COVID Model Projections

December 22, 2021

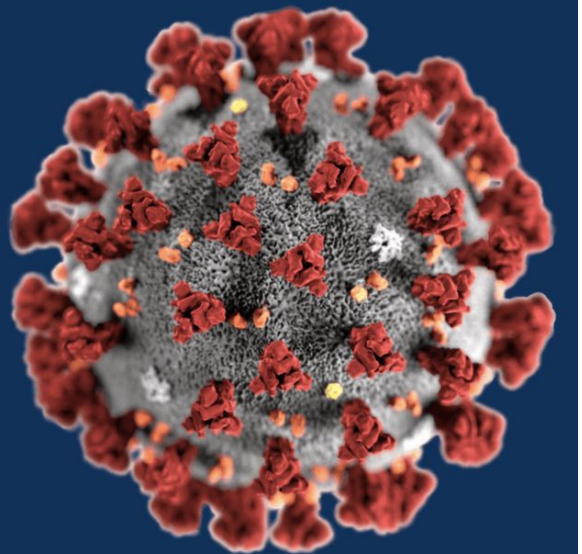
BC COVID-19 Modelling Group

@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

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

State of the COVID-19 Pandemic in BC

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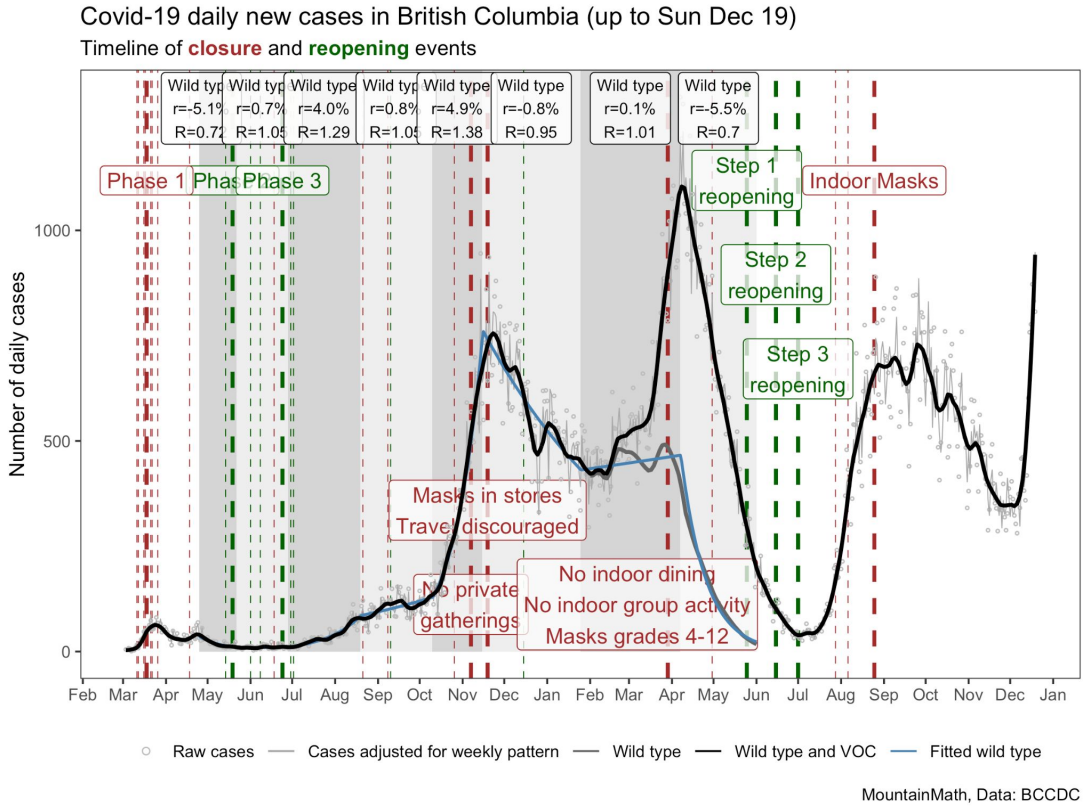
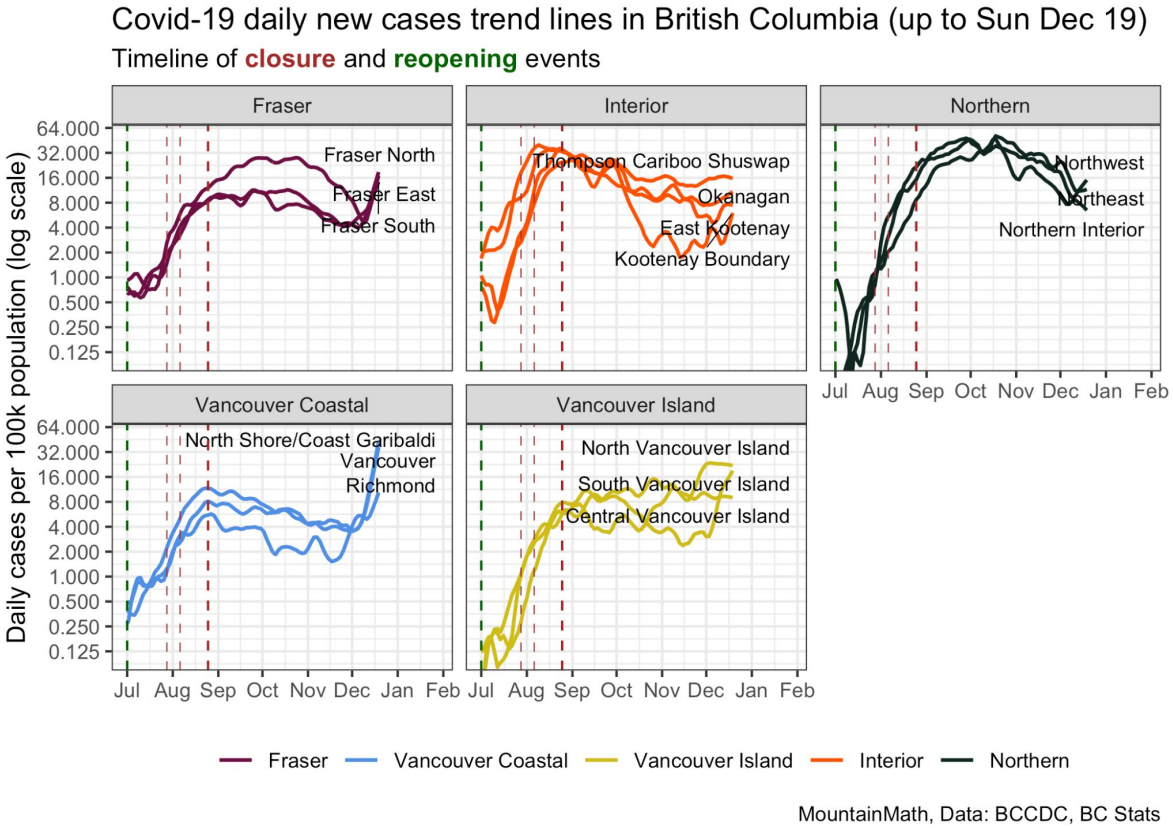


After the long decline in cases we saw since September, the establishment of Omicron has lead to a dramatic increase over the past two weeks.

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; BC's Vaccine Card to come into effect on September 13 (first dose) and October 24 (second dose)

COVID-19 in BC Health Regions



We don't have timely surveillance data for Omicron, so we are left to infer Omicron from the change in case trajectories.

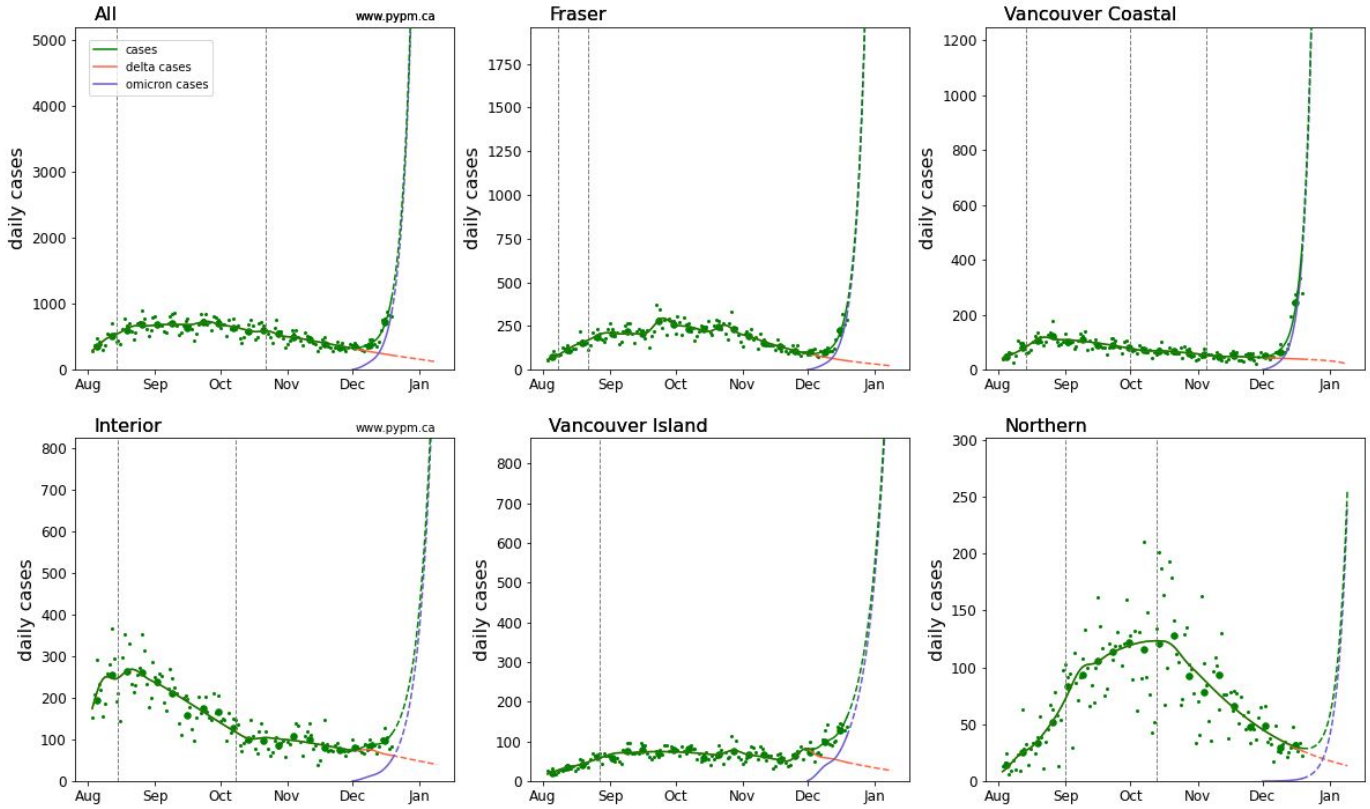
All Vancouver and Fraser Health Regions show a clear upward trend, as does South Vancouver Island. We can be fairly certain that Omicron is established in communities there.

Overview

Omicron is now established and spreading within BC:

- Case rates…
- New information about Omicron
- Projections…
- Hospitalization capacity
- Communities that are highly vaccinated have much lower COVID rates [This should stop being true but may still be due to the lag…]
  - 95% vaccinated communities have 3.4 times fewer cases than those with 75% vaccinated (12+)
- Rapid spread means we have little time to respond, but we can slow the spread of Omicron in BC as we did with previous variants: **getting vaccinated, wearing tight fitting masks, improving ventilation, avoiding large indoor gatherings, and improving testing and contact tracing**
- Slowing the spread of Omicron buys time to **deliver booster shots**, which raise the immune protection against Omicron. Models indicate that a fast roll out of booster shots is one of the most effective ways to lower peak hospital demand from Omicron.

Omicron model fits to BC data



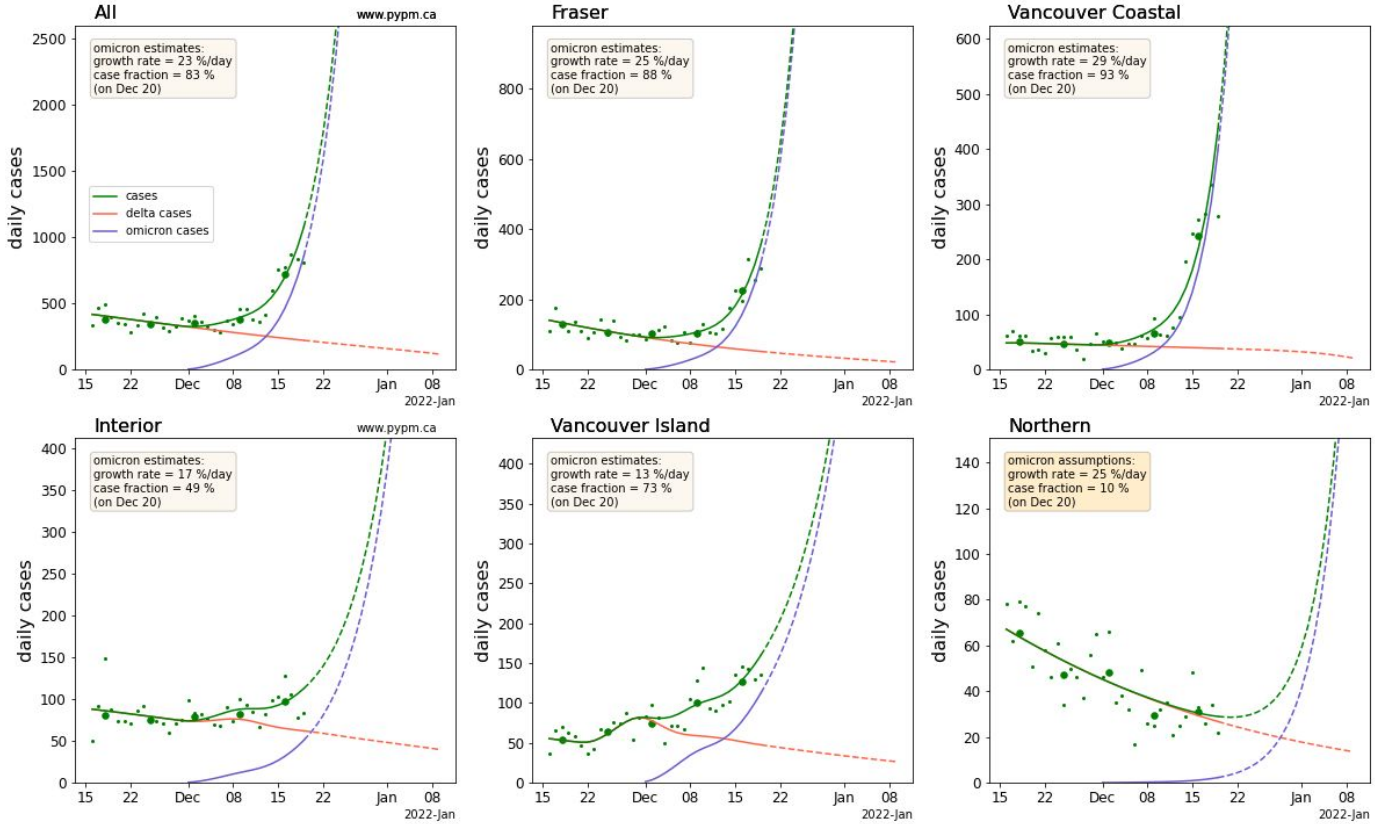
Maximum vertical axis corresponds to daily case rate of 100 per 100,000.

If transmission rates are not reduced, all HA will reach that level in the coming weeks.

Northern HA does not yet show growth arising from omicron

Source (D. Karlen). See www.pypm.ca. These models include vaccination but have no age structure. Vertical lines show fitted dates for transmission rate changes. The larger dots show weekly averages.

Omicron model fits to BC data (zoomed in)

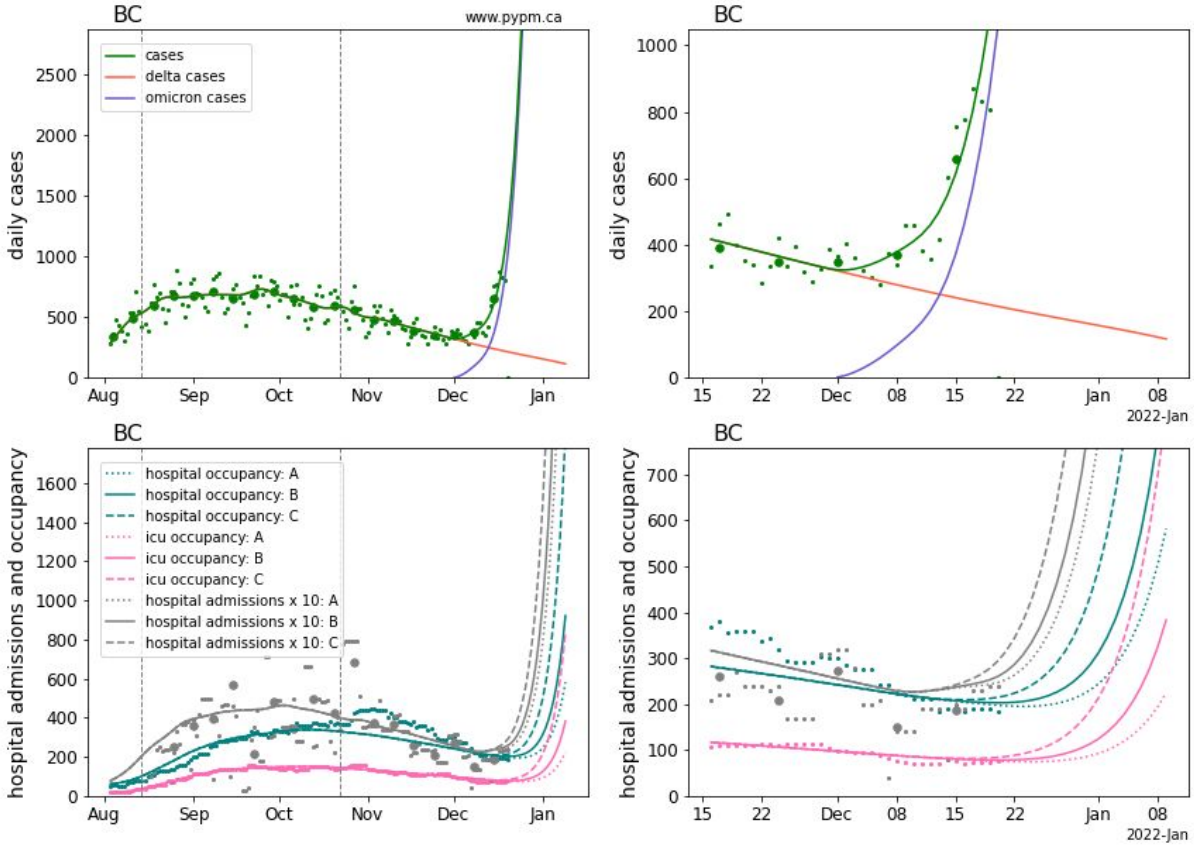


Maximum vertical axis corresponds to daily case rate of 50 per 100,000.

Interior and Island HA data difficult to interpret. More data are needed to better estimate the omicron parameters. Northern HA does not yet show growth arising from omicron, so parameters are set to hypothetical values.

Source (D. Karlen). See www.pypm.ca. These models include vaccination but have no age structure. The larger dots show weekly averages.

Omicron model projections for health care demands



Three severity levels are considered:

- **A**: Probability for an immunized person to need hospitalization is reduced by the multiplicative factor of 0.3 and the probability of death is reduced by that factor squared. The length of hospital stays for all infected by omicron are reduced by the same factor of 0.3.
- **B**: The severity factor is 0.5, instead of 0.3.
- **C**: The severity factor is 1. In other words, there is no reduction in severity as compared to delta infections.

It is too soon to judge which, if any, of these severities are supported by data. All the levels considered lead to rapid growth in hospital demands, far in excess of capacity.

The small points are daily data and the larger circles are weekly averages to help guide the eye. The curves show model projections of demand: no capacity limits are imposed.

Source (D. Karlen). See www.pypm.ca. These models include vaccination but have no age structure. The larger dots show weekly averages.

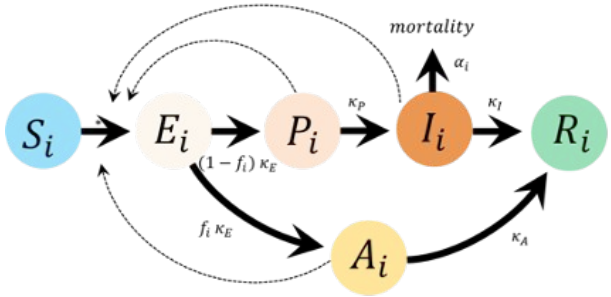
Accounting for uncertainty with Omicron

Given that vaccine effectiveness against infection ($VE_{infection}$) and the probability of a severe case among infected individuals who are vaccinated relative to unvaccinated ($P_{severe\ vac}$) **are unknown**, we can use models to explore the impact of these unknowns.

Using a different model, we can explore uncertainty in Models were used to determine the impact of Omicron on case numbers and hospitalization rates per million Canadians, accounting for age, vaccination status, and prior exposure.

A growth rate of 20% per day was assumed, which is similar to or lower than reported in other jurisdictions (doubling time of 3.5 days).

Given that vaccine effectiveness against infection ($VE_{infection}$) and the probability of a severe case among infected individuals who are vaccinated relative to unvaccinated ($P_{severe\ vac}$) **are unknown**, these



SEAPIR Model (Day et al. 2020)

S: susceptible

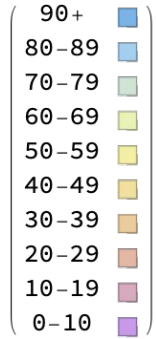
E: exposed

A: asymptomatic (less infectious)

P: pre-symptomatic (infectious)

I: symptomatic (infectious)

R: recovered



10 age classes

{0-9,10-19,...80-89,90+}

2 immune classes

- Vaccinated (or recovered)
- Susceptible

Projected cases: uncertainty in vaccine effectiveness

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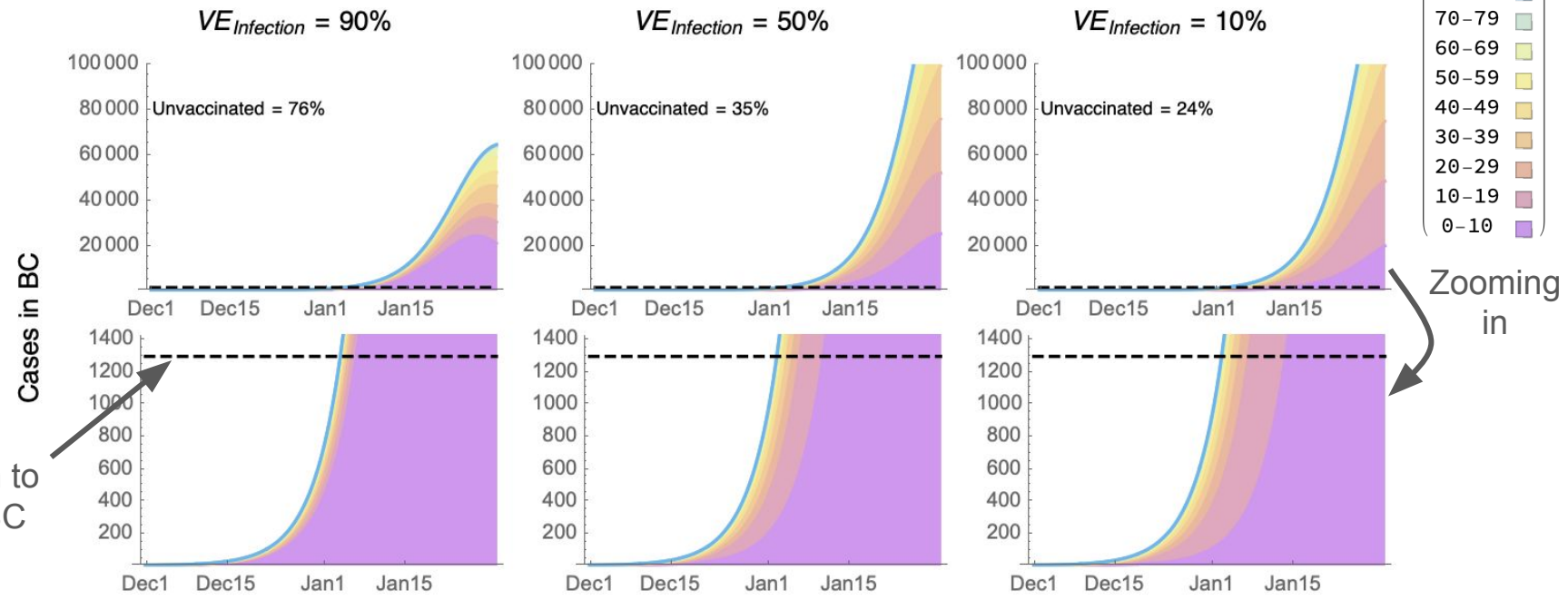
Doubling every 3.5 days



If most of Omicron's advantage comes from being more transmissible and vaccine effectiveness against infection remains high, most cases will be among the unvaccinated.

Regardless, case numbers exceed levels yet seen in the pandemic by early January.

If most of Omicron's advantage comes from being able to infect and spread among vaccinated individuals, a smaller portion of cases will be among the unvaccinated.

Projected number in hospital with a daily growth rate of 0.2

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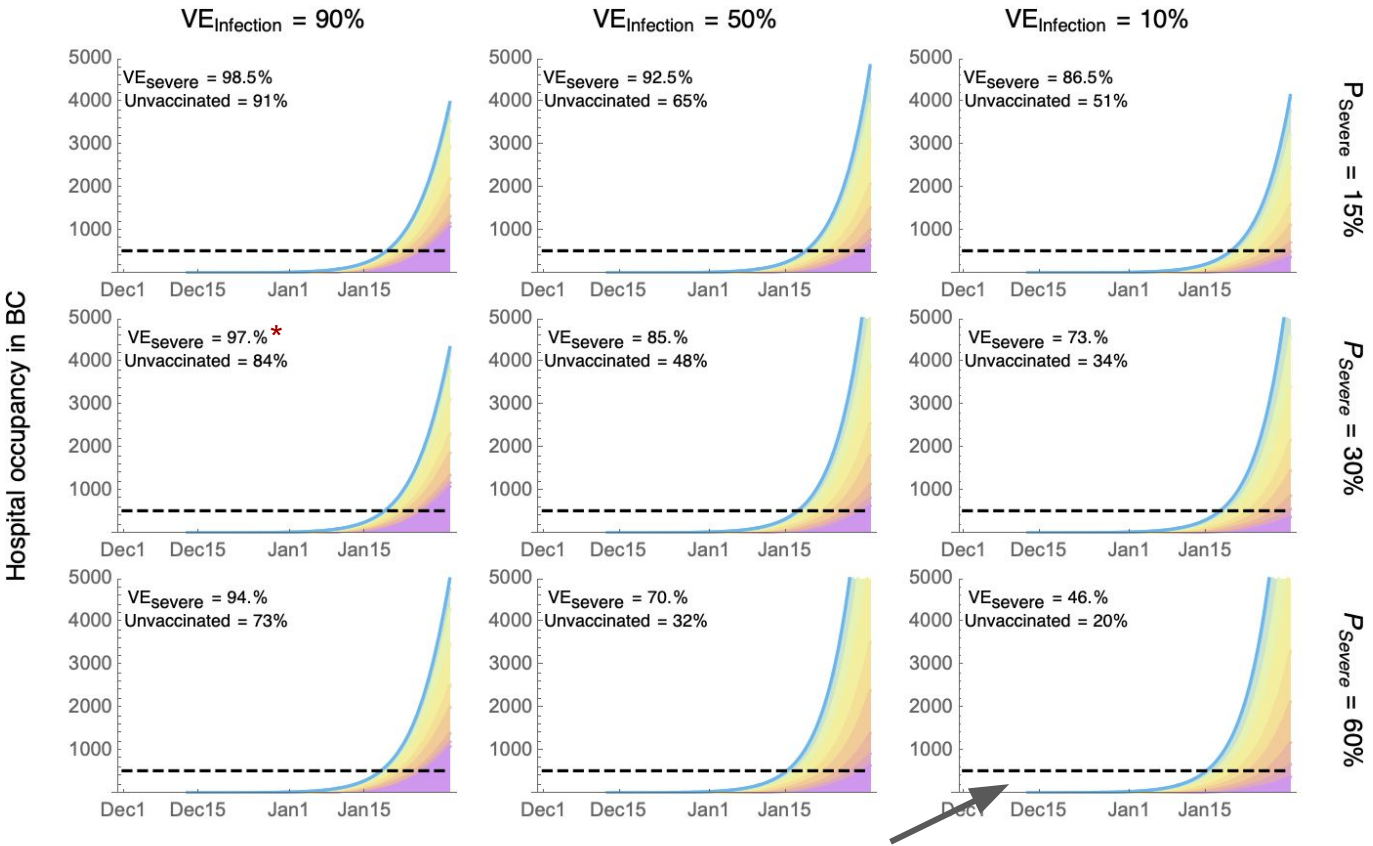


*Consistent with VE against Delta

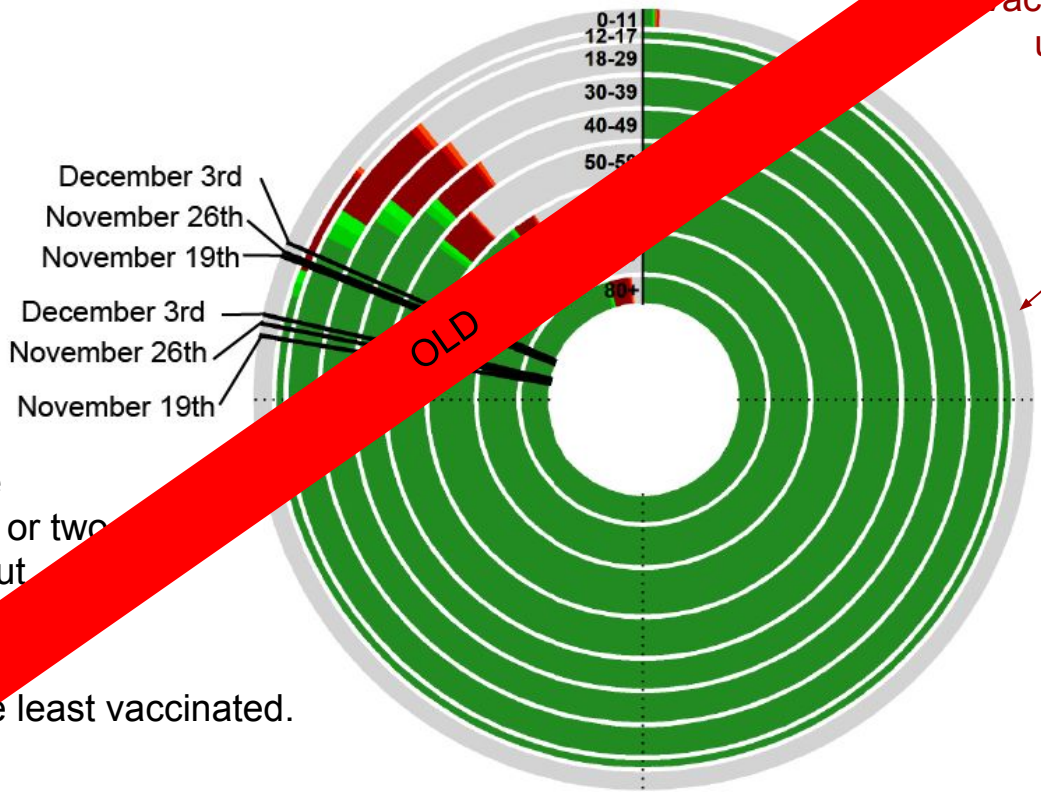
Maximum to date

If Omicron grows at a rate of 20% per day and severity among the unvaccinated remains the same, we expect hospitals to exceed capacity regardless of vaccine effectiveness (columns) and severity among the vaccinated (rows).

Probability of a severe case among infected individuals who are vaccinated compared to unvaccinated.

Closing the circle: Vaccination status by age

December 3rd update includes data through November 27th, 2021



accinations of children under 12 opened November 29th.

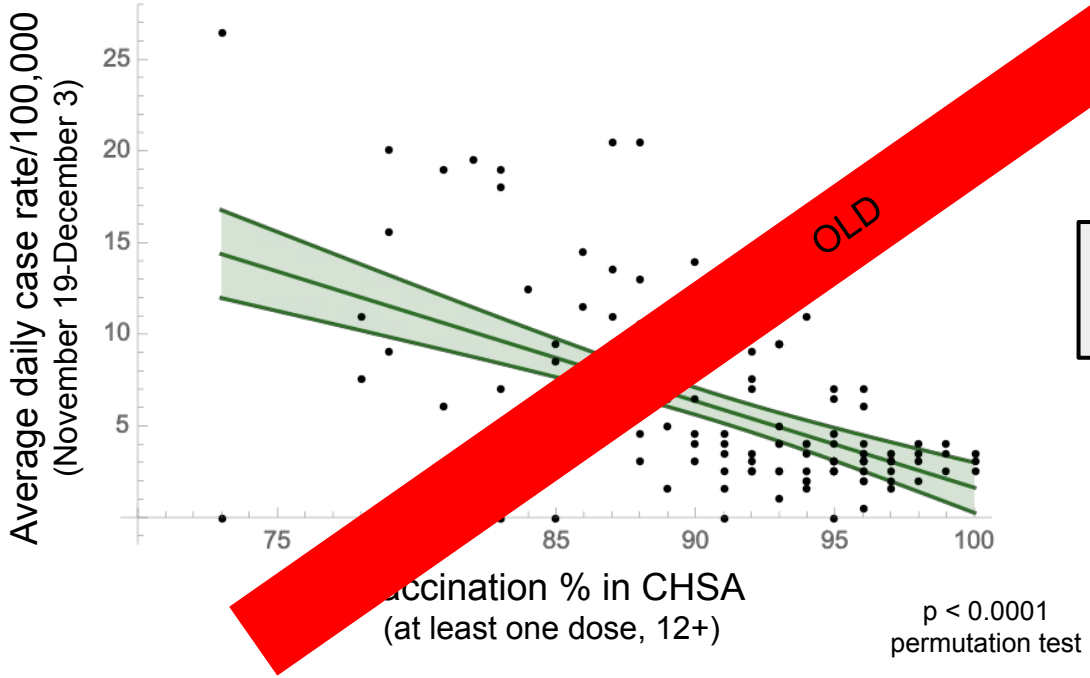
Slight progress:
The fraction of BC's entire population with either one or two doses increased only about 0.4% over the past week.

Adults aged 50-5 e least vaccinated.

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

A pandemic of the unvaccinated: Communities at risk

We continue to see a major effect of vaccination levels across Community Heal[illegible]ce Areas (CHSA). For the most recent two-weeks of cases, communities with 95% of eligible [illegible]accinated have **3.4 times** fewer COVID-19 cases than those with 75% vaccination.



Vaccinations protect communities, as well as protecting individuals.

Source (S. Otto). BCCDC data portal's surveillance dashboard data; see maps for regions that would most benefit from community vaccination drives (accessed December 6, 2021).

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

A Primer on Omicron

How fast will Omicron spread in Canada?

This question **cannot be answered**, because we do not kn… much of Omicron's advantage comes from transmitting better to those with no prior ex…, how much comes from reinfecting those who have had COVID-19 (Omicron reinfecti… are about double that of Delta, Pulliam et al.), and how much comes from transmissi… vaccinated people.

What we do know:

- Fewer South Africans than Canadi… been fully vaccinated (25% vs 76% of the entire populations)
- More South Africans have ha… -19 (~40% accounting for 3M known cases and 8 fold underreporting)
- Globally, many fully vacci… travellers have caught Omicron
- Anecdotal evidence … airborne transmission between fully vaccinated participants at gatherings
- A lab study with … virus finds neutralizing antibody protection from vaccines drops but is not lost

OLD

→ Substantial risk of rapid spread in Canada, even among vaccinated

A Primer on Omicron

How fast will Omicron spread in Canada?

If Omicron spreads approximately as rapidly in Cana[illegible]seen in South Africa and UK, with selection per day between 10% (lo[illegible]20% (high), all provinces would see rapid growth in cases, with Omic[illegible]minating in the next month.

OLD

	BC		SK	MB	ON	QC	NB
Recent growth per day	[illegible]	-0.06	-0.05	+0.01	+0.02	+0.01	+0.03
...with Omicron (low)	[illegible].07	+0.04	+0.05	+0.11	+0.12	+0.11	+0.13
..with Omicro[illegible]	+0.17	+0.14	+0.15	+0.21	+0.22	+0.21	+0.23
Doubling time[illegible]w)	10 days	17 days	14 days	6 days	6 days	6 days	5 days
Doubling time of O (high)	4 days	5 days	5 days	3 days	3 days	3 days	3 days

A Primer on Omicron

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OLD

What would these growth rates per day mean for the pandemic in BC?

	BC						B
Recent growth per day	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.03
...with Omicron (low)	.07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.13
..with Omicro[illegible]	+0.17	+0.14	+0.15	+0.21	+0.22	+0.21	+0.23
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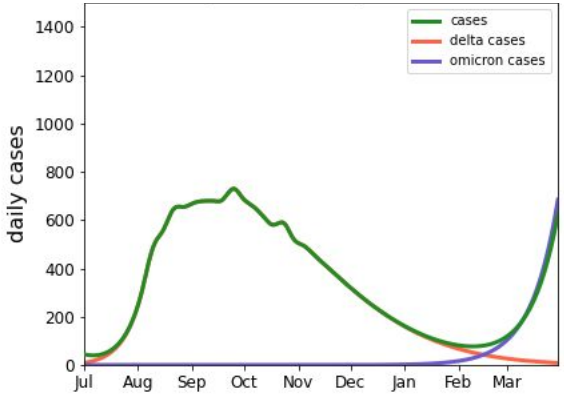
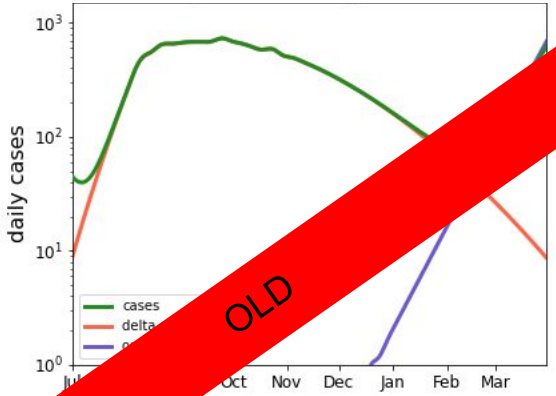
BC projections for Omicron with daily growth of 7% and 17%

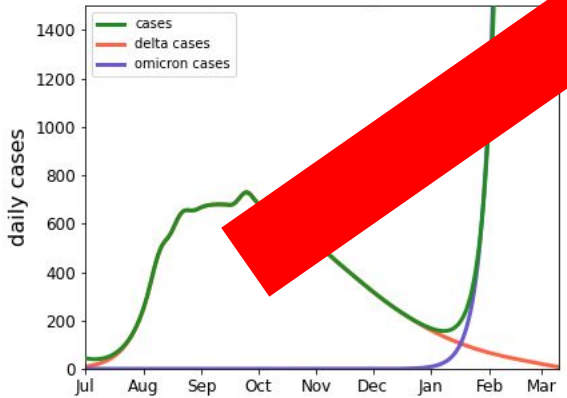
7% (linear scale)



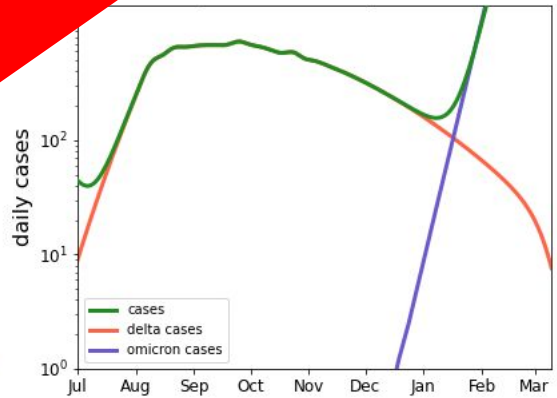
7% (log scale)



17% (linear scale)



7% (log scale)



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assumptions:

Maintain current health measures

- Community transmission of Omicron starting in mid-December

Findings:

- 7% daily growth would be similar to the start of the fourth wave (July/August)
- 17% daily growth would give little time to respond with additional measures

The fraction of cases leading to hospitalization and deaths is unknown. If unchecked, health care demands will grow rapidly, as seen in South Africa.

Source (D. Karlen). See www.pypm.ca.

A Primer on Omicron

What does Omicron mean for our health?

Very preliminary data indicates that COVID-19 with O[illegible]n:

- may be associated with mild symptoms, e[illegible]ally among vaccinated individuals
- may be more common in children
- has led to a rise in hospitalized c[illegible]n South Africa, predominantly among unvaccinated individuals

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→ Getting vaccinated p[illegible]cluding eligible children, trains the immune system and will hel[illegible]d severe disease, even with Omicron.

→ A rapid ri[illegible]ases will inevitably increase the number of severe cases, especially a[illegible]ong the unvaccinated, and will impact the medical care system.

The uncertain future of the pandemic in BC with Omicron

Data on Omicron is scant and should be interpreted cautiously

- Rates of spread in highly-vaccinated populations in Canada may differ from those observed in South Africa and elsewhere
- Risks of *severe disease*, *hospitalization,* and *death* are not yet well-defined for this variant. It may take many weeks before adequate data is compiled to estimate these risks and distinguish between vaccinated vs unvaccinated people, different age groups and co-morbidities, etc.
- Nonetheless, we believe there is a significant risk of a new wave of infection. We will monitor the situation in the next weeks with the goal of providing the best possible forecasting for BC

OLD

Our best protection against Omicron is to use the tools that we have already learned: **get vaccinated, wear tight fitting masks, avoid large gatherings, isolate when sick, improve ventilation, increase testing, & trace contacts to limit spread of Omicron.**

Key messages

State of the Omicron wave in BC:

-

Unknowns:

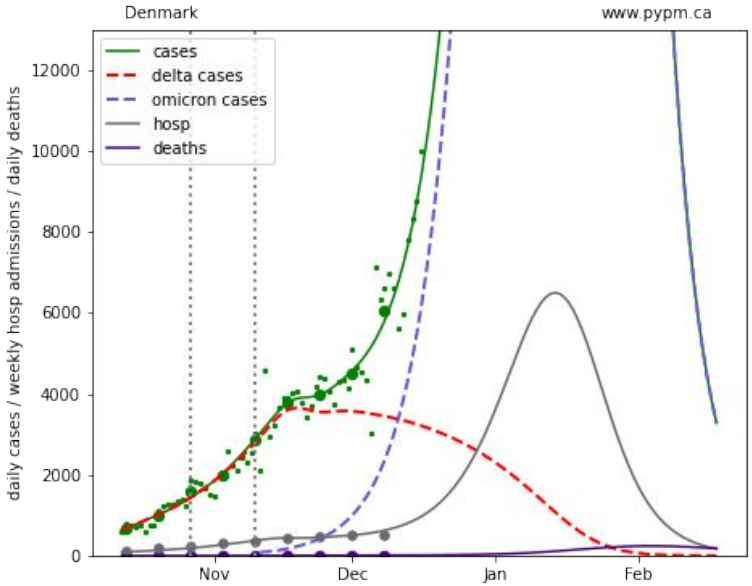
-

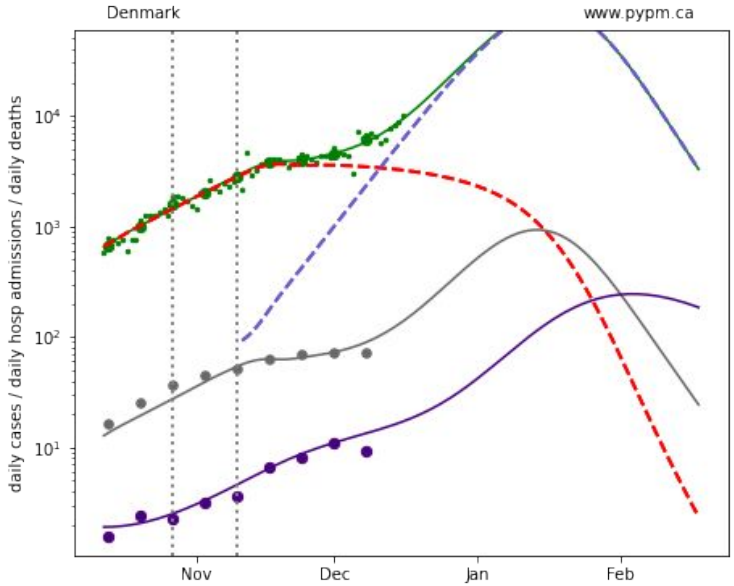
Challenges:

- Flying blind: unable to track trajectory once testing and hospitals reach capacity
- Action to reduce transmission cannot be delayed until hospital

Possible saviour: If a large majority of infections produced by omicron are asymptomatic and go undetected, herd immunity is developing more quickly than we think, and the overall impact of omicron is reduced. Herd immunity comes about when the fraction of the population susceptible to infection is so low, that new infections do not make up for the reduction in the number of contagious people (through recovery or isolation). See the next slides using data from Denmark as an example.

Omicron model fit to Denmark data (symptomatic factor = 1)

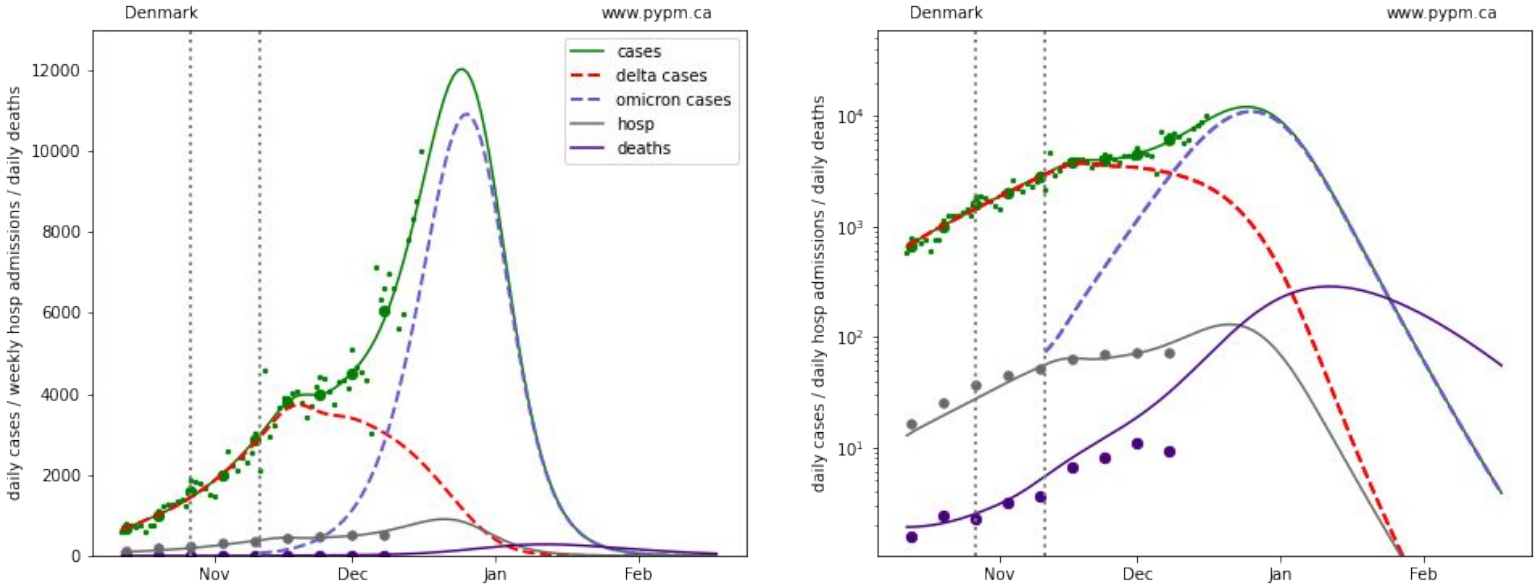




This is the omicron model fit to Denmark data, assuming that the fraction of infections leading to symptoms (and therefore reported as cases) is the same for omicron as it is for delta.

Source (D. Karlen). See www.pypm.ca. These models include vaccination but have no age structure. The vaccine effectiveness against omicron is assumed to be 20%. The larger dots show weekly averages.

Omicron model fit to Denmark data (symptomatic factor = 0.1)



This is the omicron model fit to Denmark data, assuming that the fraction of infections leading to symptoms (and therefore reported as cases) is 10 times smaller for omicron than for delta.

Source (D. Karlen). See www.pypm.ca. These models include vaccination but have no age structure. The vaccine effectiveness against omicron is assumed to be 20%. The larger dots show weekly averages.