OHSU COVID Forecast
Edition: 6/25/2021

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Key Outcomes
Hospitalized Patients

Census decline has slowed.

As of 6/21/2021, the census was 144.

Source: https://public.tableau.com/profile/oregon.health.authority.covid.19#!/vizhome/OregonCOVID-19HospitalCapacitySummaryTables_15965754787060/HospitalizationbySeveritySummaryTable
Regional Hospital Census

Continued decline in Region 7

Other regions are flat or decreasing.

The decline in average state census by region has halted in all regions except the Midwest.
As of 6/21, of the 563 occupied ICU beds, 36 (6%) are filled with COVID patients.

### Share of Occupied w/COVID

<table>
<thead>
<tr>
<th>Region</th>
<th>ICU</th>
<th>Non-ICU</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>2</td>
<td>2%</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>3</td>
<td>10%</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>5</td>
<td>6%</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>6</td>
<td>25%</td>
<td>0%</td>
<td>3%</td>
</tr>
<tr>
<td>7</td>
<td>13%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>9</td>
<td>11%</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>Total</td>
<td>6%</td>
<td>3%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Source: [https://public.tableau.com/profile/oregon.health.authority.covid.19#!/vizhome/OregonCOVID-19HospitalCapacitySummaryTables_15965754787060/HospitalizationbySeveritySummaryTable](https://public.tableau.com/profile/oregon.health.authority.covid.19#!/vizhome/OregonCOVID-19HospitalCapacitySummaryTables_15965754787060/HospitalizationbySeveritySummaryTable)
New Cases per Capita

Case level decline has slowed.

Oregon still has 14th highest rate of cases per capita.

Source: http://91-divoc.com/pages/covid-visualization/
Hospitalization Rate

For the most recent week (6/6-6/12) of complete data, the hospitalization rate is 6.7%.

While many high risk people have been vaccinated, amongst those who become a case, the hospitalization rate has remained constant and perhaps even increased.

Source: https://public.tableau.com/profile/oregon.health.authority.covid.19#!/vizhome/OregonHealthAuthorityCOVID-19SummaryTable_15889676399110/OregonsEpiCurveSummaryTable
Positivity rate has dropped below 5%.

The most recent complete week (6/6-6/12) had a test positivity of 4.0%.

Testing rates have declined by about one-third in recent weeks.

Statewide Forecast
Vaccine Rates by Age

Older age groups are plateauing in vaccine rates and younger groups are beginning to increase.

As of week of starting 6/21, below are percentages that have received first dose:

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>80+</td>
<td>81%</td>
</tr>
<tr>
<td>70 to 79</td>
<td>85%</td>
</tr>
<tr>
<td>60 to 69</td>
<td>74%</td>
</tr>
<tr>
<td>50 to 59</td>
<td>65%</td>
</tr>
<tr>
<td>40 to 49</td>
<td>64%</td>
</tr>
<tr>
<td>30 to 39</td>
<td>62%</td>
</tr>
<tr>
<td>20 to 29</td>
<td>54%</td>
</tr>
<tr>
<td>10 to 19</td>
<td>36%</td>
</tr>
<tr>
<td>9 and younger</td>
<td>0%</td>
</tr>
</tbody>
</table>

Model Assumption-Vaccine Volume

Both fast and slow scenarios show a decline. The difference between them and the alternative scenarios provides an ability to observe how sensitive this factor is to the census.

This projection does not include the eventual expansion of eligibility to younger children (<12).

The Delta variant is expected to grow quickly and become dominant once it gets going. Oregon continues to have very few samples that have been identified.

Source: Actuals from https://outbreak.info/location-reports?loc=USA_US-OR, Projections by Simulation by OHSU
Model Assumption-Virus Spread Rate

The two scenarios for strain composition produce different transmission levels for the circulating virus.

The “Fast” scenario assumes delta variant is introduced this week at 4% prevalence and has an R0 of 6. The Slow scenario assumes the R0 is similar to the gamma variant.

Source: Actuals from [https://outbreak.info/location-reports?loc=USA_US-OR](https://outbreak.info/location-reports?loc=USA_US-OR), Projections by Simulation by OHSU
Model Assumption- Policy/Behavior

This chart shows the effectiveness of the policy amongst those assumed to be susceptible.

As more opening of restrictions occurs the effectiveness of policy amongst susceptible is expected to decline.

Three scenarios are shown showing fast fade, fear and fatigue cycle, and no fade.

Note: The estimated intervention effectiveness includes increased transmissibility due to the variant. Thus, if the estimated R is the same but the variant has increased it will mean the intervention effectiveness, shown in the chart, has increased.
The census showed sharp drop corresponding with “Extreme” risk level. A slower drop is expected thereafter.

The primary scenario is

- Fear and Fatigue Cycle
- Slow Variant
- Slow Vaccine

Model: The OHSU state hospital census forecast is an SIR model that includes traditional assumptions about first transmission (2/1/2020), doubling rate (5 days), days from exposure to admissions (12 days), length of stay (8 days, 13 days for ICU), and recovery period (14 days). It has an innovative feature which is that it includes a factor that moderates transmission rates which is called policy effectiveness. The factor is estimated historically for key policy dates and/or weekly intervals. It also allows future policies to be projected.
Previous Forecasts

Previous forecasts can help assess accuracy of the model.

The model fit from the previous slide helps indicate current model fit. This is typically very high because each week is given a parameter and thus is very flexible to the data.
Census Forecast-Alternative Scenarios

Scenarios:

Variant
a) Fast (ie. Delta grows fast)
b) Slow (ie. Delta grows slower)

Policy/Behavior:

a) Fast Fade in policy restrictions
b) Fear and Fatigue in policy restrictions
c) No Fade in policy restrictions

Vaccine:

a) Fast (quicker distribution)
b) Slow (slower distribution)
As of 6/21, the estimated population proportions are:
- Susceptible: 38%
- Vaccinated: 42%
- Infected: 14%
- Vaccinated & Infected: 6%

Projection uses primary scenario.
Review of Leading Indicators
Leading indicators from google are showing mild increasing trend.

Source: SDI from: https://data.covid.umd.edu/
DEX from https://github.com/COVIDExposureIndices/, Google mobility reports from https://www.google.com/covid19/mobility/
Higher Risk Behaviors

Continued increase in indoor restaurants.

Shops, time w/others, and large events are all more steady.

Source: https://covidcast.cmu.edu/
Mask wearing decline has continued

Source: https://covidcast.cmu.edu/
Symptoms

Community reports of COVID-like symptoms through Facebook surveys showed a brief increase but remains low.

Source: https://covidcast.cmu.edu/
Policy Issues
Vaccine Hesitancy: Barriers

Chart shows the percent of people indicating various barriers to obtaining a vaccine amongst those who have tried or received a vaccine.

Top barriers are “No appointments”, “Technical difficulties”. These responses may reflect people who received vaccine during busier periods.

Much smaller percentages indicated problems with “Travel”, “Documents”, “Appointment times”, and “Vaccine type”.

Source: https://cmu-delphi.github.io/delphi-epidata/api/covidcast-signals/fb-survey.html#barriers-to-vaccination
Delta Wave

Several states are having larger levels of Delta variant measured in samples of viral sequences.

The map shows the percent of samples in the last 30 days to be B.1.617.2.

Missouri has a rate of 60%. Other states with high percentages include Utah (59%) Kansas (42%) Mississippi (31%) Colorado (32%) Arkansas (31%) Nebraska (28%) Nevada (21%)

Source: https://outbreak.info/location-reports?loc=USA
Delta Wave

This chart shows the hospital census for the states with the highest share of delta variant.

All of these states are either flat or increasing in recent weeks.

Appendix
The most recent forecast was issued on 6/10.

The model shows two scenarios and both show continued declines.
CDC Forecast-Ensemble

Below on left are individual models. On the right is the average with confidence interval.

Source: https://covid.cdc.gov/covid-data-tracker/#forecasting_weeklycases
As of 6/18, the IHME model is shown below.

Projections and scenarios

We produce three scenarios when projecting COVID-19. The reference scenario is our forecast of what we think is most likely to happen:

- Vaccines are distributed at the expected pace.
- Governments adapt their response by re-imposing social distancing mandates for 6 weeks whenever daily deaths reach 8 per million, unless a location has already spent at least 7 of the last 14 days with daily deaths above this rate and not yet re-imposed social distancing mandates. In this case, the scenario assumes that mandates are re-imposed when daily deaths reach 15 per million.
- Variants B.1.1.7 (first identified in the UK), B.1.351 (first identified in South Africa), and P1 (first identified in Brazil) continue to spread from locations with (a) more than 5 sequenced variants, and (b) reports of community transmission, to adjacent locations following the speed of variant scale-up observed in the regions of the United Kingdom.
- In one-quarter of those vaccinated, mobility increases toward pre-COVID-19 levels.

The worse scenario modifies the reference scenario assumptions in three ways:

- First, it assumes that variants B.1.351 or P.1 begin to spread within three weeks in adjacent locations that do not already have B.1.351 or P.1 community transmission.
- Second, it assumes that all those vaccinated increase their mobility toward pre-COVID-19 levels.
- Third, it assumes that among those vaccinated, mask use starts to decline exponentially one month after completed vaccination.

The universal masks scenario makes all the same assumptions as the reference scenario but also assumes 95% of the population wear masks in public in every location.

Model Assumption: Population w/First Dose

This is the schedule used by the model for the percent of population w/first dose by week and age group.

The vaccination rate projections will be updated to reflect younger ages next week.

Source: OHSU COVID Forecast Model
Model Assumption: Hosp Rate

This shows the assumed hospitalization rate projected based on the change in susceptible population from vaccination.

The actual hospitalization rate has not followed this and remains high. It is believed that the hospitalizations per infection may have exhibited more of a decline.

Source: OHSU COVID Forecast Model
Model-Key Parameters

Key Assumptions
1) Vaccine schedule follow “slow” schedule with prioritized age groups
2) Vaccine acceptance rate, varies by age group.
3) Lagged affect on protection (2 weeks until vaccinated have protection)
4) Efficacy of vaccine (54% at first dose, 95% after second dose at 24 days)
5) Policy Scenarios have constructed to account for likely reduction in policy restrictions.
6) Ascertainment rate- True infected are estimated to be 3.5 times larger than cases.
7) Virus strain $R_0$ values (alpha=4.62, Epsilon=3.7, Gamma=4.6/5, Delta=6, Wild=3.08)
8) Hospitalization rate has been adjusted to reflect higher risk individuals being vaccinated within age groups.

Source: OHSU COVID Forecast Model
Acknowledgements

Each week this model requires updates, input and expertise from many people.

I would like to thank Alexandra Nielsen for developing a multi-strain simulation model, Brian O’Roak and Xuan Qin, at OHSU, for their expertise to understand genetic sequencing information, and the hospital forecasting workgroup for their feedback on weekly forecasts, including collaboration with Julie Maher and Erik Everson at Multnomah County PDES.

I would also like to give a special thank you to Michael Johnson from St. Charles Health who helped develop an early version of the model that has proven to be a good structure to handle the many twists and turns the problem has required.

Thank you!