COVID Model Projections

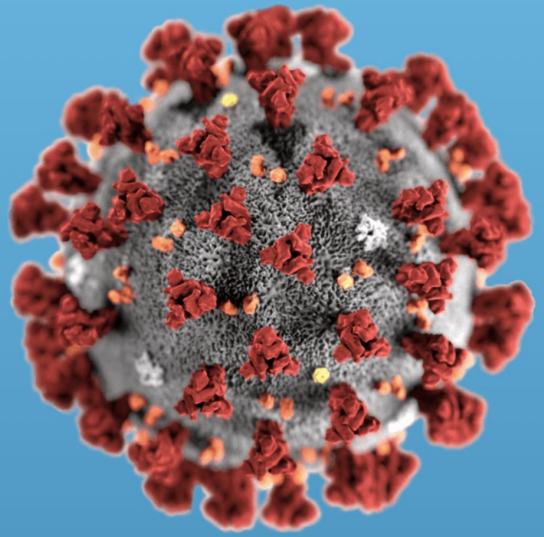
April 30, 2021

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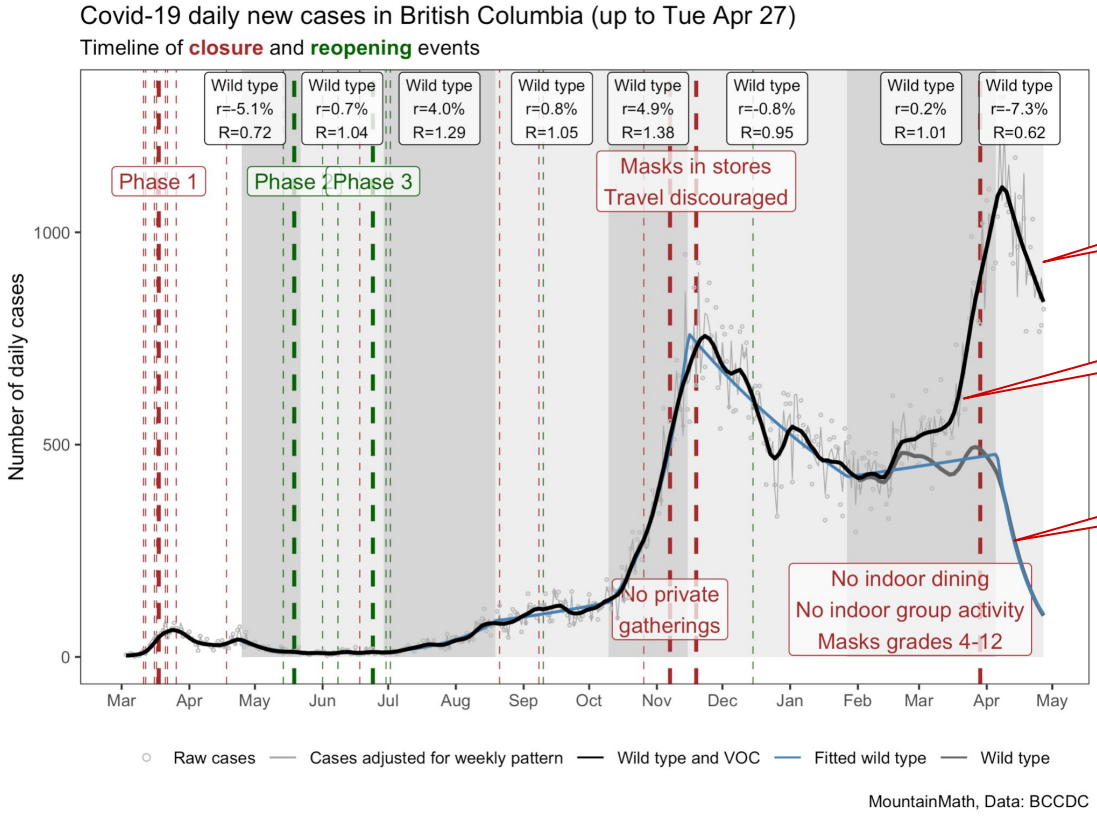
Independent and freely offered advice, using a diversity of modelling approaches.

Bending down the VOC curve

Key messages

- BC has bent down the epidemic curve, which was driven by variants of concern (VOC).
- Declines are seen across most Health Authorities, with the Fraser Health Authority continuing to face higher levels of COVID-19 cases.
- The current number of cases was predicted to be higher had we continued with levels of activity in early 2021. Looking across the whole province, data are consistent with a ~30-40% decline in transmission rates since March 2021.
- Declining transmission likely reflects a combination of individual actions, vaccination campaigns targeted toward hotspots (sectors and communities with high transmission), and increased restrictions (e.g, no indoor dining).
- Hospitalization and ICU occupancy is projected to remain high through May.
- Before careful relaxation of current restrictions can begin, we will require substantial levels of vaccination, which should be reached across BC in June.

State of the COVID-19 Pandemic in BC



April 2021: BC has bent down the COVID-19 curve

March 2021: Steep rise in COVID-19 cases

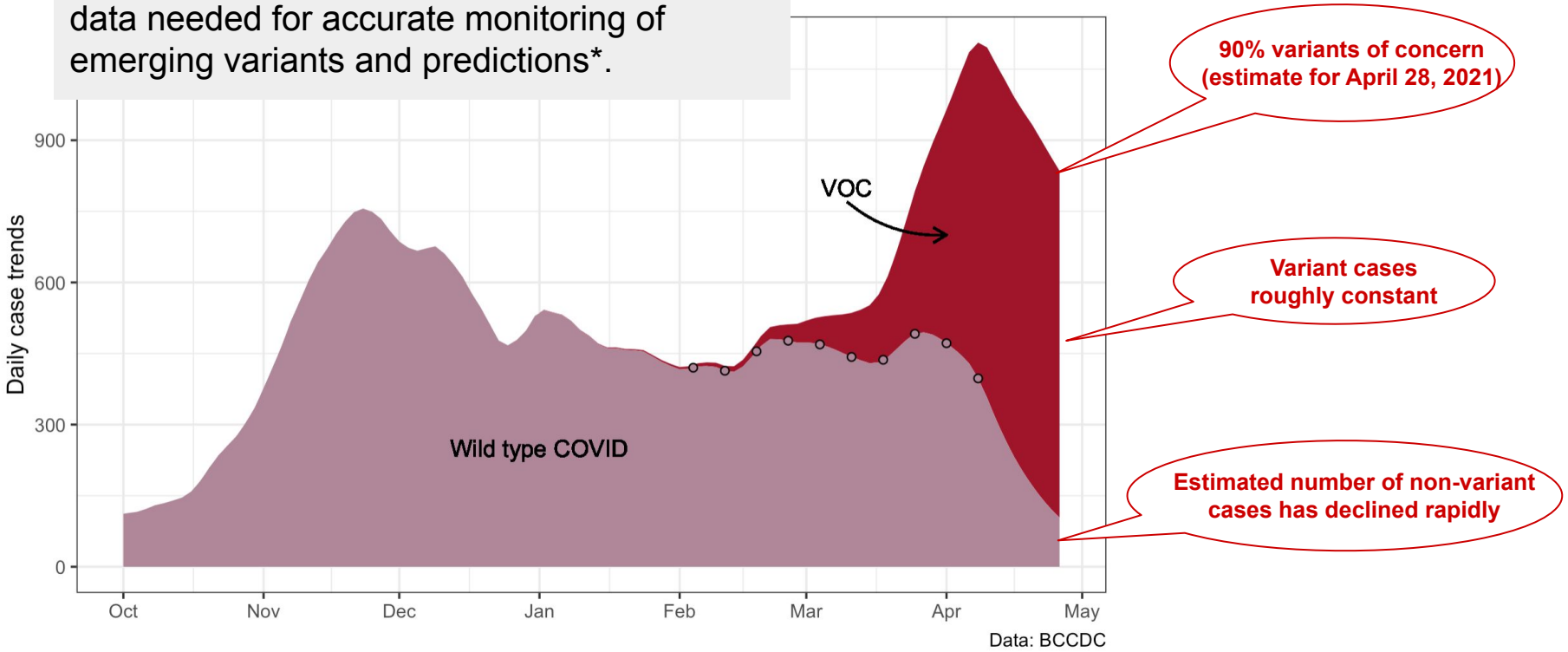
Much of the recent decline appears driven by fast declines in non-variant cases

Recent measures work:
Change reflects a combination of individual actions, vaccination campaigns in hotspots, and increased restrictions (e.g, no indoor dining).

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.

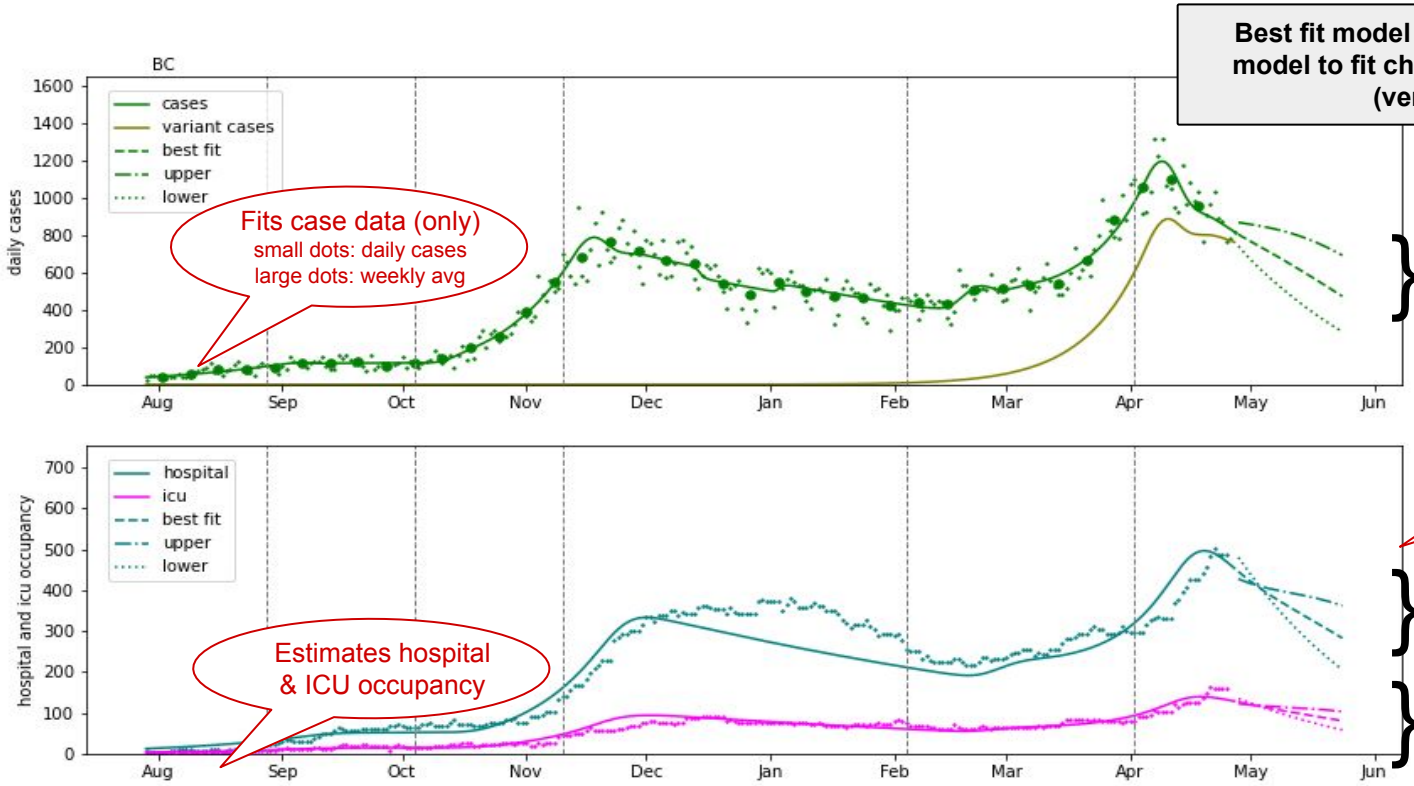
State of the COVID-19 Pandemic in BC

Data needed: Up-to-date VOC and genomic data needed for accurate monitoring of emerging variants and predictions*.



Source (J. von Bergmann). Case data from BC COVID-19 Database (http://www.bccdc.ca/health-info/diseases-conditions/covid-19/data) and smoothed using STL trend line that removes day-of-the-week effects. VOC data from BCCDC (April 7, 2021). *Last data point provided in a Joint Statement graphic on April 15, 2021.

Model fit to case data (up to April 27)



Best fit model to case data, allowing model to fit changes in transmission (vertical bars).

Fits case data (only)
small dots: daily cases
large dots: weekly avg

Projected cases with vaccination rollout (68% confidence limit)

Hospital demand may remain high over next month

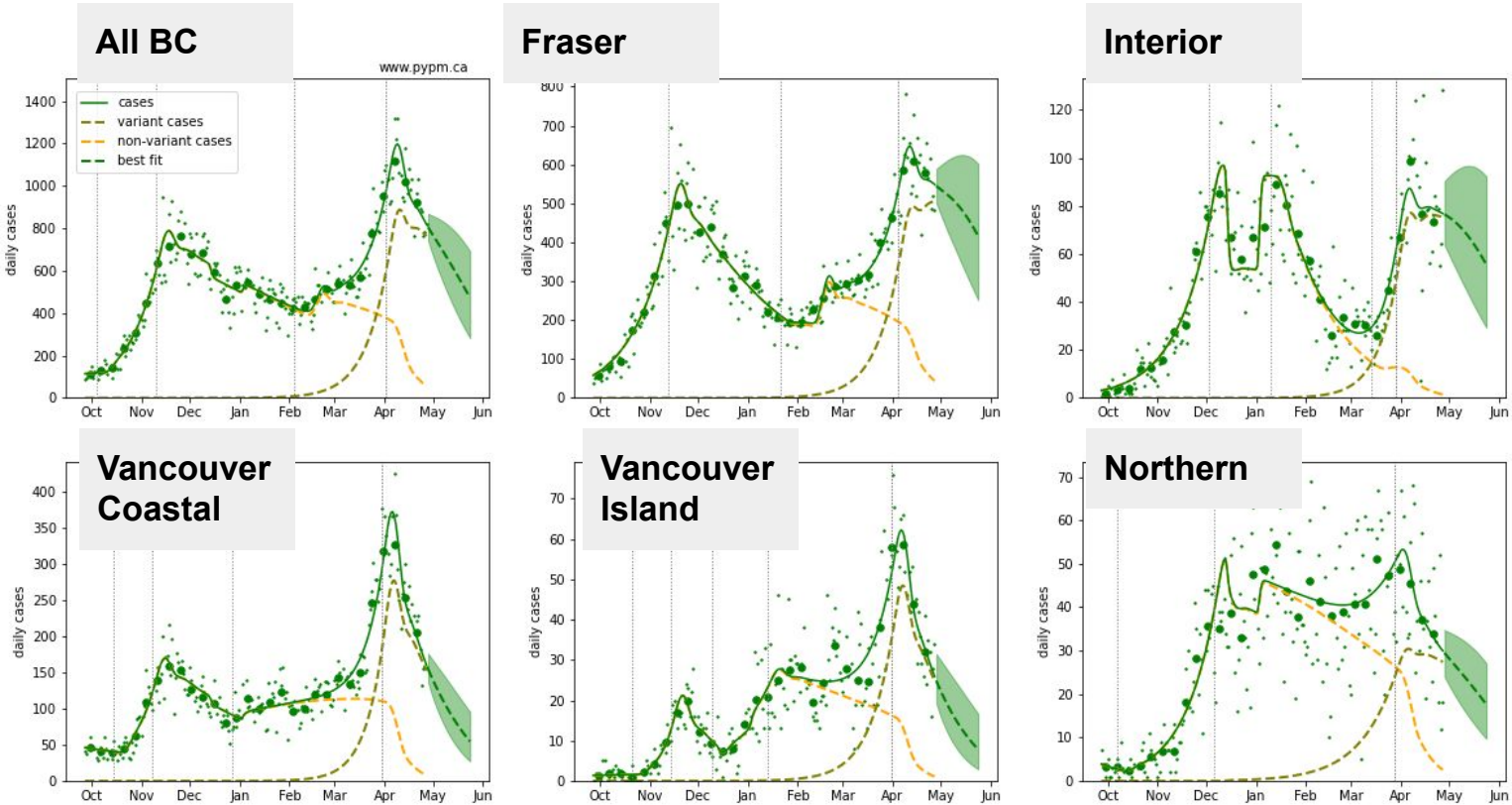
Estimates hospital & ICU occupancy

Projected hospitalizations (68% confidence limit)

Projected ICUs (68% confidence limit)

Source (D. Karlen). See www.pypm.ca. Assumes homogeneous mixing (no age structure). Assumes vaccination rate of 1st doses continues at 35,000/day, removing vaccinated individuals from susceptible class following a delay before immunity develops (median 16 days). Vaccination model benchmarked with data from Israel: see link.

Model fit to case data by Health Authority



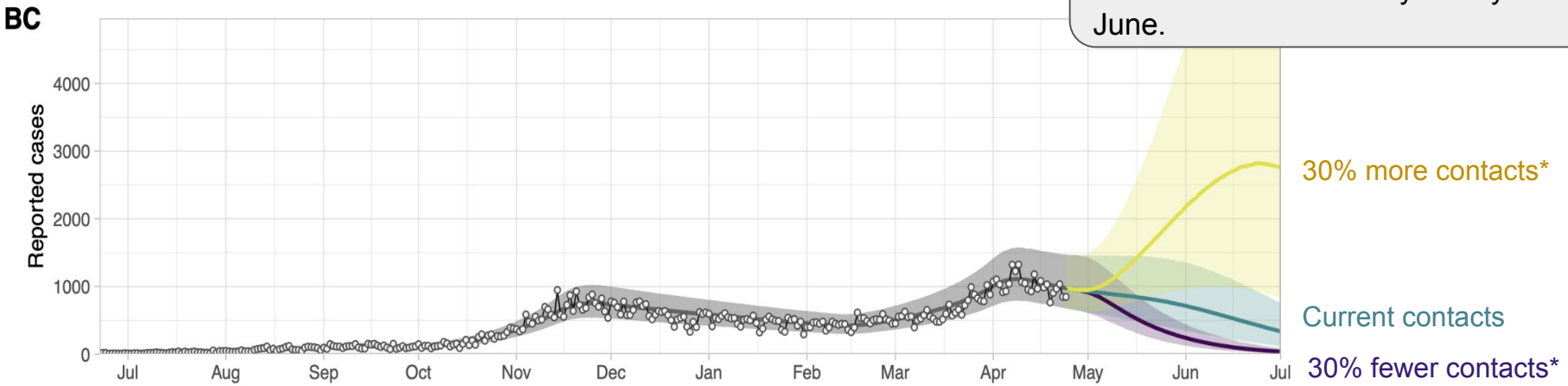
Case rates declining substantially in most Health Authorities, although cases likely to remain high in Fraser.

Variant and vaccination data by health authority unavailable.

Source (D. Karlen). See www.pypm.ca. Assumes homogeneous mixing (no age structure). Assumes vaccination rate of 1st doses continues at 35,000/day (assumes vaccines given to all ages and in proportion to HA populations). Vaccination model benchmarked with data from Israel: see this link. Model fits to case data projected into May assuming current public health measures. Shaded bands indicate range of trajectories consistent with case data (68% CL).

Near-term incidence projection

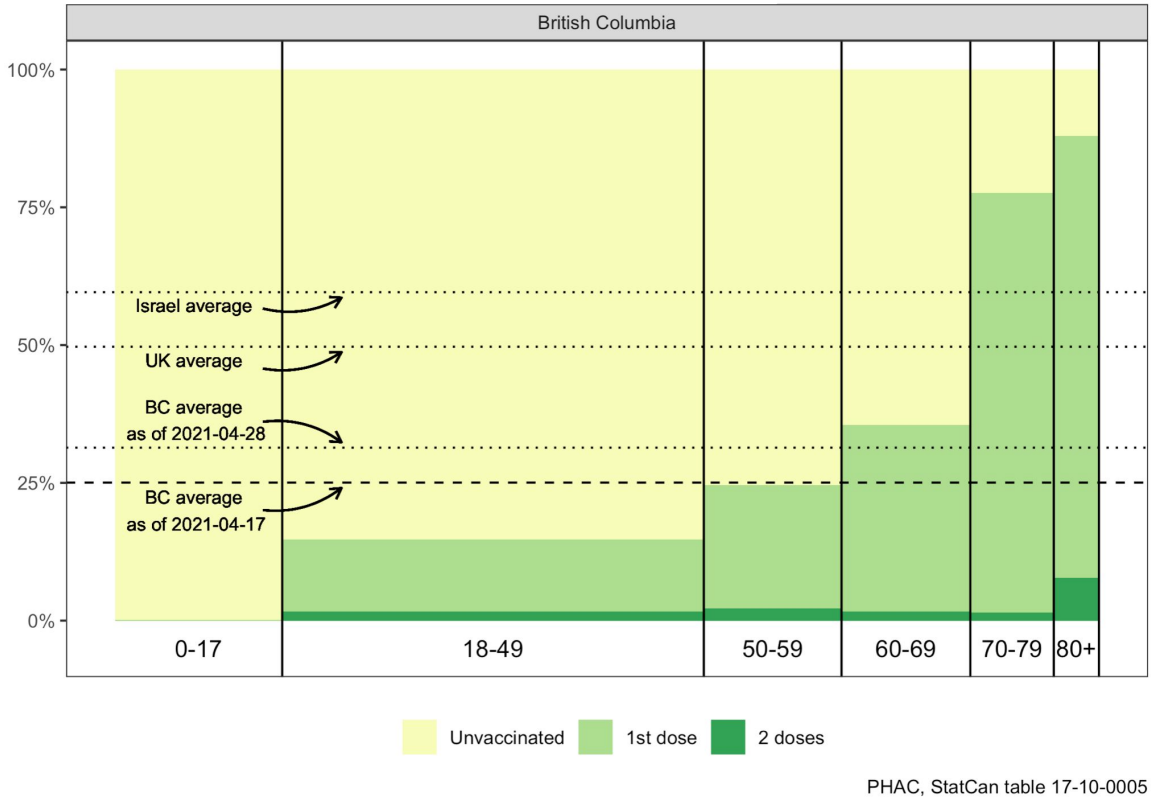
Vaccination roll-out is included and begins to noticeably dampen transmission in late May - early June.



Source (E. Are, C. Colijn). Active case numbers projected forward, accounting for VOC data from BCCDC (April 7, 2021). These data provide % of cases that were VOC by week (see slide 5). These data were fit by a logistic function to estimate percent VOC by day (see Appendix of April 14 report). Assuming a 40% increase in transmissibility (consistent with the estimated selection *s* in the Appendix of April 14 report), the percent VOC is used to create an overall reproduction number *R* for the virus population. *R* changes in time as the VOC rises in frequency. The social distancing parameter (among others) is estimated to fit the data using the 'covidseir' R package (M. Irvine, S. Anderson). * Measured as *f*, the relative contact rate among those willing and able to distance

Vaccination status by age group

Last BC data update April 17



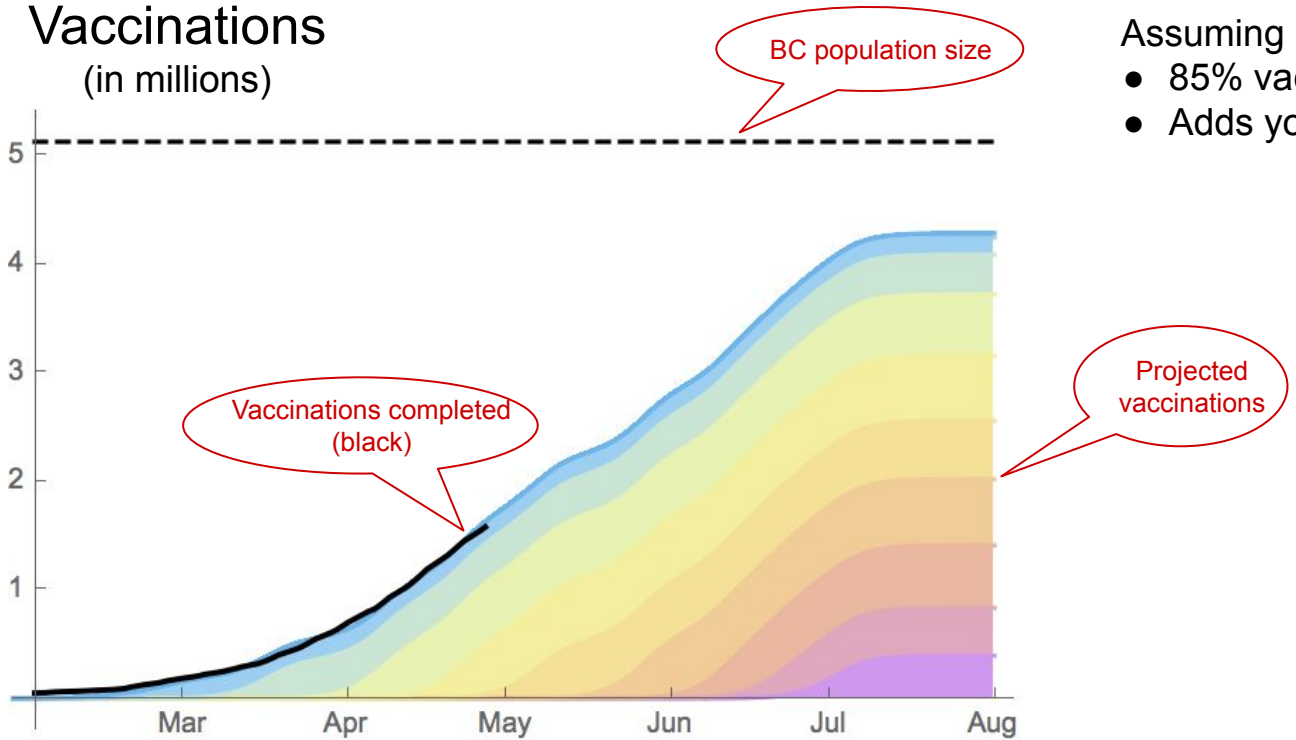
Israel: 59.6% vaccinated (at least one dose). Schools fully reopened on Apr 26 with no restrictions; no restrictions on travel; immunity passports being used for indoor dining, gyms and sports; no restrictions on indoor/outdoor socialization in groups of 50 or less

UK: 49.7% vaccinated (at least one dose). Schools fully open with optional rapid testing available and masks for secondary students; travel is discouraged; indoor dining remains closed; outdoor socializing only, in groups of up to 6.

Countries with high vaccination levels are seeing enough decline in cases to reopen slowly

Source (J. von Bergmann). Vaccination data https://health-infobase.canada.ca/covid-19/vaccination-coverage/ Benchmarks from Israel and UK: https://www.gov.il/en/Departments/Guides/ramzor-cites-guidelineshttps://www.gov.uk/guidance/covid-19-coronavirus-restrictions-what-you-can-and-cannot-do

BC's age-based vaccination plan



Assuming BC's age-based roll-out plan

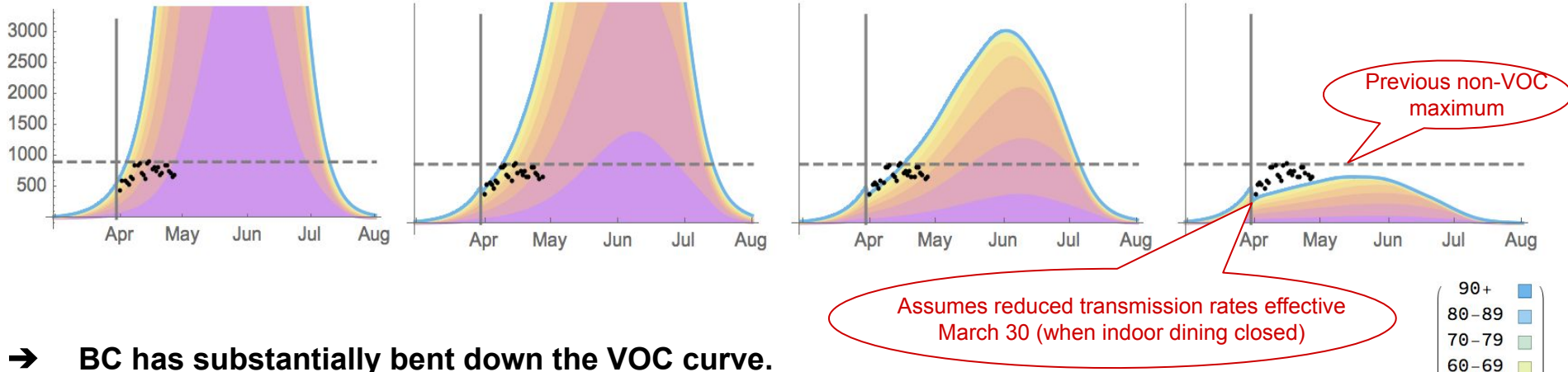
- 85% vaccine uptake rate
- Adds youth vaccination in June

Source (S. Otto). Vaccinations completed from https://health-infobase.canada.ca/covid-19/vaccine-administration/ (87564 subtracted based on second doses before those were paused). 85% uptake rate from PHAC Modelling Group Report (2021-04-08), as found in older age groups (65+) and assuming younger individuals will be encouraged to accept vaccinations more than currently estimated (72% for under age 45). UPDATE: Accelerated vaccinations in 40-65 due to AstraZeneca approval.

How far have we bent down the VOC curve?

Previous (April 14) projections for daily VOC cases with recent data (dots)

March transmission levels | Reduced by 20% | Reduced by 30% | Reduced by 40%



➔ **BC has substantially bent down the VOC curve.**

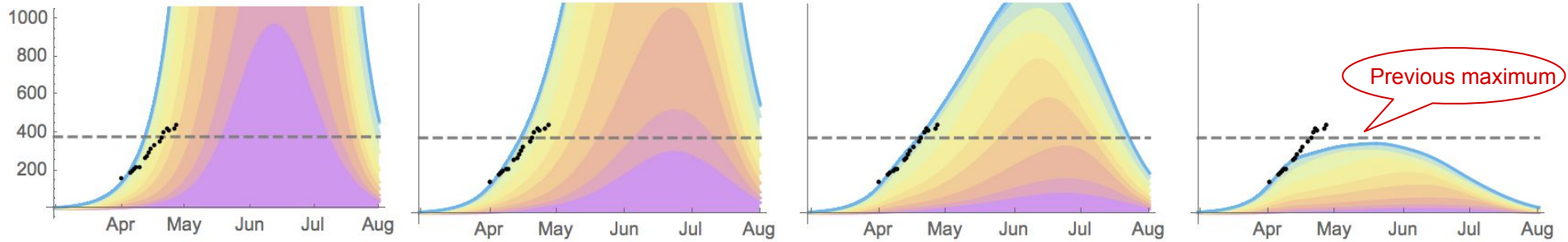
➔ **Best match to recent data provided by projections that assumed restrictions at the end of March would cause a 30-40% decline in transmission relative to February/March 2021**

Projections for VOC only:
- Assumes 90% vaccine efficacy and 85% uptake
- 64% higher severity of VOC
- Dots show data times %VOC (est.)

Source: S. Otto. Based on model in Day et al. (2020) with age-based vaccination campaign, age-based contact matrix (Mulberry et al. 2020), and two distancing classes as in Anderson et al. (2020). Adjusts transmission to match growth of VOC in March, with total number of active VOC cases as on March 31, 2021.

in Hospital (VOC only)

March transmission levels | Reduced by 20% | Reduced by 30% | Reduced by 40%



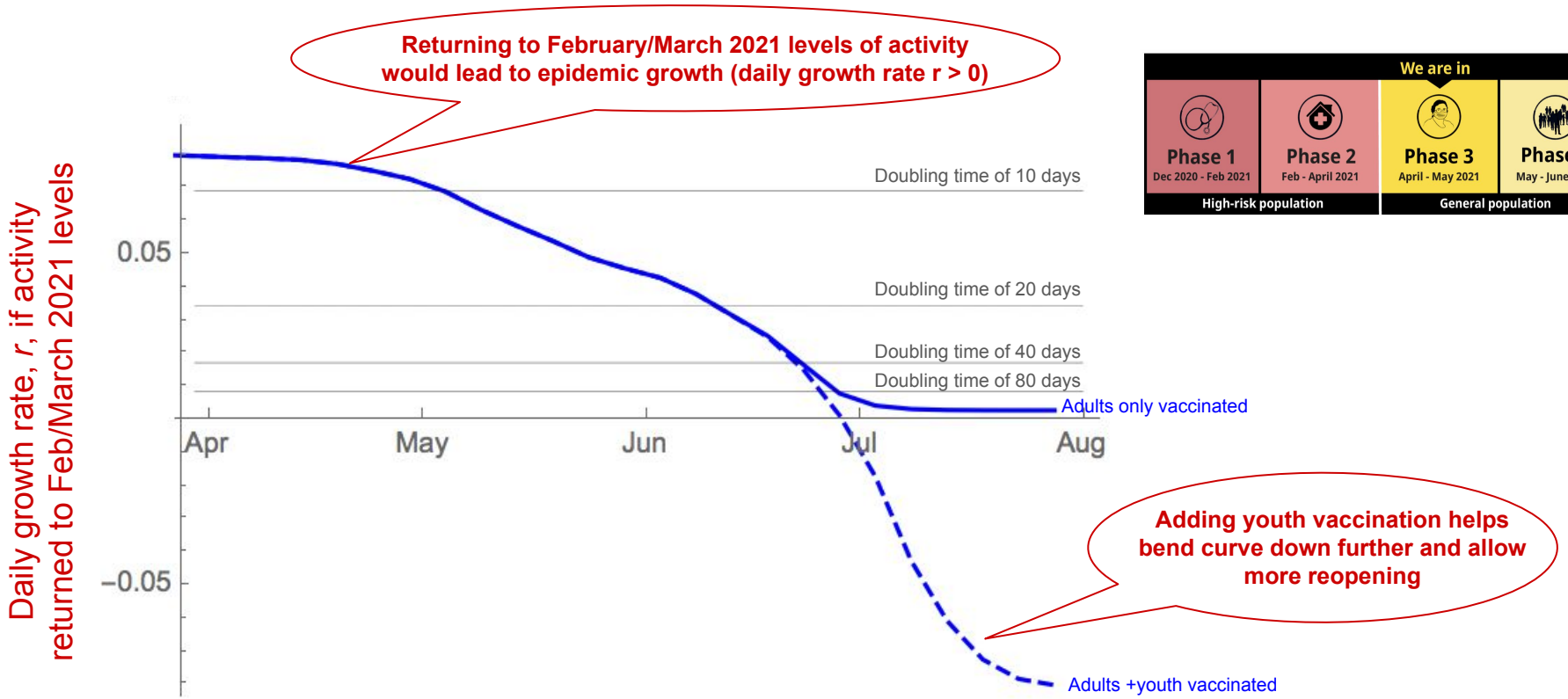
➔ **While BC has substantially bent down VOC curve (consistent with right hand plots), hospital and ICU demand projected to remain high over next month.**

➔ **Hospital and ICU demand is uneven across BC and will be severe in heavily affected areas (Fraser especially)**

Projections for VOC only:
- Assumes 90% vaccine efficacy and 85% uptake
- 64% higher severity of VOC
- Dots show data times %VOC (est.)

Source: S. Otto. Based on model in Day et al. (2020) with age-based vaccination campaign, age-based contact matrix (Mulberry et al. 2021), and two distancing classes as in Anderson et al. (2020). Adjusts transmission to match growth of VOC in March, with total number of active VOC cases as on March 31, 2021. Length of stay from CIHI (https://www.cihi.ca/en/covid-19-hospitalization-and-emergency-department-statistics on 10 April, 2021).

How much longer do we need current restrictions?



Source (S. Otto). Based on model in Day et al. (2020) with age-based vaccination campaign, age-based contact matrix (Mulberry et al. 2021), and two distancing classes as in Anderson et al. (2020). Calculates the expected daily growth rate (leading eigenvalue) if we were to go back up to transmission levels of VOC in February/March on the date shown on the x-axis, accounting for how the vaccination roll-out reduces number of susceptible individuals.

Further messages

Demand on hospitals is predicted to remain high over the next month.

We are unlikely to be able to re-open to February/March 2021 levels of activity until June. To re-open even more would likely require adding additional control measures.

Additional mechanisms to control transmission:

- ➔ Rapid testing to detect and isolate individuals early, even if they do not have symptoms (asymptomatic and presymptomatic cases)
- ➔ Targeting vaccinations to locations and sectors of the population most at risk of COVID-19 (reducing transmission)
- ➔ Improving ventilation systems (lowering aerosol-based transmission)
- ➔ Identifying secondary contacts by rapid testing of primary contacts (before symptoms) and supporting individuals in their ability to self-isolate

Further messages

- Data gaps in BC loom large:
  - Existing data do not allow us to assess inequalities in the incidence of disease or vaccine coverage, without more information about case outcomes and vaccination roll-out by age and health district.
  - Serological survey data has not been released from recent surveys. These data are essential for estimates of numbers of people previously infected, which impacts predictions about the level of vaccination required to achieve herd immunity.
  - Data on presumptive and confirmed numbers of VOC is not provided or incomplete. This hinders a full understanding of VOC impacts.
  - Hospital/ICU utilization data by VOC is needed to better estimate near-term demand.
  - Crucial genetic data is missing. Only 11 of >10,000 COVID-19 (0.1%) genomes sequenced in BC in 2021 have been uploaded to the global GISAID database. This impedes the global effort to learn about which variants matter and how they impact disease.
- Predictions are made less accurate by these data gaps
- More timely access to more complete data will improve forecasts and help identify where additional actions are needed