

SitRep 15: COVID-19 transmission across Washington State

Ian Painter¹, Grace Huynh², Juan M. Lavista Ferres², Ruth Etzioni³, Barbra A. Richardson^{3,4}, Niket Thakkar⁵, and Mike Famulare⁵

¹Washington State Department of Health; ²Microsoft AI For Health; ³Fred Hutch Cancer Center; ⁴University of Washington;

⁵Institute for Disease Modeling

Results as of September 8th 2020.

This week we are updating the format of the report to include more detail on the current situation around Washington State. We will continue to highlight situations that we think warrant special attention. 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

Using data from the [Washington Disease Reporting System](#) (WDRS) through August 28 we estimate the effective reproductive number (R_e) in western Washington is likely between 0.42 and 1.29, with a best estimate of 0.86. We estimate that in eastern WA, R_e was likely between 0.87 and 1.57 on August 23, with a best estimate of 1.22. Recent increases in R_e in eastern Washington are driven in part by increases in cases in Whitman county, we estimate R_e for eastern Washington excluding Whitman county was likely between 0.69 and 1.43 with a best estimate of 1.06.

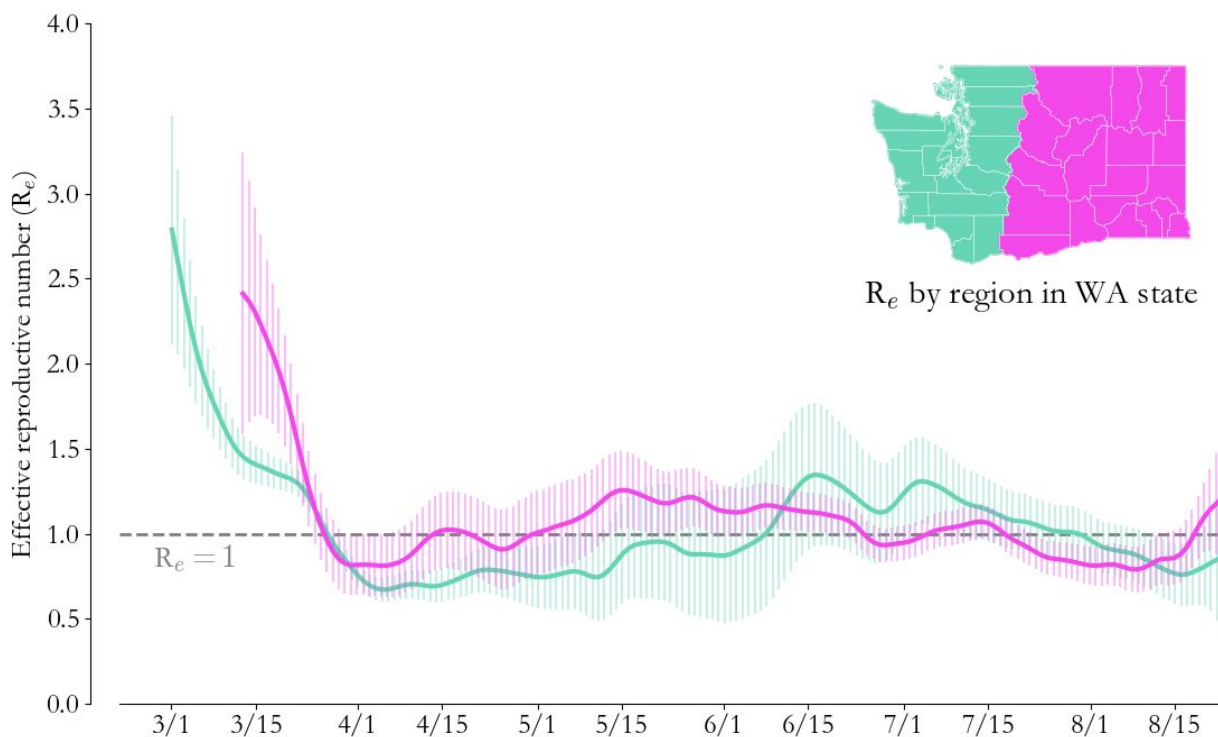


Figure 1: R_e estimates for eastern (pink) and western (green) WA, with 2 standard deviation error bars. Our most recent estimates suggest that R_e is likely above 1 in eastern WA as of August 23, and slightly below 1 in western WA. For details on how these estimates are generated, see our [technical report](#).

Details

Case counts in both eastern and western Washington have declined substantially since the start of August. These decreases are occurring across all age groups. Hospitalizations and deaths, which generally lag trends in cases are also starting to show substantial decreases. Case counts in individual counties have generally followed these same trends, especially in areas that were previously hotspots. Yakima county has continued to see steep declines in case counts and test positive rates.

The notable exception to decreasing trends is Whitman County, which has seen a sharp spike in cases starting August 19, almost entirely among individuals ages 18-23. While many of these cases are linked to the return of students to WSU, this outbreak also has the potential to drive cases into the general population. There is also some preliminary indication that the recent decrease in case counts in the combined Benton/Franklin counties region has slowed or even stopped.

Despite the similar reductions in case counts and values for R_e between eastern and western Washington, per capita cases and test positive rates remain substantially higher in eastern Washington.

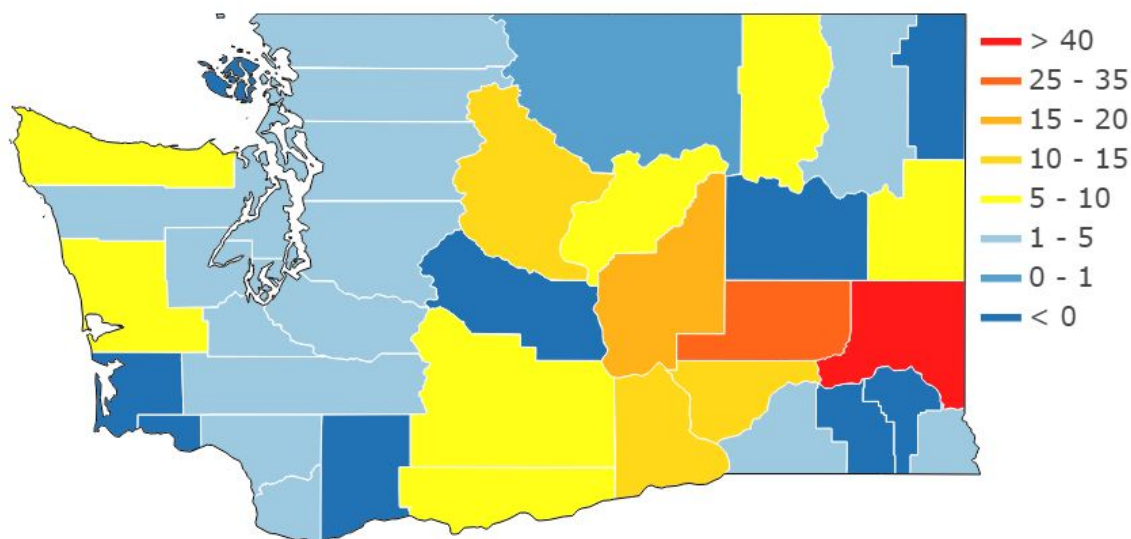


Figure 2. Test positive rates (percentage of COVID-19 tests which are positive) for the 7 days ending August 28. Test positive rates in eastern Washington as a whole remain higher than in western Washington.

Implications for public health practice

It is encouraging to observe that the overall trend in case counts is declining, with R_e levels as low as that seen in early April, when mobility and economic mobility was much reduced. This suggests that individual behaviors such as mask wearing, limited gathering size, and keeping physical distance are offsetting the recent increases in social and economic activity compared to early in the pandemic. However, given the lack of population immunity to COVID-19, we note that the risk remains high of new outbreaks sparking larger increases in case counts across the general population. The risk of super spreading that may arise where social distancing and mask use compliance is low remains a concern, and the situation in Whitman county illustrates how rapidly the number of cases can increase as a result.

County level data shows that cases are declining in the majority of counties. One notable exception is Whitman county which shows a sharp increase in cases associated with the recent outbreak among WSU students.

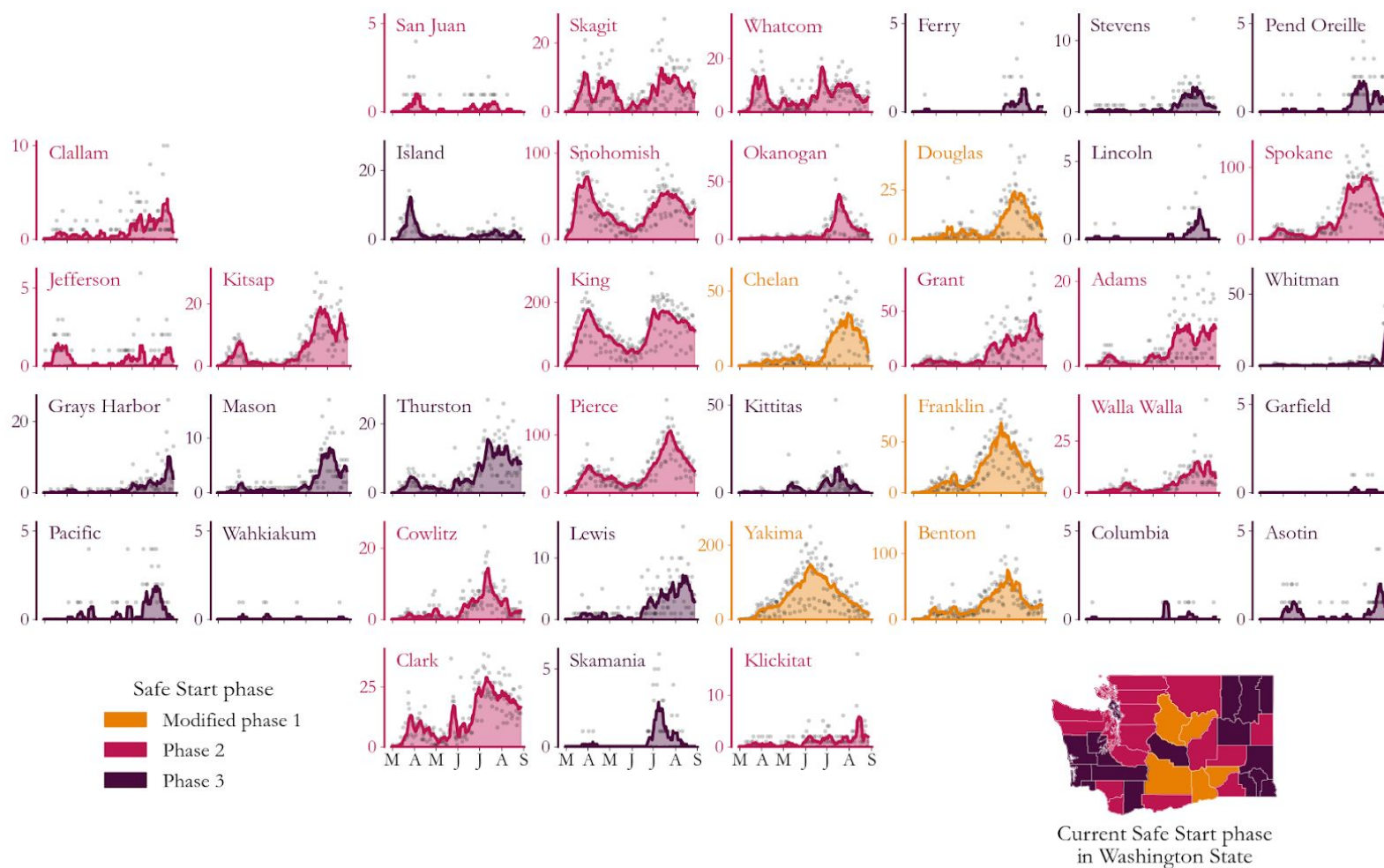


Figure 3: Daily COVID-19 positives (dots) and 7-day moving averages (curves) arranged geographically and colored by [Safe Start phase](#) as of August 28. Case trends across counties highlight geographic correlations, and help us better understand region-level estimates of the transmission rate (see Figure 1). This week, we see decreasing case counts in the majority of counties with the notable exception of Whitman county. We also see the potential beginnings of rises in Benton and Franklin counties and in Snohomish county.

Case (daily positive tests), hospitalization, and mortality data for King county, Yakima county, and the combined Benton/Franklin counties region illustrate differences in patterns of declines. In particular, while both Yakima and the Tri-Cities area experienced large outbreaks in June and July, subsequent declines have continued through August in Yakima while they have stagnated in Benton and Franklin.

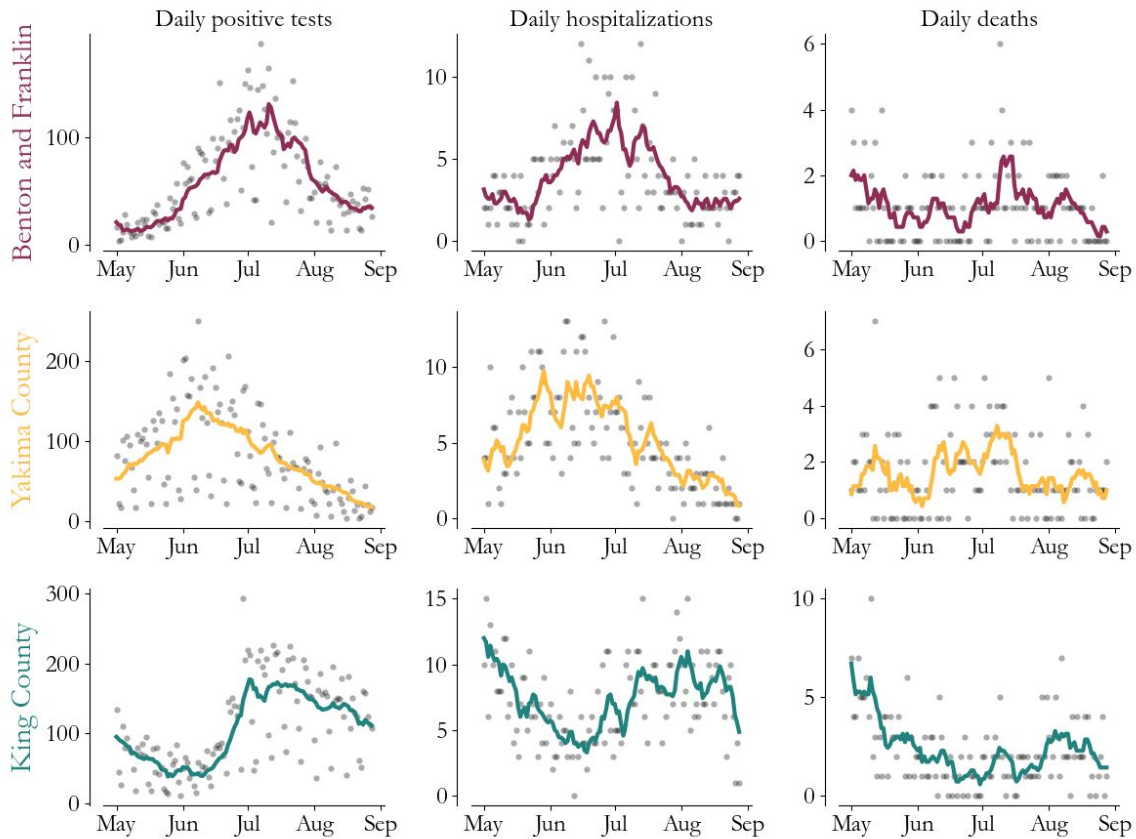


Figure 4: Cases (left), hospitalizations (middle), and deaths (right) are smoothed with a 7-day rolling average (curves) to highlight trends. Yakima county (middle) has sustained a sharp decrease in cases since early June and hospitalizations since late June; King county (bottom) has sustained a steady decrease in cases since early July, with decreases in hospitalizations lagging substantially. The Benton and Franklin counties region (top) has seen steep drops in case counts during the late July early August time period, but decreases have slowed substantially since.

Below we show model-based estimates of COVID-19 prevalence for King county, Yakima county, and the combined Benton/Franklin counties region. These trends in estimated infections mirror those observed in case counts and show that stagnating trends in Benton and Franklin may be masking underlying increases in COVID-19 transmission.

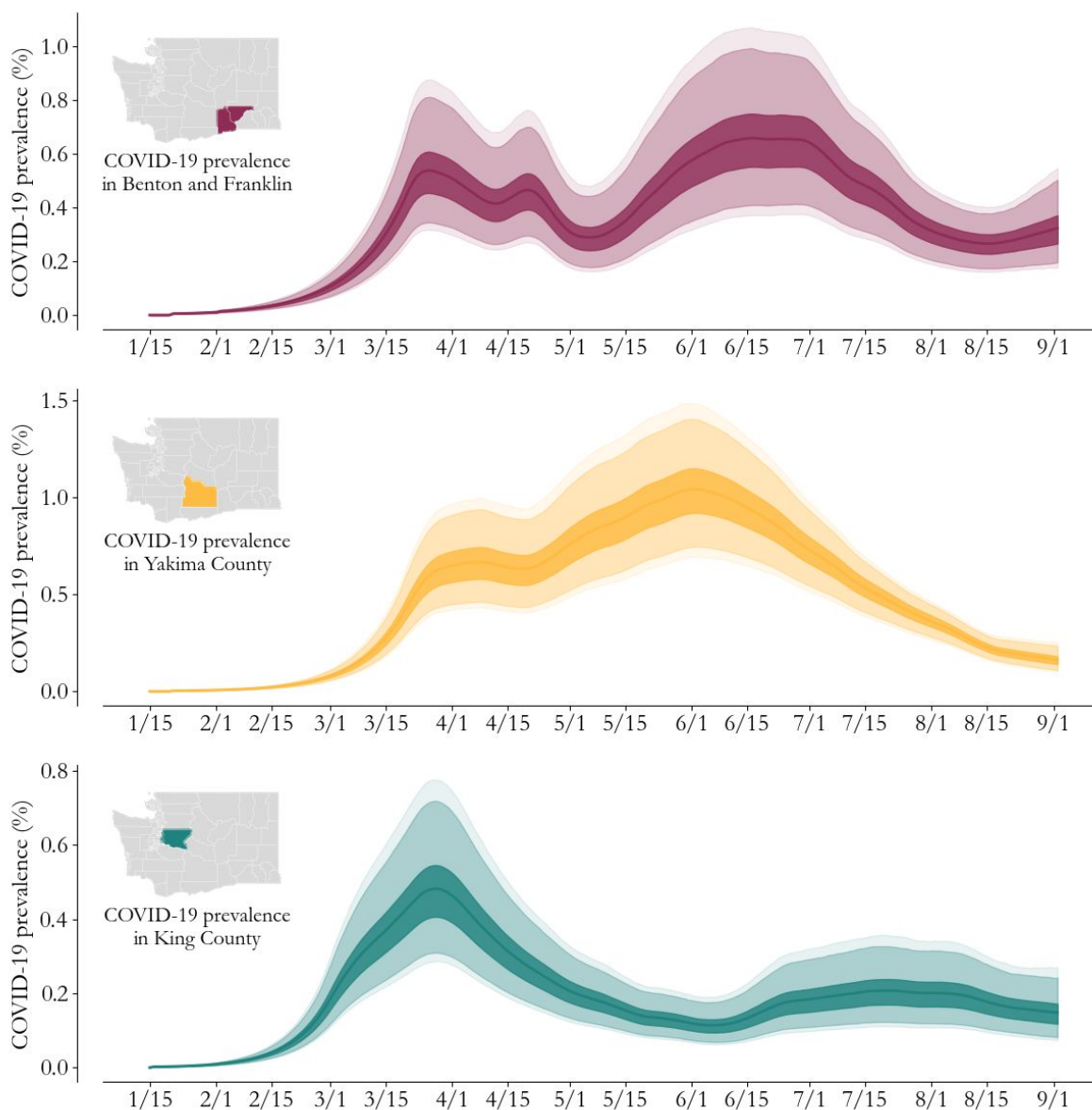


Figure 5: Estimated percentage of the population actively infected with COVID-19 (50% CI dark, 95% CI light, 99% CI lightest) in Benton and Franklin counties, Yakima county and King county. Case counts, hospitalizations and deaths provide a window into what is happening in a community, but they don't directly measure how much infection is occurring. Model based prevalence provides a way to estimate the underlying rate of infection. Consistent with trends in new diagnoses, we see a sustained decrease in Yakima county, more recent decreases in King county and a potential break in the decreasing trend in Benton and Franklin counties. For more information on our model, see [our recent technical report](#).

Non-mobility interventions -- including the statewide mask mandate, business restrictions, workplace risk mitigation efforts, and other policies -- have reduced transmission rates despite increased population mobility since April.

Reductions in the transmission rate through March and subsequent declines in cases through April during the first wave of COVID-19 cases in Washington state were strongly associated with decreases in mobility as measured by anonymized and aggregated cell-phone tracking data like the fraction of phones at home all day reported by [Google](#). But since then, mobility is an increasingly poor correlate of trends in the transmission rate across the state, with transmission rates typically falling despite stable or rising mobility and economic activity. This decoupling of mobility and control of transmission has grown as other personal and business interventions have become more widely adopted.

To describe the impacts of mobility reductions separately from the effects of other interventions, we used our estimated effective reproductive numbers (color below) to create a statistical model¹ separating transmission changes into those due to changes in mobility and those due to other factors. In grey, we use that model to estimate the reproductive number if reduced mobility was the only control measure. The comparison illustrates that transmission rates now are lower than can be explained by mobility alone, suggesting that while we may be more mobile than in April, we are interacting more safely - likely due to mask wearing, restrictions on gathering sizes and indoor bar closures limiting the potential for transmission events.

¹ Technical note: The mobility counterfactual is derived from a [generalized additive model](#) (GAM) that uses linear regression to decompose our effective reproductive number estimates from case and hospitalization data into a contribution from regional mobility ([Google's residential percent change from baseline](#), smoothed to remove weekend effects) and a flexible contribution from unmeasured effects to be estimated by the model. The specific formula for the uncertainty-weighted linear regression is $\log(rt) \sim \text{percent_home_smoothed} + \text{RW2}(\text{day})$, where RW2 refers to a second-order random walk constrained to start from zero on May 18, the start of [King County's mask mandate](#) -- the first in the state and an assumed proxy for the start of the significant growth in mask usage around the state. Code and data to reproduce the analysis are [available on GitHub](#).

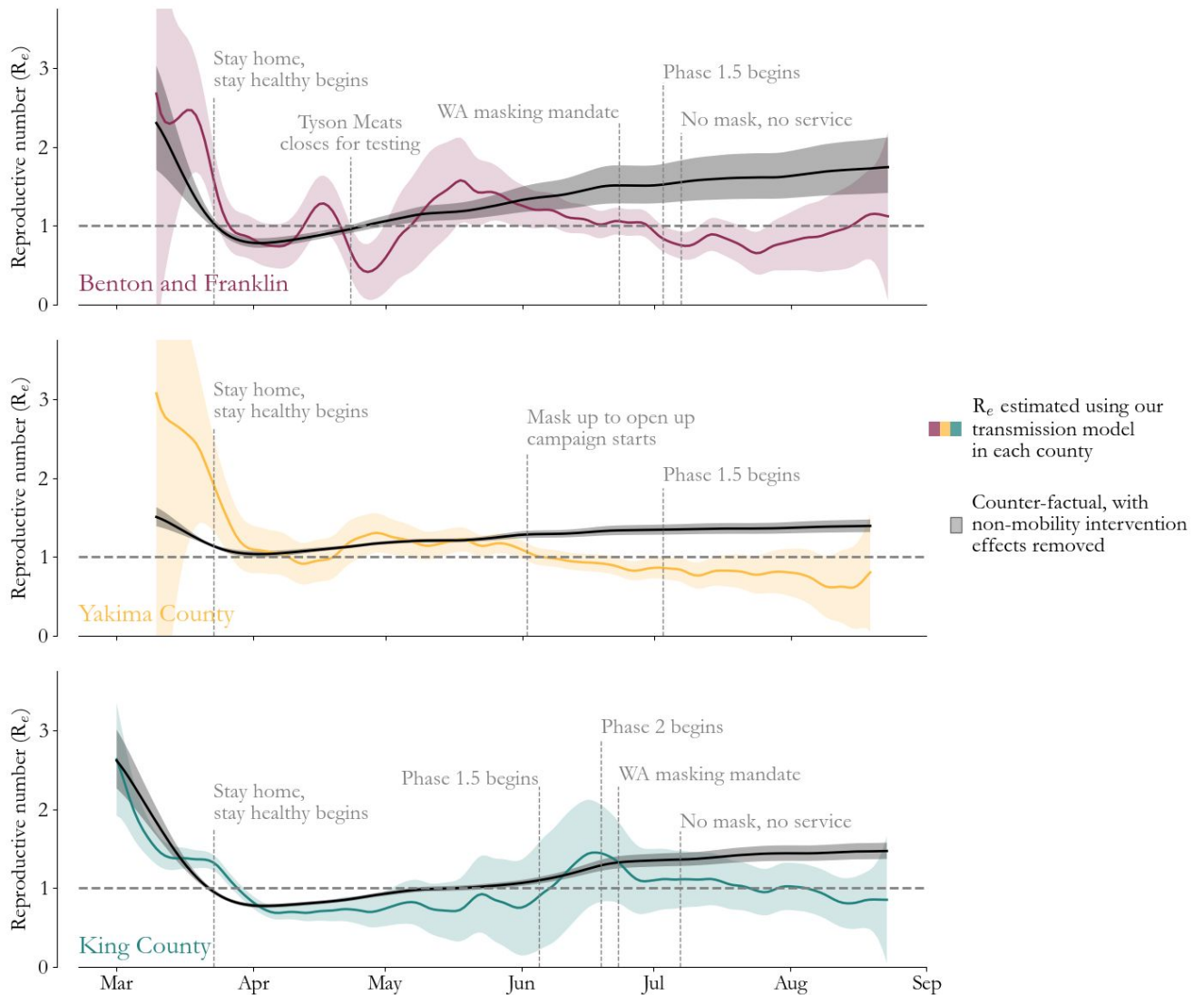


Figure 6: Estimated effective reproductive number (R_e) for Benton and Franklin counties (top), Yakima county (middle) and King county (bottom), together with projected values for R_e (grey) under a scenario where observed associations between mobility and R_e during the April to May period were maintained through August. The gap between the projected values and the estimated values is an estimate of the impact of the non mobility related changes that have occurred since July. Recent increases again in the Benton-Franklin region indicates local control measures may be slipping and adherence to mask, gathering, and workplace control policies needs to increase to prevent a resurgence of COVID-19.

Transmission modeling can help contextualize the reproductive numbers in Figure 6. In King County, if staying at home was the only way we could suppress COVID transmission, we would have expected significantly more burden than observed as people became more mobile through late spring and into summer. This divergence between activity and observed trends highlights that people are interacting more safely than early in the epidemic, saving lives as a result.

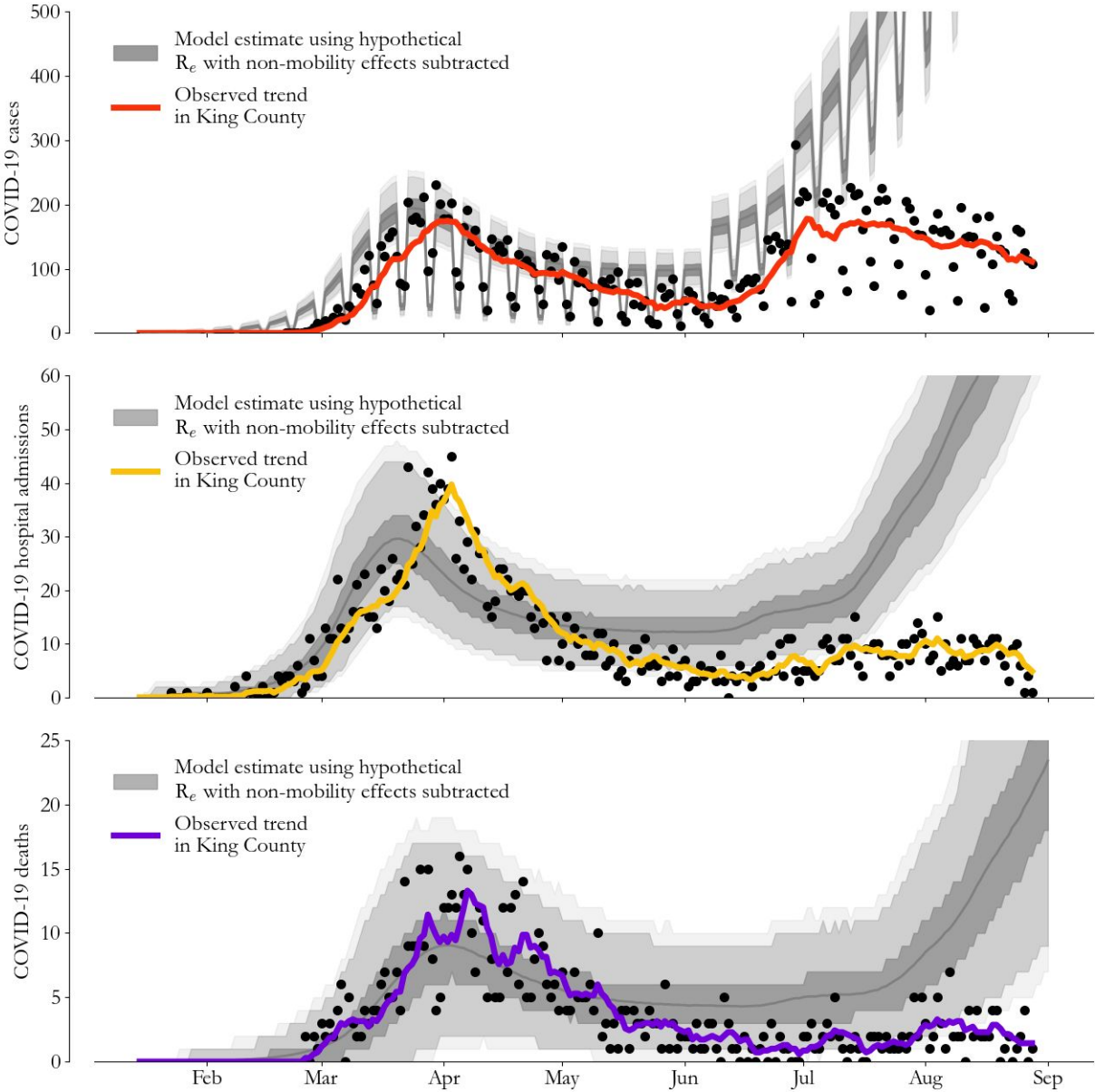


Figure 7: Cases (top), hospitalizations (middle), and deaths (bottom) in a transmission model (grey) where the percentage of phones at home (see Figure 6) determines transmission. Comparison to observed trends (colored curves) illustrates that mobility increases through the summer have been offset by safety practices like masking, limiting group size, and staying 6 feet apart when out. Continued adherence to these more individualized and targeted policies limits the need to return to stronger mobility restrictions.

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, hospitalization, and death data compiled on September 6, and to hedge against delays in reporting, we analyze data up to August 28 across the state.** 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.

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 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. This report is based on models developed by IDM that are being advanced to better represent the state by Microsoft, and both together volunteer to support WA DoH in its public health mission. 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. This collaboration and its outputs will continue to evolve as scientific frontiers and policy needs change over time.