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

Report as of 11-12-2020, 12pm , updated 11-13-2020, 12pm

ACKNOWLEDGEMENTS

This is an update to the Oregon Health Authority's (OHA's) previous modeling reports. 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, and reviewed a draft of the report. 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.

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 recent changes in COVID-19 testing volume.

MODIFICATIONS TO MODEL REPORTING

The OHA COVID-19 model reporting has been modified to respond to the changing science and needs of Oregon. These “Status Updates” replace the previous “Brief Reports” for the modeling. Key changes include:

- The Status Updates are much shorter than the Brief Reports. They are more focused on key results and less on the methods. The trends in COVID-19 cases can change rapidly, and the more concise reporting format and more straightforward software (described below) will allow for a more timely turnaround.

- The Status Update models are based on software better suited for Oregon’s needs. The new Status Updates use Rainier instead of Covasim. Rainier is software designed by 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, severe case, and mortality timeseries. After assessing Rainier, we found it could provide consistent results and as useful information for Oregon planning as Covasim, but in a more efficient manner. In addition, Rainier has the advantage of automatically adjusting for shifts in the age distribution of cases over time, and its efficiency will allow us to do regional estimates more easily. For more information about the methods used and comparison with Covasim results, see Appendices 1 and 2, respectively.

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) available at the OHA COVID-19 webpage.

FINDINGS

Effective reproduction number

We used a COVID-specific transmission model fit to COVID-19 data from the Oregon Pandemic Emergency Response Application (Opera) to estimate the effective reproduction number (R_e) -- the average number of secondary cases that a single case generates – over time. COVID-19 data through November 6[1] were assumed complete. In the model, a diagnosed case tested on November 6 reflects exposure that occurred on November 2 (4 days earlier).

From the model results (Figure 1), we estimate the statewide R_e on November 6, was likely between 1.25 and 1.69, with a best estimate of 1.47. The best estimate of R_e has been above one since October 12. It is 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 Weekly Report Nov 12).

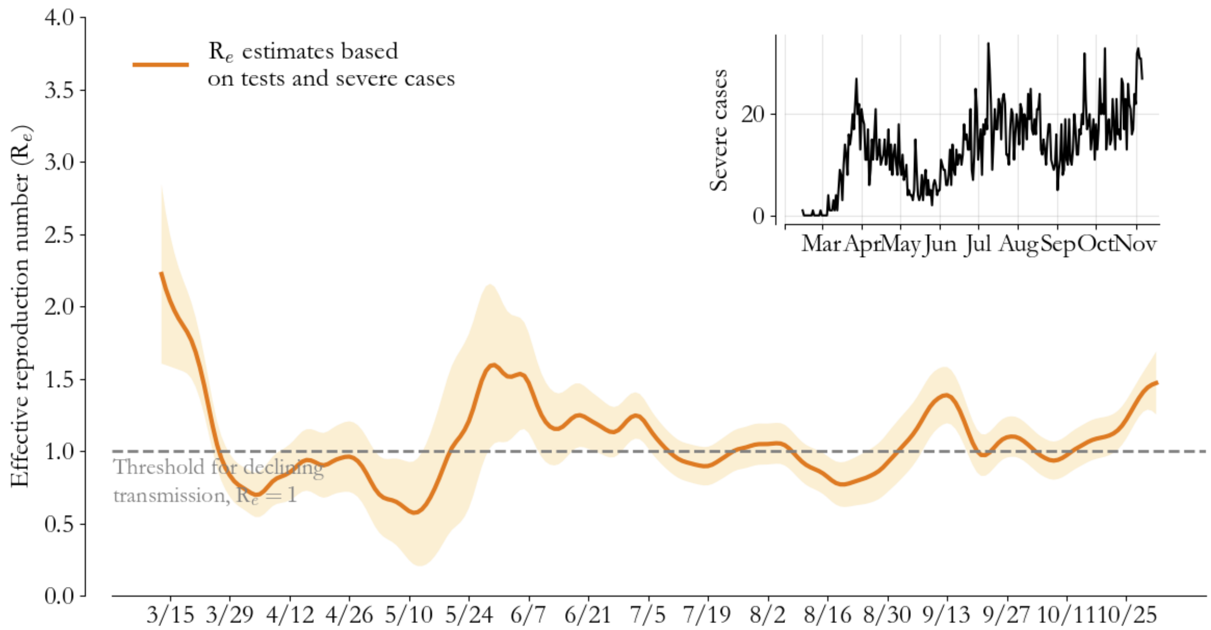

***Figure 1**: R_e estimates over time for Oregon, with shaded 95% confidence interval. Graph insert is the number of new severe cases[2] over time in Oregon, a key input for the estimates.*

[1] 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.

[2] Severe cases include both cases admitted to the hospital and individuals who died but were not hospitalized. Approximately 7% of severe cases are deaths that were not hospitalized or of unknown hospitalization status. New severe case date is the date of hospital admission (if available) or is the estimated date of onset of severe symptoms.

Our best estimate of the R_e as of November 1 is somewhat higher than the most recent estimates from other researchers, although estimates from RT Live (1.22), Covid Act Now (1.23), and CMMID (1.1) all support the R_e being above 1.[3]

Recent case trends

These R_e estimates are based on a model that used data on diagnosed cases,[4] severe cases, and deaths, while taking into account changes in testing. Examination of these outcomes confirms that cases are rising. As shown in Figure 2, the 7-day rolling average numbers of new diagnosed cases and new severe cases in Oregon had temporarily declined in early October but have been increasing since mid-October. The number of deaths has stayed relatively flat during that time.

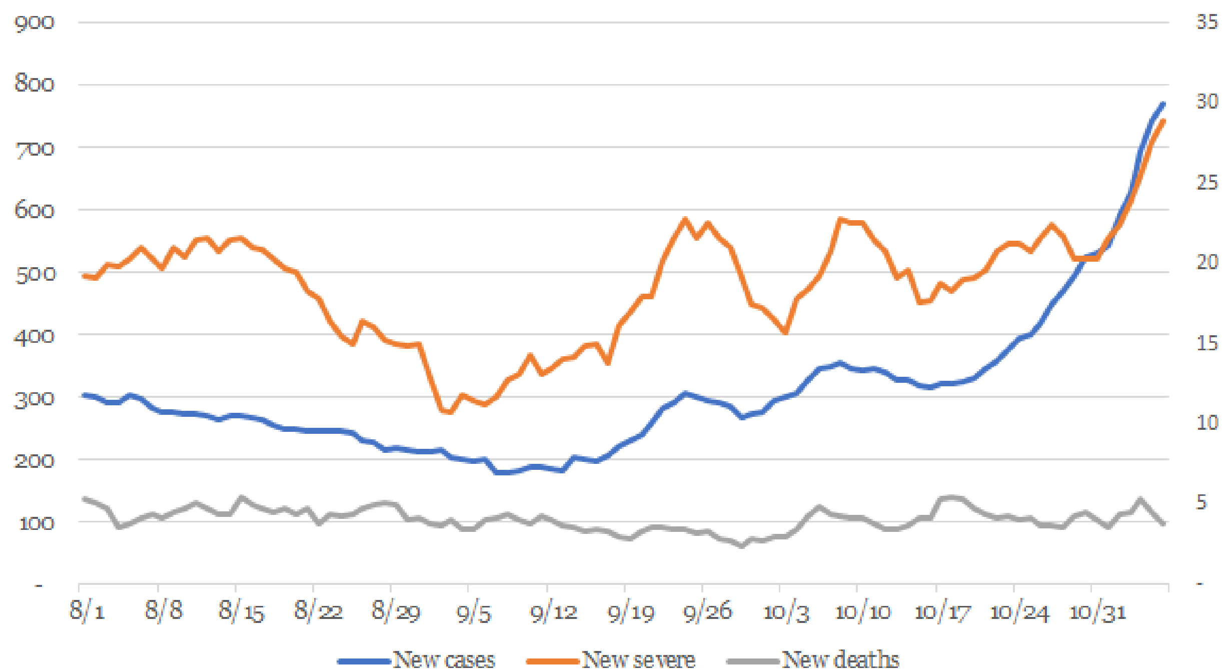

Figure 2: *Seven-day rolling average numbers of new diagnosed cases (left axis), new severe cases (right axis), and new deaths (right axis) due to COVID-19.*

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.

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[3] Accessed November 12.

[4] Total diagnosed cases include confirmed cases (positive test) and presumptive cases (symptoms with epidemiologic link). Although some of the recent increase in the number of new diagnosed cases could be related to increased testing volume, the test positivity rate has also increased.

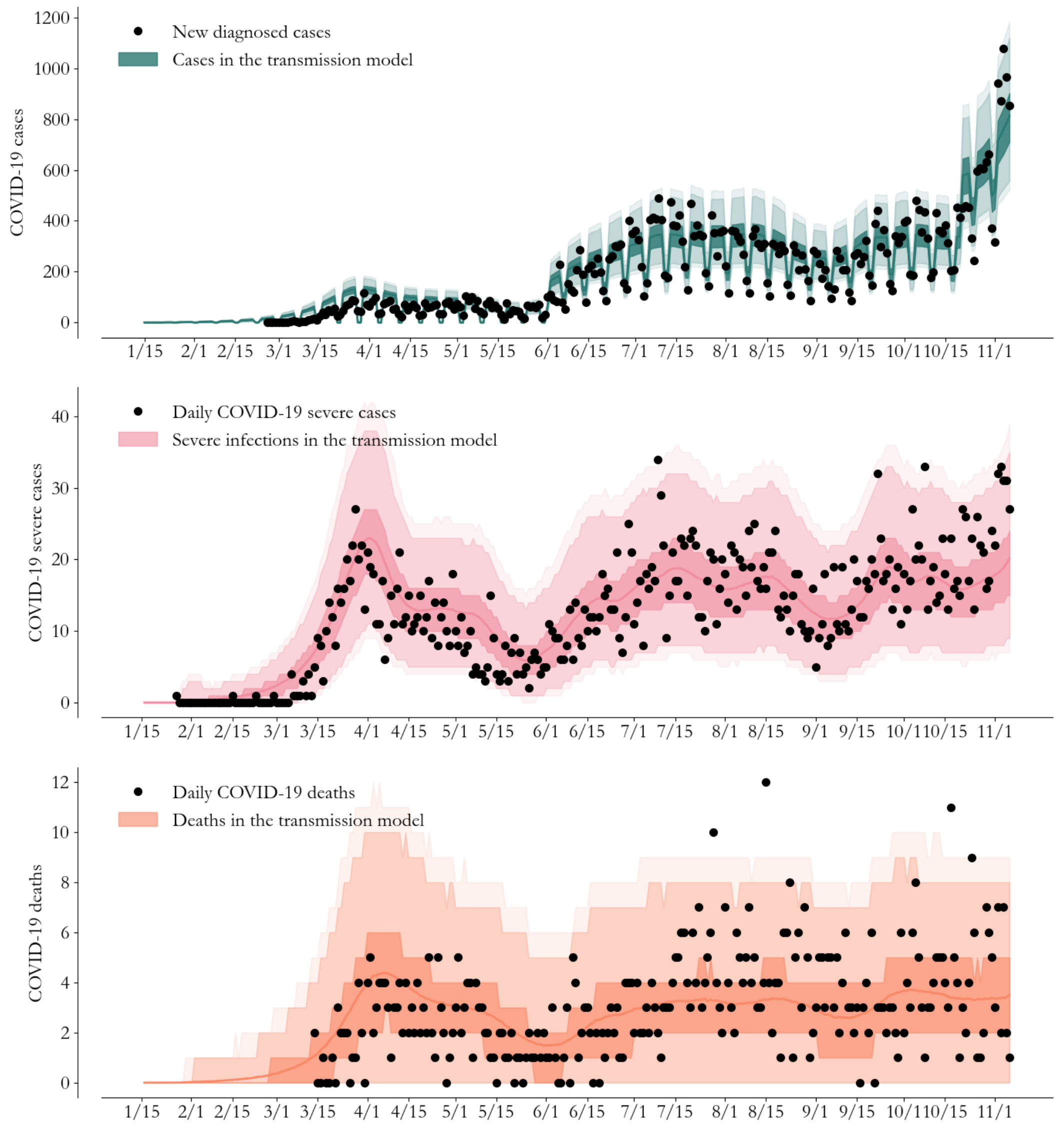

Figure 3*: Fitting the transmission model to Oregon's COVID-19 data on new diagnosed cases, new severe cases, deaths, and testing. The line represents the mean of 10,000 runs; the 25th-75th percentiles are given in dark shaded areas, 2.5th-97.5th percentiles in the lighter shade, and 1st-99th percentiles 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 severe cases by assuming severe disease is 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 November 12, but counts for recent days are incomplete due to reporting delays. To reduce the chances of underestimating recent case counts, new diagnosed cases with specimen collection date after November 6 were not used; we used the same cutoff date for hospital admissions and deaths. Counts of hospital occupancy for COVID-19 in Oregon from the HOSCAP data system, which is updated daily, show an increasing trend in occupancy since October 25.

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 measures of risk and protective behaviors over time, nor can we accurately predict them. Hence, we modeled two future scenarios with different assumptions about the R_e value after November 6.[5]

Figure 4 illustrates what could happen over the next month:

- If R_e were to be maintained at the estimated November 1 level (1.47): We would continue to see an exponential increase in new diagnosed cases. In a month, the projected number of new diagnosed cases would reach 500 per 100,000 people over a two week period. This rate translates to an average of 1,500 new diagnosed cases per day.

- If behavior changes lowered the R_e to the level of mid-October (0.91): New diagnosed cases would remain at historically high levels but would start decreasing again.

These results highlight how the level of COVID activity depends strongly on the collective success of mitigation efforts in the coming months.

[5] While our model estimated R_e through November 1, we assumed this transmission level to be constant through November 6 in all scenarios.

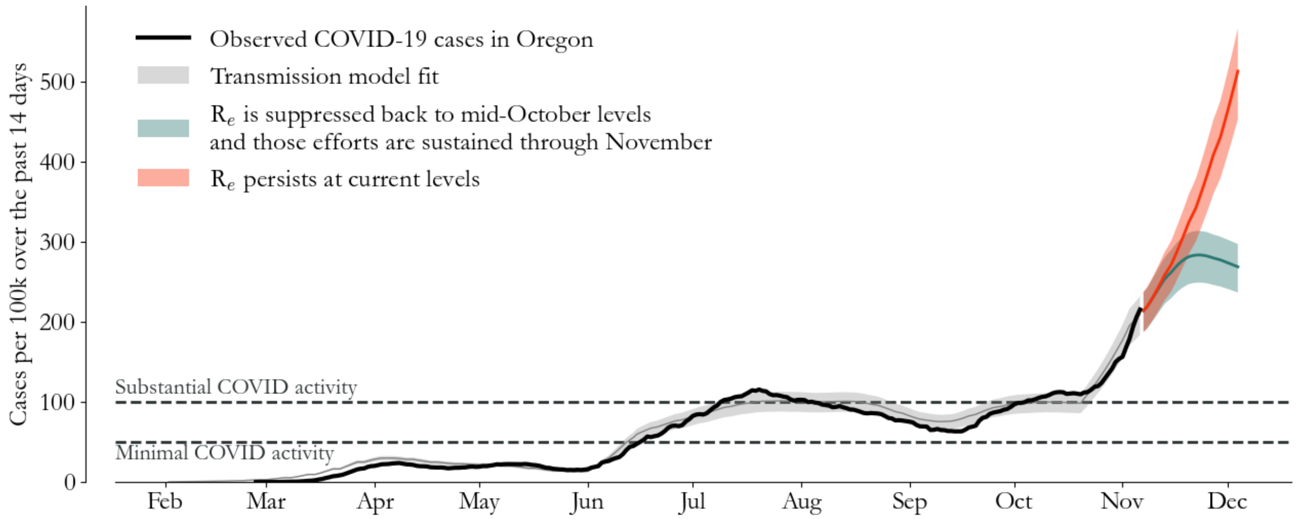

Figure 4 *Model-based projections of COVID-19 burden (as measured by new diagnosed cases per 100k population over the previous 14 days, shown in black) for Oregon illustrate potential risk of continued high transmission. Our model is fit (grey line is mean of 10k runs; shaded areas are 25th-75th percentiles) to Oregon's COVID-19 data on new tests, diagnosed cases, severe cases, and deaths. Here, we show results from future scenarios assuming transmission continues at the most recently estimated rate for Oregon (red) and assuming rates are suppressed to levels last observed in mid-October (teal). The level of COVID activity (dashed horizontal lines) is defined by the state's school safety guidelines (page 15).*

Appendix 1: Key inputs, assumptions, and limitations

We used a COVID-specific transmission model fit to Oregon data on testing, confirmed COVID-19 cases, severe 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 most recent technical report on the modeling methods.
- In this situation report, we used data from the Oregon Pandemic Emergency Response Application (Opera) compiled on November 12. To account for delays in reporting, diagnosed cases with a specimen collection date after November 6 were not used; we used the same cutoff date for hospital admissions and deaths.
- Results in this report come from data on testing, confirmed and presumed COVID-19 cases, severe cases, and deaths among people living in Oregon. We considered someone hospitalized with COVID-19 to be a severe case, but some of these patients could be hospitalized for something else and test positive for COVID-19 while at the hospital.
- 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.
- 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 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 June 1, July 17, and October 20.
- In contrast to recent reports for Washington State, we assumed age-specific infection hospitalization ratios (IHRs) and infection fatality ratios (IFRs) based on CDC COVID-19 Planning Scenarios, as well as a mean exposure-to-severe time of 12 days. Note that Rainier adjusts the overall IHR over time based on the data.

Appendix 2: What is the difference between the models used in Covasim and Rainier?

As stated by Kerr et al. (here), "Models for examining COVID-19 transmission and control measures can be broadly divided into two main types: compartmental models and agent-based (or microsimulation) models, with the former generally being simpler and faster, while the latter are generally more complex, detailed, and computationally expensive." IDM developed both Covasim and Rainier programs for modeling COVID-19. Covasim fits an agent-based model (described here) and is well-suited to in-depth explorations of interventions like contact tracing, diagnostics, and reopening of schools and businesses. Meanwhile, Rainier fits a stochastic SEIR (susceptible – exposed – infectious – recovered) model, and it was designed to algorithmically estimate Re and population prevalence over time based on local data and to conduct simple projections. Rainier has been used to generate regular situation updates for the State of Washington overall and by two regions within Washington (Example Washington Report).

The general trends in the estimated R_e over time using Rainier appeared consistent with our Covasim findings in our last report, but Rainier was able to more easily detect small changes (Figure A2). After assessing Rainier, we found it could provide as useful information for planning in a more efficient manner than Covasim. In addition, it has the advantages of automatically adjusting to changes in the age distribution of cases over time, and its efficiency will allow us to do regional estimates more easily.

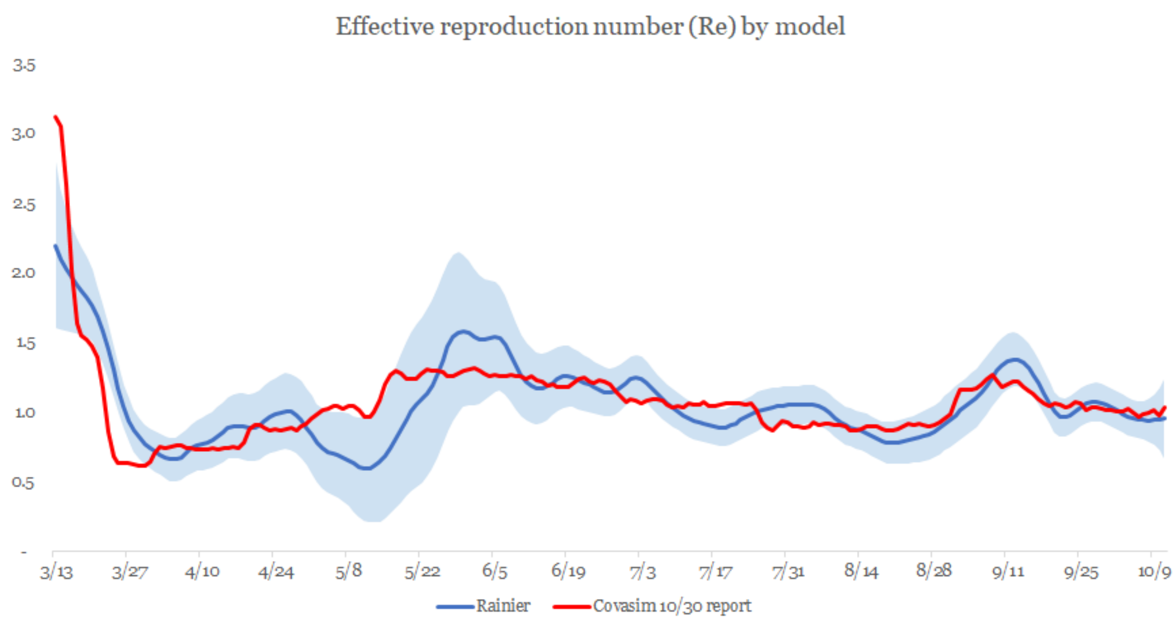

Figure A2: *Estimated effective reproduction number (R_e) over time in Oregon based on Covasim (red) results from the October 30 OHA modeling report and Rainier estimates using the same dataset (blue) with shaded 95% confidence interval.*