COVID-19 transmission across Washington State

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SitRep 39: COVID-19 transmission across Washington State

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Results as of September 21, 2021.

The current Situation Report is based on complete data through September 8. 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 September 8 may have changed. To assess changes, you can review the most up to date picture of 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.

Summary of current situation

Overview: Current model results based on data through September 8 indicate that COVID-19 transmission in Washington state is increasing, with R-effective slightly above 1 as of September 2. Prevalence of COVID-19 increased sharply from early July through mid-August and more slowly since. Current prevalence exceeds the peak levels observed in the winter surge of 2020.
Cases: Since the last report, case counts continued to increase statewide before reaching a peak in late-August. They dropped over the Labor Day weekend but have since rebounded. Testing shortages have been reported across the state, and it is not known how they may be impacting case counts. Case rates remain extremely high in most counties across the state as of September 8.
Hospital admissions: Hospital admissions also continued to increase over the past month, recently peaking at a level 60% higher than winter 2020. Admission rates appear to be flattening or declining slightly, as is overall COVID-related hospital occupancy. Both admissions and occupancy remain at extremely high levels.
Variants: The B.1.617.2/delta variant maintains predominance.
Outlook: Hospitals across the state are operating at full capacity, and projections suggest that high levels of occupancy are likely to persist through the fall.
Public health action: Vaccinate to reduce COVID-19 transmission. Wear a mask in public indoor settings and crowded outdoor settings, regardless of vaccination status, and avoid crowded situations. Vaccinate against influenza to prepare for flu season. In tandem, these actions will help prevent further burden on the healthcare system.

Statewide estimates of the effective reproductive number

Using data from the Washington Disease Reporting System (WDRS) through September 8, we are reporting the effective reproductive number (R_e) as of September 2. The green line and green-shaded region shows estimates of total R_e which accounts for contributions from behavior, variants, and population immunity, either from prior infection or due to vaccination. On September 2, $R_e$was likely between 1.04 and 1.24, with a best estimate of 1.14. R_e increased sharply in early July, reflecting rapidly increasing transmission across the state due to the delta variant. The drop in R_e starting the end of July could reflect increases in preventive behaviors, such as masking, as people became more aware of the delta surge. The recent increase in R_e above one in early September could reflect actual increases in transmission, or could result from increases in health-seeking behaviors such as testing and hospital admission after the Labor Day holiday. To reduce levels of cases and hospitalizations, total R_e needs to maintain a value substantially below 1 for a sustained period of time. Achieving this will require a combination of a high level of vaccination and widespread adoption of behaviors that reduce exposure and transmission including wearing masks in public indoor settings and crowded outdoor settings, or avoiding crowded settings altogether, regardless of vaccination status.

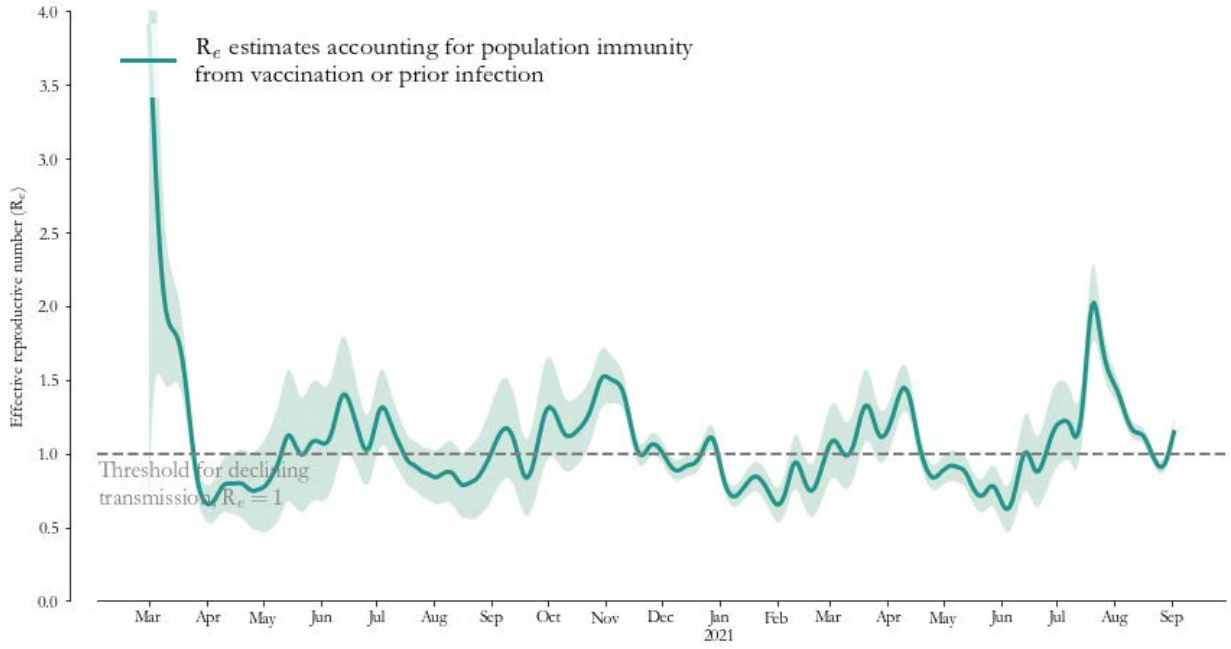

***Figure 1**: R_e estimates for Washington state. The green line and green-shaded region depict the "total" R_e, which accounts for behavior, variants, and population immunity.*

Model-based statewide prevalence

On September 8 , overall prevalence (the percentage of Washington state residents with active COVID-19 infection) in Washington state was likely between 0.52% and 1.42%, with a best estimate of 0.94% (Figure 2). This translates to 1 in 106 WA residents currently estimated to have an active COVID-19 infection (symptomatic and asymptomatic). Prevalence increased sharply through July, exceeding levels during the third wave of infection in the winter of 2020. A slight dip in prevalence occured in late August, but it rebounded in early September.

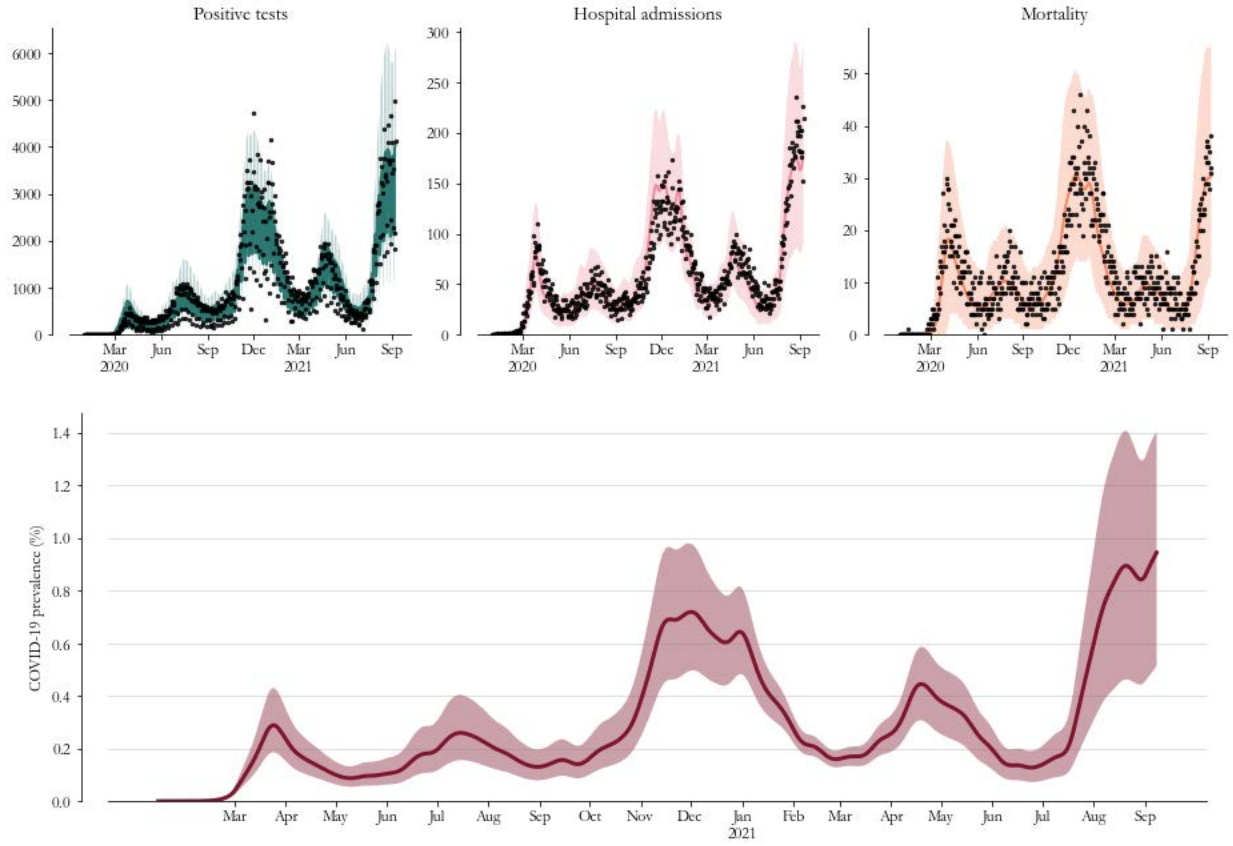

Figure 2*: Model-based prevalence estimates (bottom, 95% CI shaded) and model fit to cases (top left), hospitalizations (top middle) and deaths (top right) for Washington state. Prevalence is the percentage of Washington state residents with active COVID-19 infection.*

Model-based statewide immunity

On September 8, we estimate that overall population immunity to SARS-CoV-2 in Washington state was between 59.0% and 62.6% with a best estimate of 60.6% (Figure 3). Immunity derived from prior infection was around 19.7% (95% uncertainty interval: 18.3% to 21.2%), and additional immunity derived from vaccination was around 40.9% (95% uncertainty interval: 39.4% to 42.3%). Overall immunity has increased more rapidly since August, reflecting increases in immunity from prior infection due to the delta surge.

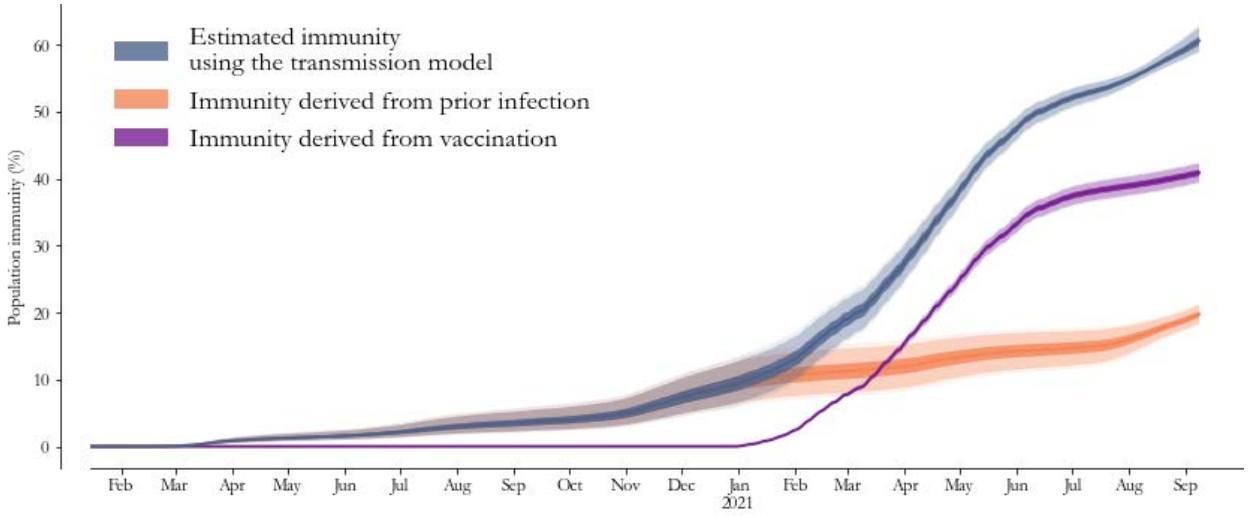

Figure 3*: Model-based estimates of population-level immunity to SARS-CoV-2 infection as of September 8. Overall population immunity is indicated in the blue line and shaded area. The percent of the population deriving immunity from prior infection, is shown in orange. Individuals who acquire immunity from both infection and vaccination are counted in the immunity from prior infection estimate. The additional percent of the population deriving immunity only from vaccination at least 14 days prior is shown in purple. 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.*

Trends in cases, hospital admissions, and deaths

Case counts have increased sharply since early July. The seven-day rolling average case count declined from a peak of 2941 on January 8 to 744 cases per day as of February 15, remained at that level for a month, increased to 1519 cases per day as of April 23, declined to 375 as of July 3 and increased to a peak of 3476 as of August 31. Cases have since declined to 3195 as of Sept 8**.** (Figure 4)

Hospital admissions also started increasing in early July and far exceeded admission levels at the peak of the winter surge of 2020. The seven-day rolling average of hospital admissions declined from a peak of 116 on January 6 to 31 as of March 6, flattened near that level until late March, increased to a peak of 84 as of April 27, declined to a low of 29 as of June 16, and flattened at around 30 through July 8. Admissions increased to 190 as of Aug 27, and have since declined slightly to 186 as of Sept. 8.

Deaths began increasing sharply in early August. The seven-day rolling average of deaths declined from a peak of 32 on January 10 to 5 as of March 23, and varied between 5 and 10 deaths per day through late July. Deaths increased rapidly in August, reaching 27 per day as of August 28 (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).

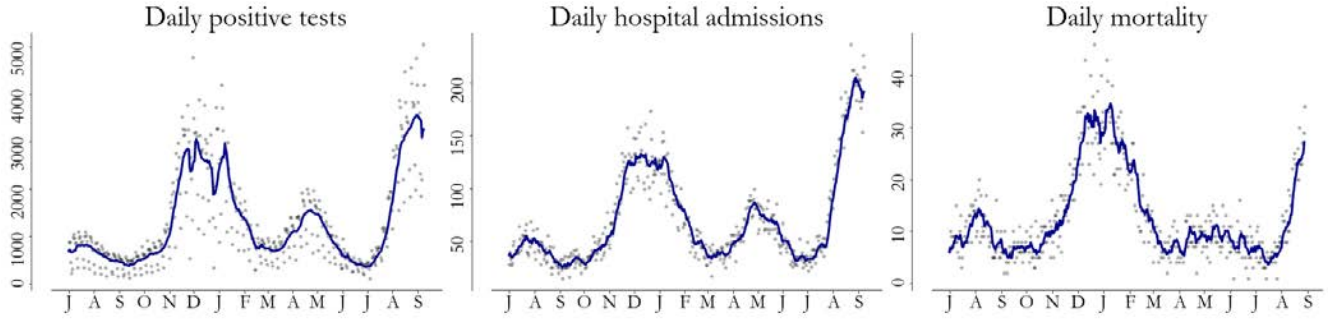

Figure 4*: Seven-day rolling case counts (left panel), hospital admissions (middle panel) and deaths (right panel) for Washington from July 2020 through September 8 (cases and hospitalizations) and August 28 (deaths) 2021. Because of how confirmed deaths are being reported, we are using an earlier cutoff for data on daily mortality.*

County-level trends

Case counts (Figure 5a): County-level case counts as of Sept 8:

- Case counts in the five largest counties (Clark, King, Pierce, Snohomish, Spokane) remain at levels exceeding their winter 2020 peak, but show recent flattening or declines.
- Among middle-sized counties, cases are also at or above prior peaks. Thurston is seeing increases in counts. Grant, Cowlitz, Skagit, Benton, Yakima, and Kitsap show flattening in counts. Franklin and Whatcom show declining counts.
- Among small counties, counts are increasing in Stevens, Grays Harbor, Lincoln, and Pacific. Counts are flattening in Douglas, Kittitas, Whitman, Walla Walla, Mason, and Island. Counts are declining in Okanogan, Clallam, Lewis, Pend Oreille, Jefferson, and Klickitat. All other small counties have fewer than 10 cases per day.
- Testing shortages have been reported from across the state, and it is unclear to what extent they may be playing a role in the flattening or declining case counts observed in some counties.

Case rates (Figure 5b): Figure 5 b shows the large increase in county-specific case rates across the state for the 2-week period ending on Sept 8 compared to the 2-week period ending on August 6. For the

period ending on Sept 8:

- 32 (the majority of) counties had rates above 500 per 100,000. 16 of those had rates over 1,000 per 100,000. No counties had 14 day rates below 100 per 100,000 people.

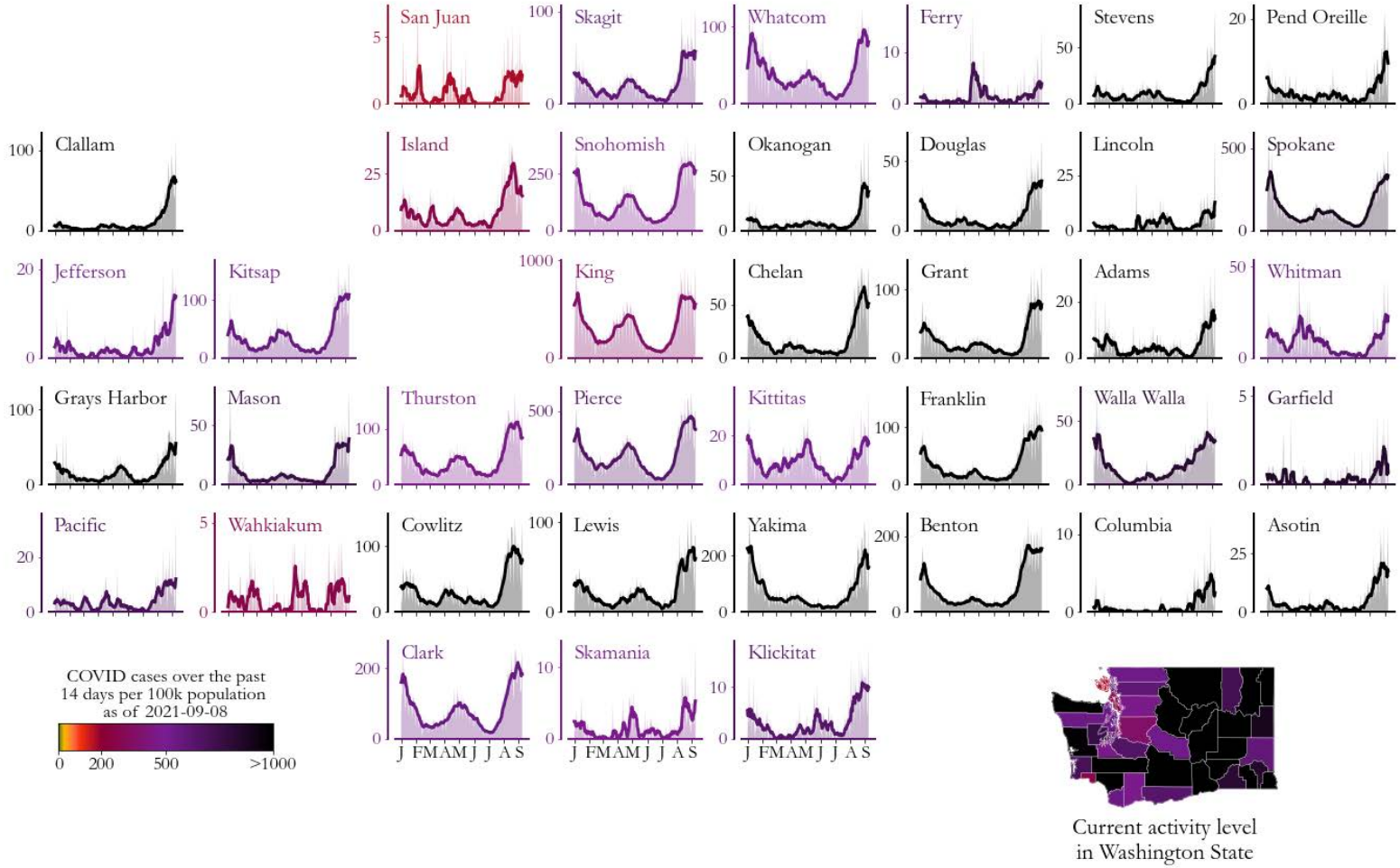

***Figure 5a**: Daily COVID-19 positives (shaded areas) and 7-day moving averages (curves) arranged geographically and colored by COVID-19 activity level (total cases from August 26 to September 8 per 100,000 people). Case trends across counties highlight geographic correlations and help us better understand region-level estimates of the transmission rate (see Figure 1).*

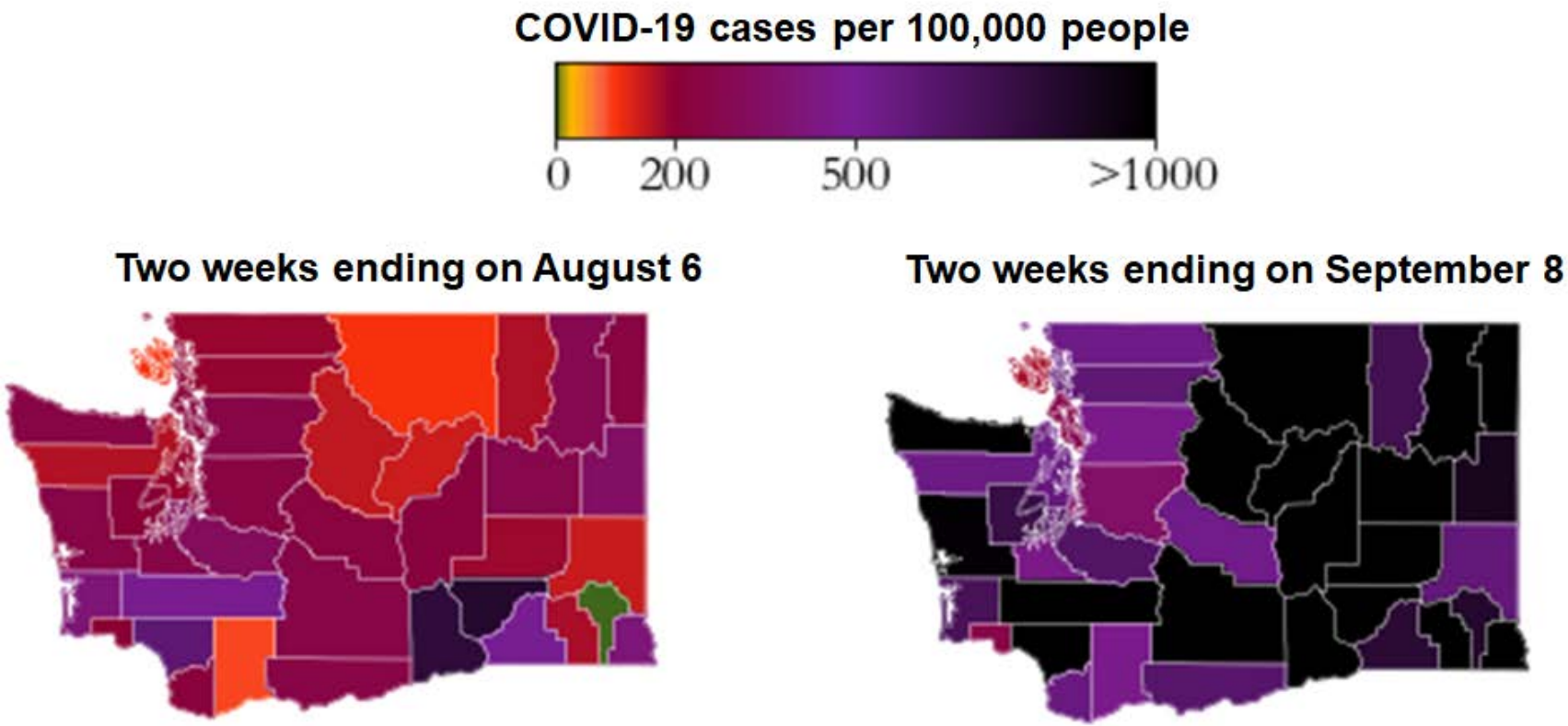

***Figure 5b**: 14-day COVID-19 case rates (cases per 100,000 people) by county over two time periods, the two-week period ending on August 6 (left), and the two-week period ending on September 8 (right).*

Trends in case rates by age group

Across Washington state, 14-day case rates (cases per 14-day period per 100,000 people) increased sharply in all age groups from early July through mid-August (Figure 6). As of September 8, case rates in many age groups show a dip and rebound related to the Labor Day holiday. The rebounds appear sharper in the 0-9 and 10-19 age groups (shown in the lower panel for improved visibility) than in the 20-69 population.

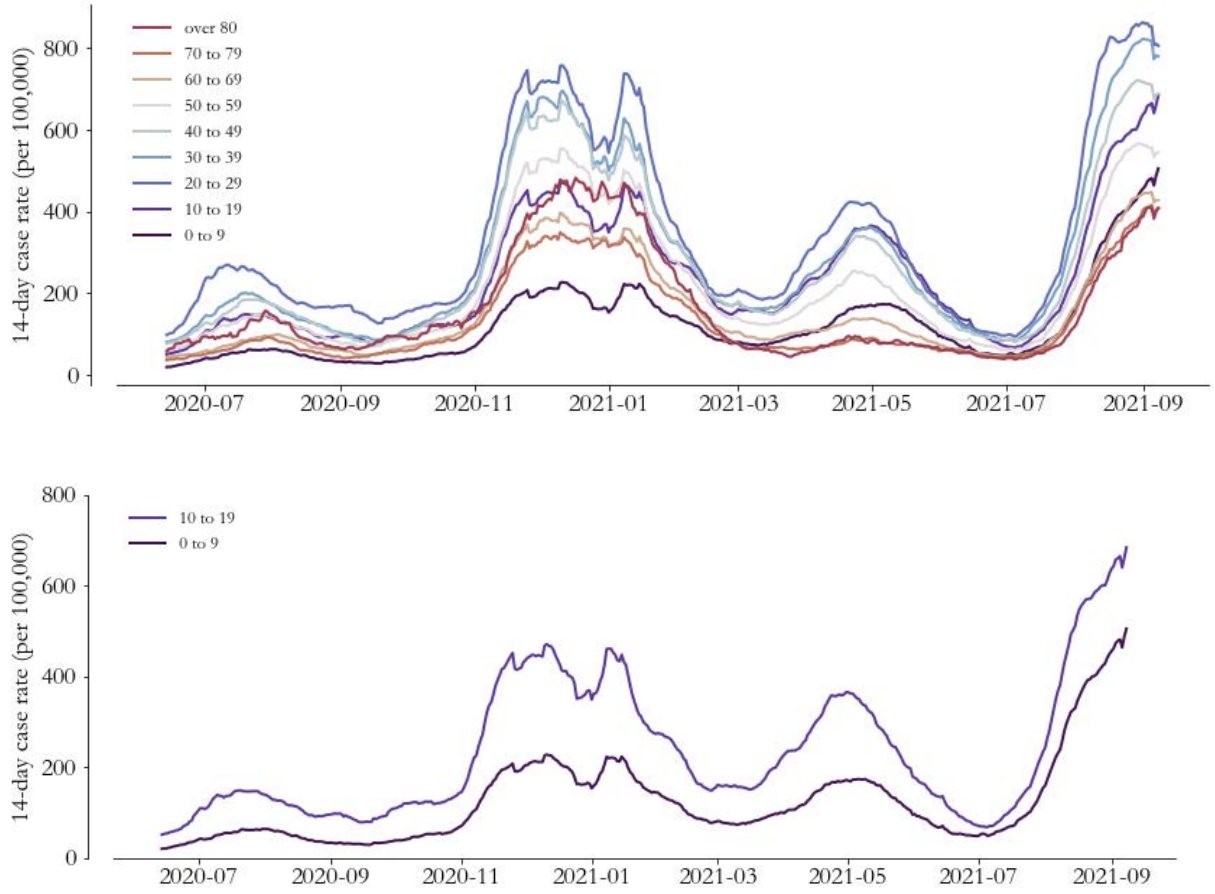

Figure 6. *14-day case rates by 10-year age group across Washington state, as of September 8, 2021. The upper panel shows rates by 10-year age group for all ages 0-80+. The bottom panel shows the rates separately for the 0-19 population.*

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 in early July. As of September 8, admission rates show a dip around Labor Day, and then a rebound in ages 70+, and flattening or slight declines in other adult age groups (Figure 7). Admission rates for ages 0-19 remain low.

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, show declines in hospital admissions in all adult age groups as of September 18, although rates remain high.

Vaccination continues to protect many Washington residents from serious illness. Hospital admission rates remain at least 9 times higher among the unvaccinated than among the fully vaccinated across age groups (for further details see the full DOH report on cases, hospitalizations, and deaths by vaccination status).

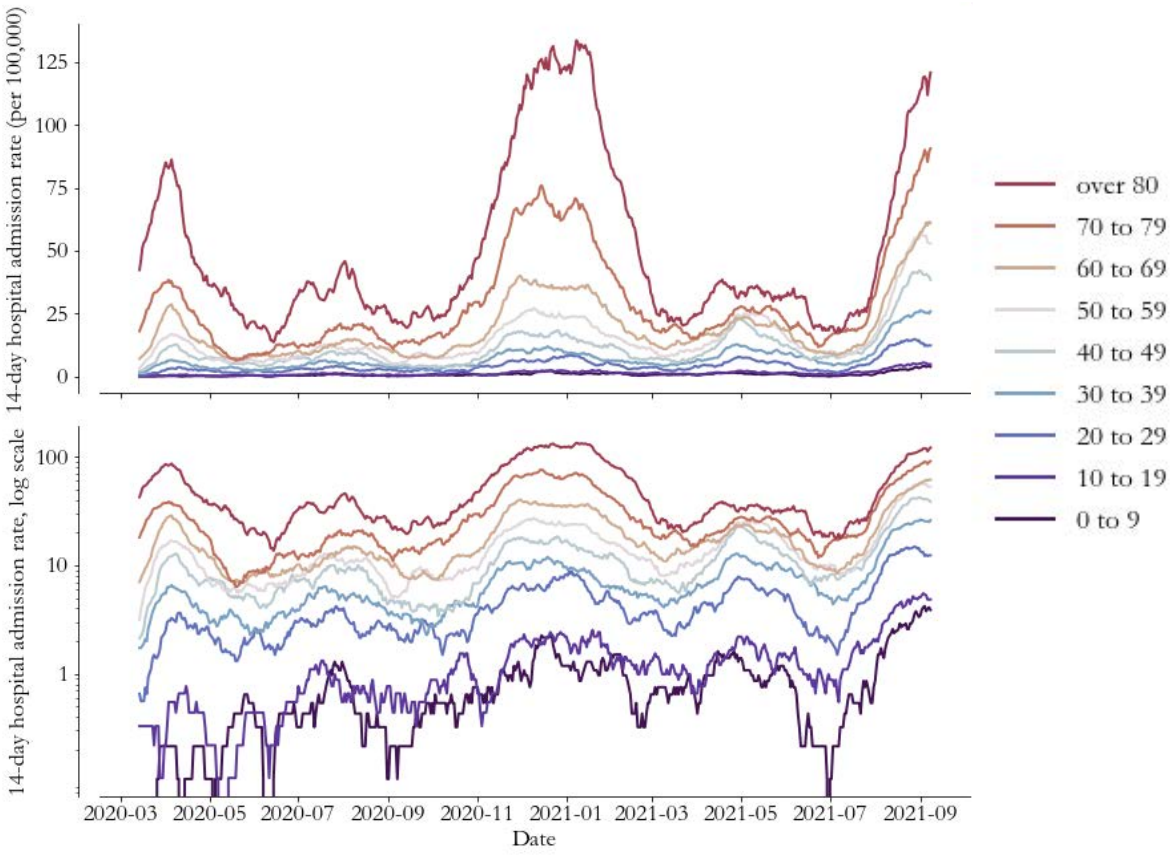

Figure 7. *Statewide 14-day hospital admission rate per 100,000 population by 10-year age group as of September 8. The top panel shows the rates on a standard numeric scale, and the bottom panel shows the rates on a log scale to be able to better compare the rate of decline between age groups that have large differences in rates.*

Hospital occupancy

Across the state, the number of total hospital beds (Figure 8, top panel) and ICU beds (Figure 8, bottom panel) occupied by confirmed or suspected COVID-19 patients increased sharply starting in mid-July. Although some recent declines are apparent as of September 18, current occupancy levels still far exceed those observed during the peak of the third wave of infection in winter 2020.

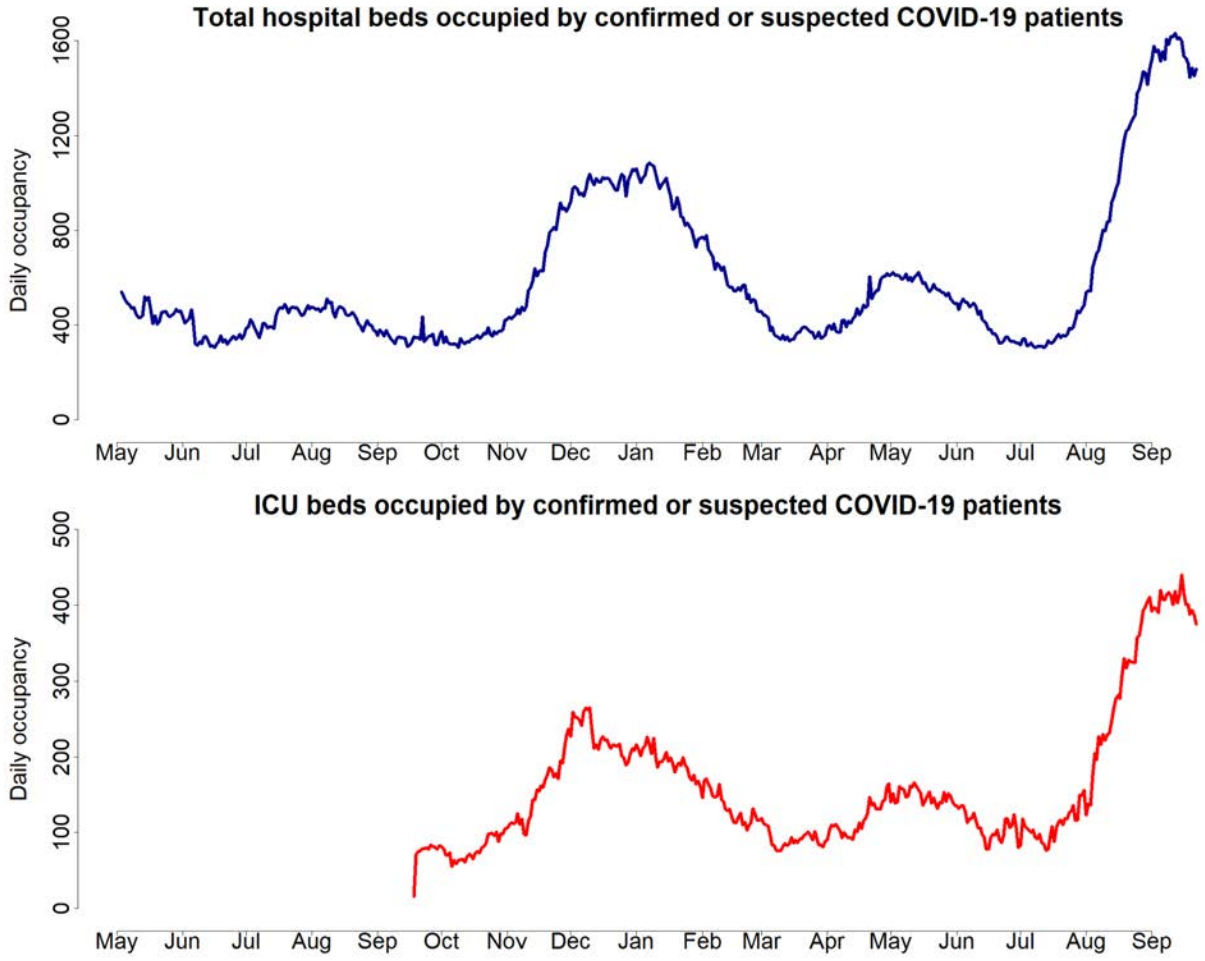

Figure 8. *Total hospital beds and ICU beds occupied by confirmed or suspected COVID-19 patients reported through the WA Health system. Data collection for ICU beds occupied by COVID-19 patients started September 17, 2020. Hospital occupancy data has minimal reporting lag, and is shown here using data up to September 18, 2021. Both confirmed and suspected cases are included, rather than just confirmed cases, since this best reflects total resources being used. Note that bed occupancy will increase faster than admissions since patients being treated for COVID-19 generally stay in the hospital for several days.*

Hospital admission projections

We have projected hospital admissions and occupancy through the end of December under two scenarios. The first scenario assumes transmission stays constant over the next two weeks at an R_e value of 0.9, followed by a modest increase in transmission through December. The second scenario assumes a moderate increase in transmission through December, increasing at twice the rate of the first scenario. While vaccination provides much more protection this fall and winter compared to last year, exposure to COVID-19 and disease transmission continues to be influenced by our behavior. Potential increases in transmission could result from the combined effects of relaxations in NPI behavior, increased travel and holiday gatherings, increasing time spent indoors with people outside one's household, other seasonal related effects and school related transmission.

Under the first scenario we project that hospital admissions will continue to decrease through December, with the rate of decrease leveling off by the end of December at between 24 and 40 admissions per day (Figure 9), a level similar to the low points seen after prior waves. Under the second scenario the decrease in admissions levels out in mid-November, followed by increases through the end of December, reaching between 141 and 240 admissions per day at the end of December. Considerable uncertainty is inherent in both scenarios, and we have little data which we can use to estimate whether increases in transmission are more likely to be modest or moderate, yet they provide some insight into potential future burdens on the health system.

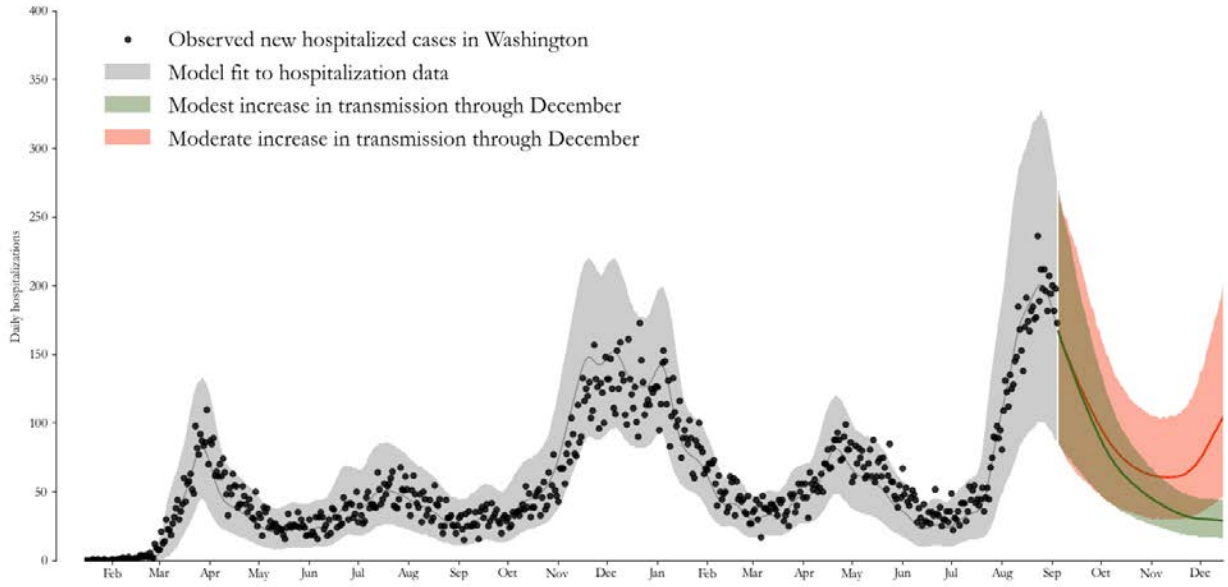

Figure 9. *Projections of hospital admissions based on two transmission scenarios, a scenario with modest increases in transmission (green line and shaded area), and a scenario with a moderate increase in transmission (red line and shaded area).*

Hospital occupancy projections

We used the hospital admission projections described above to project hospital beds occupied under the two scenarios. The modest increase in transmission scenario projects a slow decrease in beds occupied by COVID patients through the end of December, reaching between 650 and 750 beds occupied per day. The moderate increase in transmission scenario results in a slow decrease in occupancy through early November, followed by increases through the end of the year, reaching between 1100 and 2000 beds occupied per day (Figure 10). Although the number of beds occupied by COVID patients is projected to fall in both scenarios through November, overall capacity will remain tight due to a build up of delayed care and as staffing shortages continue. Seasonal increases in hospital admissions related to other respiratory viruses including influenza will likely further increase occupancy.

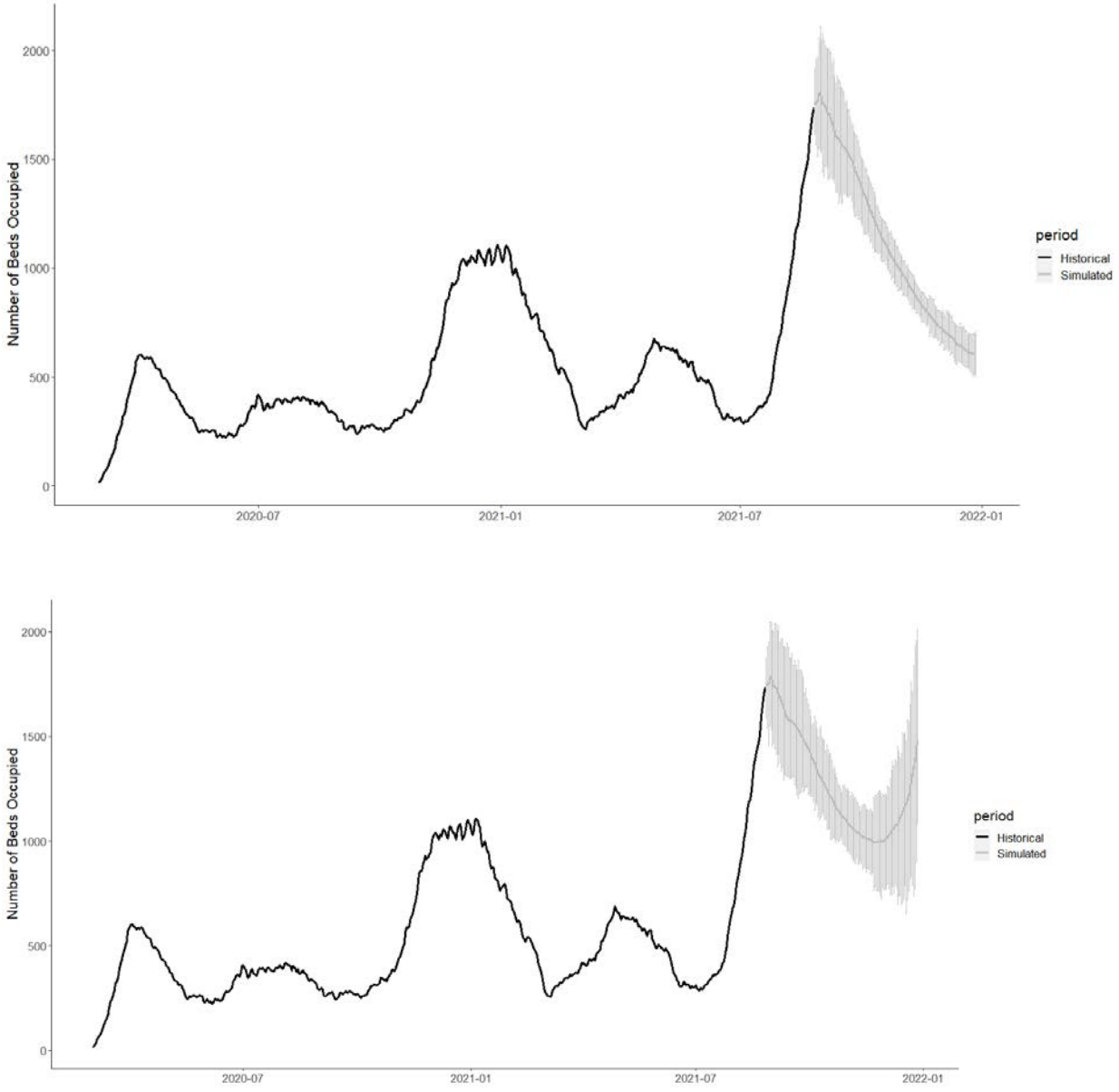

Figure 10. *Projections of hospital occupancy based on two transmission scenarios, one based on a modest increase in transmission (upper panel), and the other based on a moderate increase in transmission (lower panel).*

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 August 28, and using a multinomial generalized additive model, we estimate that as of September 20, nearly 100% of cases are due to the delta variant (B.1.617.2 and AY.1-33 sublineages) (Figure 11). Applying these estimates to the total number of cases, including those not sequenced, reveals that the number of cases of B.1.617.2/delta increased exponentially through late July, but may be plateauing slightly in early September, given that it has reached predominance. There is considerable uncertainty in these projected estimates due to the use of a method that only approximates a representative sample. Despite uncertainty in these estimates, they provide an informative picture of the evolution of SARS-CoV-2 variant strains in Washington state. A full report of whole genome sequencing of SARS-CoV-2 lineages circulating in Washington state is produced weekly by DOH.

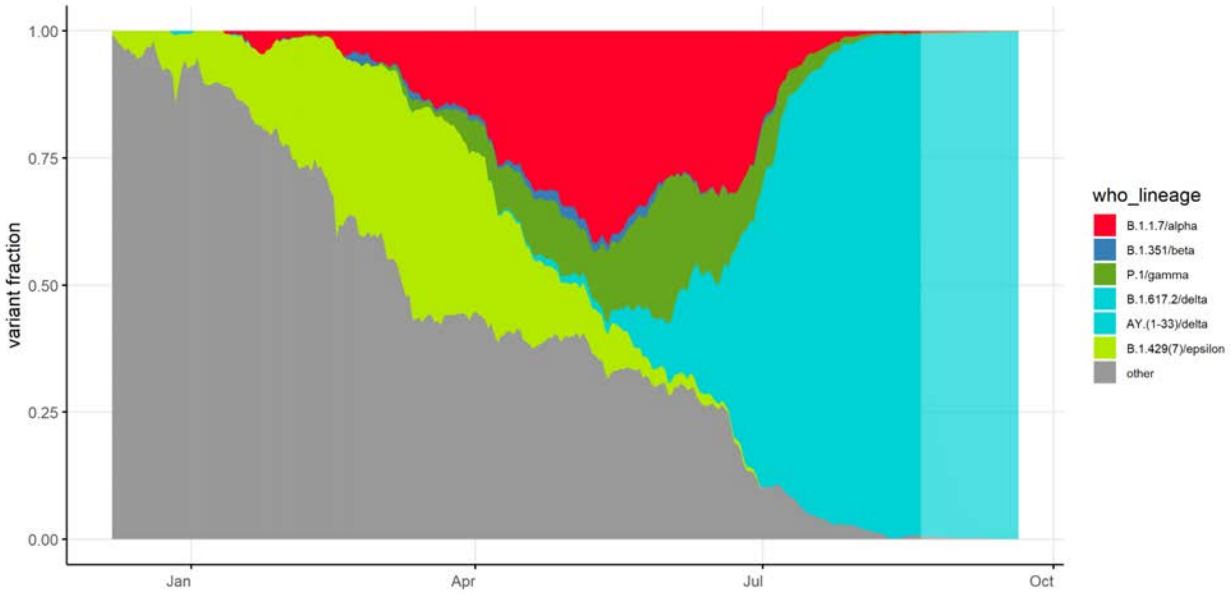

Figure 11. *Estimated fraction of cases attributable to variants of concern in Washington State. Data used in this analysis exclude sequences obtained by targeting B.1.1.7/alpha. This figure shows a seven-day running average through August 28 (darker colors) and then a multinomial growth model nowcast through September 20 (lighter colors). For the figure, variants of interest B.1.427 and B.1.429/epsilon have been combined as they are closely related. To assist with public discussions of variants, WHO proposed using labels consisting of the Greek alphabet, i.e. alpha, beta, gamma, as a practical way to discuss variants by non-scientific audiences.*

Implications for public health practice

Across Washington state, SARS-CoV-2 transmission increased exponentially over July corresponding to increasing predominance of the delta variant. Subsequently, R_e declined through August, likely due to increases in protective population behaviors such as masking. R_e has increased above one again as of early September, potentially reflecting increases in health-seeking behavior after Labor Day. It remains to be seen if the increasing trend in R_e will be sustained. Prevalence increased sharply through mid-August and while it has flattened recently, current prevalence levels exceed peak prevalence in the winter of 2020. Cases and hospital admissions, while lower than peaks at the end of August, remain very high and concerning. Increases in overall beds occupied by confirmed or suspected COVID-19 patients as well as ICU beds occupied by COVID-19 patients similarly increased sharply in August, exceeding peak levels in the winter of 2020. Although a slight downturn in COVID-related hospital occupancy is evident in mid-September, levels remain extremely high, and hospitals across the state continue to operate at capacity.

The B.1.617.2/delta variant has become the predominant Variant of Concern (VOC) in Washington state, with close to 100% of cases attributable to this variant since mid-August. Current levels of population immunity are not sufficiently high to overcome this increased transmissibility of B.1.617.2/delta, which resulted in sharp increases in cases and hospital admissions across the state through mid-August, primarily among the unvaccinated. Vaccines continue to afford strong protection against severe disease, reducing strain on an already stretched health care system.

The near-term outlook suggests that we are likely to see continued high levels of cases and hospital admissions, with increasing deaths, given that R_e remains close to 1. The impact of school reopening on community transmission is still uncertain, although there has been some indication of recent increases in case rates among school-aged children, particularly in Eastern Washington. The mid-to-long-term trajectory of both hospital admission projection scenarios presented above is being driven by the relative effects of increasing population-level immunity from infection and vaccination and increasing transmission. A modest increase in transmission is not projected to be sufficient to counteract the increases in population immunity that will occur. However a moderate increase in transmission would be sufficient. Such an increase would result in increasing hospital admissions especially among the estimated 39% of the population susceptible to infection.

Hospitals across the state continue to function at extremely high occupancy, near capacity, due to continued high volumes of COVID-19 cases and staffing shortages. This is impacting patients' ability to obtain timely care for other conditions, including cancer treatment. Increased population vaccine uptake is critical to reducing transmission, but the impacts on healthcare services will not be seen immediately. To reduce transmission and burdens on the health care system in the short term it is critical to resume use of NPIs, particularly masking in public indoor settings and crowded outdoor settings, regardless of vaccination status. Avoiding crowded events such as sporting events, concerts, and fairs, as well as large parties and celebrations is also an important means of reducing transmission. Additionally, promoting vaccination against influenza is critical given the likelihood of a severe flu season this fall. In tandem, these measures can help to prevent further pressure on the healthcare system across the state. Given the likelihood that high levels of occupancy will persist through the fall, compounded by flu season and

resumption of care for other conditions that may have been delayed by the current surge, any measures that can be taken to reduce transmission from now through the end of the year are warranted.

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 R_e 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 R_e 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 September 17, and to hedge against delays in reporting, we analyze data as recent as September 8 across the state for cases and hospital admissions, and as recent as August 28 for deaths.** This relatively conservative hedge against lags is in response to reports of increasing test delays.
- Estimates of R_e 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 R_e 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% (95% CI: 52% to 64%) 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 14 days 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, and Dr. Mike Famulare, 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.