COVID-19 transmission across Washington State

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SitRep 33: COVID-19 transmission across Washington State

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Results as of May 18, 2021.

We are publishing situation reports on a biweekly schedule on Wednesdays to better accommodate news cycles. If, on an off week, we identify a time-sensitive feature in the data, we will produce an updated report that week to ensure that changes in the situation are reported quickly.

The current Situation Report is based on complete data through May 6. The most recent 10 days are considered incomplete as it takes several days for the Washington State Department of Health to receive 90% of reported cases, hospitalizations and deaths. We continue to work on decreasing these time frames. Note that both statewide and county-specific trends since May 6 may have changed. To assess changes, you can review the case, hospital admission, and death trends including incomplete data on the Epidemiology Curves tab of the WADoH COVID-19 data dashboard. Incomplete data will continue to populate in the coming days, so flattening or decreasing trends may or may not persist. Increasing trends in the incomplete data, though, will likely only grow.

For a comprehensive and up-to-date picture of what's happening around the state, see the WA State COVID-19 Risk Assessment and WADoH COVID-19 data dashboards.

Summary of current situation

Overview: Current model results based on data through May 6 indicate that COVID-19 transmission has declined in Washington state, though R-effective remains close to 1 as of April 30. Prevalence has declined, but still exceeds levels observed in the spring 2020 surge.
Cases: Case counts show signs of decline statewide and in many counties. Case rates are declining or flattening in all age groups.
Hospital admissions: Hospital admission rates show recent signs of flattening or declining in all age groups except 80+, and hospital occupancy may also be flattening.
Vaccination: Vaccine-derived immunity is nearly double that of natural immunity statewide, indicating the important role of vaccination in reducing transmission. However, vaccination shows recent signs of slowing, with an average of ~42,521 doses administered per day as of May 15. Over 70% of the 65+ population has been fully vaccinated, but 23% of the 65+ population has not yet initiated vaccination, and over 60% of the overall population remains susceptible.
Variants: The B.1.1.7 variant, which is more transmissible and potentially poses an increased risk of severe illness, continues to spread across the state. We estimate that over 80% of cases are currently attributable to B.1.1.7. The P.1 variant is also increasing in circulation.
Public health message: Current trends are moving in the right direction, continued vaccination and maintenance of non-pharmaceutical interventions (masking, avoiding indoor gatherings) among the unvaccinated are necessary to prevent reversals

Statewide estimates of the effective reproductive number

Using data from the Washington Disease Reporting System (WDRS) through May 6, we are presenting two versions of the reproductive number (R_e) as of April 30. The orange line and orange-shaded region in Figure 1 below shows estimates of R_e that measure *only* the effects of population-level behavior and SARS-CoV-2 variants on transmission rate. On April 30, this "behavior and variant-based" Re was likely between 1.08 and 1.60 with a best estimate of 1.34. The green line and green-shaded region shows estimates of total Re which includes contributions from behavior, variants, and immunity, either from prior infection or due to vaccination. On April 30, this "total" R_e was likely between 0.71 and 1.04, with a best estimate of 0.88. As R_e closely follows trends in hospital admissions, the recent sharp decline in R_e reflects the similar trend in hospital admissions. The divergence between the "behavior and variant-based" and "total" R_e estimates began in January and has become more evident over time, due to post-infection immunity from the winter surge of infection, combined with increases in vaccination rates across the state. The growth rate of the epidemic is determined by the total R_e, and population immunity is helping control the transmission rate. To reduce levels of cases and hospitalizations, the total R_e (green line and shaded region) needs to maintain a value substantially below 1 for a sustained period of time through a combination of population behavior (such as masking, social distancing, avoiding indoor gatherings) and immunity (including through vaccination).

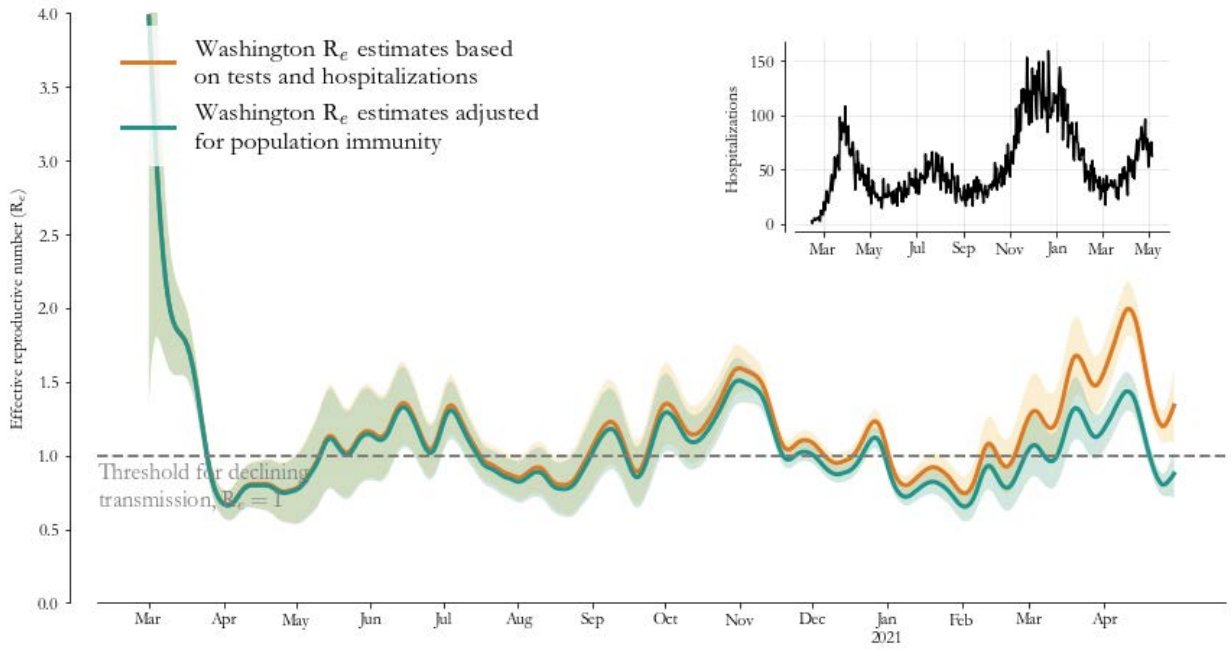

***Figure 1**: estimates for Washington state. The orange line and orange-shaded region indicate the "behavior and variant-based" , while the green line and green-shaded region depict the "total" , which accounts for behavior, variants, and population immunity.*

Model-based statewide prevalence

On May 6, overall prevalence (the percentage of Washington state residents with active COVID-19 infection) in Washington state was likely between 0.22% and 0.40%, with a best estimate of 0.31% (Figure 2). Our current estimates suggest that the peak prevalence in the fourth surge of disease occurred in late April, and surpassed the peaks of the spring and summer disease surges in 2020. Current prevalence, though lower than what it was in late April, still remains higher than the peak prevalence of both the spring and summer surges of 2020.

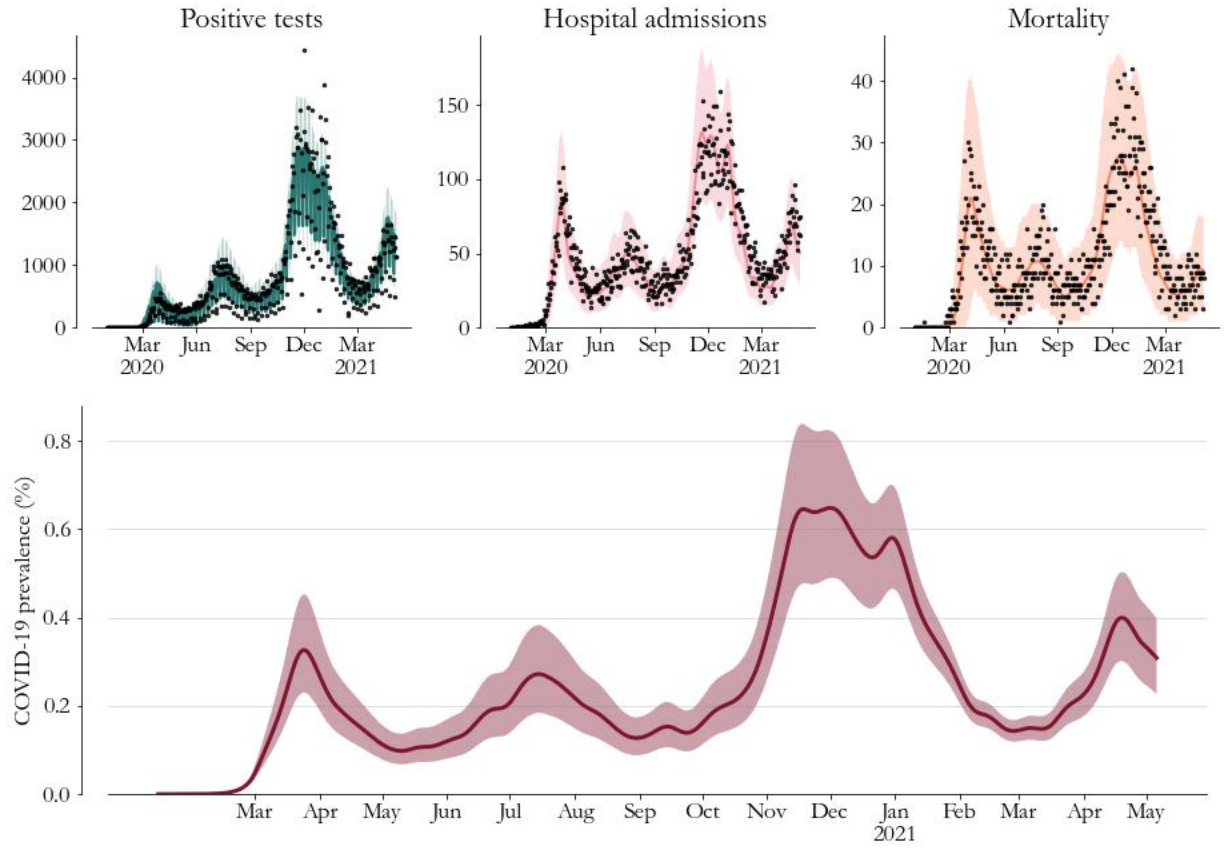

***Figure 2**: Model-based prevalence estimates (bottom, 95% CI shaded) and model fit to cases (top left), hospitalizations (top middle) and deaths (top right) for Washington state. Prevalence is the percentage of Washington state residents with active COVID-19 infection.*

Model-based statewide immunity

On May 6, we estimate that overall population immunity to SARS-CoV-2 in Washington state was between 34.9% and 38.1% with a best estimate of 36.5%. Approximately 12.9% (95% uncertainty interval: 10.7% to 15.2%) of the population have derived immunity from prior infection, and about 23.6% (95% uncertainty interval: 22.9% to 24.2%) from vaccination. Figure 3 indicates that currently, the percent of the population with vaccine-derived immunity is nearly double that with naturally-derived immunity.

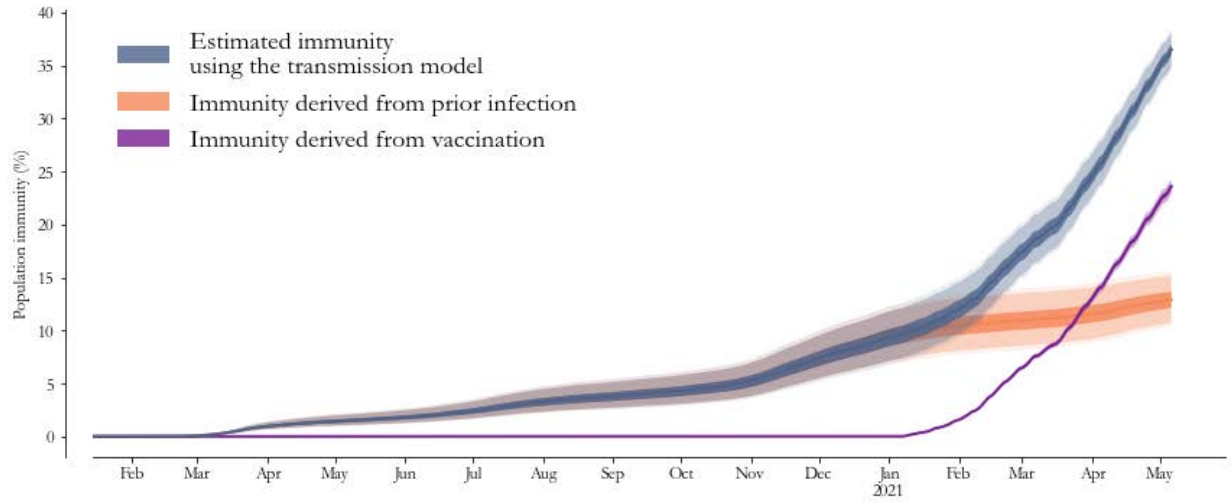

Figure 3*: Model-based estimates of population-level immunity to SARS-CoV-2 infection as of May 6. Overall population immunity is indicated in the blue line and shaded area. The percent of the population deriving immunity from prior infection, the "natural component," is shown in orange. Note that these estimates assume that either prior infection or vaccination give individuals long-term immunity against all SARS-CoV-2 variants, so waning of immunity after infection is not accounted for. The proportion of the population that derived immunity from vaccination at least 21 days prior is indicated in purple.*

Trends in cases, hospital admissions, and deaths

Case counts began increasing in late March, with some recent flattening evident in late April, and the beginnings of a decrease evident in early May (Figure 4). The seven-day rolling average case count increased from 384 cases per day on September 12 to a peak of 2913 on January 8, declined to 728 cases per day as of February 15, remained at that level for a month, increased to 1479 cases per day as of April 23, and has since declined to 1271 as of May 6.

Hospital admissions flattened in early March and began increasing in late March, with continued increase evident through late April, and a clear decline in early May. The seven-day rolling average of hospital admissions increased from 21 per day on September 4 to a peak of 122 on January 6, then declined again to 34 as of March 4, flattened near that level until late March, increased to a peak of 82 as of April 26, and has since declined to 68 as of May 6.

Deaths continued to decline through late March, and appear to be fairly flat, with some variability, as of late April. The seven-day rolling average of deaths increased from 5 per day on September 12 to a peak of 32 on January 10 and has since declined to 8 as of April 26 (note that there is an earlier cut-off date for deaths because of the additional time it takes for deaths to be verified and entered in the state vital records database).

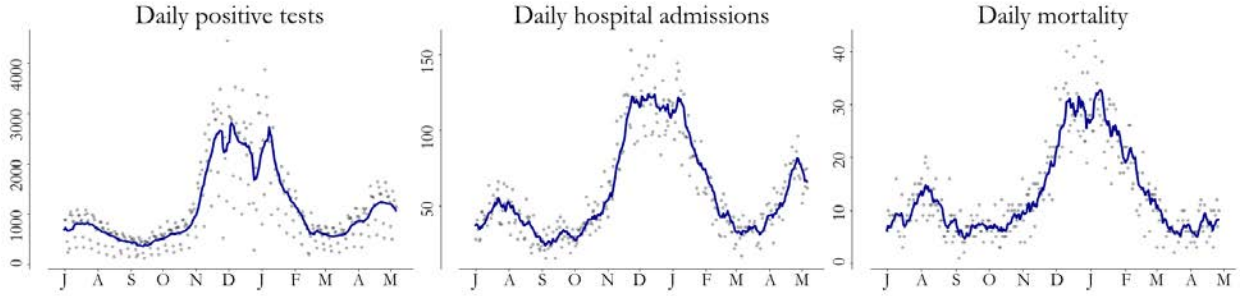

Figure 4*: Seven-day rolling case counts (left panel), hospital admissions (middle panel) and deaths (right panel) for Washington from July 2020 through May 6 (cases and hospitalizations) and April 26 (deaths) 2021. Because of how confirmed deaths are being reported, we are using an earlier cutoff for the mortality panel.*

County-level trends

Case rates: Across Washington state as of May 6:

- 2 counties had no new cases over the prior two weeks (Columbia, Garfield).
- 15 counties had 14-day rates of new cases between 100 and 200 per 100,000 people.
- 9 counties had rates between 200 and 300 per 100,000.
- 5 counties (Pierce, Kittitas, Ferry, Skamania, Lincoln) had rates above 300 per 100,000.

Case counts: Trends in county-level case counts show trends towards flattening or declining in most counties, with only a few counties continuing to have increases in counts:

- Among the five largest counties, case counts in Clark and Spokane are flat, while King, Pierce, and Snohomish are seeing declines.
- Among middle-sized counties, case counts continue to increase in Whatcom county. Counts have flattened in Grant and Thurston, and are declining in Benton, Cowlitz, Franklin, Kitsap, Skagit. Cases in Yakima have remained fairly flat since mid-February, and are now declining.
- Among small counties, case counts are on the increase in Lewis. All other small counties still have fewer than 10 counts per day, on average, but increases are evident in Kittitas, and Stevens (in the incomplete data). Cases are declining in Ferry after a recent sharp increase.

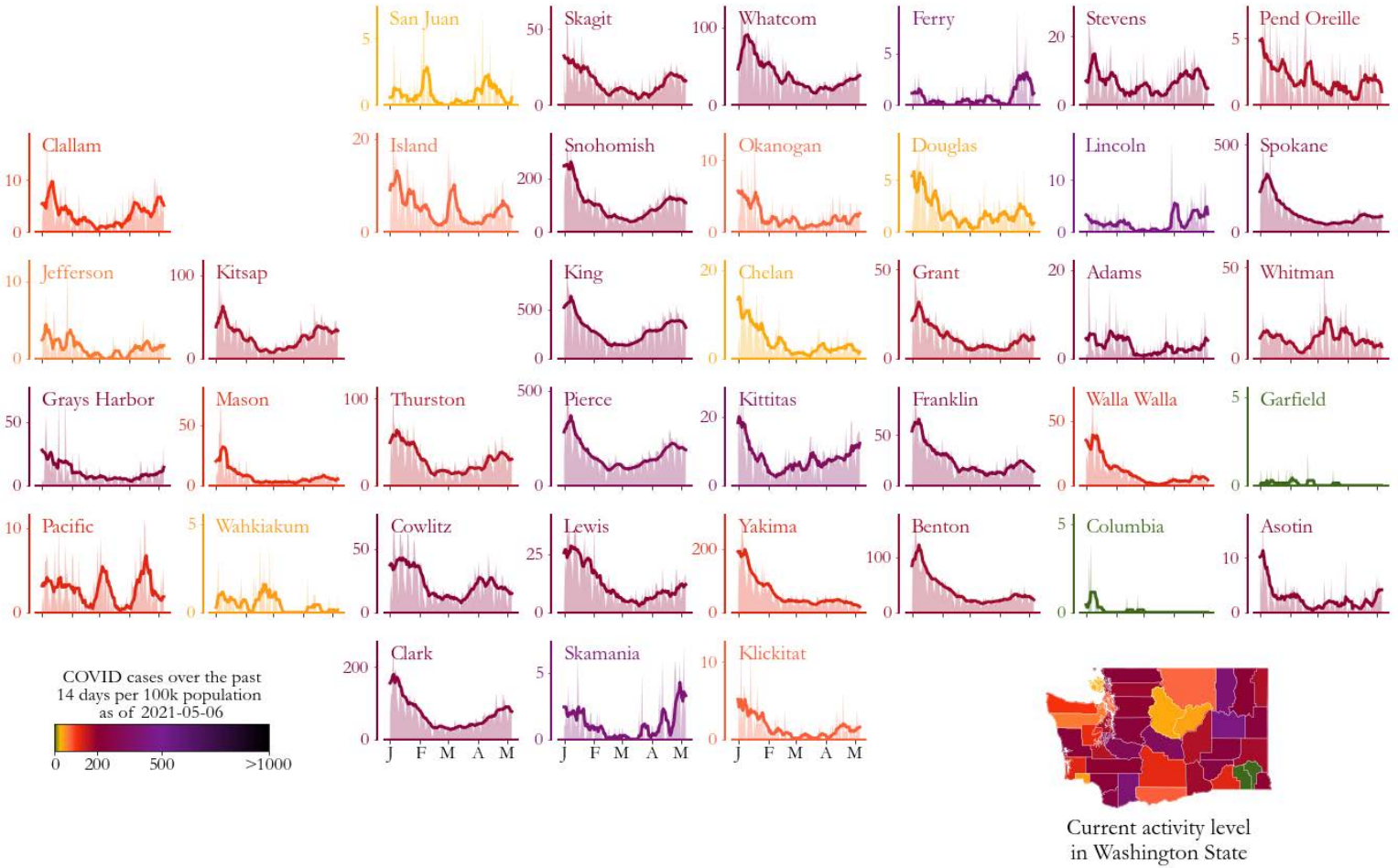

***Figure 5**: Daily COVID-19 positives (shaded areas) and 7-day moving averages (curves) arranged geographically and colored by COVID-19 activity level (total cases from April 23 to May 6 per 100,000 people). Case trends across counties highlight geographic correlations and help us better understand region-level estimates of the transmission rate (see Figure 1).*

Trends in case rates by age group

Across Washington state, the declines in case counts across age groups that began in early January (Figure 6) largely flattened from mid-February to mid-March, and then increased through mid-April. As of May 6, case rates (cases per 14-day period per 100,000 people) appear to be declining in most age groups, and flattening in children aged 0 to 9 and adults 60-69, and have remained flat in ages 70 and over. Adults aged 20-29 continue to have the highest case rates, followed by youths 10-19 and adults aged 30-39. Until mid-March, children aged 0-9 consistently had the lowest case rates, but have subsequently surpassed the rates observed in the 60-69, 70-79 and 80+ age groups.

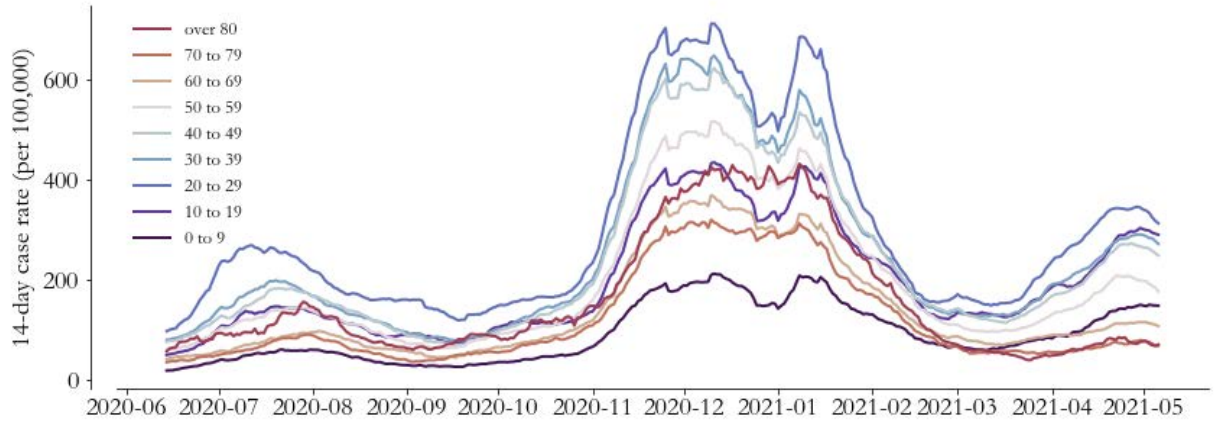

Figure 6. *14-day case rates by 10-year age group across Washington state, as of May 6, 2021.*

The top panel of Figure 7 indicates that a smaller proportion of adults aged 60 and older have tested positive since mid-February in comparison to the proportion of the population belonging to this age group. Conversely, the 20-29 year old age group now accounts for a disproportionately large fraction of cases in comparison to the population fraction for this age group. The bottom panel shows that overall testing by age has remained fairly proportional to the population age distribution, although in early May it appears that a slightly larger proportion of tests were conducted among 10-19 year olds in comparison to their population fraction.

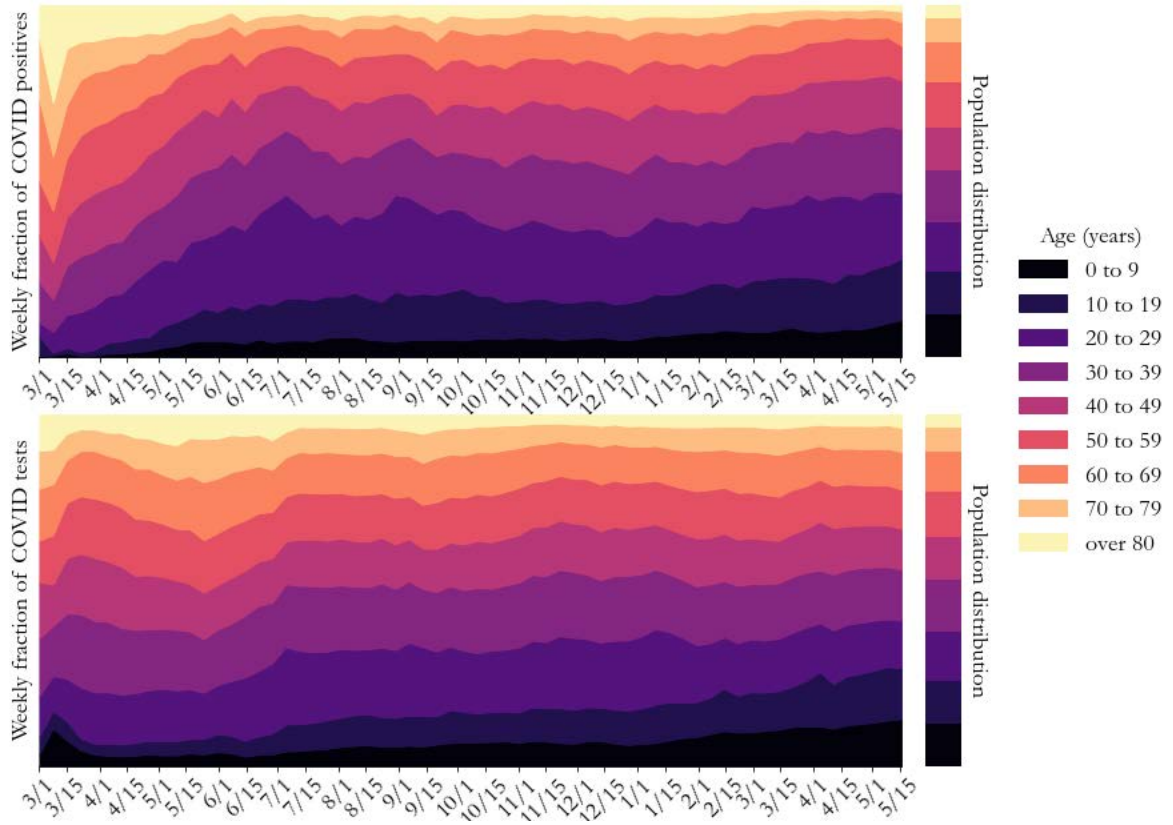

Figure 7. *The top panel of this graph shows the weekly age distribution of COVID-19 cases and the bottom panel shows the weekly age distribution of COVID-19 tests. The colors represent 10-year age groups. Early in the pandemic, populations over age 60 represented a greater fraction of total COVID-19 cases relative to their fraction of the population as a whole. Over time, the age distribution of cases has shifted towards younger individuals (shown in darker colors). In comparison, the bottom panel indicates that this trend is generally not present in the distribution of tests, which indicates that the age-distribution of the underlying infected population is changing over time.*

Trends in hospital admission rates by age group

Hospital admission rates (first hospital admissions per 14-day period per 100,000 population) across Washington state began increasing across all age groups in mid-March. These increases flattened earlier among ages 80+, in early April, but persisted in other age groups until early May. As of May 6, slight declines are evident in all groups spanning ages 20 to 79 (Figure 8). The hospital admission data shown here are from WDRS and incorporate information from both case investigation/contact tracing, as well as syndromic surveillance, and represent the most reliable source of data on first hospital admissions for COVID-19, although data are less timely than the WA Health system. More current data (not shown) from the WA Health system, which rely on daily reports by hospital facilities around the state, suggest further flattening or slight declines of total hospital admission rates (rates of first admission and readmissions) in ages 20-79 as of mid-May. In addition, these more recent data from the WA Health system show resurgent increases in the 80+ population. In combination, these two sources of information on hospital admissions suggest that flattening in admission rates across most age groups may be a sustained trend.

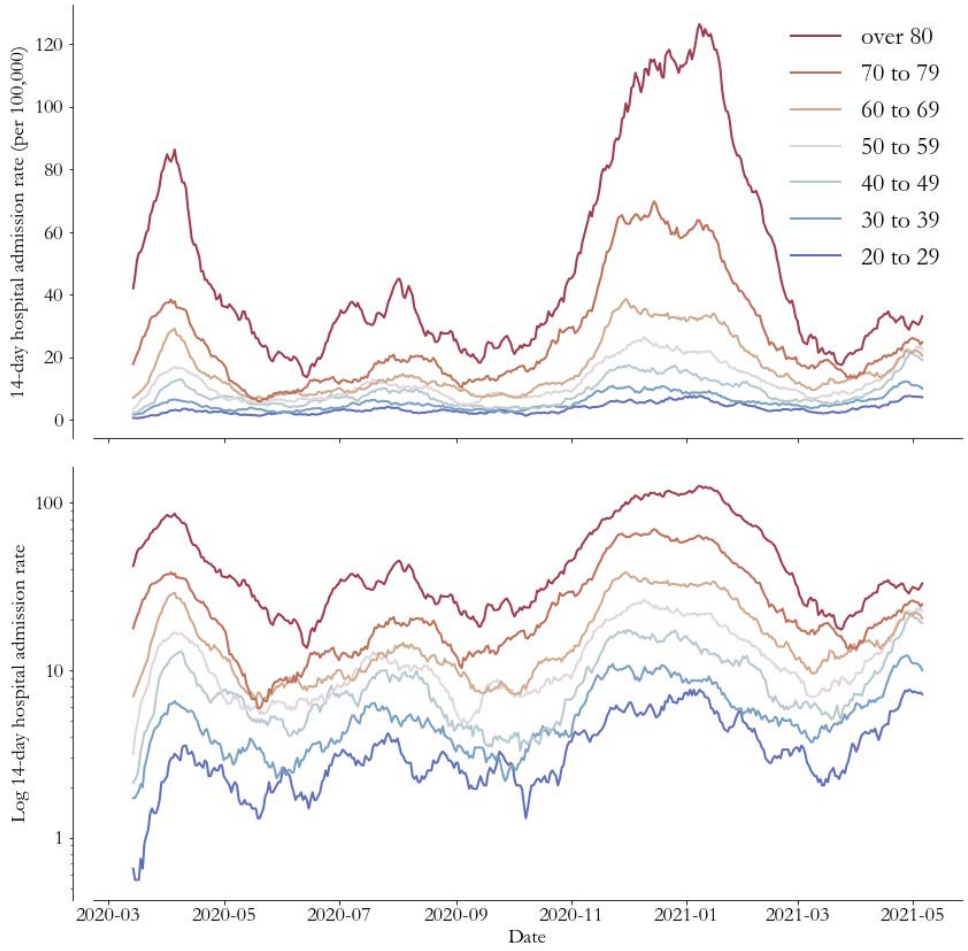

Figure 8. *Statewide 14-day hospital admission rate per 100,000 population by 10-year age group as of May 6. The top panel shows the rates on a standard numeric scale, and the bottom panel shows the rates on a log scale to be able to better compare the rate of decline between age groups that have large differences in rates.*

In order to assess the impact of vaccination on COVID-19 hospital admission rates among adults aged 45 and over, we compared two-week rates of first-time hospital admission between unvaccinated and fully-vaccinated adults in two age groups, ages 45-64 and 65+ (Figure 9). The hospital admission rate in unvaccinated individuals aged 45-64 is about 18 times higher than rates in those in this age group who are fully protected by vaccination (i.e. those who are 14 days after 2nd dose of Pfizer or Moderna vaccines, or 30 days after a Johnson & Johnson dose). The hospital admission rate in unvaccinated individuals 65 and older is approximately 11 times that in fully protected individuals in this age group. Notably, the steep increase in hospital admission rates among the unvaccinated were driving the observed increases in hospital admissions among ages 45-64 as of late April.

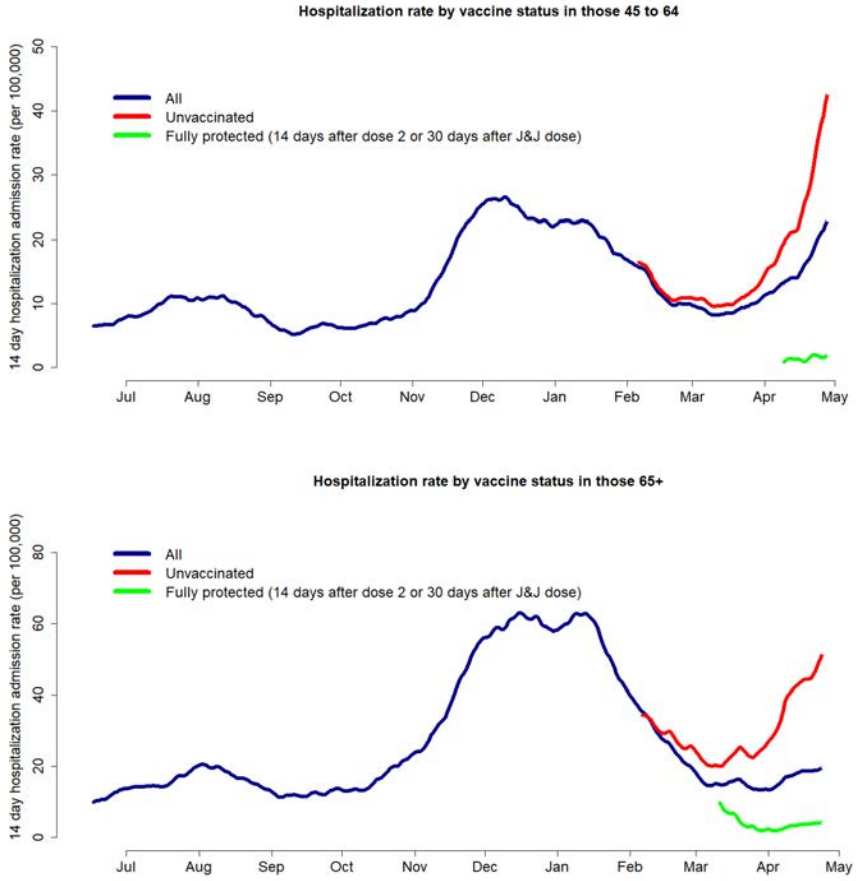

Figure 9. *Comparison of hospital admission rates between unvaccinated and fully-vaccinated adults age 45-64 (top panel) and 65 and older (bottom panel). Colors represent vaccination status, red = unvaccinated, green = those who are fully protected (14 days after 2nd dose or 30 days after J&J dose), dark blue = overall admission rate in this age group. Vaccination status of individuals hospitalized for COVID-19 is determined by linking case data reported to WDRS with vaccination data reporting the Washington State Information Immunization System. Estimates are adjusted for vaccinations that get reported directly to CDC, missed linkages and population growth.*

Hospital occupancy

Across the state, the rapid increase in the number of hospital beds occupied by confirmed or suspected COVID-19 patients that started in early November slowed substantially in early December and remained fairly flat until mid-January (Figure 10). Steady declines occurred until mid-March, after the number of beds occupied increased until early May. As of May 14, it appears that occupancy is beginning to flatten. Similarly, ICU beds occupied by confirmed or suspected COVID-19 patients increased through early December, flattened thereafter, and declined from January until mid-March, after which increases were evident until early May. Although there is some variability in the data, it appears that the number of ICU beds occupied has also flattened as of May 14.

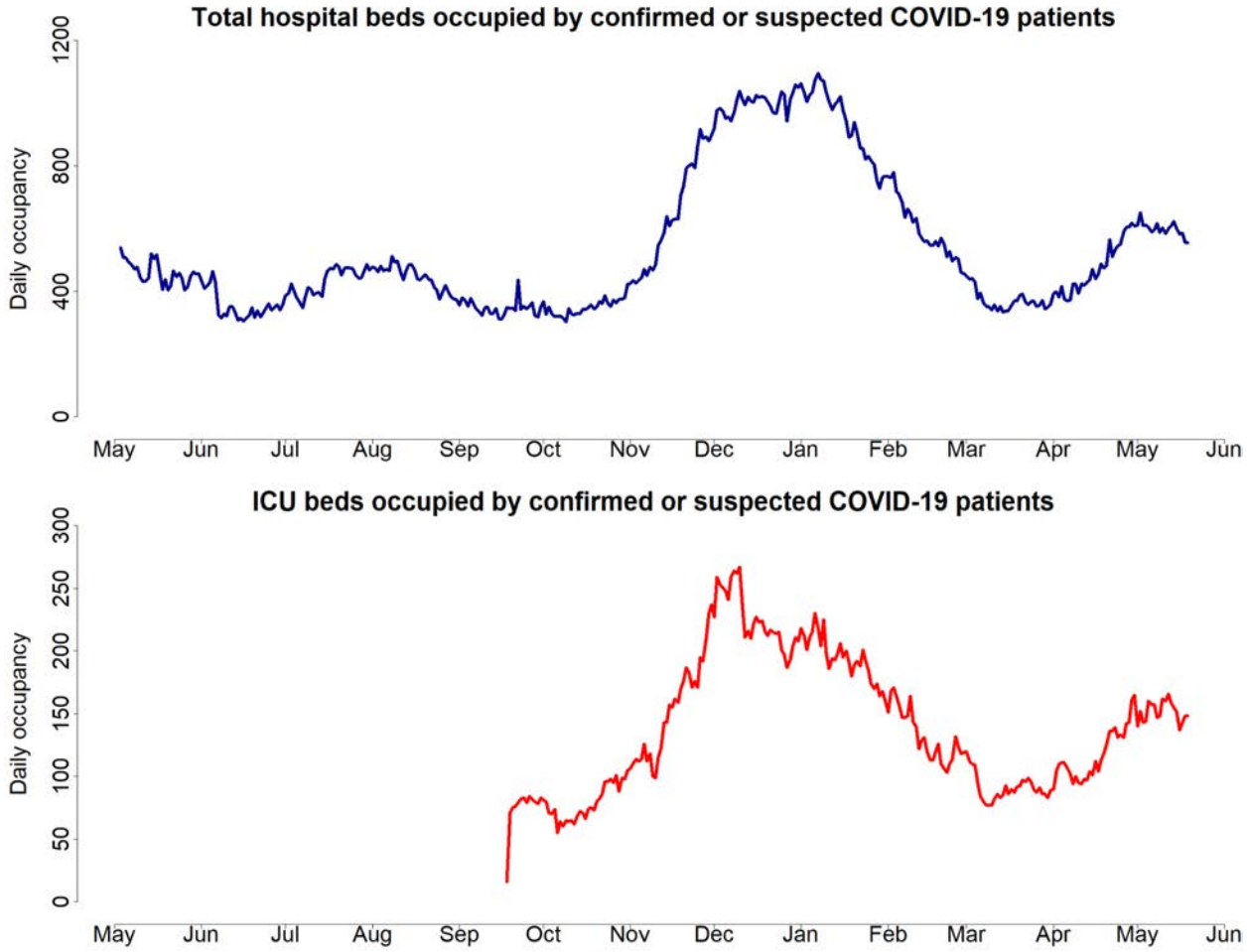

Figure 10. *Total hospital beds and ICU beds occupied by confirmed or suspected COVID-19 patients reported through the WA Health system. Data collection for ICU beds occupied by COVID-19 patients started September 17. Hospital occupancy data has minimal reporting lag, and is shown here using data up to May 14. Both confirmed and suspected cases are included, rather than just confirmed cases, since this best reflects total resources being used. Note that bed occupancy would continue to increase for a period of time even if admissions plateau since patients being treated for COVID-19 generally stay in the hospital for several days.*

Fraction of cases attributable to variants of concern

Using genetic sequence data from DOH as well as collaborating institutions on the GISAID platform, we have estimated the fraction of cases in WA that are attributable to SARS-CoV-2 variants of concern and variants of interest. Extrapolating from data available through late April, and using a multinomial generalized additive model, we estimate that in mid-May, over 80% of cases are attributable to B.1.1.7, and about 10% are due to P.1 (Figure 11), with B.1.429(7) largely outcompeted. This estimation relies on a method that only approximates a representative sample, and results in high uncertainty in these estimates. Nevertheless, this provides an informative picture of the time evolution of SARS-CoV-2 in Washington state. A full report of whole genome sequencing of SARS-CoV-2 lineages circulating in Washington state is produced weekly by DOH.

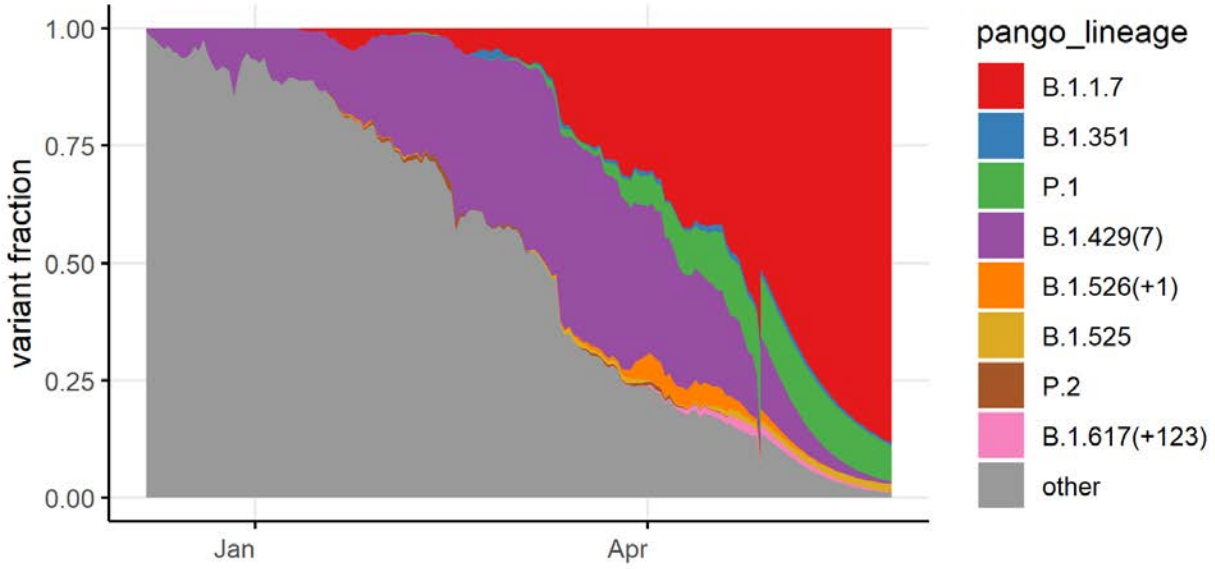

Figure 11. *Estimated fraction of cases attributable to variants of concern in Washington State. Data used in this analysis exclude sequences obtained by targeting B.1.1.7. This figure shows a seven-day running average through late April and then a multinomial growth model nowcast through mid-May. For the figure, variants of interest B.1.427 and B.1.429 have been combined as they are closely related, and similarly for B.1.526 and B.1.526.1.*

Implications for public health practice

Across Washington state, SARS-CoV-2 transmission has declined since early April although R_e remains close to one even after adjusting for population immunity. Statewide, prevalence is declining as of May 6, but remains higher than prevalence in the spring of 2020 and similar to mid-November 2020. Case counts are declining slightly statewide, and most counties are experiencing flattening or declining trends in case counts. Similarly, case rates are flattening or declining across age groups, as are hospital admission rates. Overall hospital admissions have declined sharply since late April, and we have yet to see a major increase in mortality, although deaths lag case and hospital data by several weeks and data on deaths require longer time to completion. Increases in hospital occupancy have also flattened in early May. In combination, these data suggest that trends in the state are improving, but that continued vaccination and maintenance of NPIs among the unvaccinated are necessary to prevent reversals.

Vaccination rates across Washington state have fallen from around 60,000 doses/day in early May, to slightly over 42,000 doses/day in mid-May, reflecting a decline in demand. The proportion of the population protected by vaccine-derived immunity is now nearly double the proportion protected by immunity from prior infection, showing the important role of vaccination in recent improving trends. Our recent analysis indicates that hospital admission rates among the unvaccinated population 45-64 are 18 times as high as those in the fully vaccinated population, and among the 65+ population, hospital admission rates are 11 times as high in unvaccinated persons than in vaccinated persons. These data highlight the strong protection against severe disease afforded by vaccination and provide evidence of the need for greater vaccine coverage across the state population, where 36% of people are currently fully vaccinated. After accounting for the additional time after vaccination to achieve full immunity, we estimate that currently 63% of the population remain susceptible.

Variants of Concern (VOC) continue to spread across Washington state, and currently, the B.1.1.7 and P.1 VOC comprise the greatest proportion of circulating variants in the state. The B.1.1.7 variant is more transmissible and is linked to more severe disease, but currently available vaccines are protective against it. The P.1 variant is also more transmissible, and may cause more severe disease, but currently available vaccines are less protective against P.1.

In comparison to prior surges of infection, the current surge has resulted in a greater number of cases than either the spring or summer surges of 2020 and peak prevalence in the current surge has exceeded that of the spring 2020 peak. However the peak in hospital admissions is similar to what was observed in the spring of 2020, and mortality has so far been lower than either the spring or summer waves of 2020 (although mortality lags cases and hospital admissions by several weeks). This likely indicates that vaccination is preventing many people from suffering severe disease, despite increased prevalence of variants, and provides further motivation for greater vaccine coverage statewide.

As with declines following earlier surges of infection, the reasons for the declines that we currently observe in cases and hospital admissions in Washington state remain unclear, and similar declines are being observed in many geographically diverse regions of the United States. Potential reasons may include increases in population immunity due to vaccination, possible seasonality of SARS-CoV-2 similar to that observed in other coronaviruses, or changes in population behavior in response to public awareness of surges in disease. However, none of these can be empirically verified currently. Current declining trends are promising, however, they should not be taken as signs that the pandemic is over. Continued caution and use of NPIs, as well as greater population vaccination, remain as critical as ever in order to prevent reversal of current positive trends.

Key inputs, assumptions, and limitations of the IDM modeling approach

We use a COVID-specific transmission model fit to testing and mortality data to estimate the effective reproductive number over time. The key modeling assumption is that individuals can be grouped into one of four disease states: susceptible, exposed (latent) but non-infectious, infectious, and recovered.

- For an in-depth description of our approach to estimating and its assumptions and limitations, see the most recent technical report on the modeling methods. The estimates this week and going forward use the updated method in that report, which results in some statistically-insignificant retrospective changes to relative to our previous report.
- In this situation report, we use data provided by Washington State Department of Health through the Washington Disease Reporting System (WDRS). **We use the WDRS test, hospital admission, and death data compiled on May 16, and to hedge against delays in reporting, we analyze data as recent as May 6 across the state for cases and hospital admissions, and as recent as April 26 for deaths.** This relatively conservative hedge against lags is in response to reports of increasing test delays.
- Estimates of describe average transmission rates across large regions, and **our current work does not separate case clusters associated with known super-spreading events from diffuse community transmission.**
- Results in this report come from data on testing, confirmed COVID-19 cases, and deaths (see previous WA State report for more details). Also as described previously, estimates of are based on an adjusted epi curve that accounts for changing test availability, test-positivity rates, and weekend effects, but all biases may not be accounted for.
- This report describes patterns of COVID transmission across Washington state, but it does not examine factors that may cause differences to occur. The relationships between specific causal factors and policies are topics of ongoing research and are not addressed herein.
- **Our modelling framework has been updated to take vaccination data into account.** Detailed methodological documentation is currently being prepared by the Institute for Disease Modeling. At a high level, based on observational data, our approach assumes that on average 58.0% (52% to 64% 95% CI) of those vaccinated after the first dose and an additional 24.4% after the second dose (for a total of 82.4% [95% CI: 77% to 87%) are protected from SARS-CoV-2 infection 3 weeks after each dose. Among vaccinated people not protected from SARS-CoV-2 infection, our modelling framework assumes roughly 20% to be protected from experiencing severe COVID-19 symptoms (i.e. hospitalization or death) while still able to transmit the virus. One critical limitation to note is the use of the same assumptions for all vaccines. Therefore, for this report, the single-shot Johnson & Johnson vaccine was considered equivalent to first-doses of the Pfizer or Moderna vaccines. This limitation is not expected to have a large influence on results since the Johnson and Johnson vaccines currently constitute a small proportion (less than 4%) of the total vaccine doses administered to-date in Washington state.

Collaboration notes

The Institute for Disease Modeling (IDM), Microsoft AI For Health, the University of Washington, and the Fred Hutchinson Cancer Research Center are working with WA DoH to provide support for regional modeling of case, testing, and mortality data across Washington State to infer effective reproduction numbers, prevalence, and incidence from data in the Washington Disease Reporting System. Modeling and analysis for the report are led by WA DoH and are based on models developed by IDM and advanced by Microsoft to better represent the state. The WA DoH wishes to thank IDM for their support in model development and implementation for this report, in particular, Dr. Niket Thakkar, PhD, of IDM, who developed and shared software and programming scripts and provided technical and scientific advice to

the WA DoH. This collaboration has evolved alongside the science, data systems, and analysis behind the models, and it reflects the ongoing commitment of all parties involved to improve our understanding of COVID-19 transmission and to support WA DoH in its public health mission. This collaboration and its outputs will continue to evolve as scientific frontiers and policy needs change over time.
These reports were previously published on the IDM InfoHub. Going forward, as of December, 9, 2020, new reports will be published on the DOH website. IDM will continue to provide technical assistance for the reports, as part of this collaboration.