Update on COVID-19 in Canada: Epidemiology and Modelling

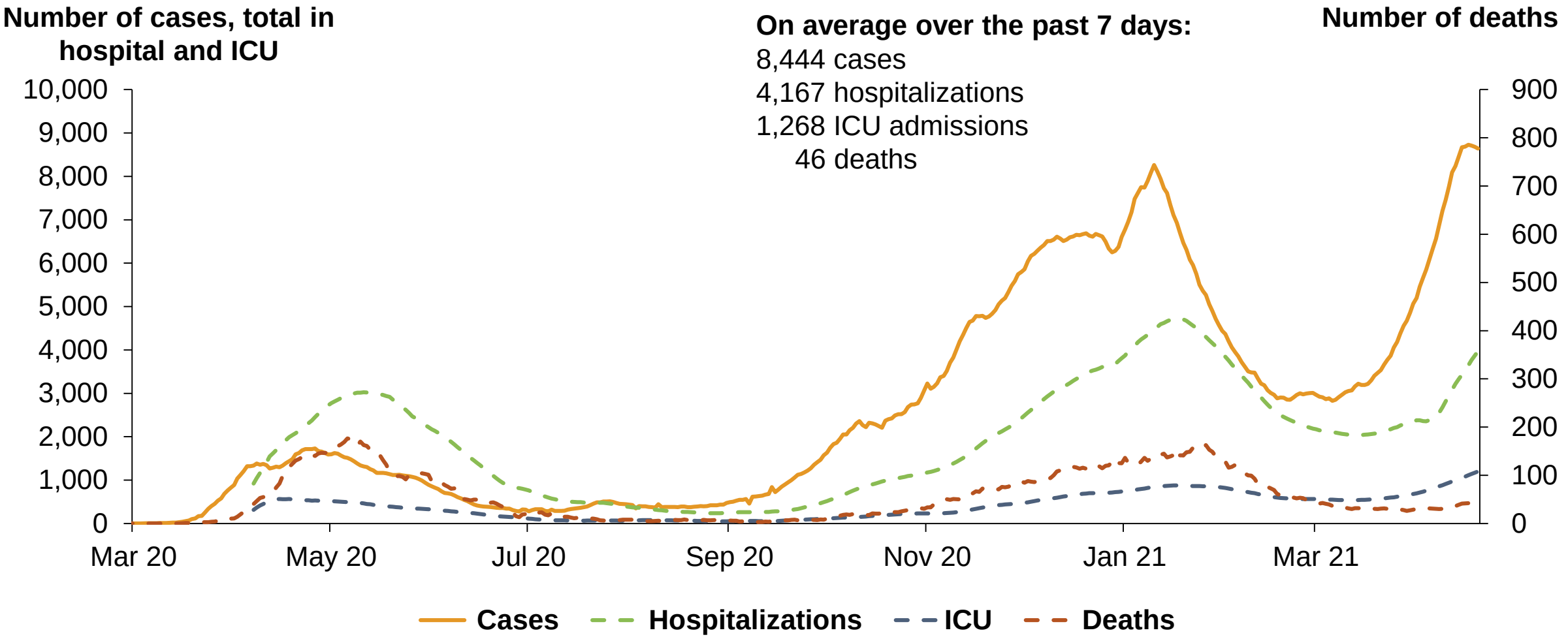
April 23rd, 2021

Canada.ca/coronavirus

Public Health Agency of Canada
Agence de la santé publique du Canada

Canada

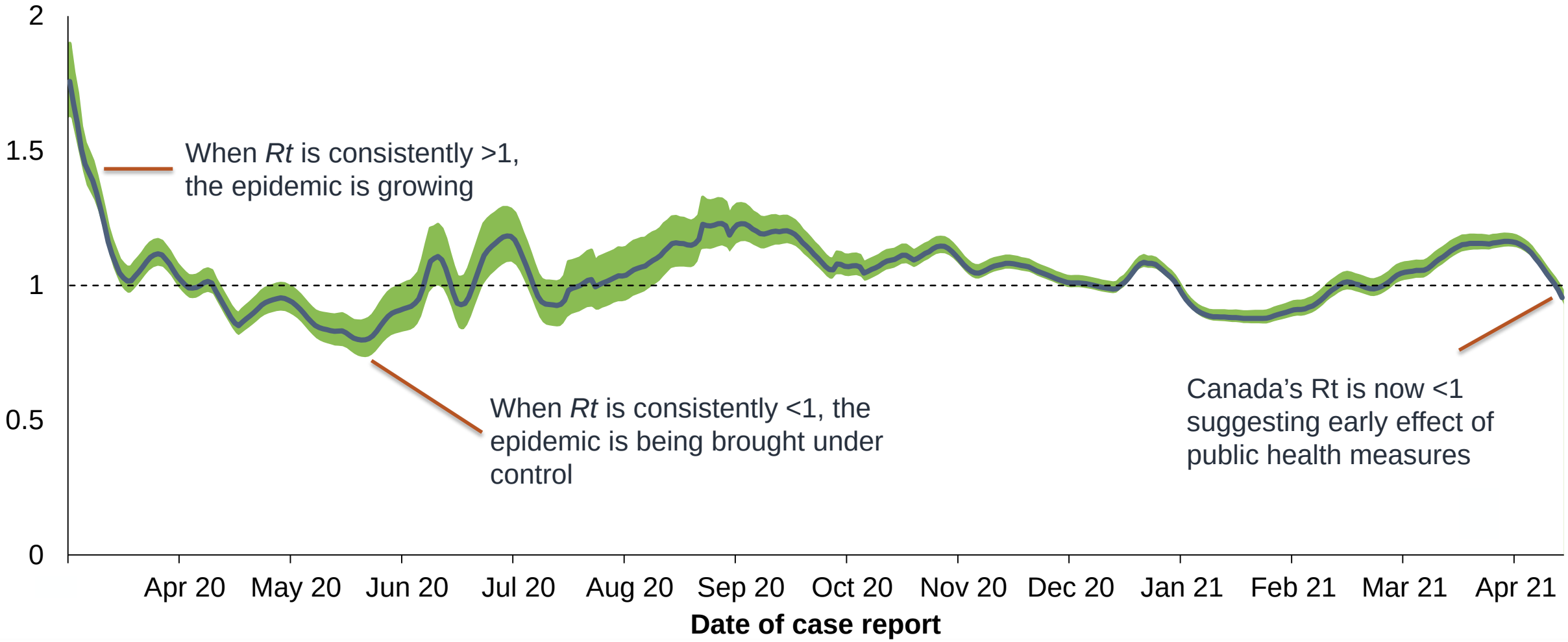
National disease and severity indicators have increased considerably over the past month



Data in figure as of April 20, 2021

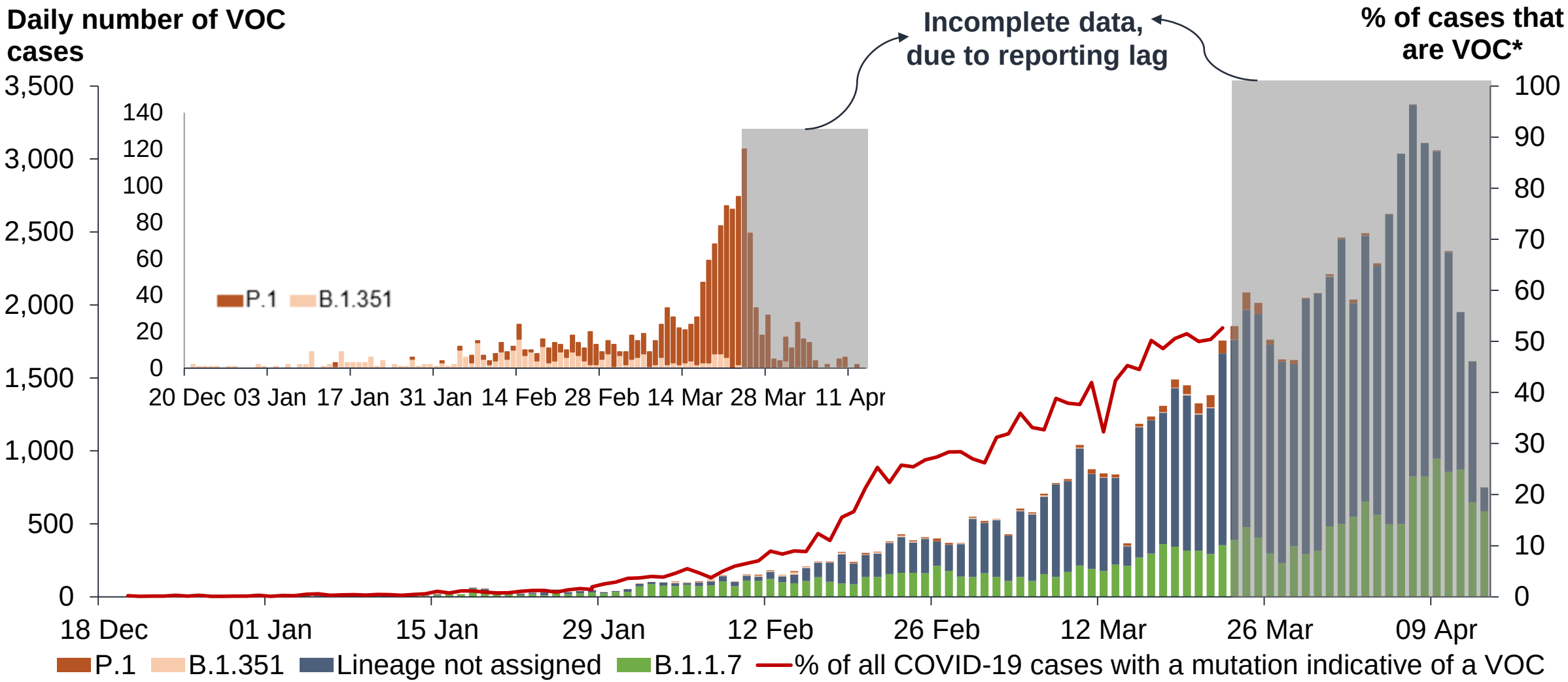
Note: *Trend lines reflect 7-day moving averages. Total hospitalizations and ICU admissions include all people in hospital and in ICU on that day. The average length of stay in hospital is approximately two weeks.*

For the first time in many weeks, national *Rt* has fallen below 1



Data as of April 19, 2021
Note: *7-day moving average.*

Variants of concern make up more than half of recently reported COVID-19 cases in Canada

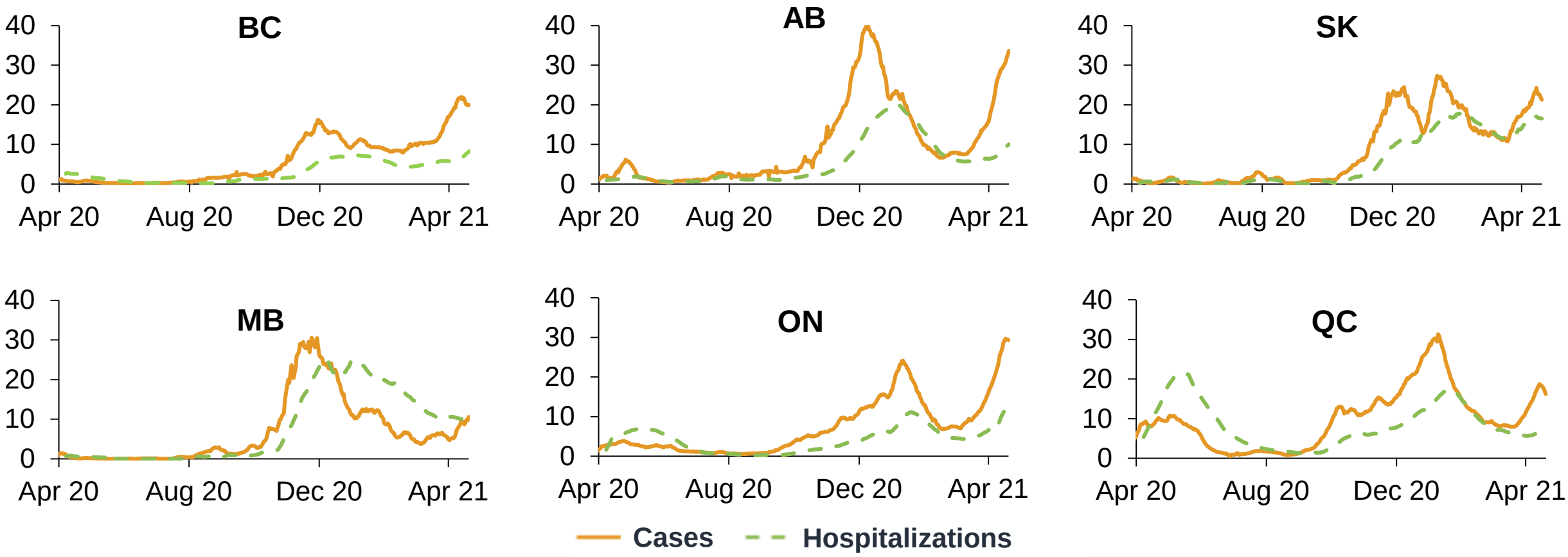


Data as of April 20, 2021

Note: *By laboratory specimen collection date. *Includes cases with confirmed VOC lineage and cases with a mutation indicative of a VOC. VOC cases with no assigned lineage are reported only by ON and PEI, resulting in underestimation of national number of cases with no assigned lineage. Data from SK are excluded from this analysis.*

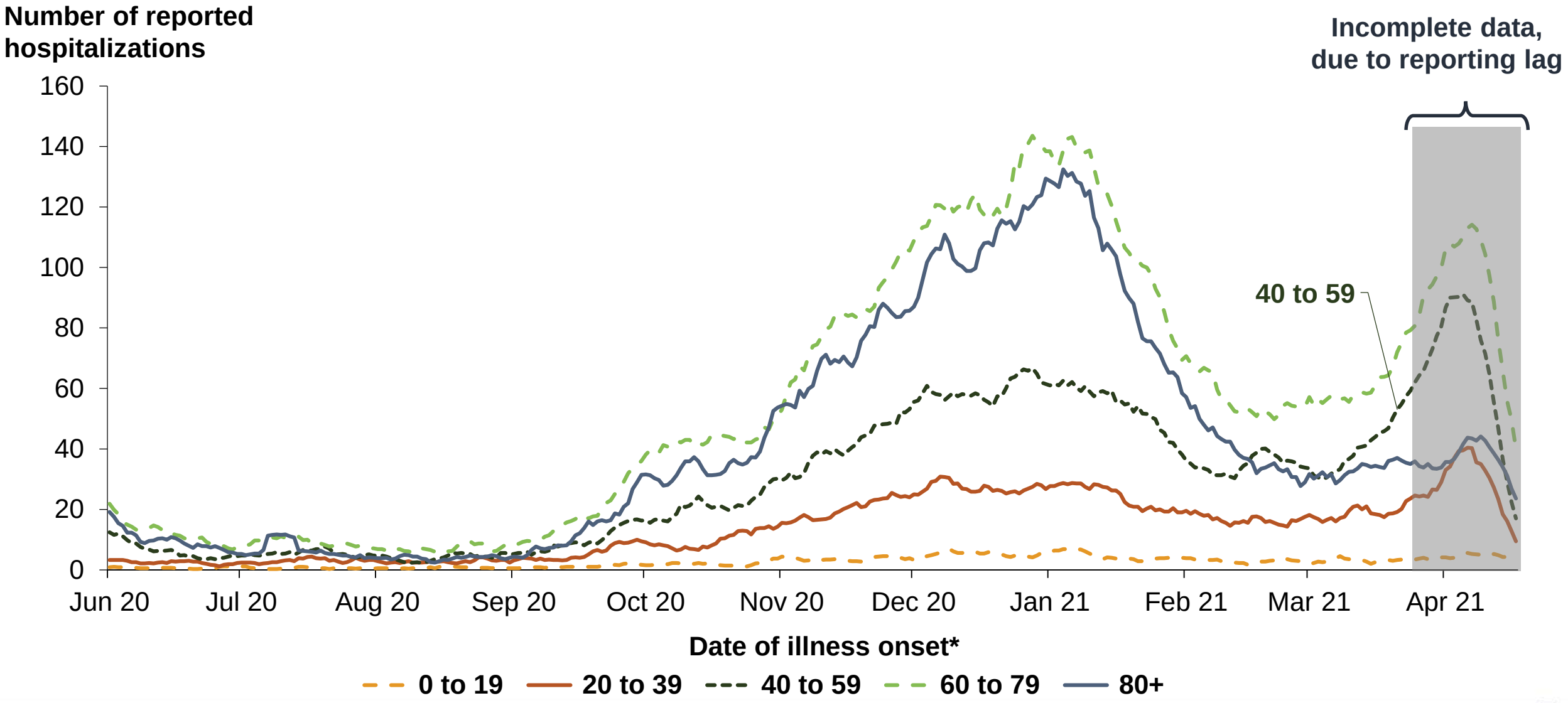
Increase in COVID-19 incidence and severe illness in heavily impacted provinces

Number of cases and hospitalizations per 100,000 population



Data as of April 20, 2021

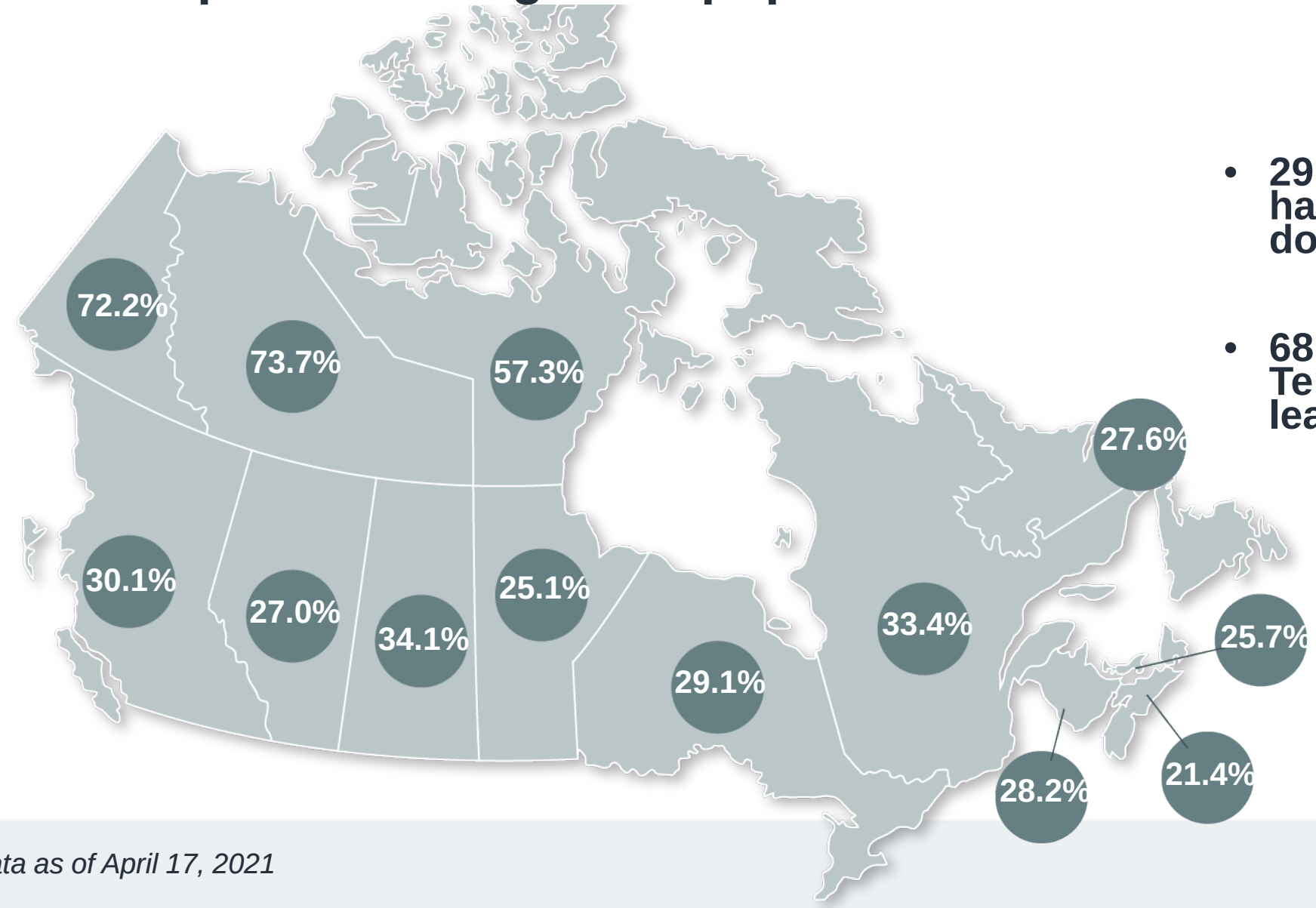
Steepest rise in hospitalizations observed among those aged 40-59 years



Data as of April 20, 2021

Note: *Trend lines reflect 7-day moving averages. *The earliest of the following dates: Onset date, specimen collection date, laboratory testing date, date reported to province or territory, or date reported to PHAC.*

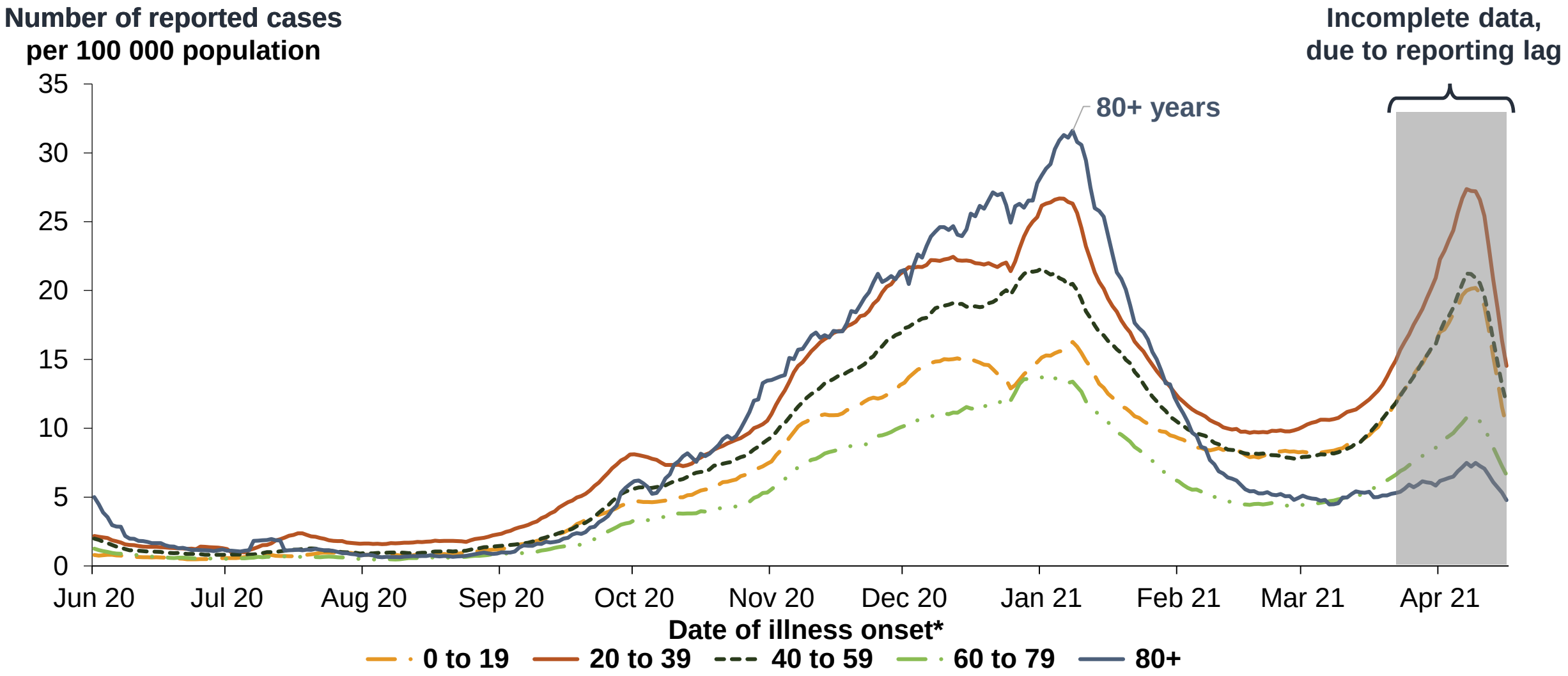
Vaccination coverage is increasing across Canada, with benefits being seen in prioritized high-risk populations



- **29.9% of Canadian adults have received at least one dose**
- **68.8% of adults in the Territories have received at least one dose**

Data as of April 17, 2021

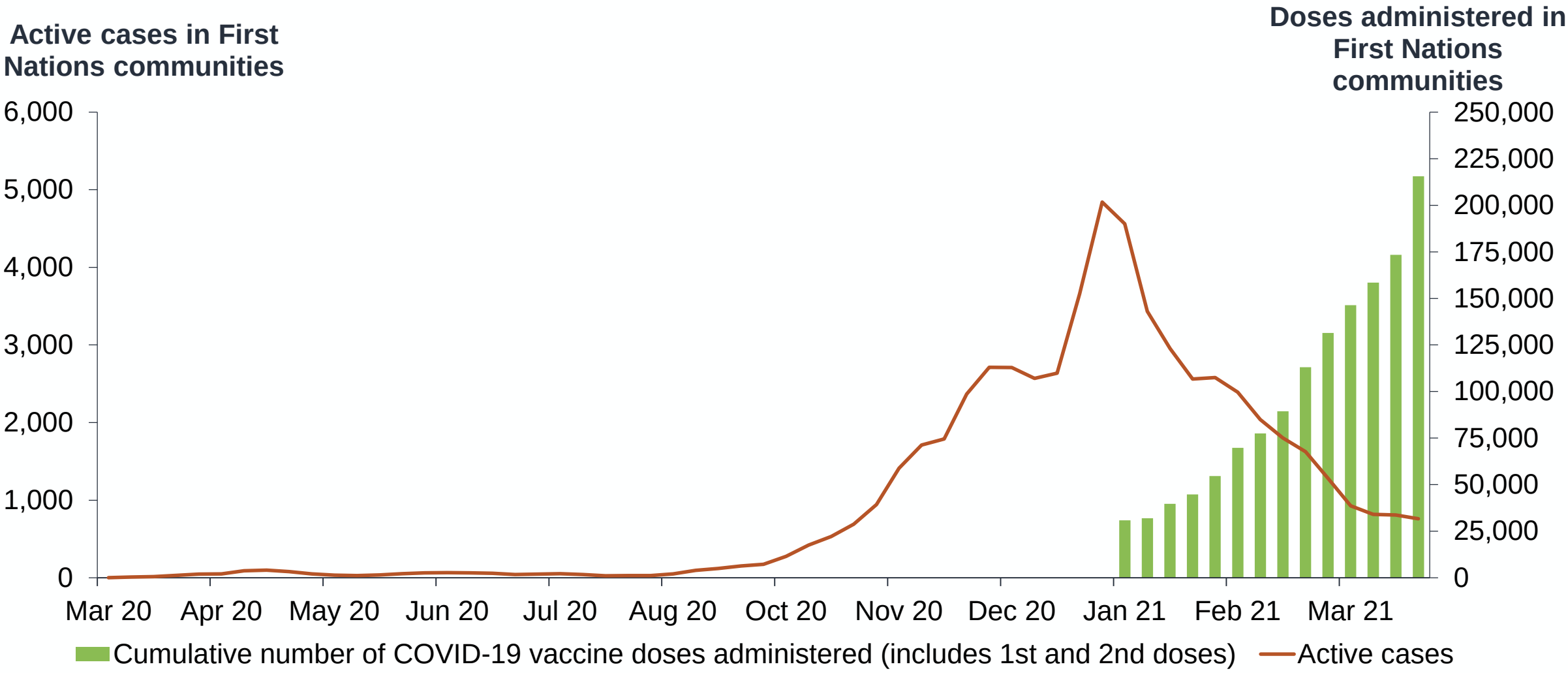
Dramatic decline in incidence rates among adults aged 80 years and older



Data as of April 20, 2021

Note: *Trend lines reflect 7-day moving averages.* *******The earliest of the following dates: Onset date, specimen collection date, laboratory testing date, date reported to province or territory, or date reported to PHAC.*

Sustaining public health measures as vaccination coverage expands is keeping Indigenous communities safer

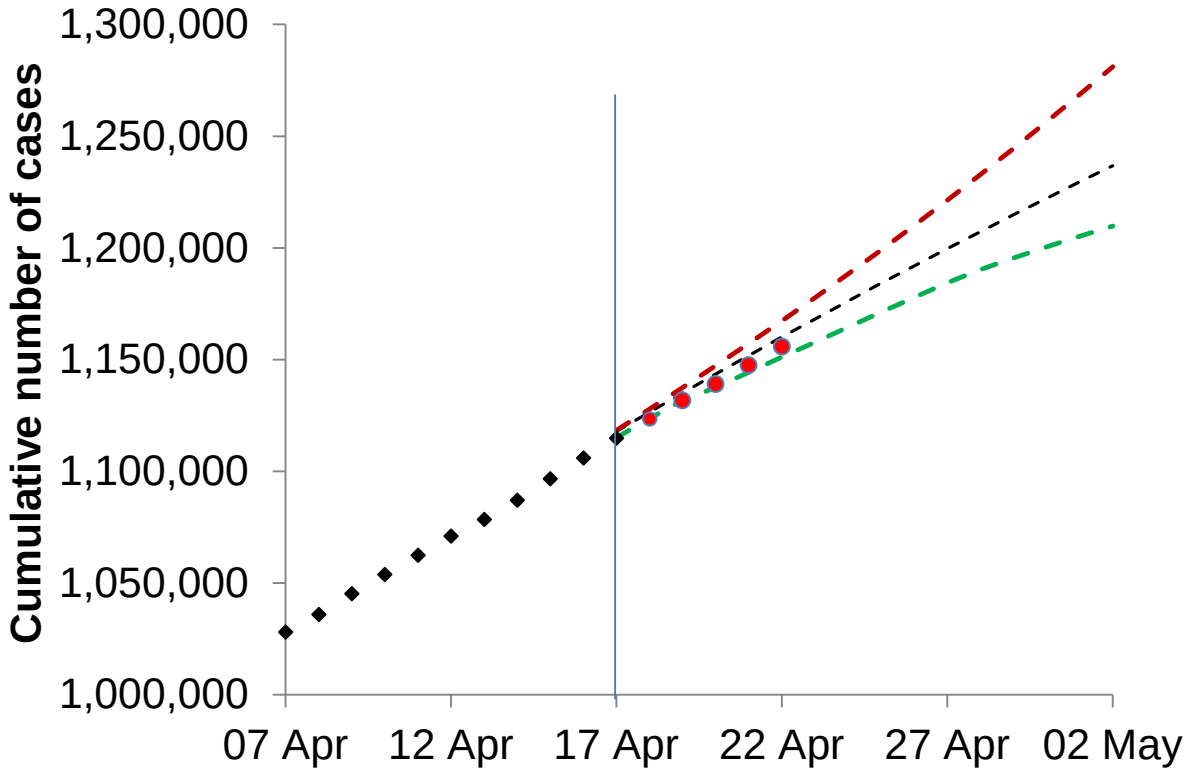


Data as of April 20, 2021

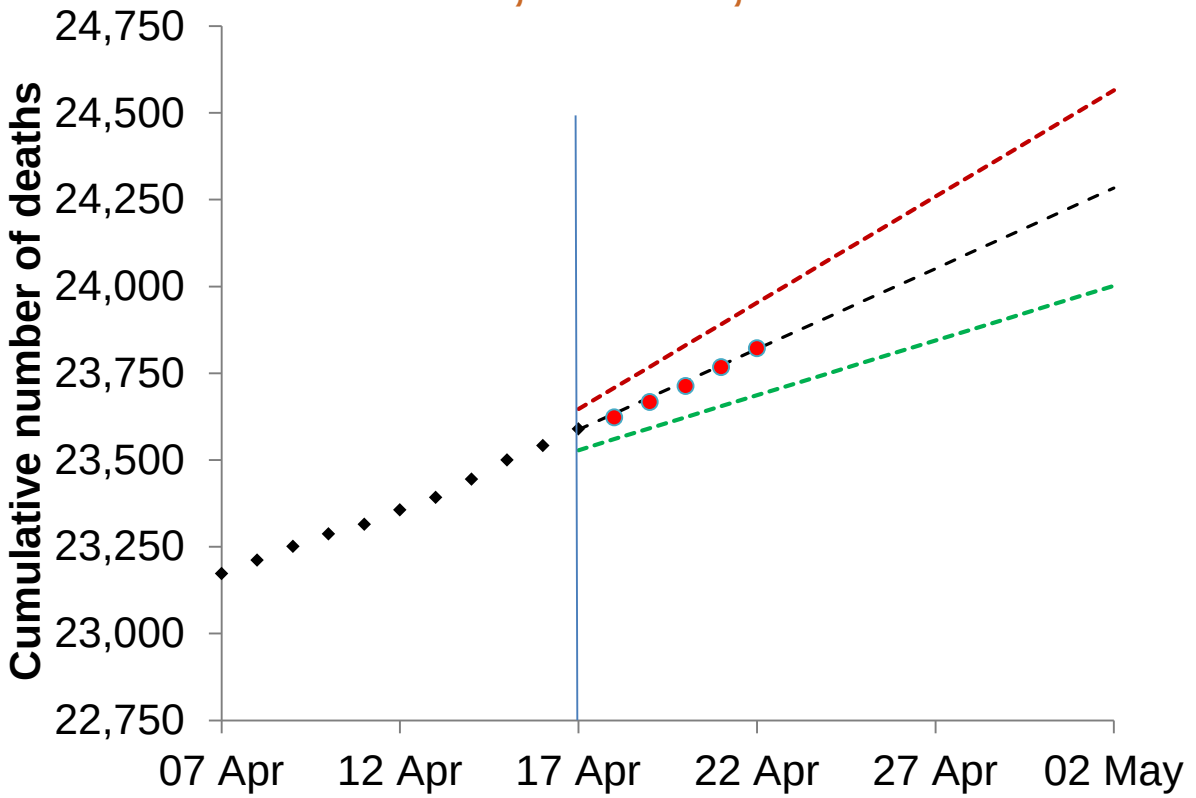
Note: *Data from Indigenous Services Canada. Current week data is incomplete.*

Short-term forecast predicts slower increase in cases, with a slight acceleration in deaths

Cumulative cases predicted to May 2, 2021:
1,209,780 to 1,281,040



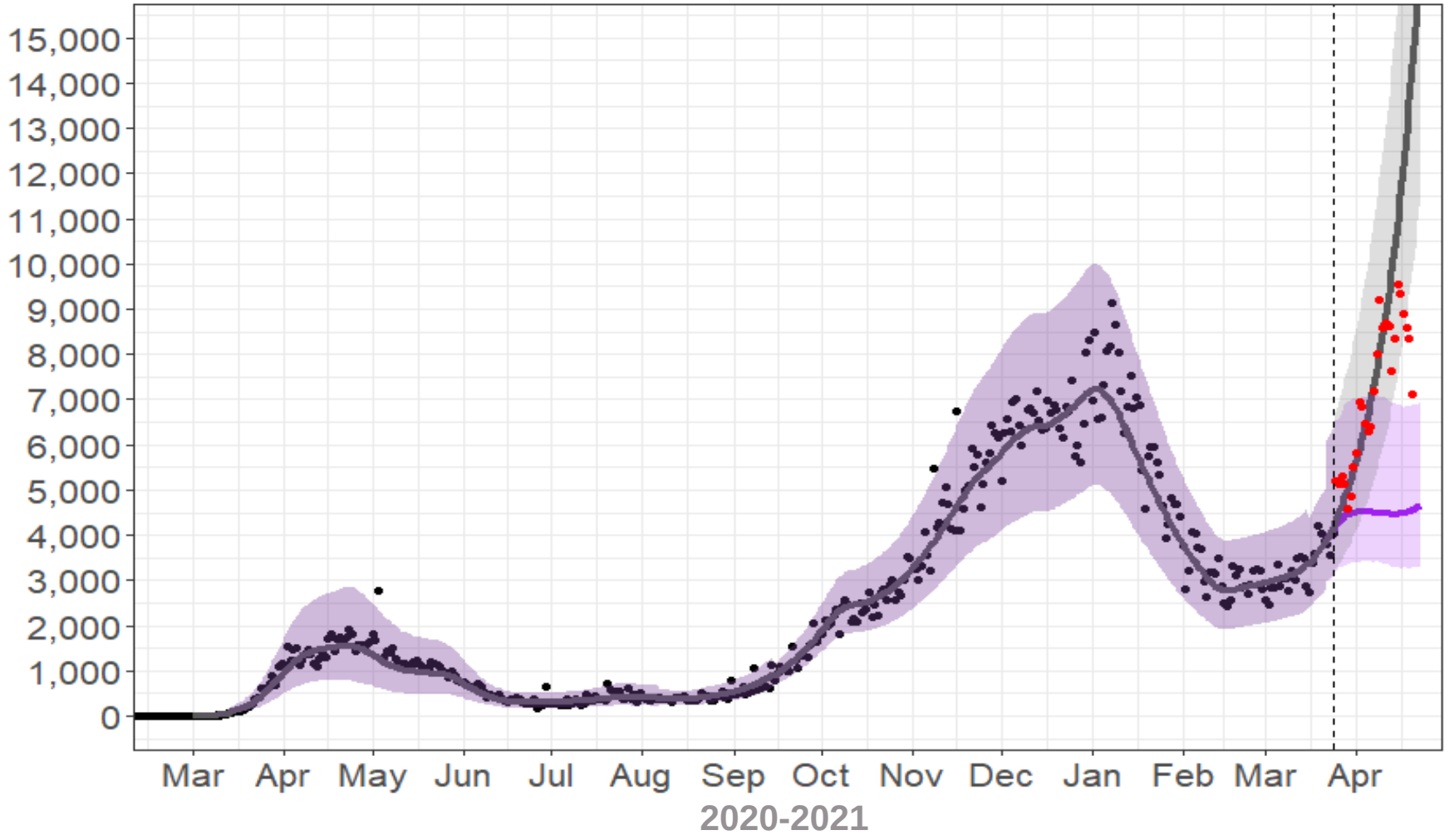
Cumulative deaths predicted to May 2, 2021:
24,000 to 24,570



Cumulatively reported cases in Canada by April 17
Cases added since April 17 when the prediction was made
Prediction to May 2
Lower 95% prediction limit
Upper 95% prediction limit

Data as of April 20, 2021
Note: *Extrapolation based on recent trends using a forecasting model (with ranges of uncertainty).*

The previous longer-range modelling forecast from March 26th continues to play out in the data we are seeing now



***Grey line** - with spread of VOCs and we maintain the current number of people we contact each day

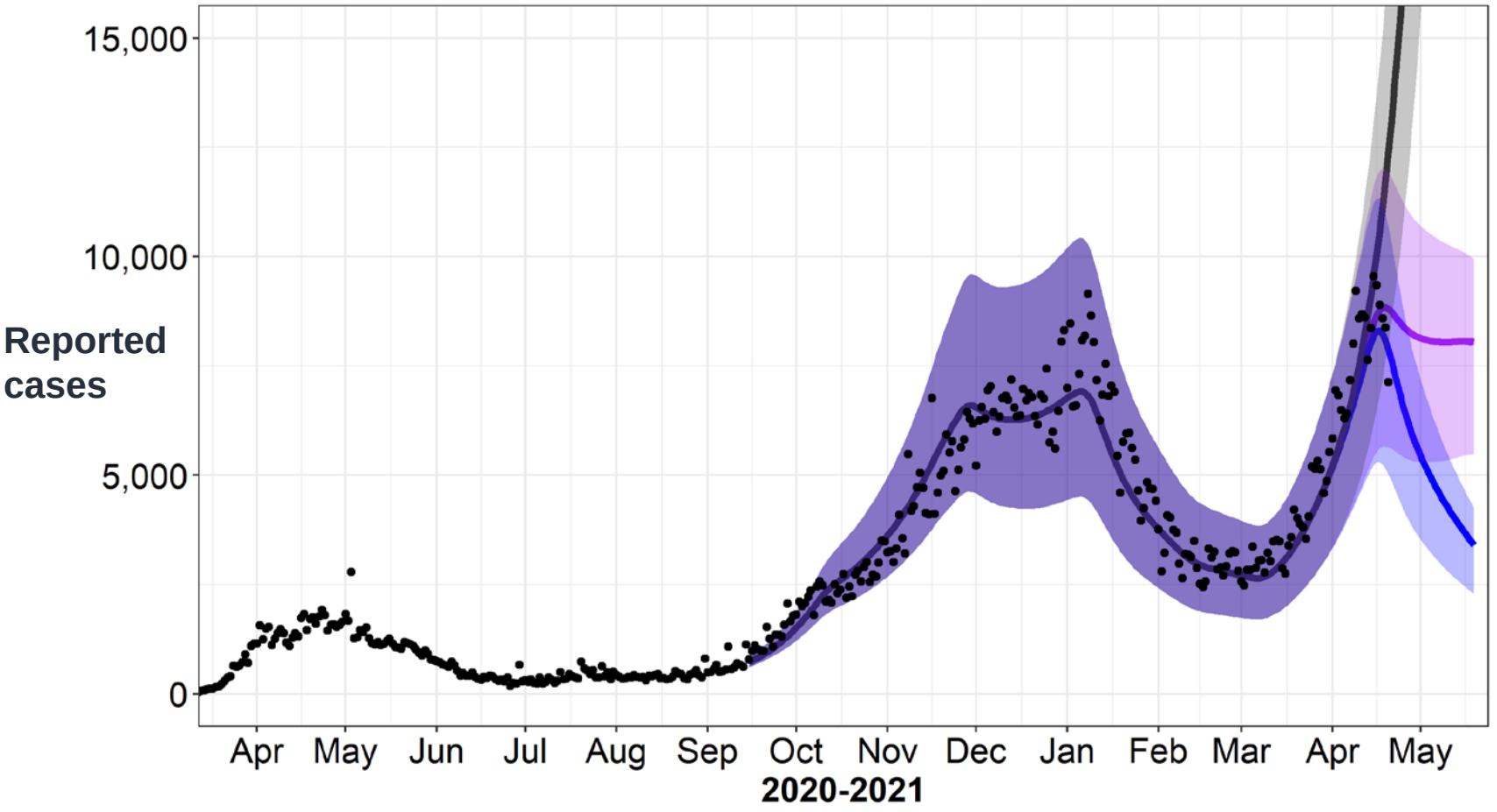
***Purple line** - If VOCs are controlled by reducing the current number of people we contact each day by 20-30%

Red points - surveillance data after the forecast from March 25th to April 20th

**Model data as of March 24, 2021. Surveillance data as of April 20, 2021.*
***Note:** Ensemble of output from PHAC-McMaster and Simon Fraser University.*

It assumes VoC introduced in mid-Dec (~1 week prior to first detected case in Canada) at very low prevalence; VoC is 50% more transmissible than wildtype; growth rates AND replacement rate are negatively correlated with the strength of public health measures. Proportion of VoC is indirectly fitted when calibrating to data. Recent changes in testing rates are not taken into account in this forecast. SFU methods are at https://www.sfu.ca/magpie/blog/variant-simple-proactive.html

Longer-range forecast shows strong measures are required to counter more transmissible variants as vaccines continue to roll out



Without recent changes to public health measures. ***Many jurisdictions have recently implemented measures to prevent this trajectory***

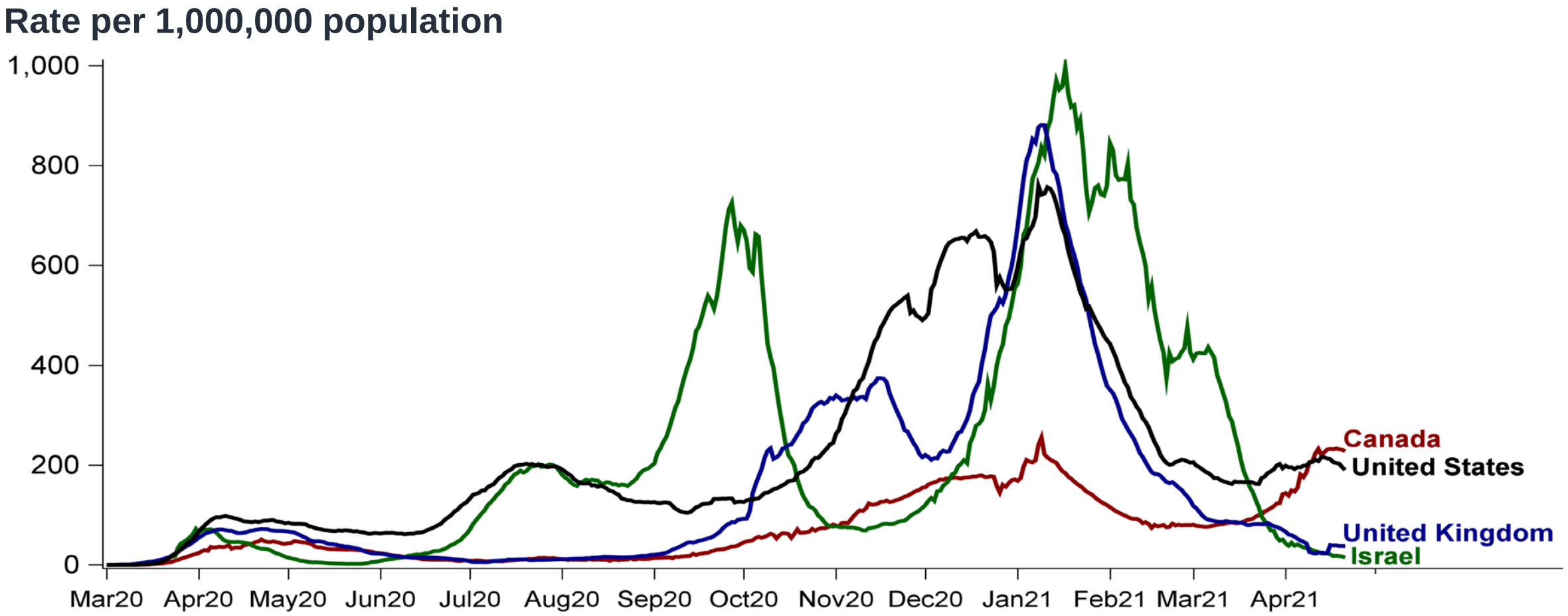
Implementation of recent public health measures and adherence to them **reduces** contact between people by **30%**

Implementation of recent public health measures and adherence to them **reduces** contact between people by **40%**

Data as of April 19, 2021

Note: *Model developed by PHAC and McMaster University. Model considers impact of vaccination and increased transmissibility of VOCs, refer to annex for detailed assumptions on modelling.*

International experience shows strong and sustained measures are needed to suppress rapid growth of more contagious variants

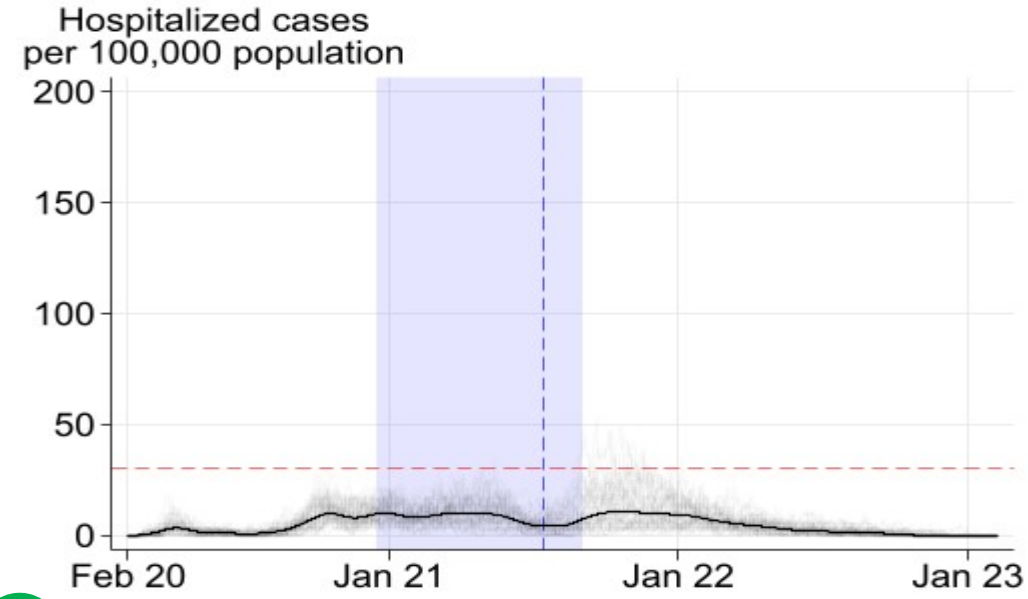


Data as of April 20, 2021
Note: *7-day moving average.*

High uptake of 1st vaccine dose will influence whether it will be safe to lift restrictive public health measures this summer

PLAUSIBLE SAFE LIFTING SCENARIO

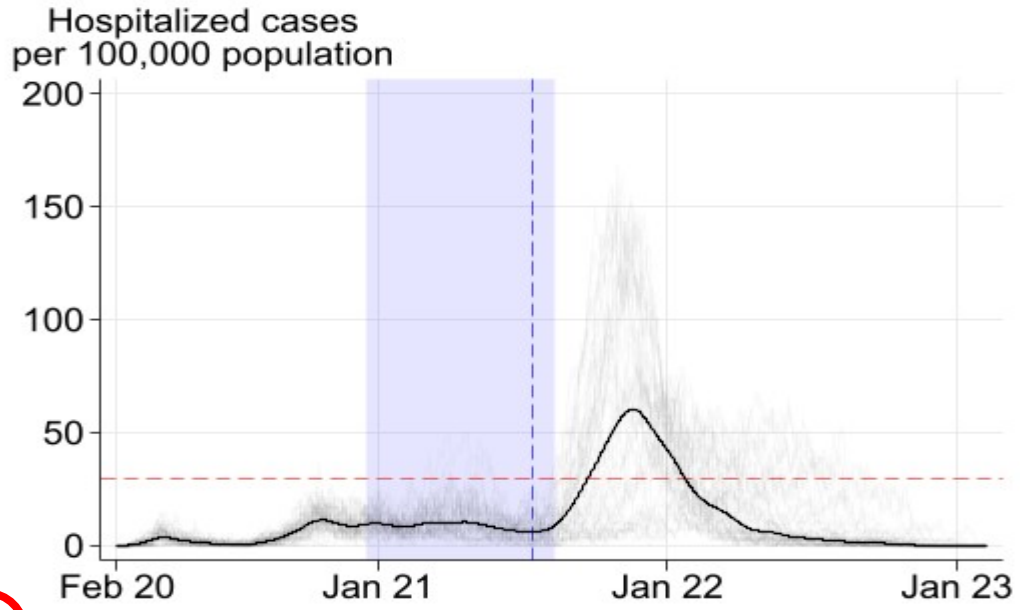
1st dose vaccine uptake is at least **75%** among adults



OUTCOME: hospital capacity not exceeded

PLAUSIBLE ALTERNATIVE SCENARIO

1st dose vaccine uptake is at least **55%** among adults



OUTCOME: hospital capacity widely exceeded in fall 2021

Hospital capacity | Measures lifted | Median hospitalized cases | Vaccination period

Physical distancing, mask wearing, and other personal protective measures alongside current levels of testing and tracing would be maintained even when restrictive public health measures are lifted.

Note: In both scenarios, measures are lifted when **20% of the Canadians have received their second dose.**

Many factors influence the epidemiological situation and timing for adjusting public health measures…

Factors which could allow lifting of restrictive measures **SOONER:**

- Vaccines highly effective
- Faster vaccine roll out
- High vaccine uptake
- Transmission is controlled
- Public health is able to test and trace
- Hospitals and ICUs have enough capacity to meet community needs

Factors which could result in lifting of restrictive measures **LATER:**

- Vaccines less effective
- Slower vaccine roll out
- Low vaccine uptake
- Transmission not controlled
- Public health unable to test and trace
- Hospitals and ICUs at risk or unable to meet community needs

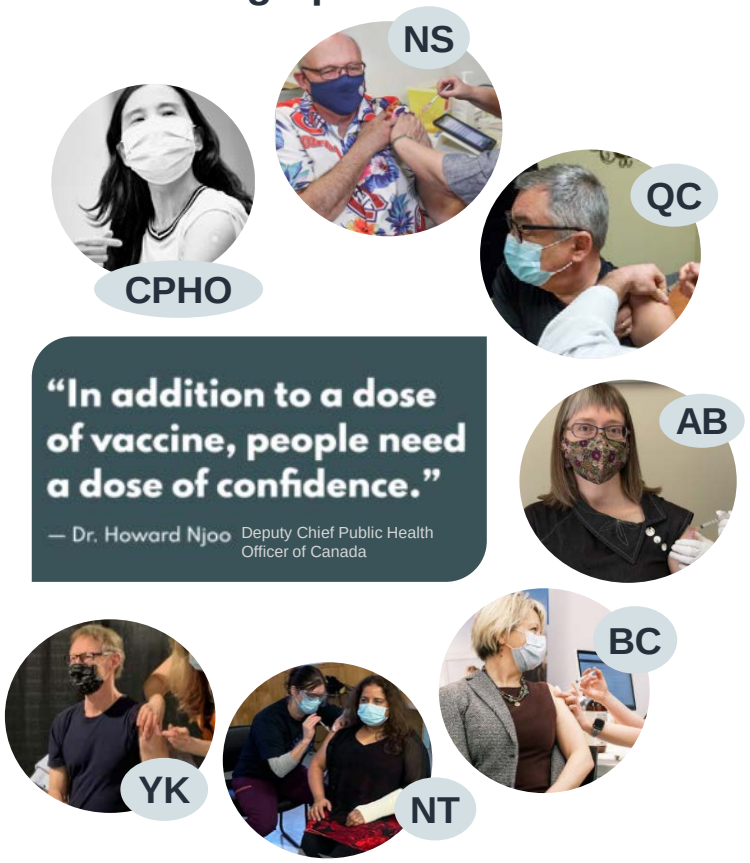
When more people are vaccinated, together with continued adherence to public health measures, we will get to lower levels of COVID-19, so we will have fewer restrictions to enjoy more activities

Summer holds promise if we can all keep doing our part

Vaccines can help lead us out of this pandemic and we can all contribute to their success by:

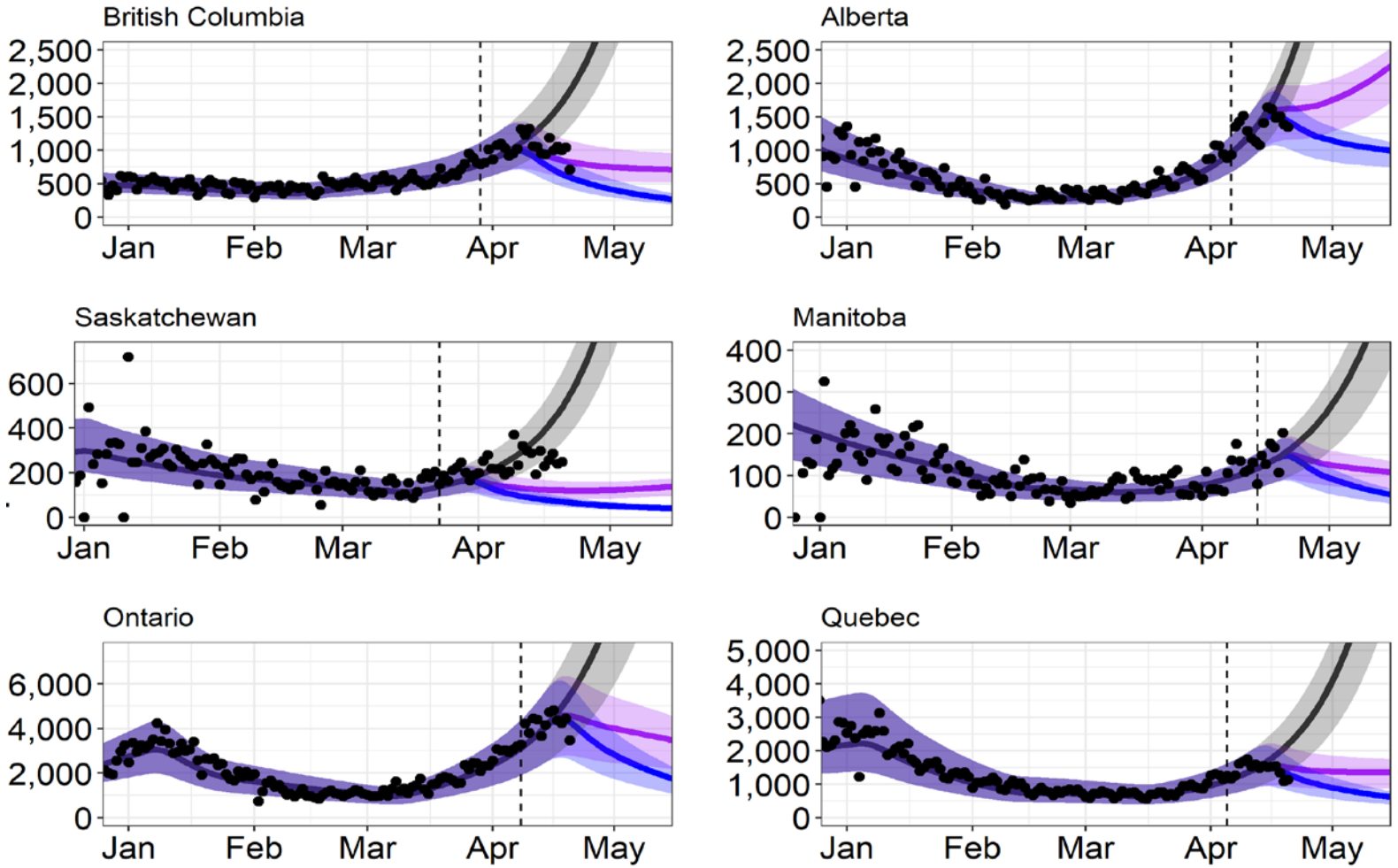
- Get vaccinated as soon as it's your turn
- Support others to get vaccinated when it is their turn
- Keep following public health advice
- Keep up with Wash, Mask, Space

Chief Medical Officers of Health rolling up their sleeves



ANNEX

Longer-range forecast shows strong measures are required to counter more transmissible variants while vaccines continue to roll out



Without recent changes to public health measures. ***Many jurisdictions have recently implemented measures to prevent this trajectory***

Implementation and adherence to recent public health measures **reduces** contact between people by **30%**

Implementation and adherence to recent public health measures **reduces** contact between people by **40%**

Data as of April 19, 2021

Note: *Model developed by PHAC and McMaster University. Model considers impact of vaccination and increased transmissibility of VOCs, refer to annex for detailed assumptions on modelling.*

Longer-range forecasting model assumptions

- The forecast for April 23rd uses a compartmental model reflecting the biology of COVID-19 and public health response developed by PHAC in collaboration with McMaster University. It projects the near future given recent incidence of COVID-19 and scenarios for public health measures, variants of concern and vaccination.
- The model assumes that VOCs are 50% more transmissible compared to previous strains. This value is used to estimate the rate at which VOCs replace existing strains.
- VOCs are considered to have been introduced in mid-December (~1 week prior to first detected case in Canada) at very low prevalence. The proportion of cases due to VOCs is indirectly fitted when calibrating to data.
- Changes to public health measures impact the speed with VOCs replace previous strains; stronger public health measures result in slower growth and replacement rates.
- Since many jurisdictions have recently strengthened public health measures, and it is too soon to determine the full impacts of these measures, so their potential impacts are not yet reflected in the forecast. Recent changes in testing rates are not taken into account either.
- The forecast includes a graph showing the expected increase in cases if public health measures had not recently been strengthened (grey line), one that assumes recent changes to public health measures will decrease transmission by 30% (purple line), and one that assumes recent changes to public health measures will decrease transmission by 40% (blue line).
- The forecast includes simplified assumptions on vaccine roll-out, including an assumption that vaccinations are 60% effective against infection after one dose, a simplified roll-out that does not prioritise by age, and a static vaccination rate. Because only simplified assumptions on vaccine roll-out are included, the forecast is limited to 30 days.
- The forecast from March 26th uses a slightly different approach, with the following differences:
  - It combines the PHAC-McMaster model with a model developed at Simon Fraser University to create an ensemble forecast
  - The ensemble forecast assumes VOCs are 40-50% more transmissible and includes a graph showing expected increases in cases with VOC spread (grey line), and a graph which assumes that transmission (including VOCs) is controlled (purple line) by public health measures that are equivalent to a 20-30% reduction in rates of contact between people in Canada
  - Forecasts are limited to mid-April because assumptions related to vaccination roll-out are not incorporated

Lifting of restrictive measures modelling assumptions

- Complex models, including a deterministic, age-structured compartment model and an agent-based model, are used to explore scenarios for the lifting of restrictive public health measures. These models were initially developed to model measures needed to control COVID-19 and have recently been adapted to model the effects of vaccination and transmission of variants of concern.
- Assumptions in the model are either obtained based on current data and knowledge of the transmission of COVID-19 and updated as new data and evidence emerge or obtained by fitting the models to surveillance data. Key assumptions informing the scenarios presented here include:
  - VOC were introduced in December 2020 and are 50% more transmissible and 40% more virulent than previous strains, but do not have immune breakthrough from vaccines;
  - The vaccine is 60% effective at preventing infection and 80% effective at preventing hospitalization after one dose, and 92% effective at preventing infection and 96% effective at preventing hospitalization after two doses;
  - Hospital bed capacity in Canada is estimated at 30 per 100,000;
  - Vaccination roll-out proceed in order of priority groups as recommended by NACI with a 4-month interval between doses starting from March 4, 2021. The 4-month delay progressively decreases to the regular 28-day delay by August. The entire vaccination rollout period is Dec 14, 2020 to Sep 5, 2021;
  - In the scenarios shown, restrictive measures are lifted and not re-imposed once 20% of the eligible population have received their 2nd dose of vaccine (which is at the same time point in both scenarios) to show what would happen based on different levels of vaccine acceptance in the population. Until then, the epidemic is controlled by a combination of restrictive closures, case detection, isolation, contact tracing and quarantine, and personal distancing;
  - The model assumes 4 weeks after restrictive measures are lifting, the border reopens and the number of imported cases increases from 2 per 100,000 per week to 12 per 100,000 based on current reduction in travel volume due to border restrictions, imported cases are estimated from the PHAC importation model;
  - Restrictive measures refers to closures of settings such as workplaces/businesses, leisure facilities, and other public settings. Even when these measures are lifted, personal distancing by the public and current levels of testing and contact tracing are maintained.
  - Vaccine acceptance by age group is estimated using data from two Canadian surveys (2020 Canadian Community Health Survey – September 2020) and EKOS probability based research panel (January 6-11, 2021). The 75% vaccine acceptance model is the average overall acceptance ranging from 72% (18-44) to 84.7% (65+). The 55% vaccine acceptance model is the average overall acceptance ranging from 50.4% (18-44) to 59.3% (65+).