitalizations and ICU admissions as share of reported cases

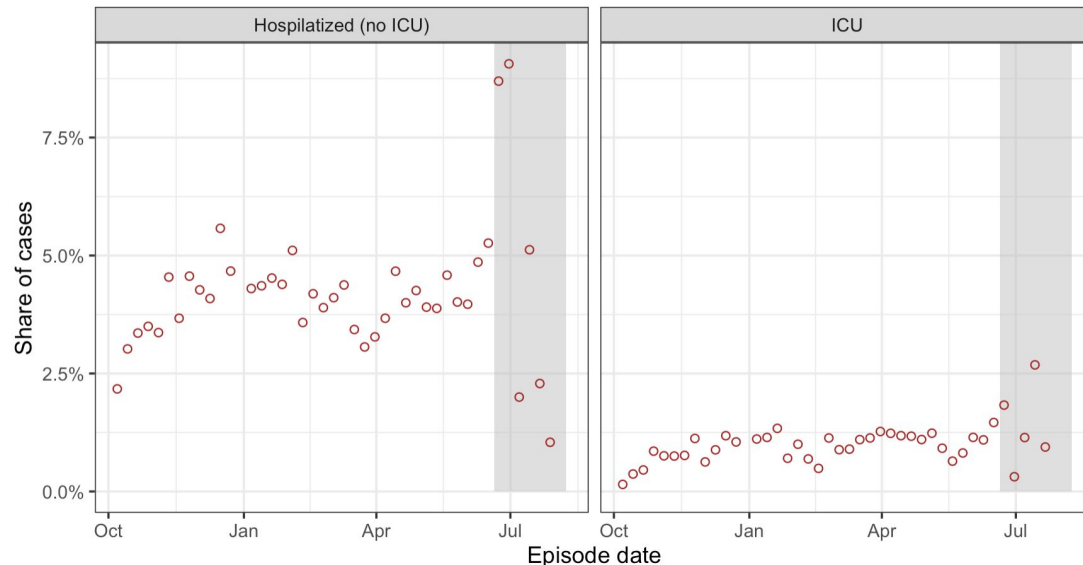
The fraction of cases requiring hospitalization has remained relatively consistent throughout 2021. Other Canadian jurisdictions are similar (see Appendix).

We do not expect this fraction to drop with vaccination since **most cases and hospitalizations are in unvaccinated individuals** and asymptomatic vaccinated infections are likely not reported.

There are many possible effects that could change the fraction, including: vaccination, age distribution of infections, changing severity, testing protocols, changes in undetected infections.

British Columbia Hospitalization rates

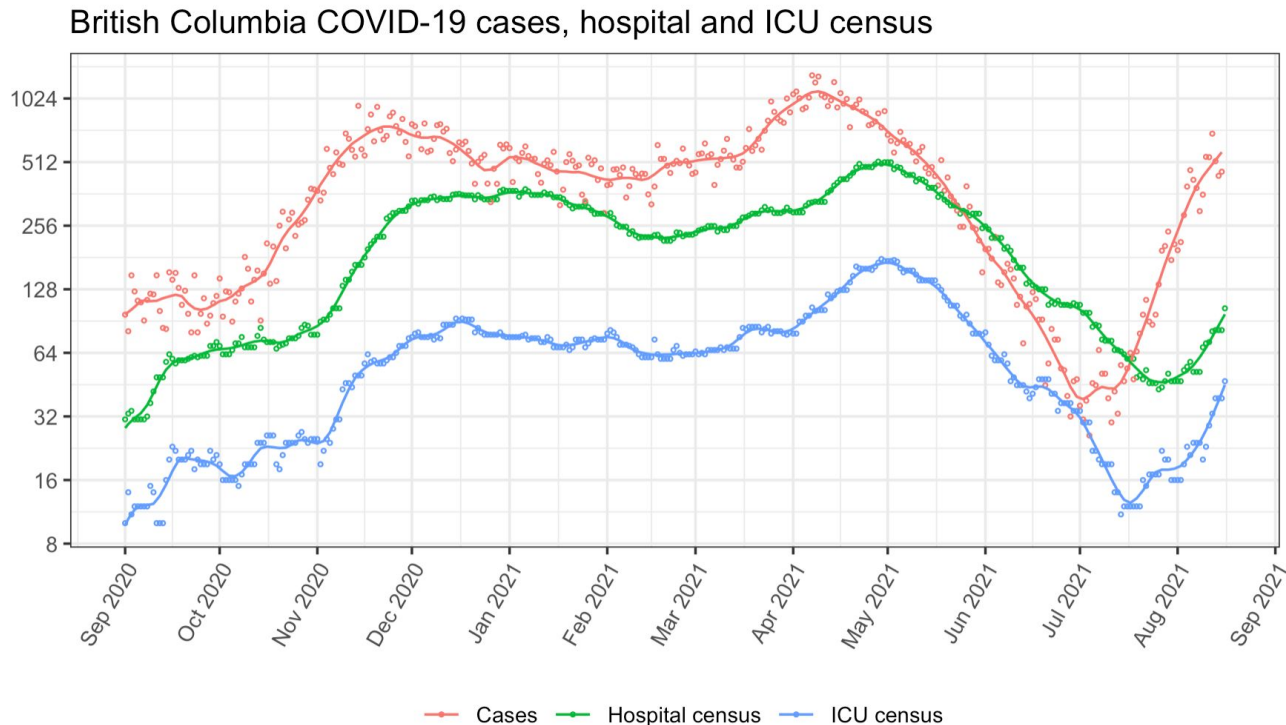
(excluding the most recent data points from trend because of right-censoring)



MountainMath, Data: StatCan table 13-26-0003

# Cases, hospitalizations and ICU occupancy over time

Despite the success of the provincial vaccination programme, hospitalization and ICU occupancy are now rising.



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

# Longer term projections - no change scenario

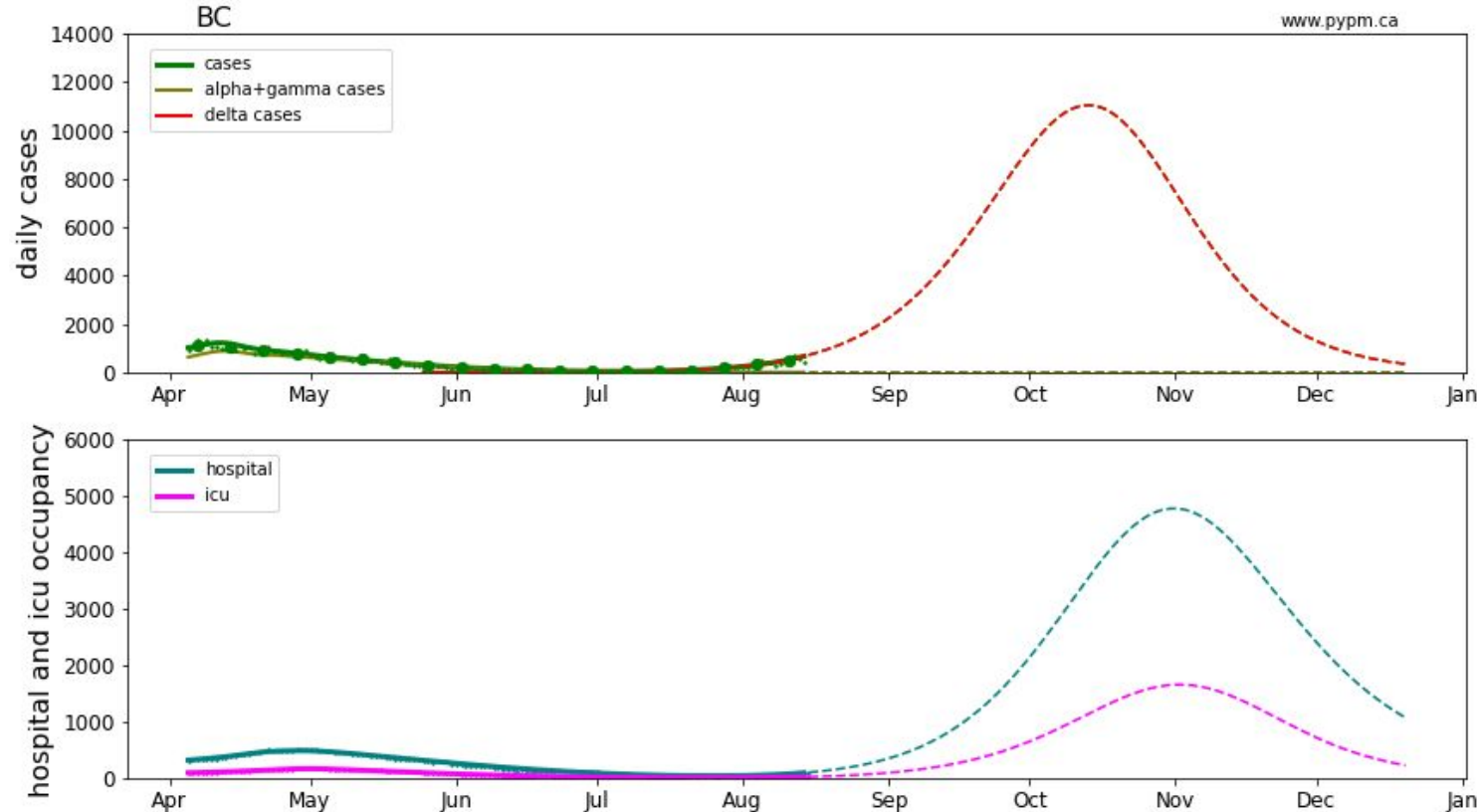
The following slides show projections for the BC situation, assuming no change to current behaviour is made in the coming months. No capacity limits are imposed.

- These are therefore not forecasts. We would expect measures would come into force before reaching capacity limits.

Two projections were done independently using very different model approaches. The hospital occupancy projections are very close, despite different structure and assumptions in the models.



# Longer term projection (no action taken)



If transmission continued at present rate, daily cases would dwarf the previous record of April 2021. Infection rates eventually decline due to the herd effect.

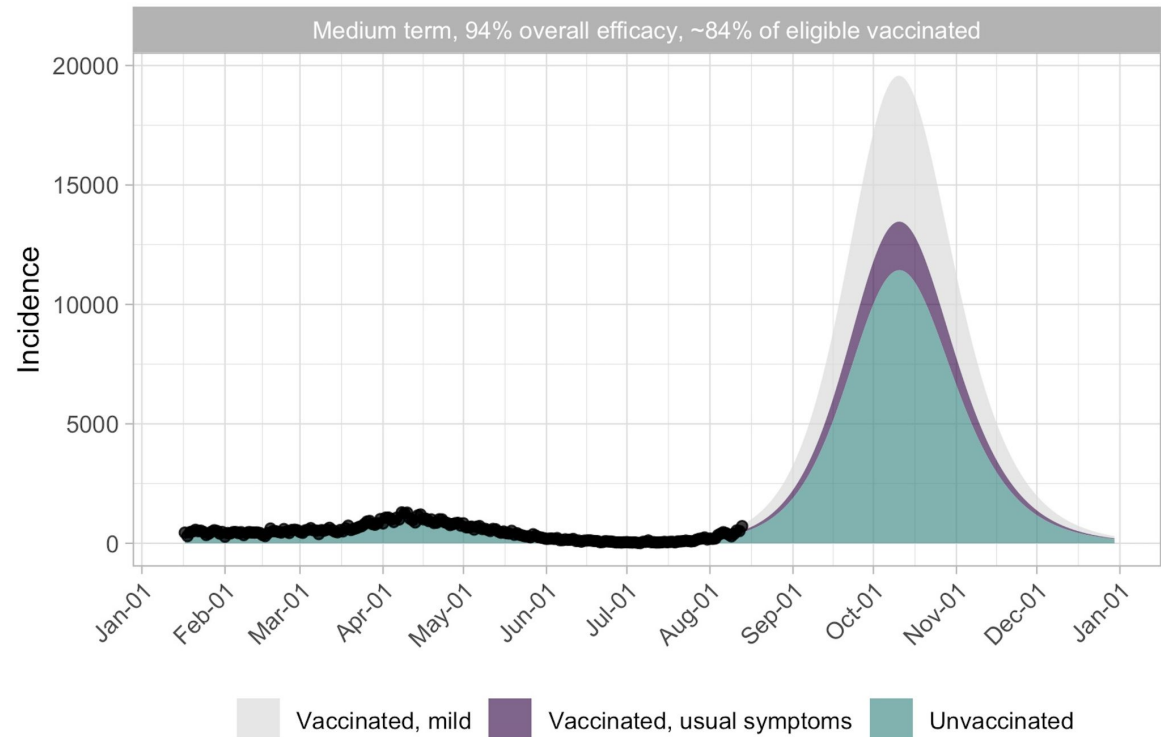
In this scenario, hospital and ICU demands would exceed available capacity (including surge beds).

# Medium-term projection: 94% overall efficacy and transmission matched to recent BC trend

Many sources of uncertainty (not shown), including the transmission rate, based on current growth, and vaccine efficacy.

All scenarios that project current transmission forward result in **high case numbers among unvaccinated individuals**.

Mild or asymptomatic vaccinated individuals are shown (grey), but likely would not be reported.

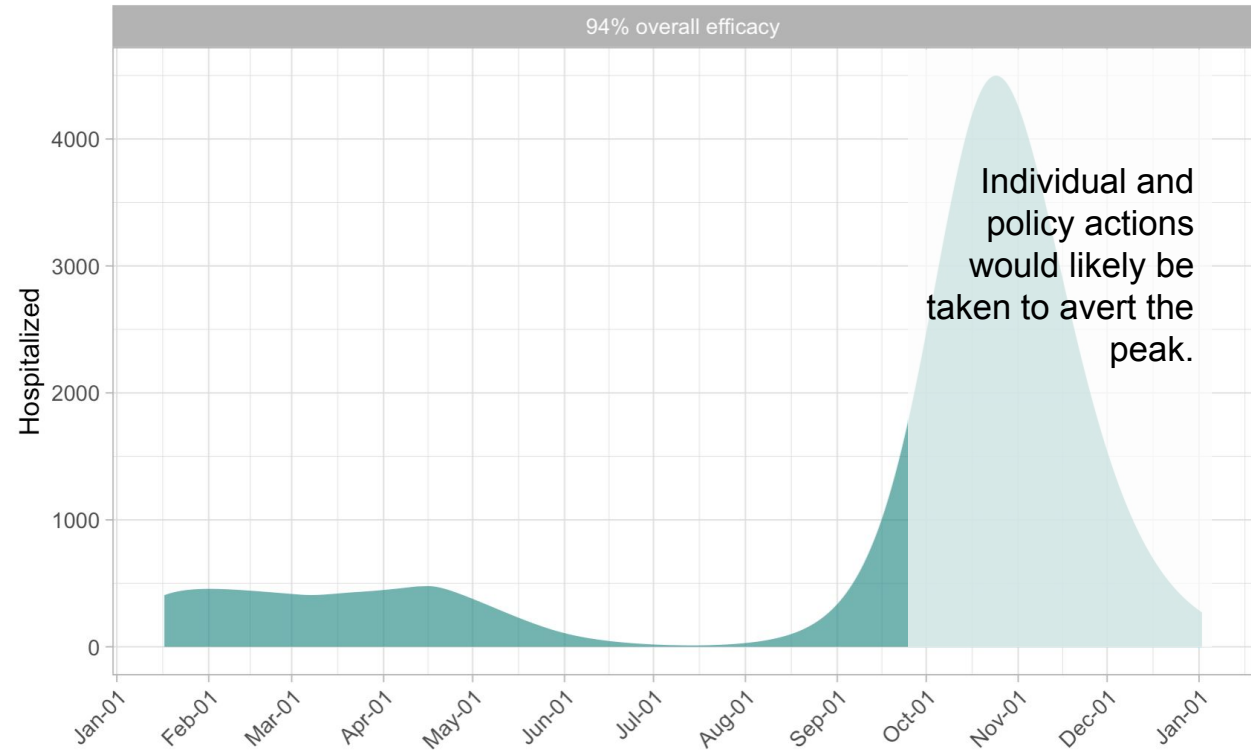


# Projected census hospitalization from unvaccinated infections

Estimated using the age distribution of cases, age-based risk and duration of hospitalization.

**Optimistic:** no breakthrough infections shown, but some may require hospital care. No increase in severity (from May to Fall 2021) due to Delta.

**This is a *projection*, not a *prediction*:** it will change if we change measures or behaviour, or substantially increase vaccination rates.



Model: Age- and contact-structured vaccination model, BC data. See <https://www.medrxiv.org/content/10.1101/2021.02.23.21252309v1>

# COVID-19 and children

Last year, few children were exposed. Children are unlikely to get severe disease compared to adults, but can require hospital care and can get long COVID.

Will COVID-19 in schools this year be like last year?

- With measures largely removed, community transmission will be higher
- Schools have reflected community transmission. Exposures in schools will likely be higher with higher community transmission.
- Children under 12 are currently unvaccinated
- Transmission within schools could increase sharply without control measures in place, and because of Delta (higher transmission rate).
- The US is seeing considerable school transmission.

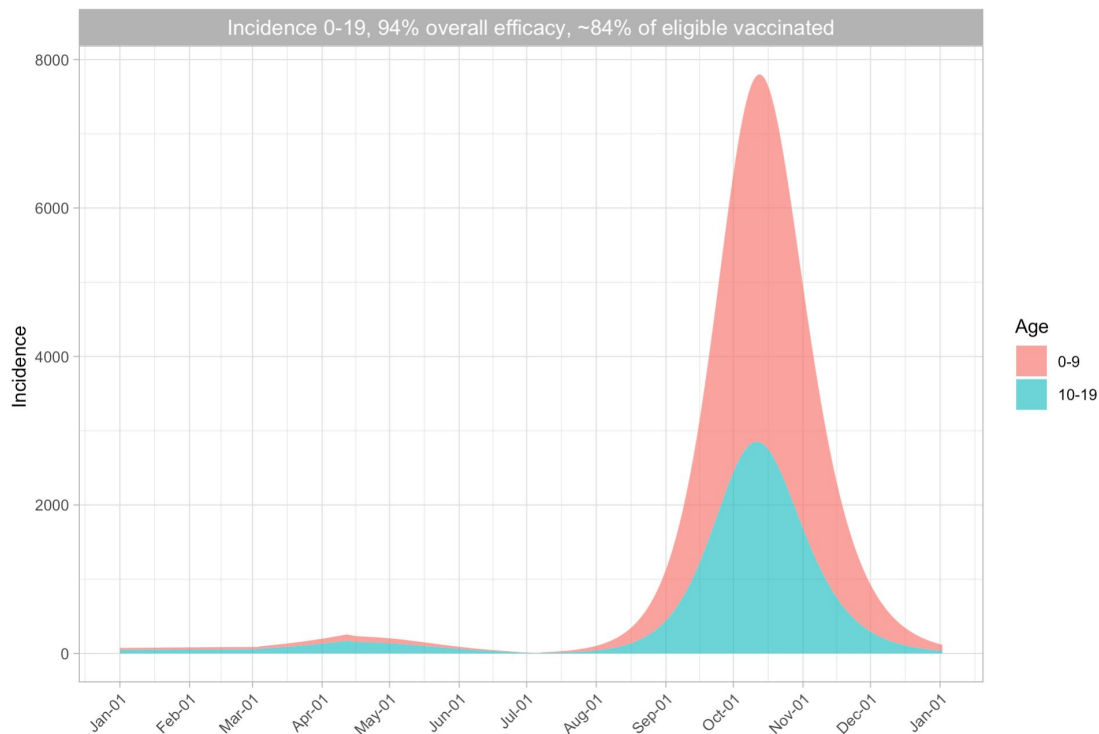
The 2020-2021 school year is likely not a good model for the coming school year.

# Model projections for 0-19 infections in BC

Children make up a much larger portion of the *unvaccinated* people than they do of the total population.

For example children under 10 are 9% of the population, but 36% of the unvaccinated population.

High community transmission in the context of vaccination is likely to lead to large numbers of infections in children.



Model: Age- and contact-structured vaccination model, BC data. See <https://www.medrxiv.org/content/10.1101/2021.02.23.21252309v1>

# What actions are needed to avoid a crisis?

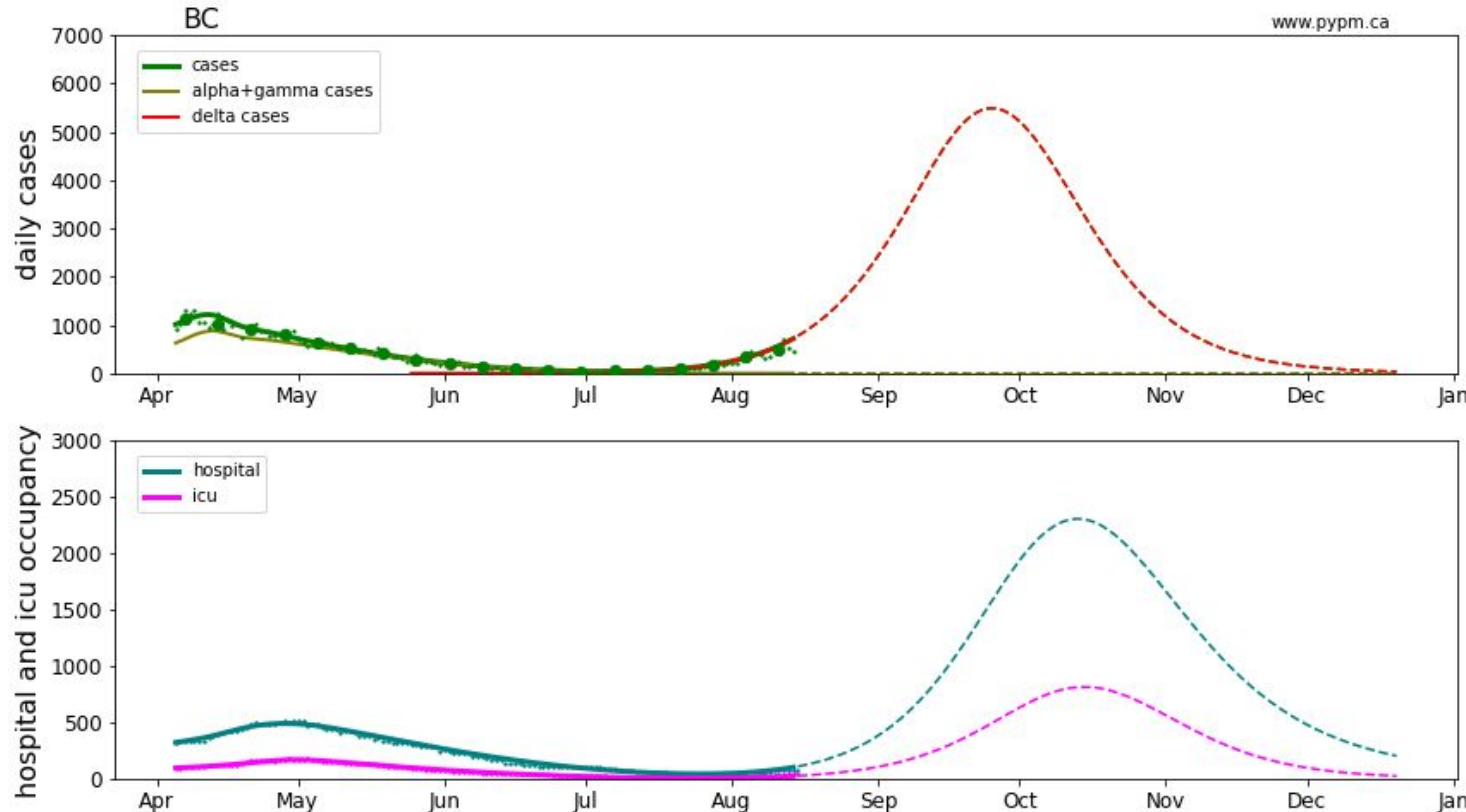
Transmission will need to be reduced to avoid exceeding health care capacity.

The next slides show model projections for two scenarios:

1. Expansion of vaccination to 90% of total population
  - Vaccination of children under 12 is not yet approved. Even with rapid rollout, vaccine immunity grows slowly. On its own, it is insufficient to avoid a potential crisis.
2. Measures to reduce transmission brought in during expansion of vaccination to 90% of total population
  - Keep the growth of infections under control while vaccine immunity continues to build. Delta growth has been stopped in several [EU nations](#).
  - Relaxation of measures can take place once vaccine immunity is sufficient to prevent growth of delta infections

**Only the second scenario, with measures that reduce contact rates and transmission, is effective soon enough to avoid a major health care impact.**

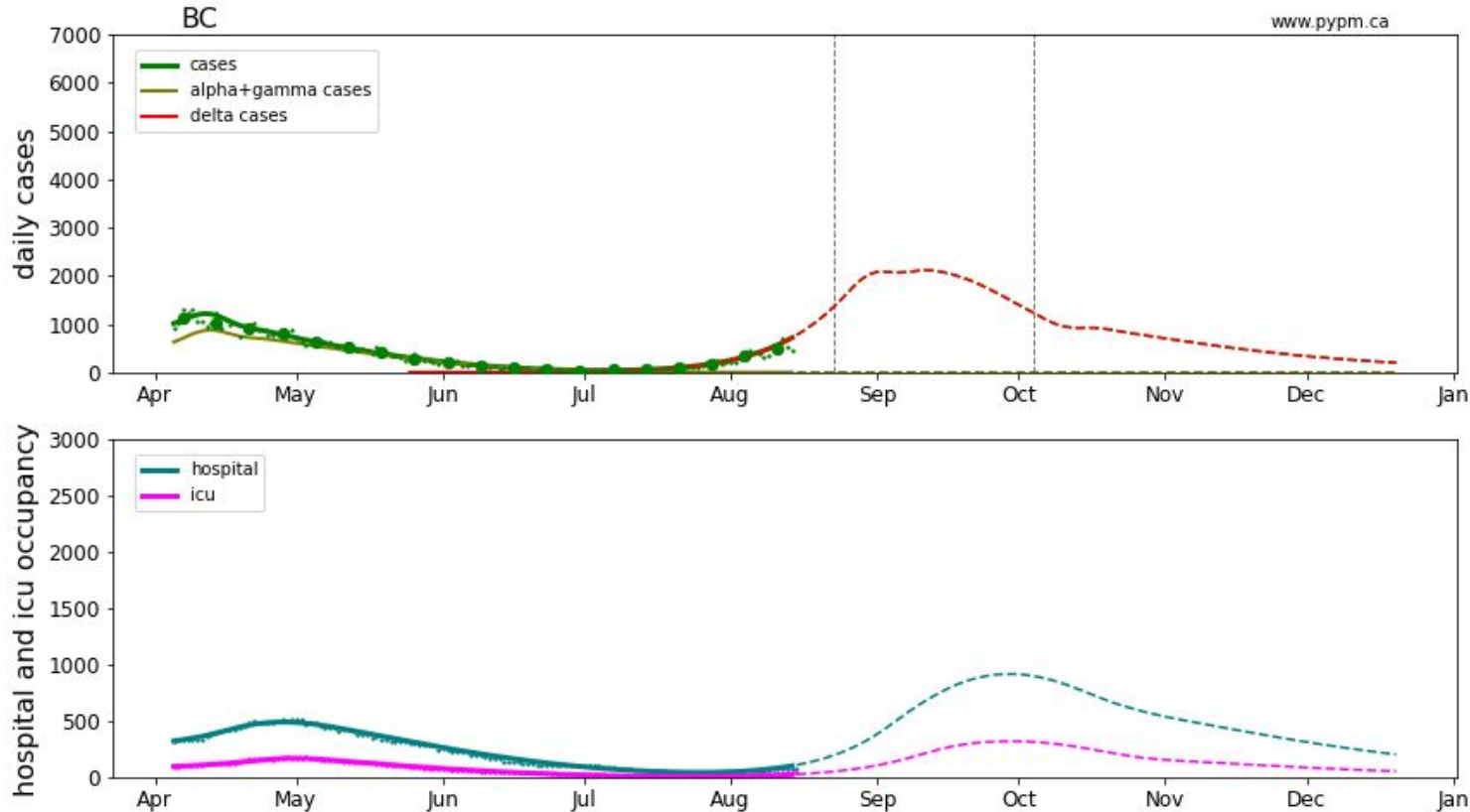
# Longer term projection (expansion of vaccine coverage)



In this scenario, first dose vaccinations increase by 20,000 per day starting next week until 90% of population is vaccinated.

Due to the delay in gaining vaccine immunity, the peak hospital demand remains unacceptable.

# Longer term projection (measures and vaccine expansion)



In this example, measures enacted next week stop the growth of delta, while vaccine immunity builds. Measures are rescinded after six weeks.

While demands exceed previous levels, they are reduced compared to the vaccination only scenario.



# Final words

Like all US states and other provinces in Canada, BC is experiencing rapid growth due to the Delta variant in an environment with significant community transmission.

Many US states now have more than 90% of ICU beds currently in use with demand continuing to increase. (Source: HHS). States are seeing increasing hospitalizations in children with some children's hospitals reaching capacity.

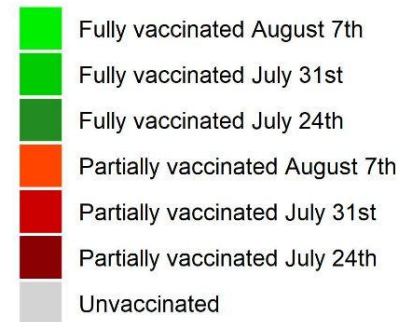
BC is currently on the same path, with serious consequences for health care.

By taking action to reduce transmission and expand vaccination, the impact on the health care system can be reduced significantly.

# Appendix

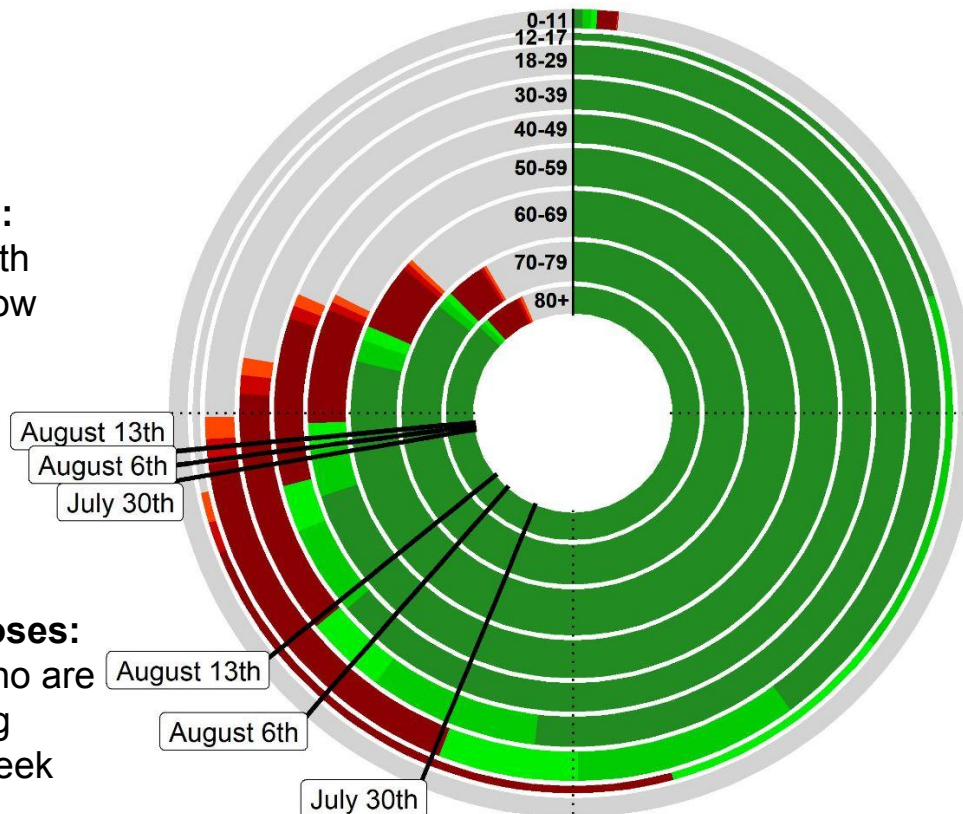
# Closing the circle: Vaccination status by age

August 14th update includes data through August 7th, 2021



## Slow progress on 1st doses:

Fraction of BC's population with at least one vaccine shows slow growth, rising <1% per week.



## Slowing progress on 2nd doses:

Fraction of BC's population who are fully vaccinated shows slowing growth, now rising ~3% per week

Source (B. Wiley). Design by Blake Shaffer ([https://blakeshafter.shinyapps.io/app\\_vaccines/](https://blakeshafter.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>

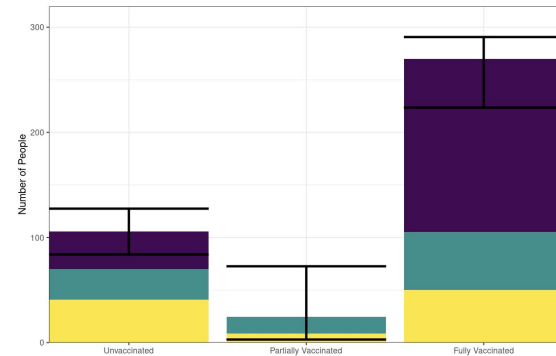
# Projecting vaccination status

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.

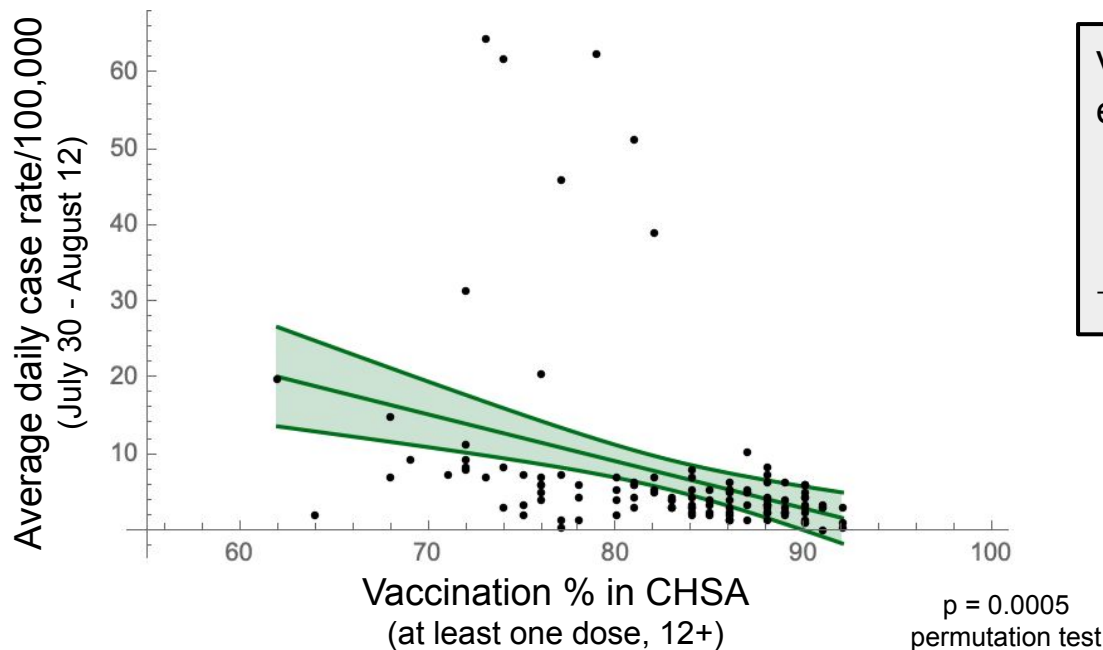
While most accurate over short time frames, this app provides event organizers a clearer picture of the susceptibility of their participants to COVID-19.

Estimated Group Vaccination Coverage



# Vaccination helps

Community Health Service Areas (CHSA) with higher vaccination rates have significantly lower daily case counts in BC. Communities that are 70% of eligible people vaccinated have **five** times higher rates of COVID-19 cases than those with 90% vaccination.



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

- 8.3-fold lower infection rates<sup>a</sup>
- 2.6-fold lower chance of hospitalization if infected<sup>b</sup>

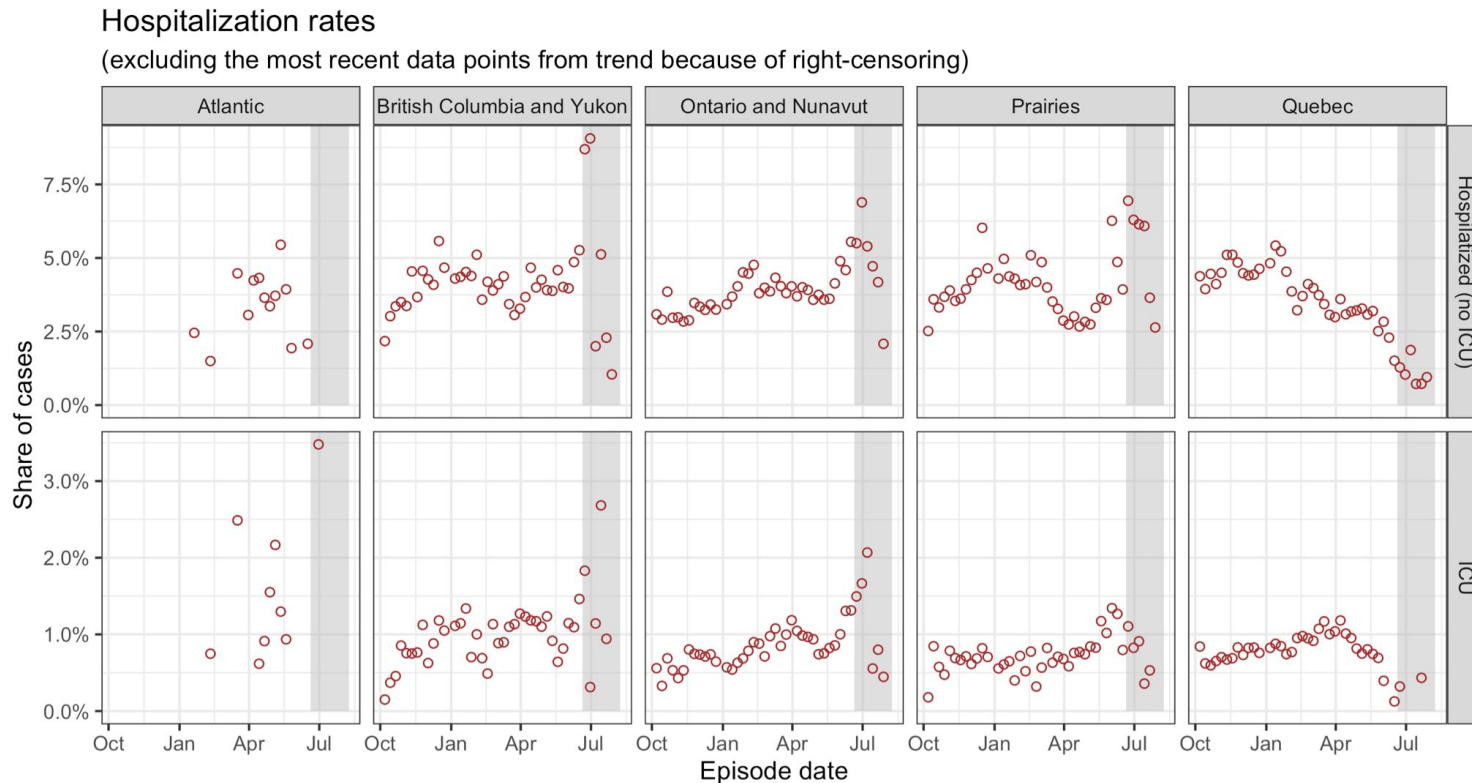
→ Vaccination double protects

Source (S. Otto). BCCDC data portal's surveillance dashboard [data](#); see [maps](#) for regions that would most benefit from community vaccination drives (accessed August 13, 2021).

<sup>a</sup> [Lopez-Bernal \(2021\) NEJM](#). <sup>b</sup> [Sheikh et al. \(2021\) Lancet](#)

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

# Hospitalizations as share of cases in Canada



MountainMath, Data: StatCan table 13-26-0003