WA Situation Report 1: COVID-19 transmission across Washington State

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Results as of May 12, 2020 5 p.m.

This situation report is a concise presentation of results based on the latest data. For a thorough description of how these estimates are generated, see our earlier, detailed report.

What do we already know?

The previous IDM report showed that the average effective reproductive numbers (R_e) in Eastern and Western WA had decreased from roughly 3 to near the critical R_e = 1 threshold in both regions. However, the transmission rate through April 18 was persistently higher in Eastern WA than Western WA, and, as of mid-April, neither region was suppressing the effective reproduction number definitively below R_e = 1.

What does this report add?

With updated data from the Washington State Disease Reporting System through May 4, we find that regional R_e did not change significantly in either region since the last report. In Eastern WA, our best estimate is persistently above 1 through April 26, where we infer R_e is likely between 0.89 and 1.26 with best estimate 1.07. In Western WA, R_e was no longer definitively below 1 since April 16, and we infer it was likely between 0.59 and 1.39 with best estimate 1.0 on April 29. The uncertainty in that timespan is large enough that we have no clear inference for the direction of the trend.

We also incorporate information about deaths to estimate the prevalence of active infections over time and cumulative incidence for each region. We infer that prevalence in Eastern WA on May 1 was likely between 0.1% and 0.6%, with best estimate 0.3%, and that the cumulative incidence since the introduction of COVID-19 to Washington state was likely between 0.6% and 2.5% with best estimate 1.3%. Similarly, for Western WA, we infer that prevalence on May 4 was likely between 0.1% and 0.3% with best estimate 0.2%, and cumulative incidence was likely between 0.7% and 2.4% with best estimate 1.4%.

What are the implications for public health practice?

Washington State remains on a knife's edge. Our estimates suggest that transmission is persisting in Western WA and slowly increasing in Eastern WA. Moreover, the vast majority of people on both sides of the Cascades remain fully susceptible to COVID, and as a result, exponential growth of disease burden is still a possibility across Washington.

Physical distancing is our main tool to limit COVID-19's spread, and it will continue to be a part of our lives in some form for a while. As we collectively work to limit transmission, it is imperative that we simultaneously learn about where transmission continues to occur to better understand what activities can safely resume.

Key inputs, assumptions, and limitations of our modeling approach

We use a COVID-specific transmission model fit to testing and mortality data to estimate the effective reproductive number over time and the associated COVID-19 prevalence and incidence. 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 and its assumptions and limitations, see this earlier 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 and death data compiled on May 10, and to hedge against delays in reporting, we analyze data up to May 4 in Western Washington and May 1 in Eastern Washington.** The difference in cutoffs dates reflects observed heterogeneity in reporting lags across the state.
- 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.**
- As described previously, we also incorporate daily COVID-19 deaths into the model by assuming that the infection fatality ratio (IFR) ranges broadly from 0.2% to 2.5%, with all-age average 1%, based on published values. Similarly, based on previous studies of early data from China, we also assume that the time between infection and death is log-normally distributed (log mean 2.8, log standard deviation 0.42), with an average value of roughly 19 days. These assumptions about the fraction and timing of infections that proceed to death are used to identify the overall magnitude of prevalence and incidence in the model.
- Finally, we assume that COVID-19 was introduced into both Western and Eastern WA on January 15, with an unknown number of importation events inferred from the data. This is reflective of an inability to realistically estimate the timing and number of importations with only mortality and testing time series data. As we've discussed previously, our R_e , prevalence, and cumulative incidence estimates are robust to reasonable changes in the model's initial conditions. Over time, we may be able to incorporate more information to infer more realistic importation timings.

Models of Eastern and Western WA highlight transmission increases to varying degrees across the state.

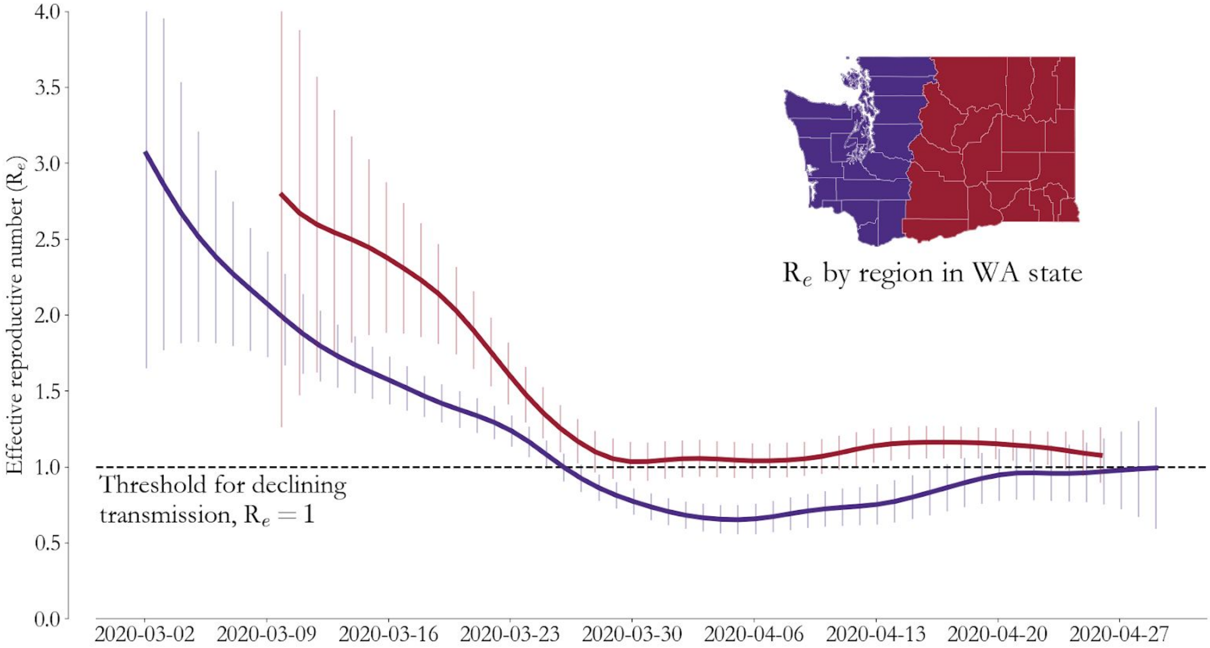

Figure 1*: R_e estimates for Eastern (red) and Western (purple) WA, with 2 standard deviation error bars. Our most recent estimates have both regions in a precarious position, with R_e potentially above one.*

In Eastern WA, the steady rise in daily cases is consistent with increasing transmission.

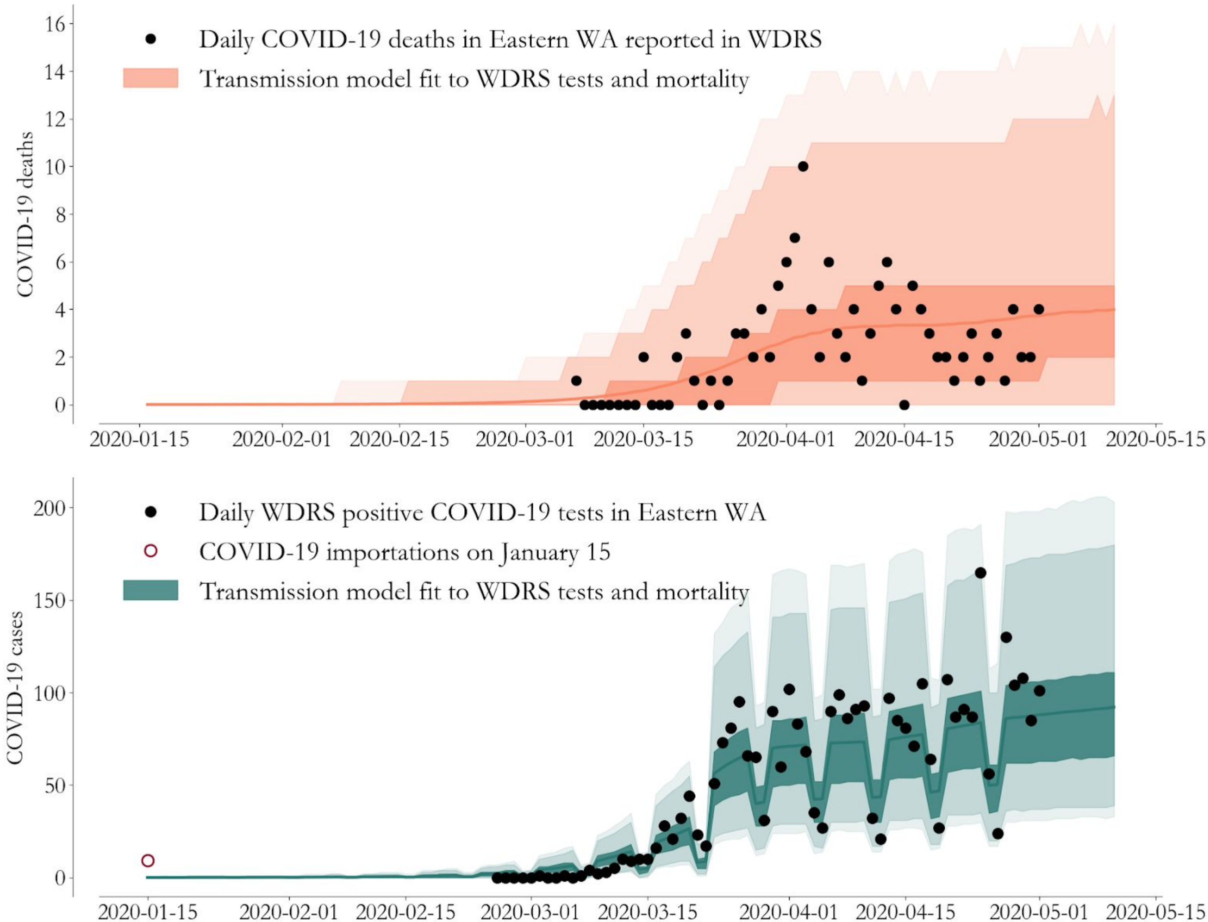

Figure 2*: Transmission model fit to data from Eastern WA. (Top panel) The model (orange, 50%, 95%, and 99% CIs shaded) is fit to daily COVID-19 deaths reported to the WDRS (black dots) under an assumed infection-fatality-ratio distribution that captures a range of uncertainty from 0.2% to 2.5%. (Bottom panel) The model (green, 50%, 95%, and 99% CIs shaded) is fit to daily case reports (black dots) accounting for weekend decreases in overall testing.*

In Western WA, daily cases and mortality are starting to plateau.

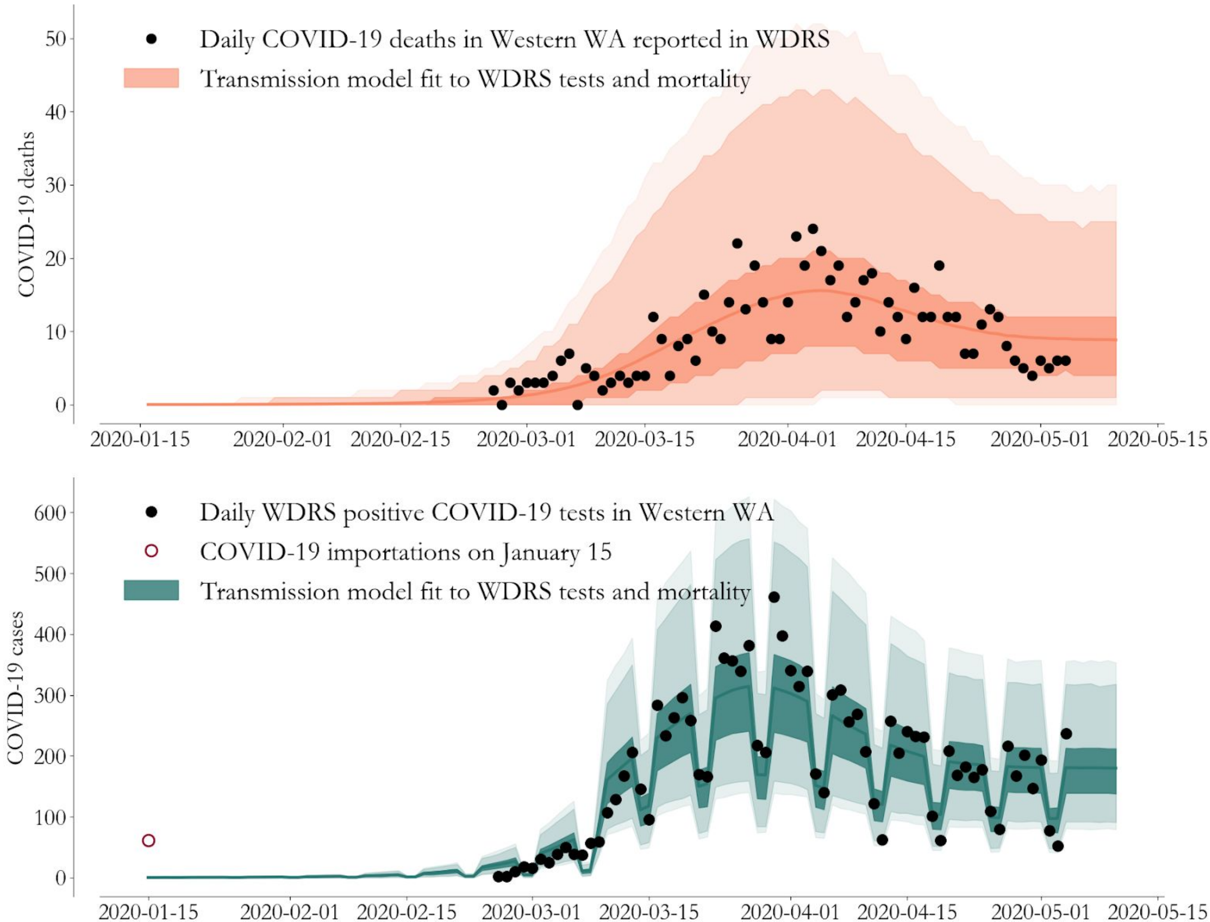

Figure 3*: Transmission model fit to data from Western WA. (Top panel) The model (orange, 50%, 95%, and 99% CIs shaded) is fit to daily COVID-19 deaths reported to the WDRS (black dots) under an assumed infection-fatality-ratio distribution that captures a range of uncertainty from 0.2% to 2.5%. (Bottom panel) The model (green, 50%, 95%, and 99% CIs shaded) is fit to daily case reports (black dots) accounting for weekend decreases in overall testing.*

Based on the fitted model, COVID-19 prevalence and incidence are likely increasing slowly in Eastern WA.

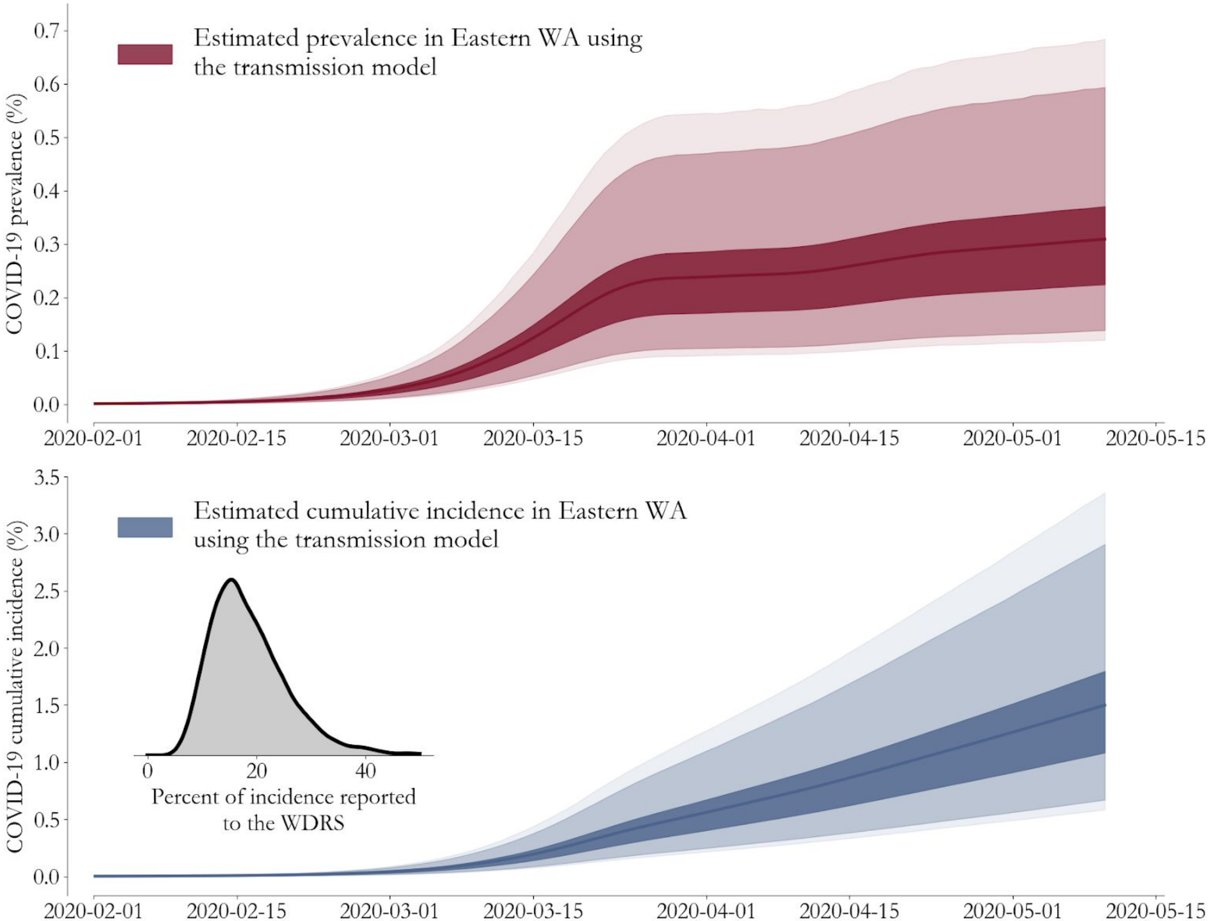

Figure 4*: Model based estimates of prevalence and incidence for Eastern WA. (Top panel) The fitted model (50%, 95%, and 99% CIs shaded) can be used to estimate the fraction of the population with active COVID-19 infections. (Bottom panel) Similarly, the model (50%, 95%, and 99% CIs shaded) can be used to estimate the fraction of the population no longer fully susceptible to COVID. Based on this cumulative incidence estimate, we can estimate the percent of infections eventually reported (inset).*

In Western WA, modeled prevalence was falling from late March to mid April, but the rate of decline has slowed since.

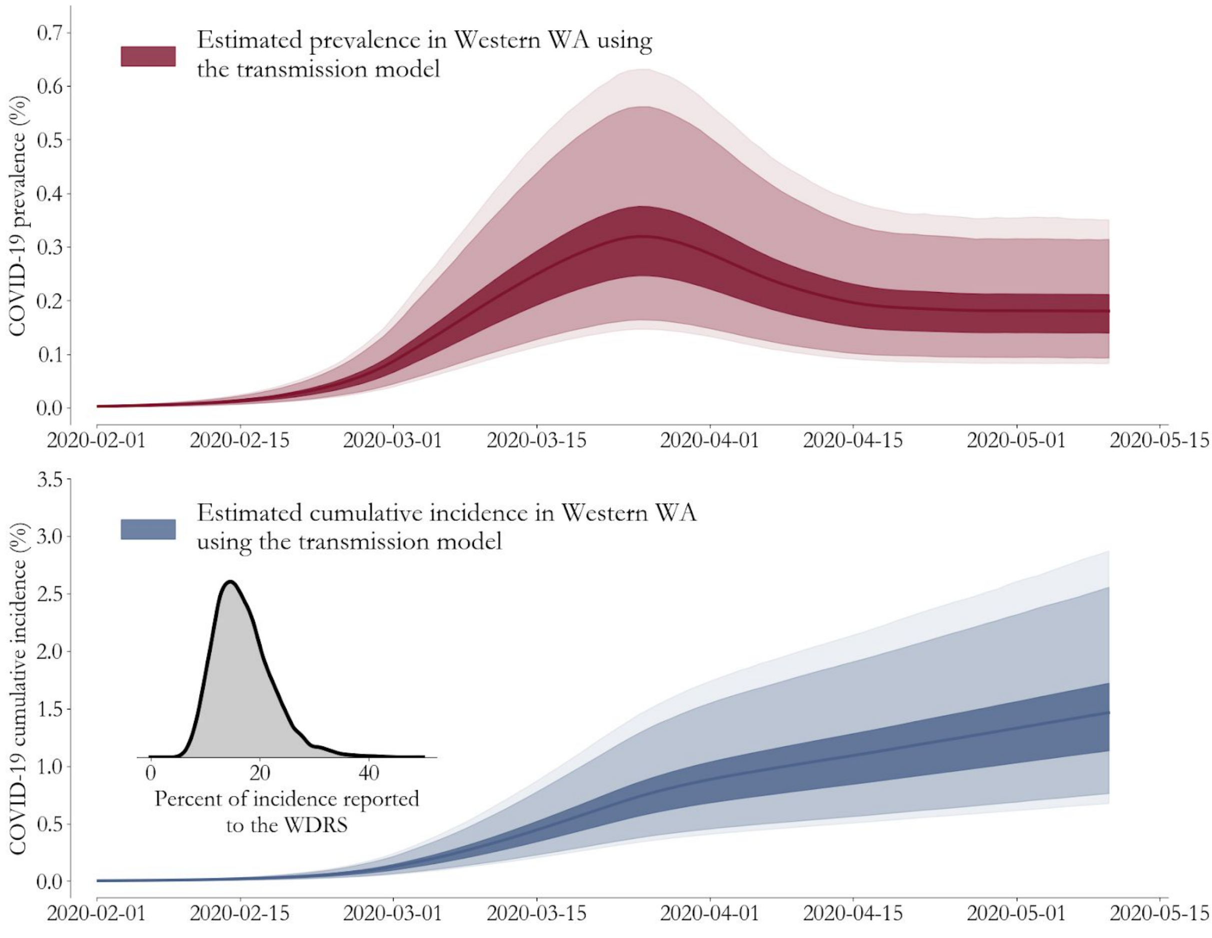

***Figure 5**: Model based estimates of prevalence and incidence for Western WA. (Top panel) The fitted model (50%, 95%, and 99% CIs shaded) can be used to estimate the fraction of the population with active COVID-19 infections. (Bottom panel) Similarly, the model (50%, 95%, and 99% CIs shaded) can be used to estimate the fraction of the population no longer fully susceptible to COVID. Based on this cumulative incidence estimate, we can estimate the percent of infections eventually reported (inset).*