STATUS UPDATE: COVID-19 EPIDEMIC TRENDS AND PROJECTIONS IN OREGON

Results as of 12-17-2020, 11 am

PURPOSE OF THIS STATUS UPDATE

This update describes trends in COVID-19 transmission over time and projects trends over the next month assuming different scenarios. This report complements the extensive epidemiologic data (e.g., demographic trends in cases, testing patterns) for Oregon available at the Oregon Health Authority (OHA) COVID-19 webpage.

RESULTS UPDATED EVERY THREE WEEKS

Please note that the COVID-19 data used for the modeling are continually being updated. (For daily up-to-date information, visit the OHA COVID-19 webpage.) The results in this brief will be updated every three weeks as more data become available, the science to inform the model assumptions expands, and modeling methods continue to be refined. The model serves as a useful tool for summarizing trends in COVID-19 transmission in Oregon and for understanding the potential impact of future scenarios. Point estimates should be interpreted with caution, however, due to considerable uncertainty behind COVID-19 model assumptions, limitations to the methods, and changes in COVID-19 testing volume and how testing data are processed.

ACKNOWLEDGEMENTS

OHA wishes to thank the Institute for Disease Modeling (IDM) for their support. For this status update, Niket Thakkar at IDM provided the software, programming scripts, and technical assistance. This report is based on aspects of IDM's technical reports (IDM COVID Reports) and Washington State Department of Health's COVID-19 Situation Reports (WA Situation Reports), adapted for Oregon.

METHODS

For this status update, we used the COVID-19 modeling software Rainier. Rainier is software designed by the Institute for Disease Modeling (IDM) to algorithmically estimate the effective reproduction number (R_e) over time based on local data and to conduct simple projections. Rainier fits a stochastic SEIR (susceptible – exposed – infectious – recovered) model to testing, hospitalization, and mortality time series. This software has been used to generate regular situation updates for the State of Washington overall and by two regions within Washington (Example WA Report).

Results are based on COVID-19 data compiled December 16 from the Oregon Pandemic Emergency Response Application (Opera) on COVID-19 testing, total diagnosed cases,[1] hospitalized cases, and deaths among people living in Oregon. To account for delays in reporting, diagnosed cases with a specimen collection date after December 4 were not used; we used the same cutoff date for hospital admissions and deaths.[2] In the model, cases tested on December 4 are reflective of exposures that occurred around November 28.

Revisions since the last status update include:

- Oregon recently changed the way testing data are reported. For modeling, we now receive counts of the total number of tests conducted, rather than on the number of people tested. While we still organize positive diagnosed cases by specimen collection date, only laboratory report date was available for negative tests. To better align these two outcomes, we redistributed negative test counts. These counts were reallocated among the laboratory report day and the two days prior, according to distribution of positive cases (by specimen date) occurring over those same three days. Because Rainier's R_e uncertainty is partially based on variation in percent positive, this redistribution of negative cases may cause the R_e confidence intervals to narrow.

- We are now reporting "hospitalized cases" (or "hospitalizations") rather than "severe cases," the latter of which included people who had tested positive for COVID-19 and died but who were never hospitalized.[3] This change was made because some COVID-19 cases in the hospital are people who tested positive for COVID-19 but were hospitalized for something else; hence, they do not necessarily have severe COVID-19 disease.

[1] Total diagnosed cases include confirmed (positive test) and presumptive cases (symptoms with epidemiologic link).

[2] This date reflects the cutoff through when individuals had a test specimen collected, were admitted to a hospital, or died. Any of these events may have been reported to OHA at a later date.

[3] Non-hospitalized deaths and deaths of unknown hospitalization status previously accounted for approximately 7% of "severe cases."

- We are using updated model parameters for the latency period and infectious period to better fit to the data, the same as those used by Washington State (Niket Thakkar, personal communication, December 10, 2020). Specifically, Rainier now assumes a person becomes infectious five days after being exposed to COVID-19, and that cases are most infectious for a four-day period.

Additional information about the methods can be found in Appendix 1.

RESULTS

Effective reproduction number

From the model results (Figure 1), we estimate the statewide R_e on November 28, ten days after the statewide freeze started (Press Release), was likely between 1.14 and 1.30, with a best estimate of 1.22. People in Oregon successfully lowered the higher level of transmission seen earlier in November, and we did not observe an increase in transmission over Thanksgiving. However, as of November 28 the R_e remained above one, indicating cases were continuing to rise.

Our R_e point estimate and confidence interval should be interpreted with caution because we estimated specimen collection dates for negative tests (and thus positive test rate for each day), as described in the methods section. It is also important to note that these estimates are based on averages statewide, but the growth in cases in Oregon has varied by county (OHA County Dashboard), race, ethnicity, and age (COVID-19 Weekly Report).

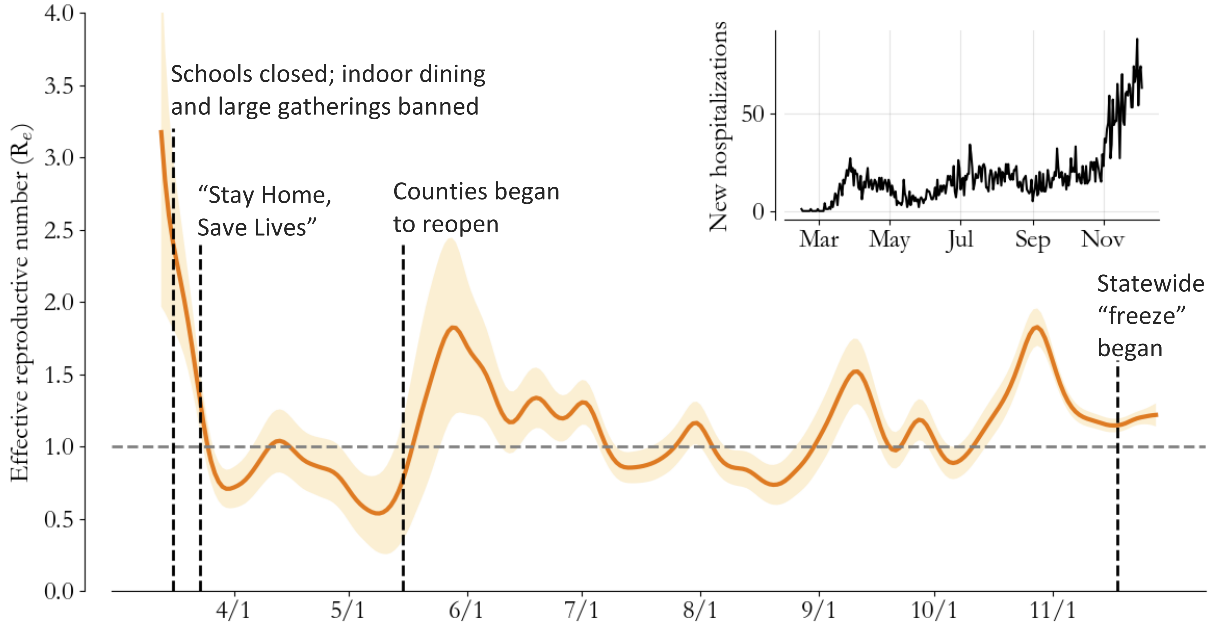

Figure 1: *R_e estimates over time for Oregon, with shaded 95% confidence interval. Graph insert is the number of new hospitalizations over time in Oregon, a key input for the estimates. Re = 1 is the threshold for declining transmission.*

Our best estimate of the R_e as of November 28 (1.22) is slightly higher than the estimate[4] for November 28 from Covid Act Now (1.08; 90% confidence interval: 0.98-1.18); other model estimates for the same date are closer to 1: CMMID (1.0; 90% credible interval: 0.96-1.04), covid19-projections.com (0.95), and RT Live (1.02; 80% credible interval: 0.88-1.14). These other models estimate the R_e after November 28th decreased somewhat or stayed the same: 0.99 (Covid Act Now as of December 7), 0.96 (CMMID as of December 3), 0.93 (covid19-projections.com as of December 1), and 1.02 (RT Live as of December 15).

[4] Accessed December 16, 2020.

Recent case trends

These R_e estimates are based on a model that used data on diagnosed cases, hospitalized cases, and deaths, while taking into account changes in testing volume and practice. Examination of these outcomes through December 4 confirms that cases were rising. As shown in Figure 2, the 7-day rolling averages of new diagnosed cases and new hospitalized cases in Oregon began increasing dramatically in mid-October. While the slope of new diagnosed cases appears to have flattened out somewhat since late-November, new hospitalizations continued to rise through December 4. The number of daily deaths has been increasing since early November.

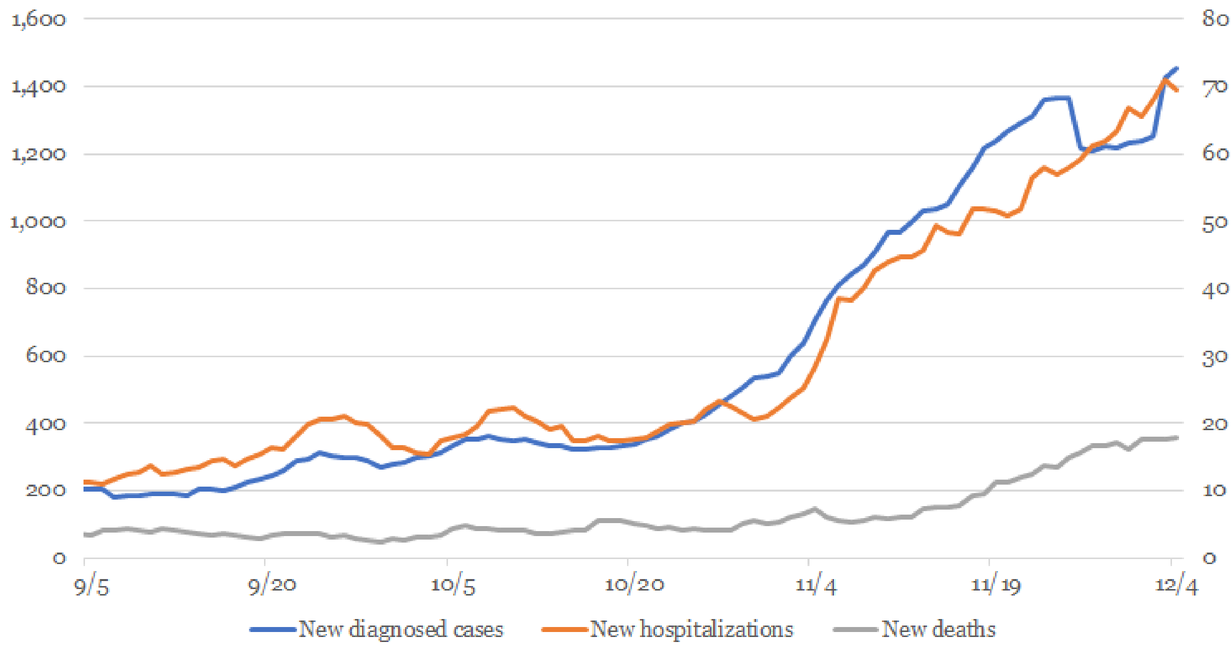

Figure 2: *Seven-day rolling average numbers of new diagnosed cases (left axis), new hospitalizations (right axis), and new deaths (right axis) due to COVID-19. Dates reflect when individuals had a test specimen collected (diagnosed cases), were admitted to the hospital, or when they died.*

Model fit to Oregon COVID-19 data

In Figure 3, one can see that the transmission model captures trends in the daily Oregon COVID-19 outcomes over time.

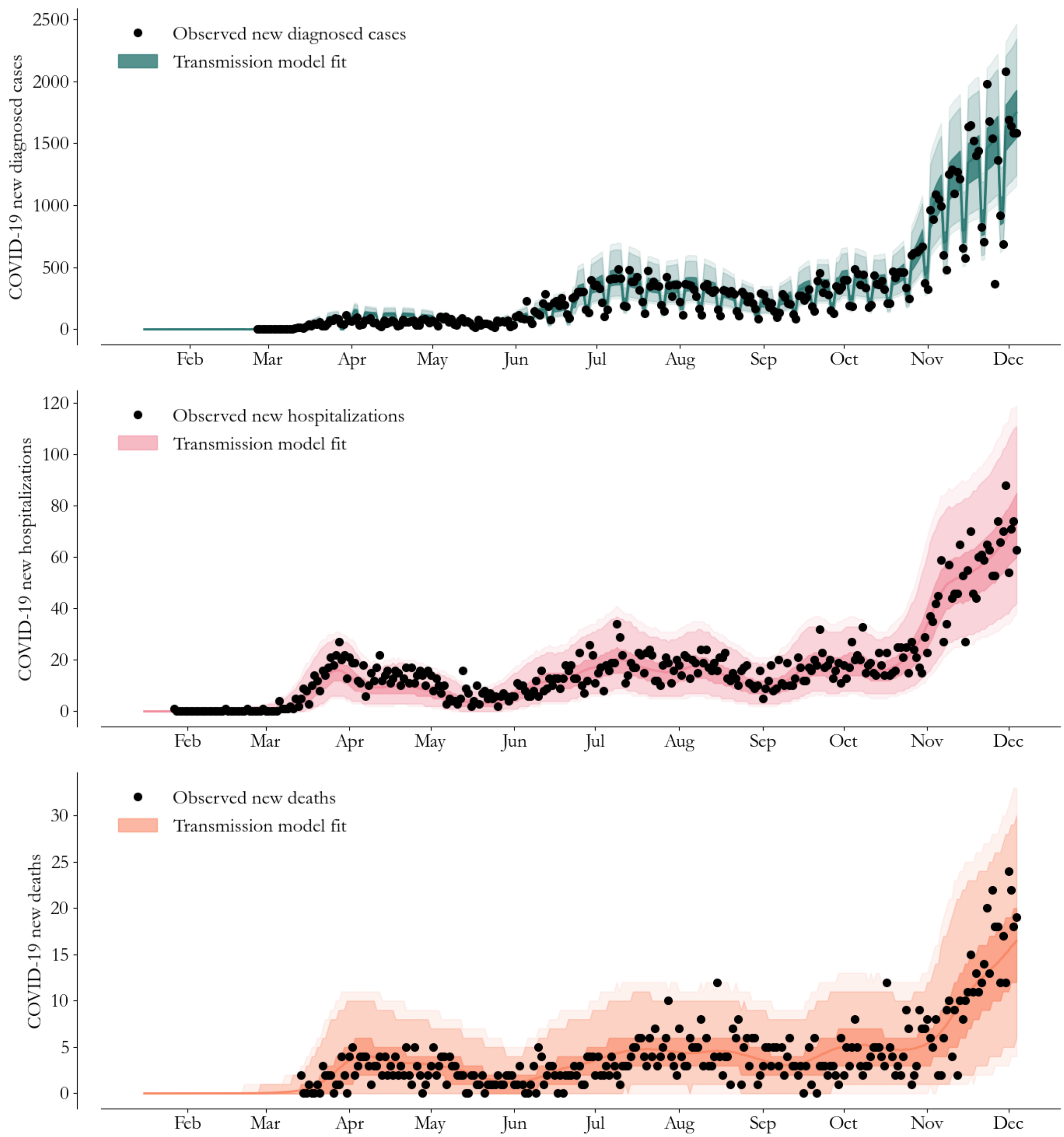

Figure 3: *Fitting the transmission model to Oregon's COVID-19 data on diagnosed cases, hospitalizations, and deaths. The lines represent the mean of 10,000 runs; the 25th-75th percentiles are given in dark shaded areas, 2.5th-97.5th percentiles in the lighter shade, and 1st-99th percentiles the lightest shade. The black dots are observed data. Top panel: Modeled cases (teal) capture the trend in observed, daily new diagnosed cases based on* R_e *estimates and a free number of importations on January 20 and February 1. Middle panel: Simultaneously, the model (pink) captures the trend in observed daily new hospitalizations by assuming hospitalizations are independent of testing volume. Bottom panel: With its time-varying infection fatality ratio, the model (orange) captures the observed trend in daily deaths.*

Delays in case reporting

The Opera data file for these analyses was obtained on December 16 but counts for recent days were incomplete due to reporting delays. To reduce the chances of underestimating recent case counts, new diagnosed cases with specimen collection date after December 4 were not used; we also used the same cutoff date for hospital admissions and deaths. We examined counts of hospital occupancy for COVID-19 in Oregon from the HOSCAP data system, which is updated daily, to see if trends in occupancy have changed since December 4; those data indicate that hospital occupancy has remained relatively steady between December 4 and December 16, suggesting the R_e may have moved closer to one since our data cutoff.

Scenario Projections

With the fitted model, we can explore outcomes under future scenarios. Predicting future trends in COVID-19 is extremely challenging. As illustrated in Figure 1, the estimated R_e has fluctuated above and below 1 since reopening began in May. Indeed, the spread of this virus appears very sensitive to changes in how people are interacting with each other (e.g., wearing masks, physically distancing, being indoors with large groups). Unfortunately, we do not have comprehensive measures of risk and protective behaviors over time, nor can we accurately predict them. Hence, we modeled three future scenarios to project what would happen to case trends if the R_e changed due to people's behavior. For all these scenarios, we assume the estimated R_e on November 28 remains constant until December 4 and changes start December 5.[5]

Figures 4 and 5 illustrate what could happen over the next month:

- If people's prevention behaviors in December were to stay similar to their behaviors in late November, with the R_e maintained at about 1.2: We would continue to see an exponential increase in new diagnosed cases. For the two-week period between December 19 and January 1, the projected number of new diagnosed cases would reach 730 per 100,000 people. This rate translates to a daily average of 2,200 new diagnosed cases. New hospitalizations would increase to 110 per day by January 1.

- If people were to be less adherent to prevention recommendations in December, returning to a transmission level where R_e = 1.3 (like in early November): New diagnosed cases would increase to 850 per 100,000 people for the two-week period

[5] The scenarios do not project the potential effects of people being vaccinated for COVID-19, but we will do that in the future after more people in Oregon have been vaccinated.

between December 19 and January 1, an average of 2,550 new diagnosed cases per day. New hospitalizations would increase to 125 per day by January 1.

- If people were to become more adherent to prevention recommendations in December, returning to a transmission level where $R_e = 0.9$ (like in early October): New diagnosed cases would decrease to 400 per 100,000 people for the two-week period between December 19 and January 1, an average of 1,200 new diagnosed cases per day. New hospitalizations would decrease to 55 per day by January 1.

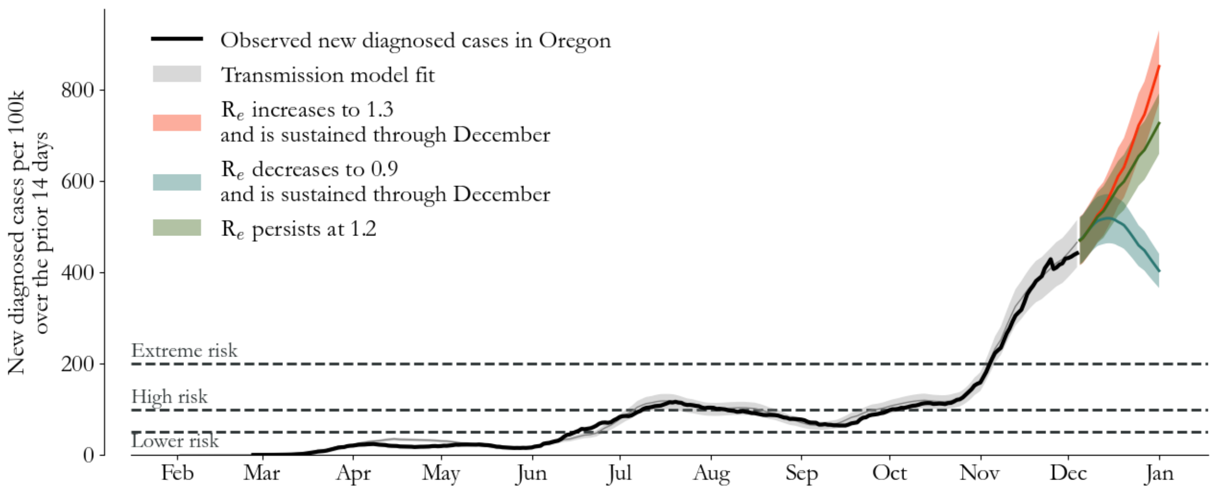

Figure 4: *Observed diagnosed cases (per 100k population over the previous 14 days) for Oregon and projected cases under three scenarios beginning December 5. The black line shows observed cases, while the grey shaded area shows the 25th-75th percentile range of the model fit. The green line shows diagnosed cases projected if the transmission level estimated for November 28 ($R_e = 1.2$) persists, the red line shows projected diagnosed cases if R_e increases to 1.3, and the teal line shows projected diagnosed cases assuming transmission decreases to $R_e = 0.9$ (shaded areas: 25th-75th percentile ranges). The risk levels of COVID activity (dashed horizontal lines) are defined by the Oregon Framework for County Risk Levels.*

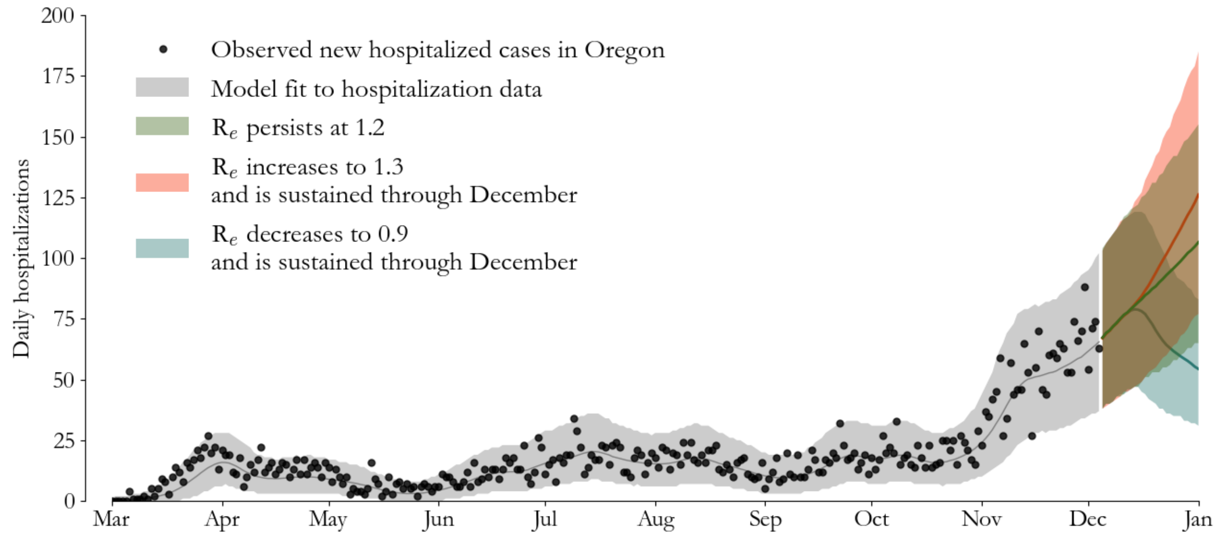

Figure 5: *Observed hospitalized cases for Oregon and projections under three scenarios beginning December 5. Black dots show observed daily counts, while grey region is the model-based 95% confidence interval. The green line shows daily hospitalized cases projected if the transmission level estimated for November 28 (R_e = 1.2) persists, the red line shows projected hospitalized cases assuming transmission increases to R_e = 1.3, and the teal line shows projected hospitalized cases assuming transmission decreases to R_e = 0.9 (shaded areas: 2.5th-97.5th percentile ranges).*

These results highlight how the COVID-19 case rates over the coming months will depend strongly on our collective efforts. The first COVID-19 vaccines arrived in Oregon on December 14, but vaccinations are still months away for most Oregonians (Press Release). For now, all Oregonians need to continue doing their part to stop the spread of COVID-19 -- wearing a mask, physical distancing, and avoiding indoor gatherings. In early October, much of the summer, and in the spring, Oregonians adopted prevention behaviors that drove the R_e below 1 and case rates decreased. The modeling scenarios demonstrate that Oregonians can decrease the rates again.

Appendix 1: Additional assumptions and limitations

We used a COVID-specific transmission model fit to Oregon data on testing, confirmed COVID-19 cases, hospitalized cases, and deaths to estimate the effective reproduction number (R_e) 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 IDM's technical report for detailed information on modeling methods, as well as the November 23 WA Situation Report for recent methodology updates.
- As described previously, estimates of R_e are based on an adjusted epidemiologic curve that accounts for changing test availability, test-positivity rates, and weekend effects, but all biases may not be accounted for.
- We included only diagnosed cases, hospitalized cases, and deaths occurring at least 12 days before our Opera data file extract to account for delays in reporting. If reporting delays are longer than that, the last few days of our model input data may undercount COVID-19 events.
- Estimates of R_e describe average transmission rates across Oregon. This report does not separate case clusters associated with known super-spreading events from diffuse community transmission. In addition, this report does not estimate R_e separately for specific populations, who might have higher risk of exposure because of their occupation, living arrangements, access to health care, etc.
- This report describes patterns of COVID-19 transmission across Oregon, 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.
- Point estimates should be interpreted with caution due to considerable uncertainty behind COVID-19 model assumptions, limitations to the methods, and recent changes in COVID-19 testing volume.
- We assumed free / undefined numbers of importations occurring on January 20 and February 1, and specified changes in testing volumes occurring around April 1, June 23, September 29, and November 1.
- In contrast to recent reports for Washington State, we assumed age-specific infection hospitalization ratios (IHRs) based on CDC COVID-19 Planning Scenarios, as well as a mean exposure-to-hospitalized time of 12 days. Note that Rainier adjusts the overall IHR over time based on the data.