

# COVID Model Projections

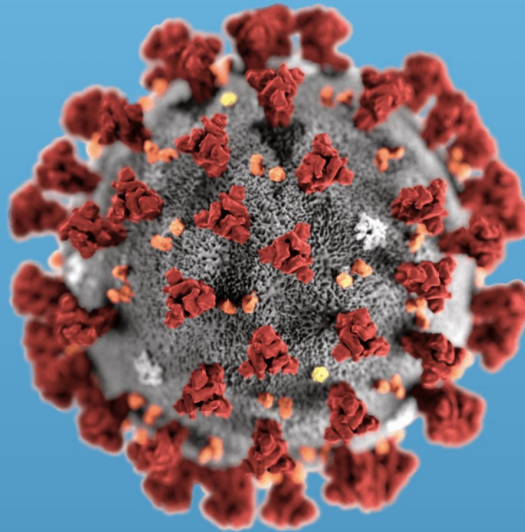
July 28, 2021

[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>

## 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: Early signs of growth

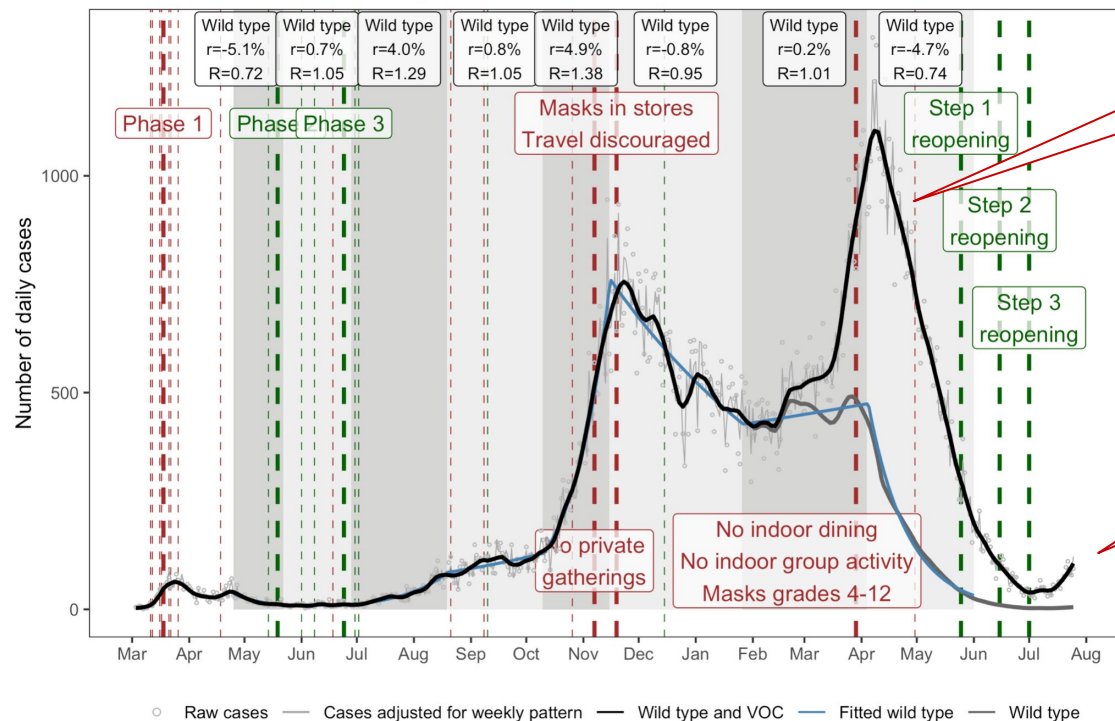
## Key messages

- COVID-19 cases are now rising in British Columbia as a whole, and most concerningly, in the Interior Health region.
- There are signs that we may be entering a rapid growth phase, and case numbers need to be watched carefully.
- Delta (B.1.617.2) continues to rise in frequency relative to other variants.
- Communities with lower vaccination rates are seeing five times as many cases as those with higher levels of vaccination.
- First dose vaccination rates are inching up slowly, by about 1% per week.
- Vaccinated individuals can still catch and transmit the virus, although their risk of doing so is about ten times lower.
- Increasing evidence shows that COVID-19 cases are often asymptomatic among vaccinated individuals, making the source of a COVID-19 infection increasingly hard to determine.

# State of the COVID-19 Pandemic in BC

Covid-19 daily new cases in British Columbia (up to Sun Jul 25)

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



MountainMath, Data: BCCDC

April 2021: BC bent down the COVID-19 curve following March 30 "circuit breaker"

Cases are showing clear growth after Step 3 reopening. The exact nature of the growth is unclear because of inadequate data on VOC, in particular Delta.

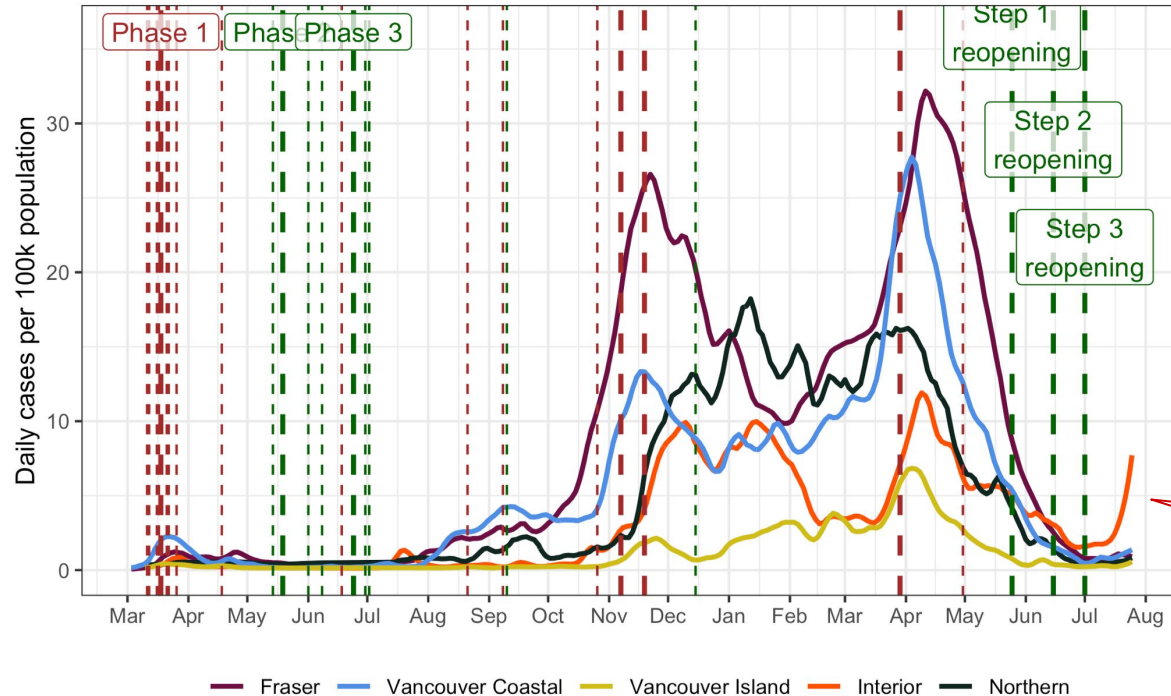
**COVID-19 is now spreading rapidly in BC, echoing growth of Delta in other regions.**

**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

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



**First-dose vaccination % of total population:**

Interior Health: 65.2%

Northern Health: 57.4%

Fraser Health: 69.4%

Vancouver Coastal: 79.9%

BC: 72.0%

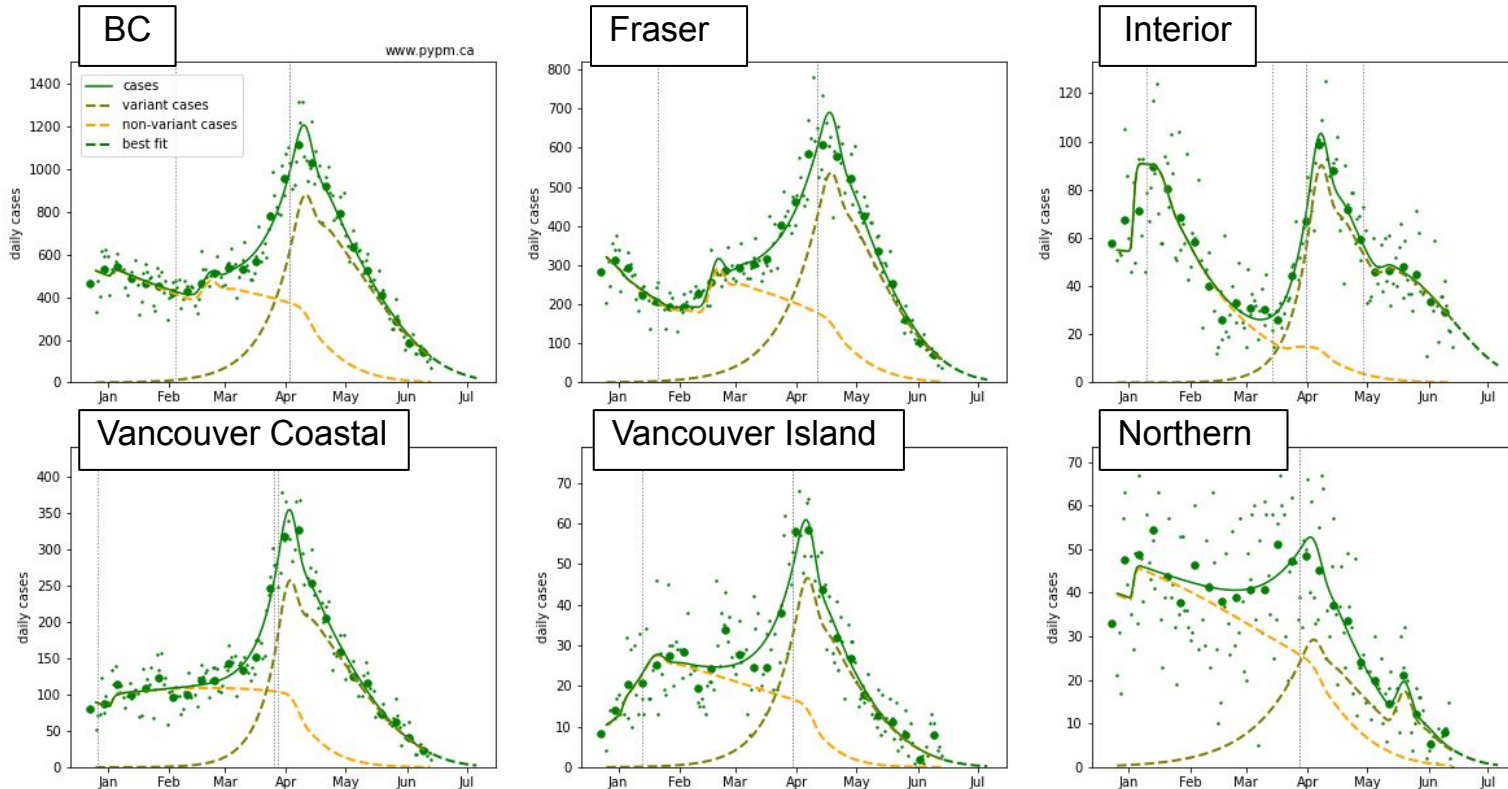
**Health Authorities are not  
equally protected by  
vaccination**

Recent rise in case  
numbers is primarily in  
Interior Health Authority

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). 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. Vaccination % by Health Authority from the BCCDC [Dashboard](#), with [BC population](#) projections.

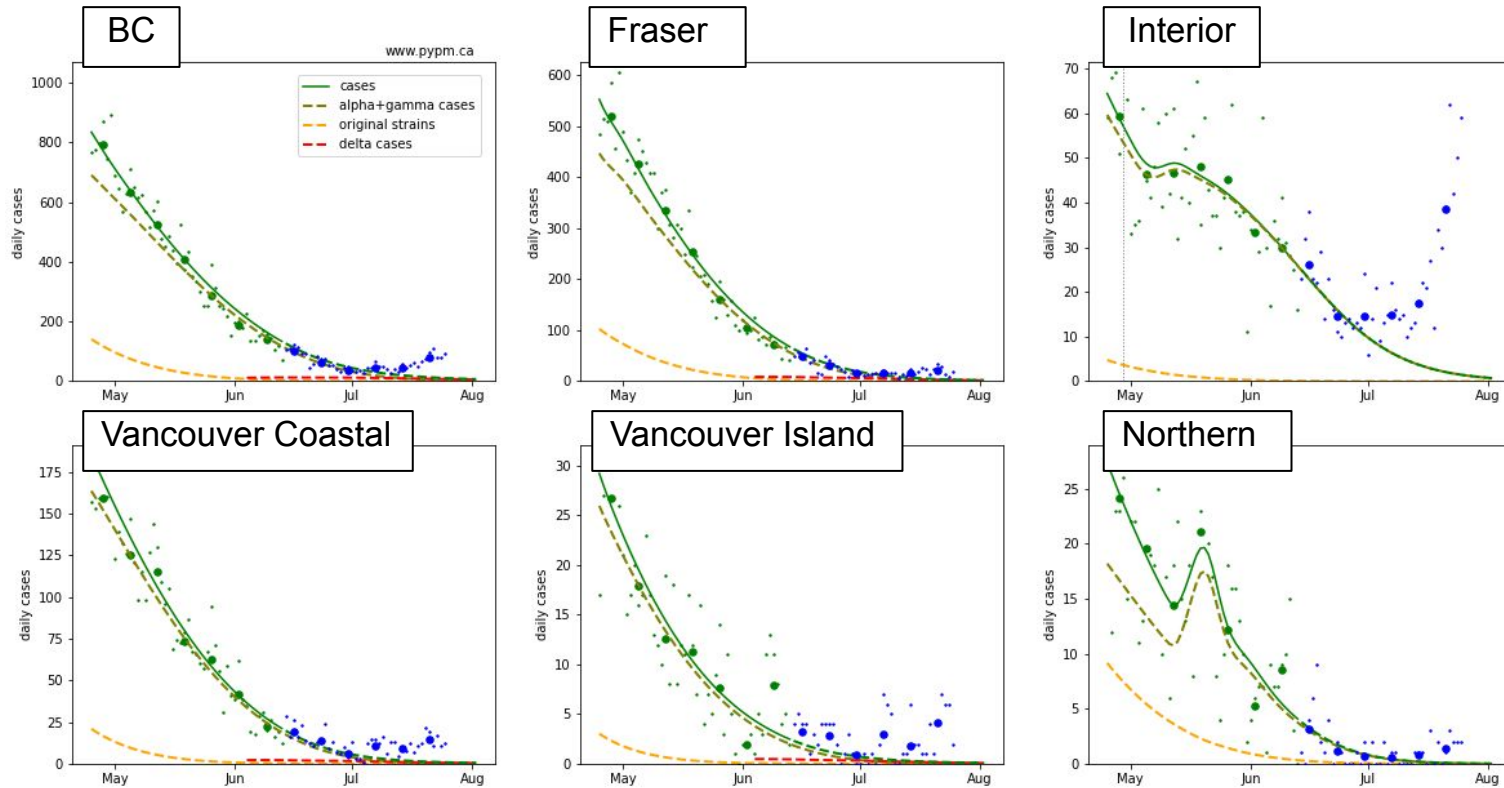
# Case data by Health Authority: June 16 model fit



**Source (D. Karlen).** See [www.pypm.ca](http://www.pypm.ca). These models have no age structure. Fitted past vaccination schedule and set vaccination rate of 1st doses after June 16 to 45,000/day (given to all ages in proportion to HA population size until 75% of the population is vaccinated). Assumes 1st+2nd dose effectiveness rises over time to 90% (see [May 14 report](#) for details). Vaccination model benchmarked with data from Israel: see [link](#). Assumes current public health measures remain in place in June.



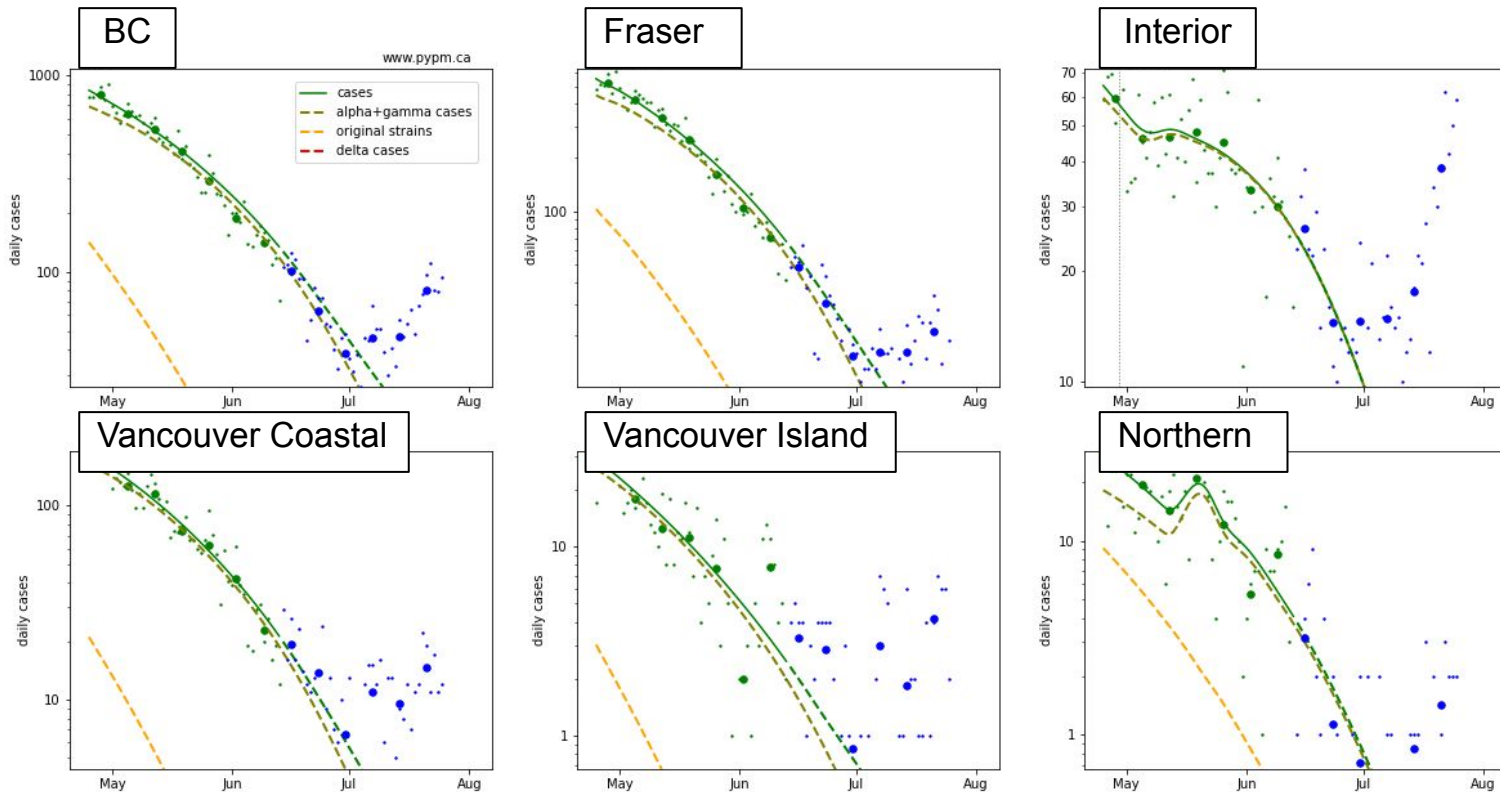
# June 16 model fit, showing recent data



Soon after Step 3 of reopening (July 1), case rates began to rise above June 16 model projections.

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# June 16 model fit, showing recent data (log scale)

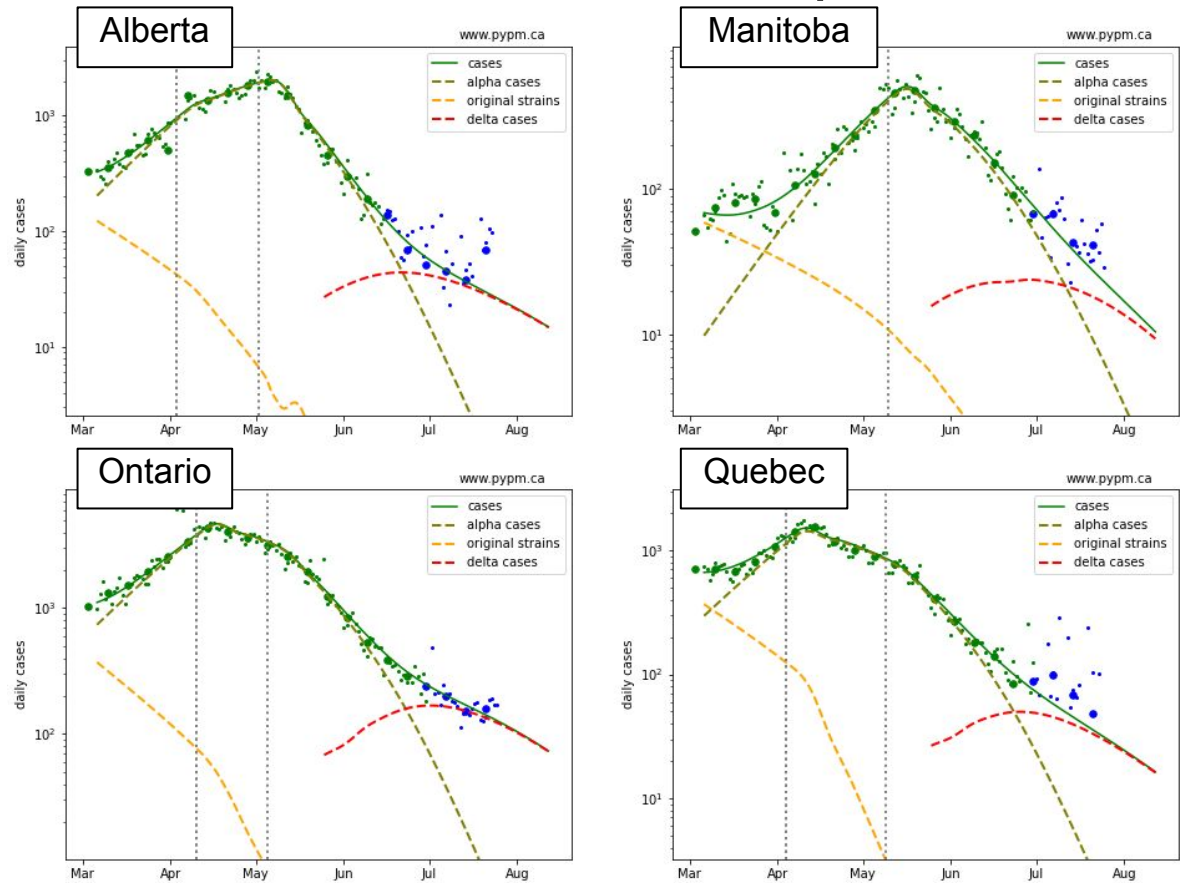


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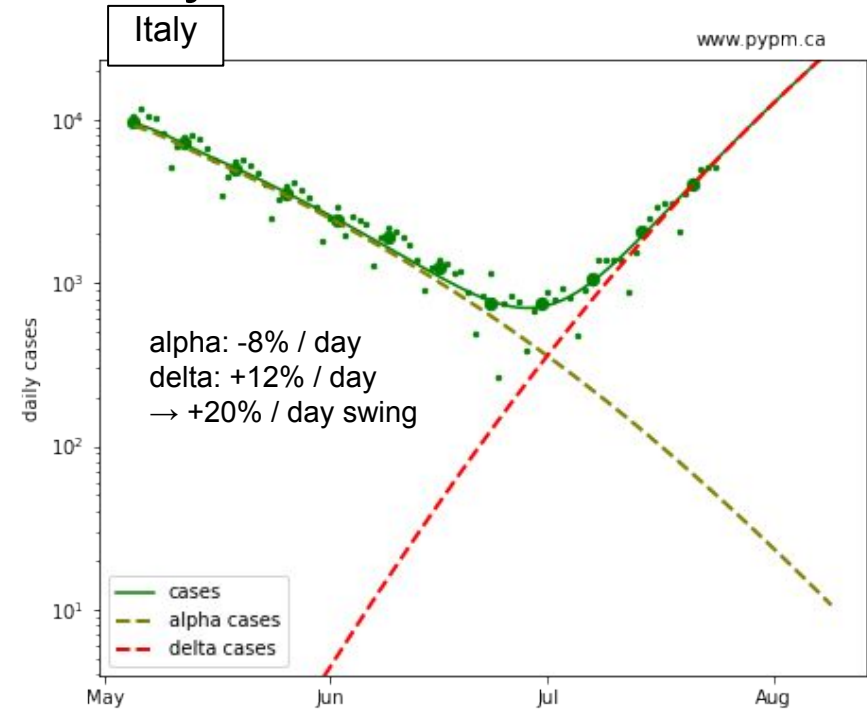
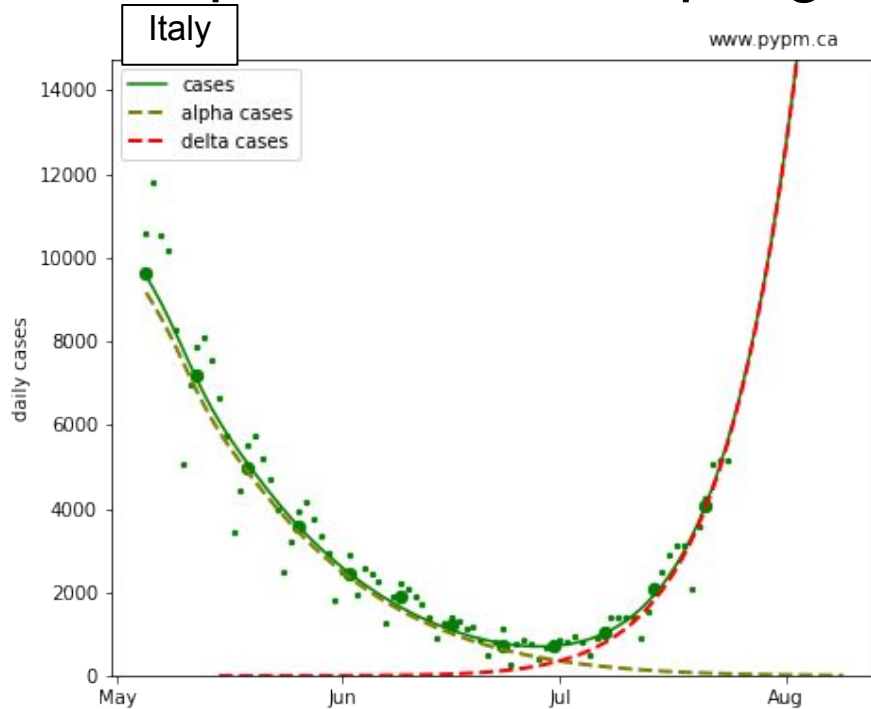
# Earlier model fits for other provinces, showing recent data



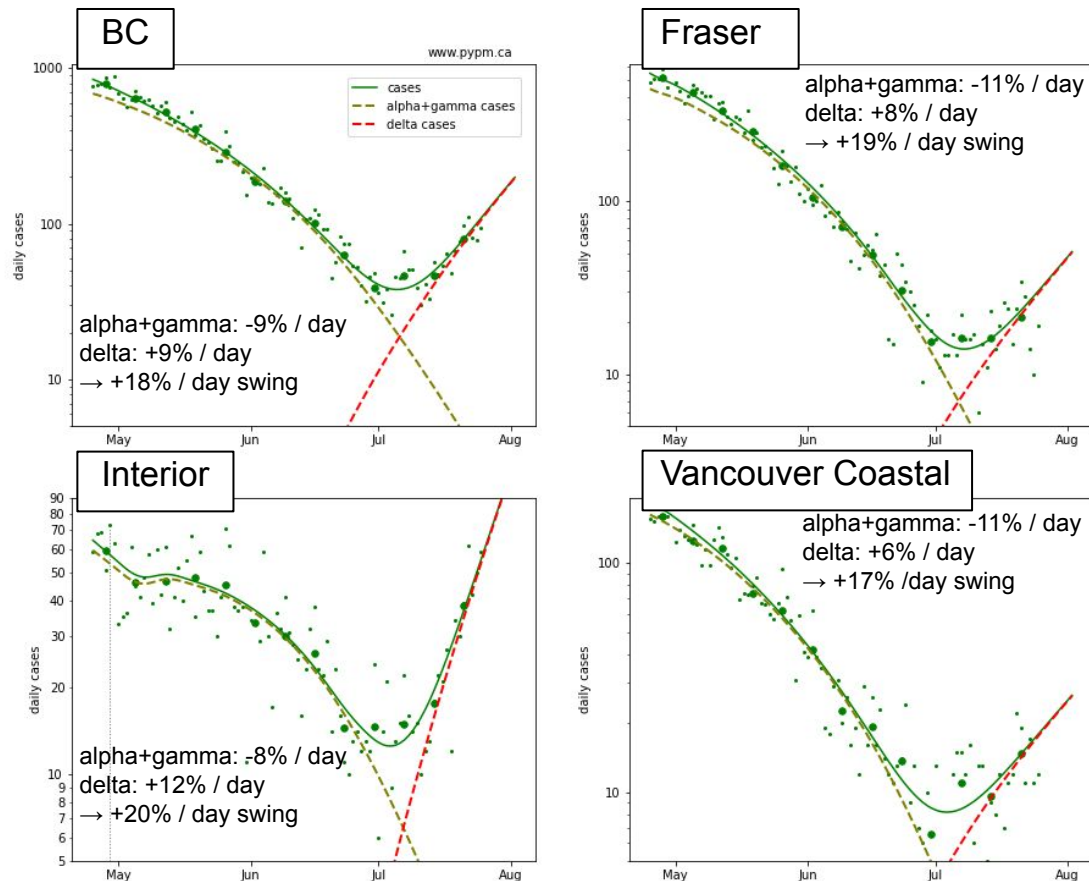
Recent data are compared to earlier model projections for 4 provinces.

The decline in case rates agree with the projections from a month earlier, with the exception of Alberta, where a significant uptick in case rate is seen in the past week.

# Example of current rapid growth: Italy



# Model fits with recent BC data



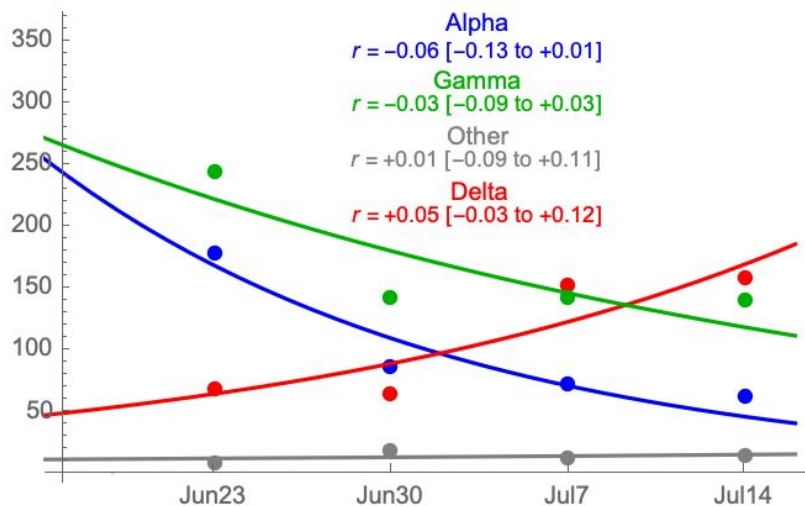
BC data fits are consistent with the pattern seen in Europe and US states, where the combination of relaxation and the emergence of delta has produced large swings in daily growth rates.

The proportion of cases due to delta may differ from these fits since the fits assume constant behaviour.

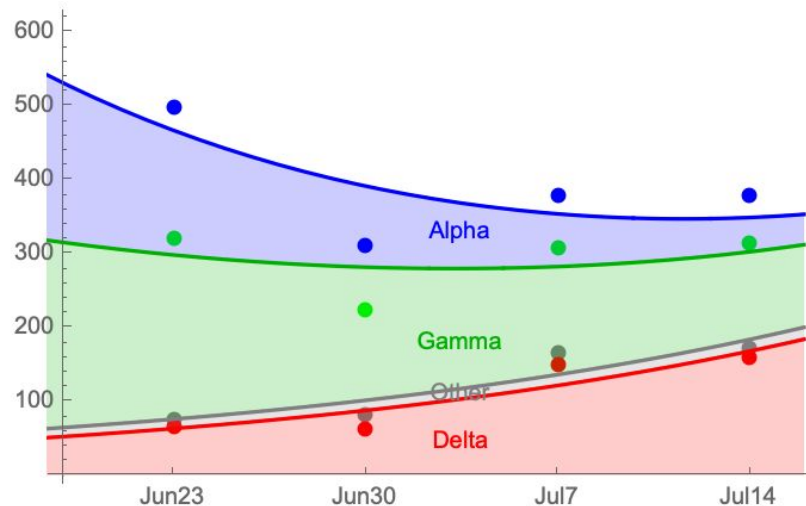
# Variants in BC

Besides Delta, COVID-19 variants have declined substantially over the past month (shown separately on the left and added together on the right), but Delta cases are rising.

Number of variant cases



New weekly cases



**Source (S. Otto).** Number of cases per week from Figure 2 of BCCDC's July 23 [Variant report](#). Uses total case numbers for each epiweek (mid-date of epiweek shown on x axis) and multiplies by the "Sample prevalence VOCs" to estimate number of each variant in each week. An exponential model fit is used to estimate average daily growth rate,  $r$ .<sup>13</sup> Estimates of growth  $r$  are highly uncertain with so few data points [95% CI in square brackets] & may be biased downwards because recent points report only "partial" VOC data.

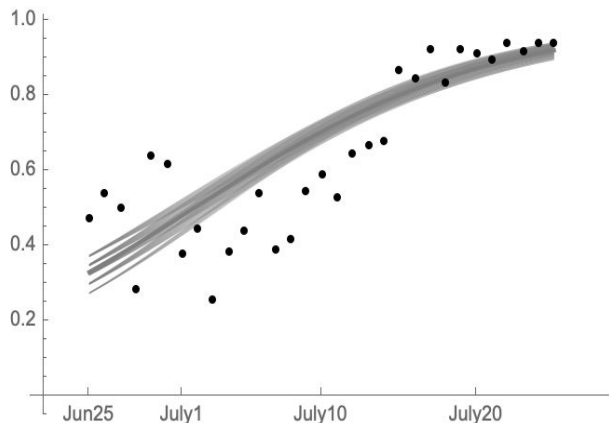
# Delta trends in Alberta

Delta is now the most common Variant of Concern in Alberta (left), making up 94% of the variants and 71% of all cases (projections for July 28th). The seven-day average case number has recently risen above 100, after a month averaging <60 cases per day (right). Delta cases have recently risen rapidly (blue), underlying the rise in overall case numbers.

## Daily selective advantage of Delta

$s = 0.105$  {95% CI: 0.091–0.119}

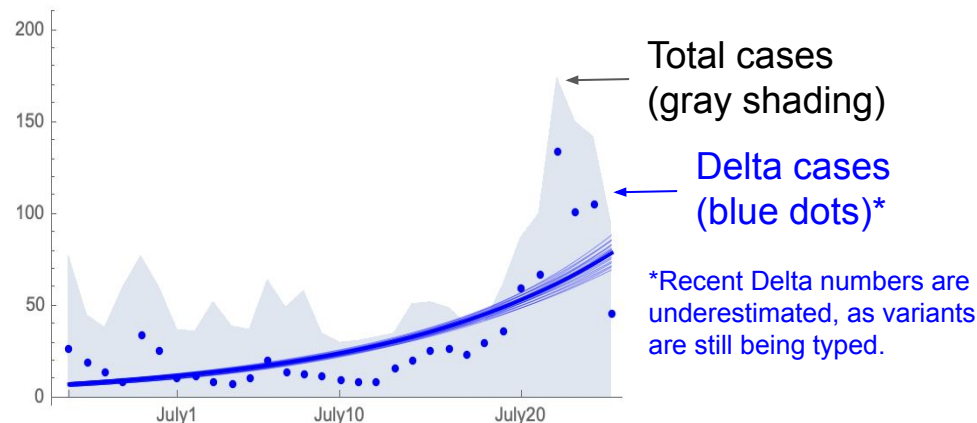
Proportion Delta of VoC



## Daily growth rate of Delta

$r = +0.078$  {95% CI: 0.070–0.085}

Number Delta



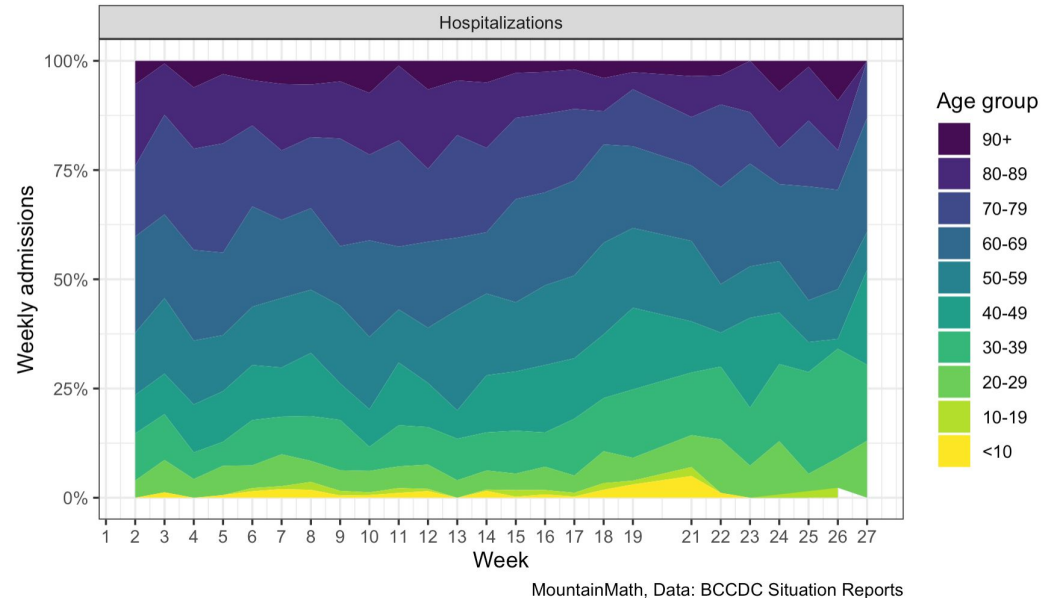
**Source (S. Otto).** Data from source file <https://www.alberta.ca/stats/covid-19-alberta-statistics.htm#variants-of-concern> (accessed July 26, using data through July 25). Uses a maximum likelihood approach, with binomial sampling among VOC to estimate  $s$  for Delta relative to other VOC (mainly Alpha) and with Poisson sampling to estimate  $r$  for Delta. Curves are fits within the 95% CI for  $s$  and initial proportion (left) or for  $r$  and initial number (right).  $r$  and  $s$  change over time and their averages shown.

# Who is at risk?

High rates of vaccination among the elderly are protecting them from hospitalization.  
People under 50 now make up the majority of COVID-19 patients in hospital.  
(<25% of hospitalized patients were under 50 years old early in 2021 but that has risen to >50% recently)

The number of people in hospital and ICU is currently very low in BC, at the lowest levels observed since September 2020.

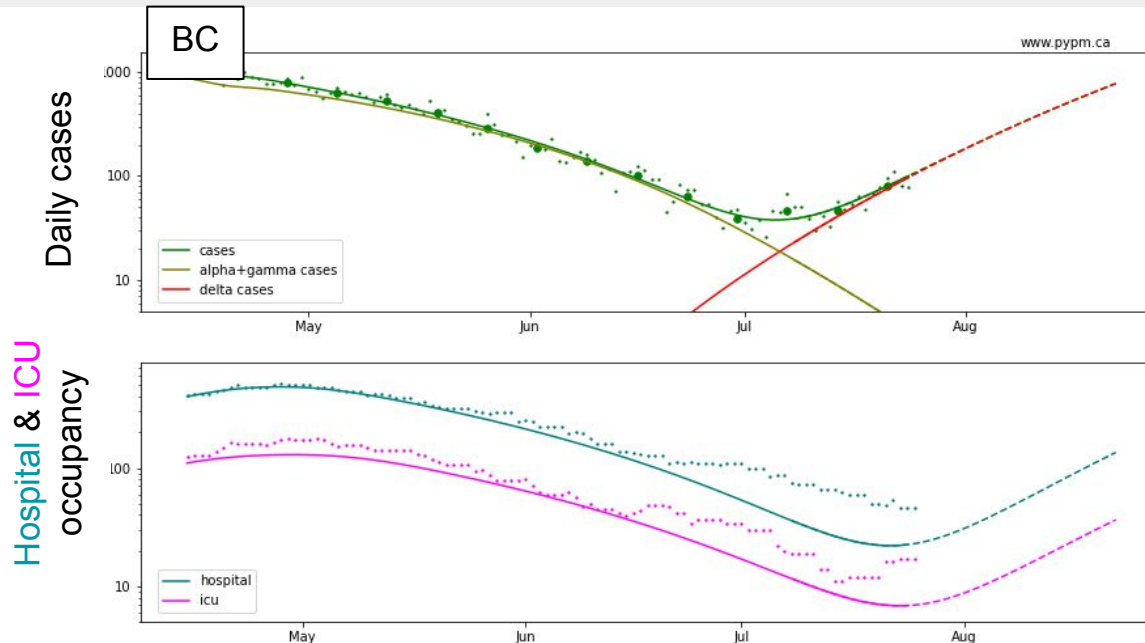
If we see consistently rising case counts, however, we expect hospitalized patients will be largely younger and less vaccinated patients, in line with experiences in other countries.





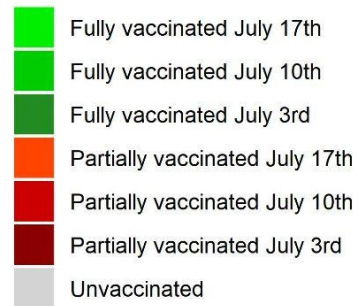
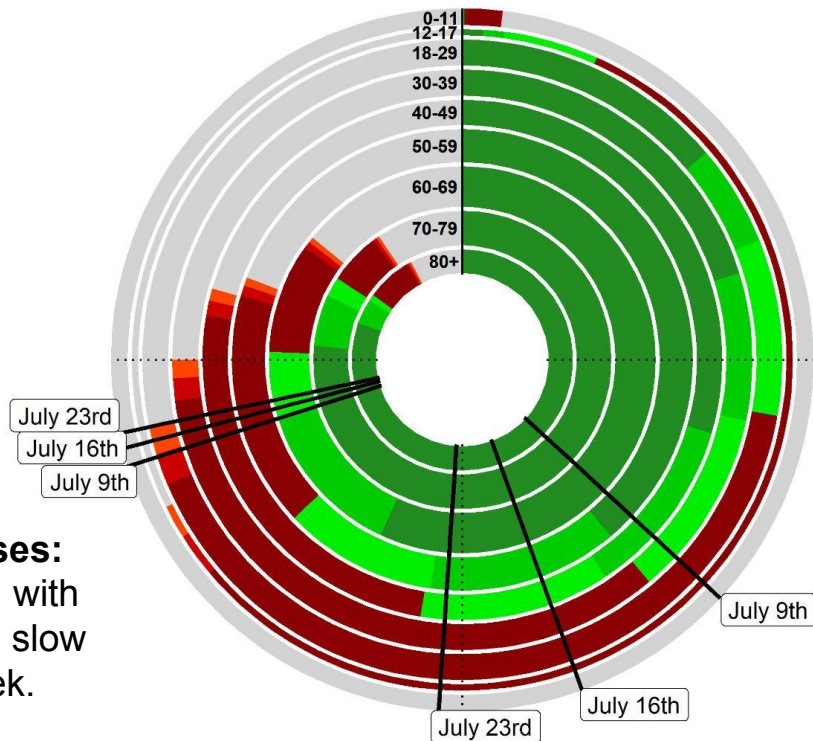
# What are the projected hospital numbers?

If cases continue to rise, hospitalization and ICU are expected to follow suit with a short delay. More people are in the hospital now than current case numbers predict, potentially due to long-term hospitalizations and underreporting of cases.



# Closing the circle: Vaccination status by age

July 24th update includes data through July 17th, 2021



## Slow progress on 1st doses:

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

## Fast progress on 2nd doses:

Fraction of BC's population who are fully vaccinated has been rising ~8% per week.

# Closing the circle: Vaccination status by age

July 24th update includes data through July 17th, 2021

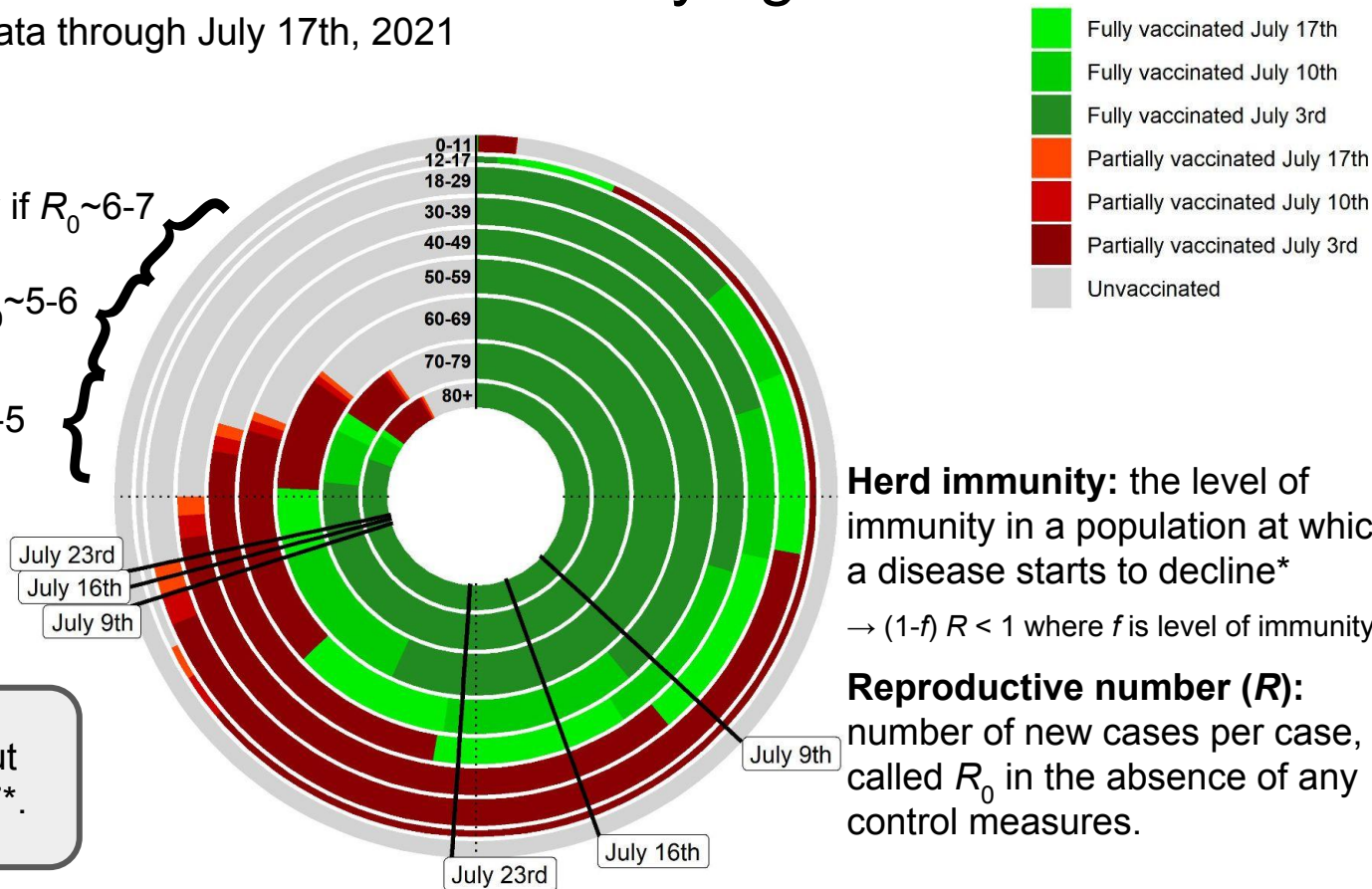
If vaccines were 100% effective:

Herd immunity if  $R_0 \sim 6-7$

Herd immunity if  $R_0 \sim 5-6$

Herd immunity if  $R_0 \sim 4-5$

$R_0$  for B.1.617.2 unknown but has been estimated to be  $\sim 7^*$ .



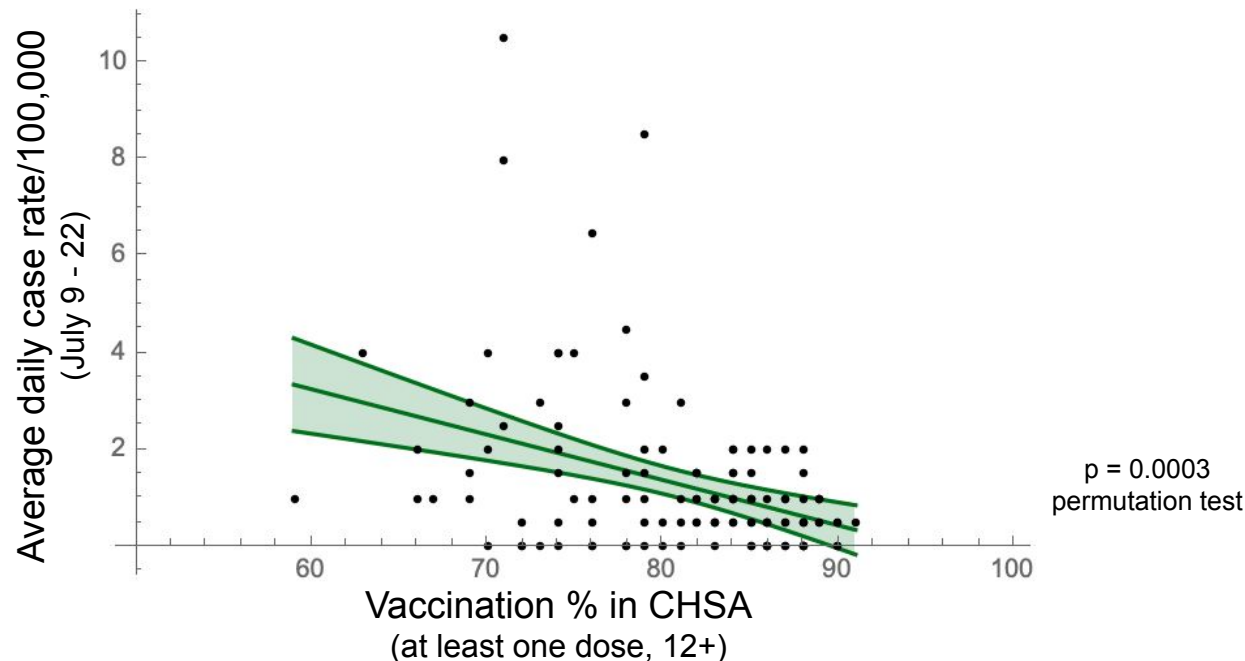
**Herd immunity:** the level of immunity in a population at which a disease starts to decline\*

→  $(1-f) R < 1$  where  $f$  is level of immunity

**Reproductive number ( $R$ ):** number of new cases per case, called  $R_0$  in the absence of any control measures.

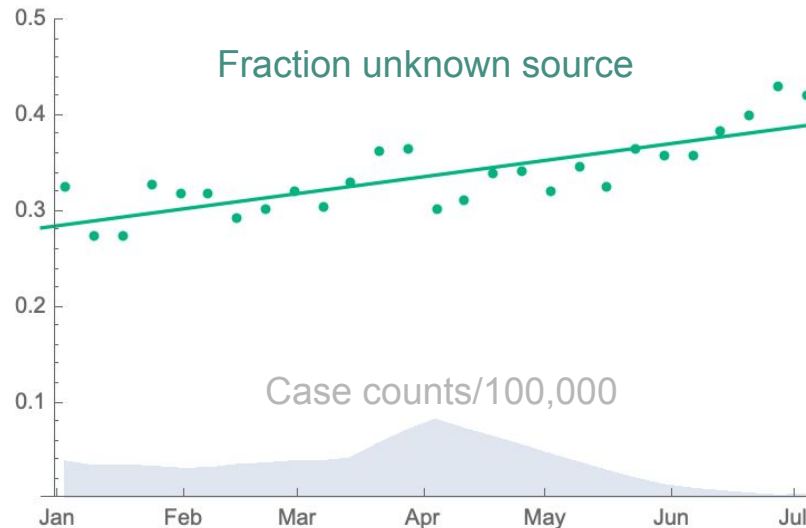
# Vaccination helps

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



# More cases have unknown sources

The likely source of cases is now more often “unknown” in BC, rising by 36% from January 1 to July 1, 2021. This trend tracks the rise in vaccinations and is consistent with **vaccinated individuals being more likely to be asymptomatic\***, if they do get infected, but still transmitting to others<sup>✦</sup>.



Cases among the vaccinated are more often asymptomatic, making it harder to know if you are infected and reducing the efficacy of contact tracing.

Continuing to mask, even when fully vaccinated, can help protect others by reducing transmission from those who are asymptomatic.

**Source (S. Otto).** Uses Table 2 data from the weekly [Situation Reports](#) from the BCCDC through epi week 27. From the fraction “pending/missing”, contact tracing appeared to improve in January 2021 and then has remained stable. “Fraction unknown source” excludes travellers and is (Domestic-unknown)/(Domestic-case/cluster + Domestic-unknown). \*Asymptomatic rate rose from 27% among unvaccinated to 39% among fully vaccinated ([Regev-Yochay 2021 Lancet](#)). ✦ Estimated risk of infection and transmission among the vaccinated has been estimated as 11.5% that of unvaccinated individuals in ([Prunas et al. 2021](#)).

# Final messages

Recent growth in cases is predominantly in communities with lower vaccination rates, with many communities in the Interior Health Authority at higher risk.

Delta (B.1.617.2) has been rising relative to other variants, consistent with a ~10% growth advantage *per day* compared to Alpha.

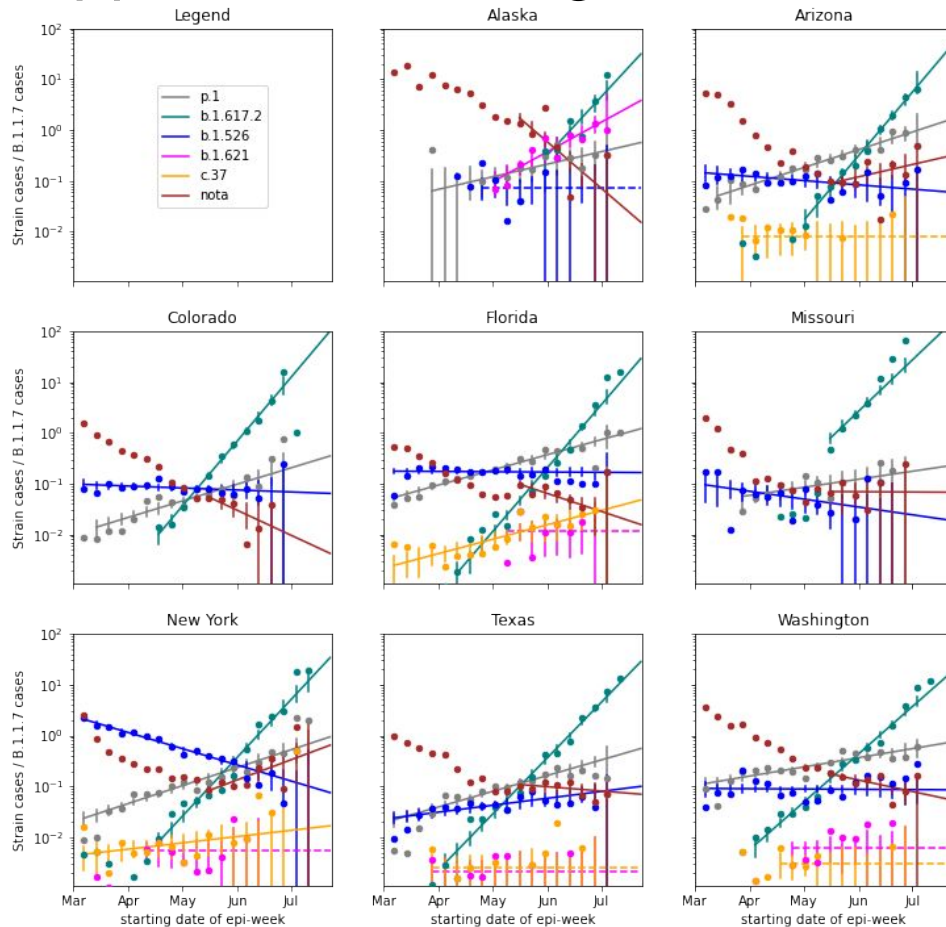
Delta case growth has been extremely rapid in many other jurisdictions. There are early signs of similar growth in BC.

While the risk of catching and transmitting COVID-19 is lower among those who are fully vaccinated (~10 times lower), there is still a risk.

To reduce the growth of cases, we encourage continued use of masks in indoor public settings, reduced exposure to poorly ventilated and crowded indoor environments, and vaccination by all those who are able.

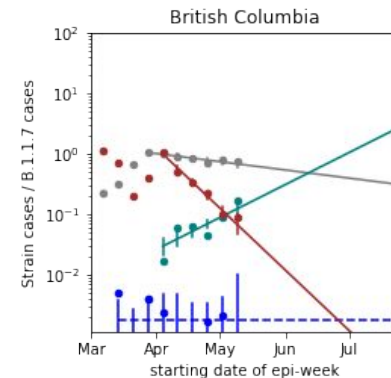


# Appendix: Tracking variants in US states



Genomic data from the United States allows estimation of growth for each variant (coloured trajectories)

## Tracking variants in BC



Data lacking in BC from recent months.

# Gamma and Delta selection coefficients

Selection coefficients for P.1 (Gamma in gray) and B.1.617.2 (Delta in teal) relative to B.1.1.7 (Alpha) in the United States.

The selection coefficient measures the relative rise in frequency per day of a variant.

