OHSU COVID Forecast

Edition: 12/17/2021

Peter Graven, PhD; Office of Advanced Analytics, BIAA, ITG

Omicron Update

Key Parameters

- Less protection (immune escape)
  - Vaccine and previous infection do not prevent infection at same rate as previous strains
  - Boosters do prevent infection
- Faster transmitting (R-naught, R_0)
  - Even without immunity escape, this means the virus just spreads faster
- Less severe (hospitalization rate)
  - Compared to Delta how much less likely is a person to be hospitalized
- Other factors
  - Length of stay, days until hospitalization, first case date, booster rate, behavior response

Omicron in Denmark

Both fully vaccinated and booster vaccinated individuals are testing positive for Omicron in Denmark.

Vaccine in Denmark is almost entirely Pfizer (83%) and Moderna (15%).

The percent breakthrough is 77% for Delta ("Other variants") and 91% for Omicron. Both are high compared to its vaccination rate of 80%.

There have been 63 hospitalized cases, which is approximately 42% of the rate for Delta (50% more likely to be incidental).

Current hospital census is 25

Table 4. Vaccination status for individuals ≥12 years infected with Omicron compared to other variants, data included in the table are from 22 November to 14 December 2021

Vaccination status (12+ year olds)	Other variants (No. of cases)	Other variants (%)	Omicron (No. of cases)	Omicron (%)
Booster vaccinated	6,679	7.3	1,074	10.3
Fully vaccinated	60,174	66.0	8,235	78.7
Not vaccinated	21,364	23.5	947	9.0
Received first dose	2,887	3.2	214	2.0
Total	91,104	100.0	10,470	100.0

Denmark

- Vaxzevria (previously called AstraZeneca) 2%
- Spikevax (previously called Moderna) 15%
- Comirnaty/BioNTech 83%

Table 6. Number and proportion of Omicron-related hospital admissions compared to other variants, data included in the table are from 22 November to 14 December 2021

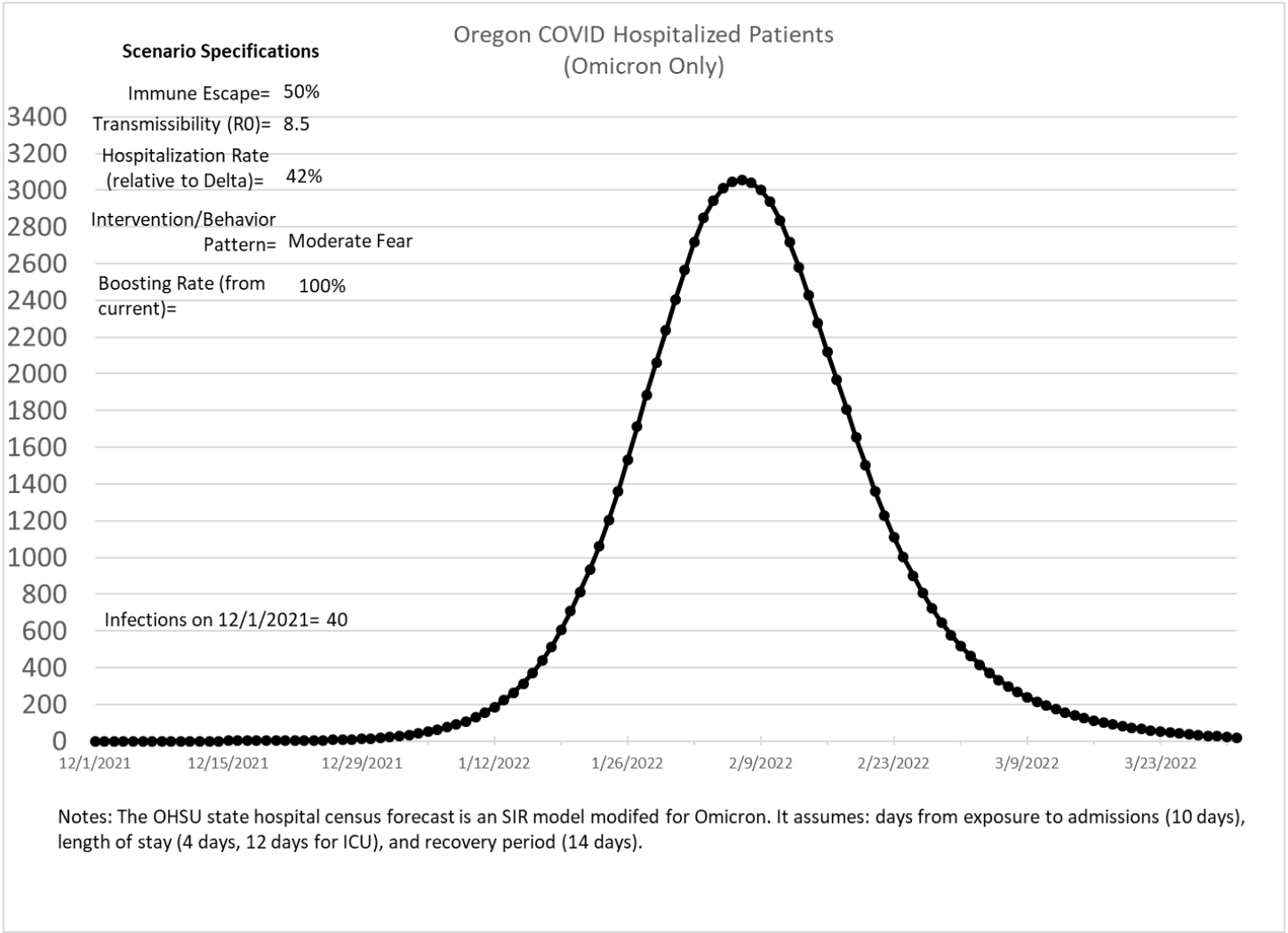
Hospital admissions in total	Other variants (No. of cases)	Other variants (%)	Omicron (No. of cases)	Omicron (%)
Have not been hospitalized	121,689	98.5	11,205	99.3
Tested positive 48 hrs or more after admission	229	0.2	14	0.1
Tested positive prior or within 48 hrs after admisson	1,642	1.3	63	0.6
Total	123,560	100.0	11,282	100.0

Table 5. Number of Omicron related hospitalizations at the time of data extraction

Omicron related hospitalizions	No. of cases
Hospitalized	25
Hospitalized in ICU	<5

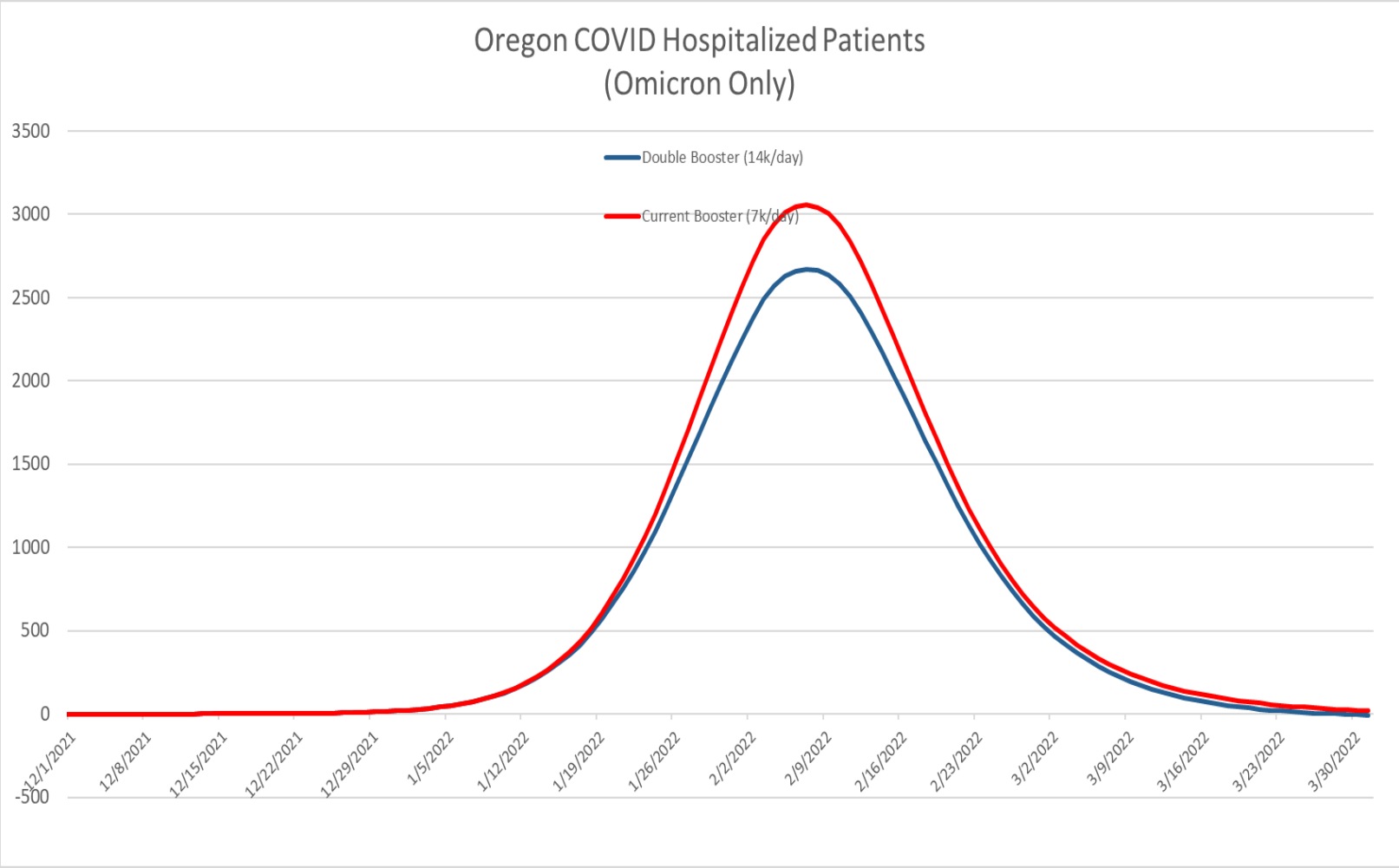
Source: https://www.ssi.dk/-/media/cdn/files/covid19/omikron/statusrapport/rapport-omikronvarianten-17122021-ep96.pdf?la=da, https://www.statista.com/statistics/1219343/covid19-vaccine-doses-distributed-in-europe-by-manufacturer/

Omicron Forecast



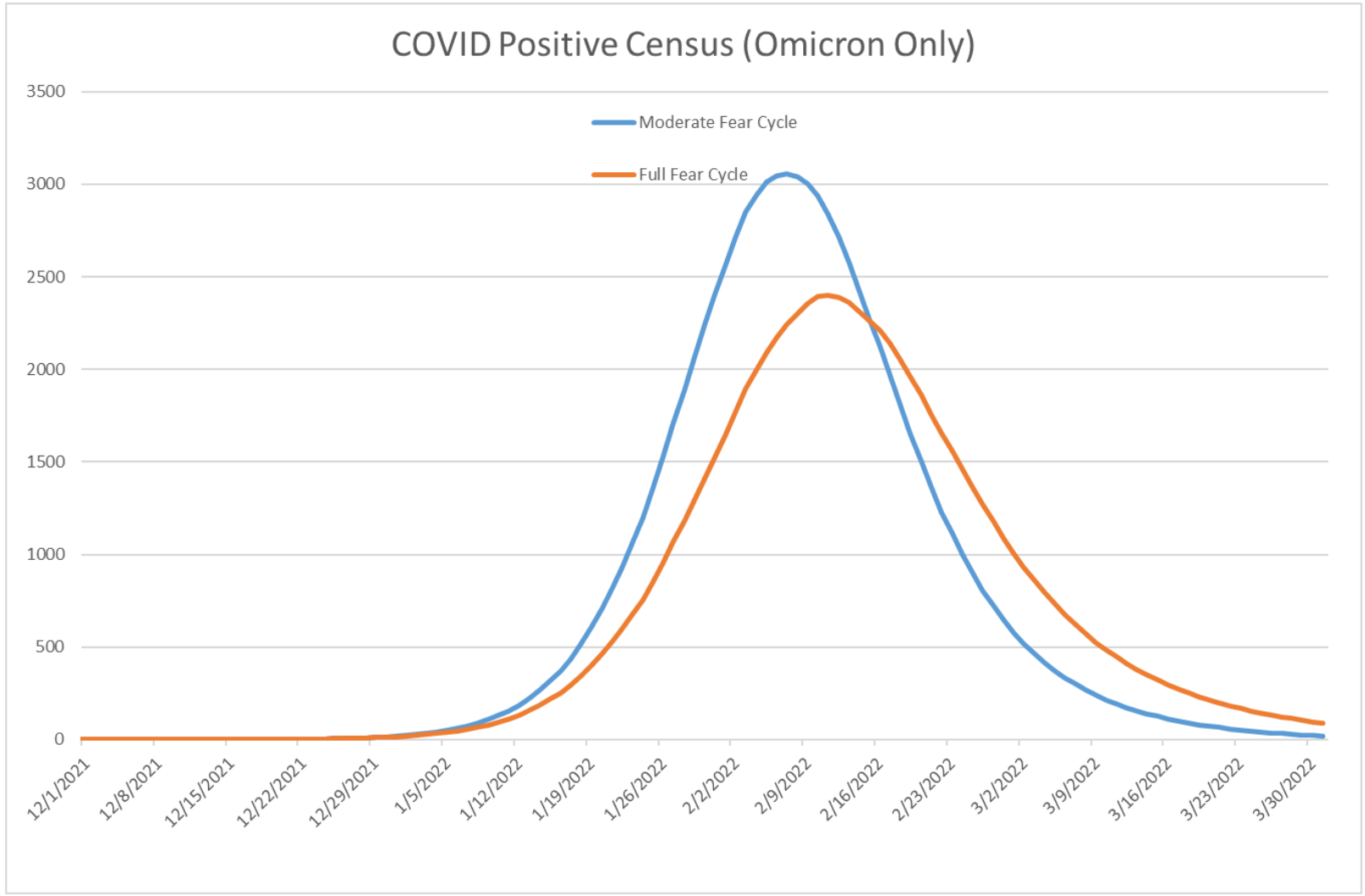
Notes: The OHSU state hospital census forecast is an SIR model modifed for Omicron. It assumes: days from exposure to admissions (10 days), length of stay (4 days, 12 days for ICU), and recovery period (14 days).

Boosting Effect

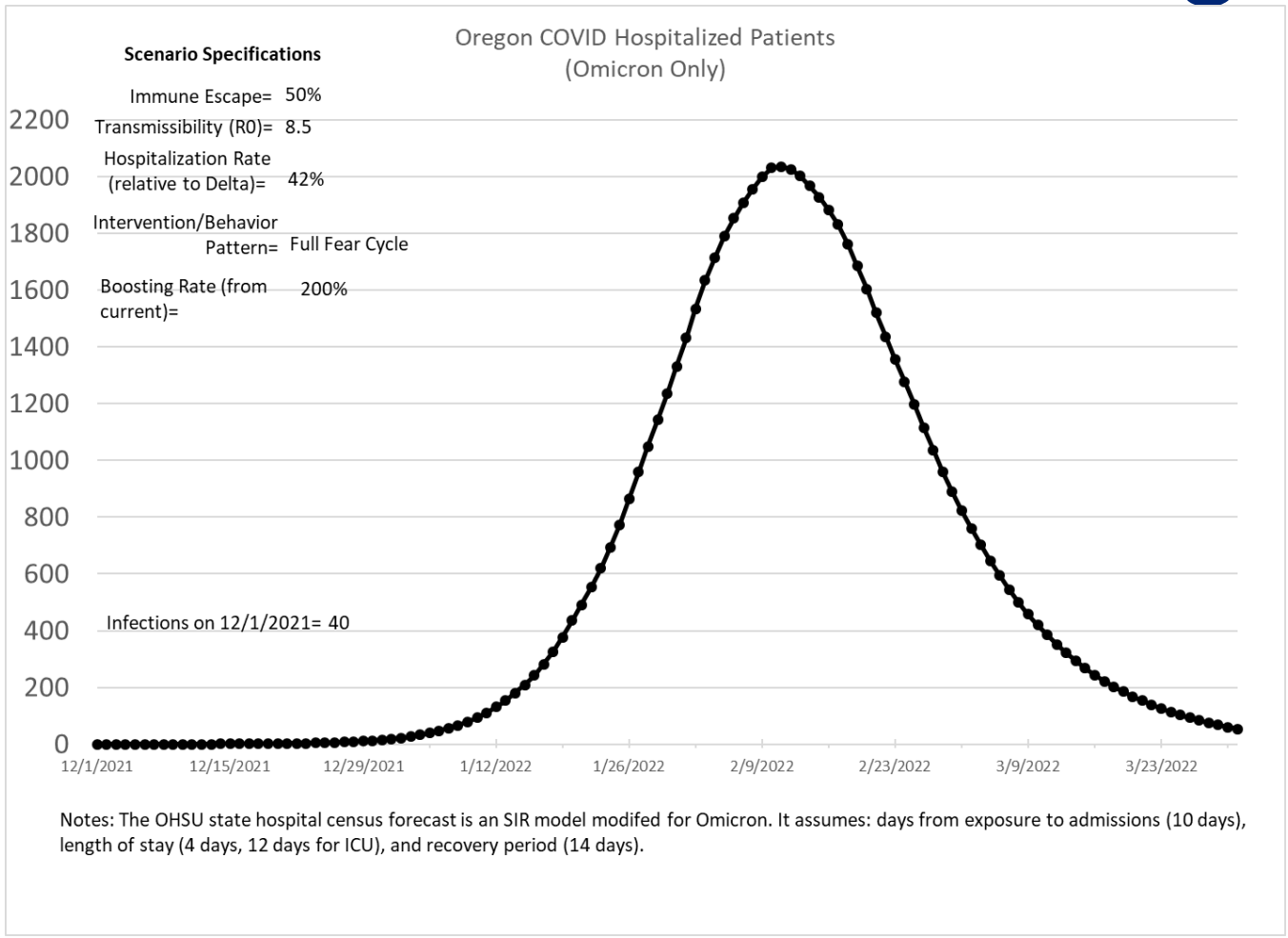


OHSU COVID Forecast Model

Behavior Effect



Forecast with Behavior Response and Increased Boosting



Notes: The OHSU state hospital census forecast is an SIR model modifed for Omicron. It assumes: days from exposure to admissions (10 days), length of stay (4 days, 12 days for ICU), and recovery period (14 days).

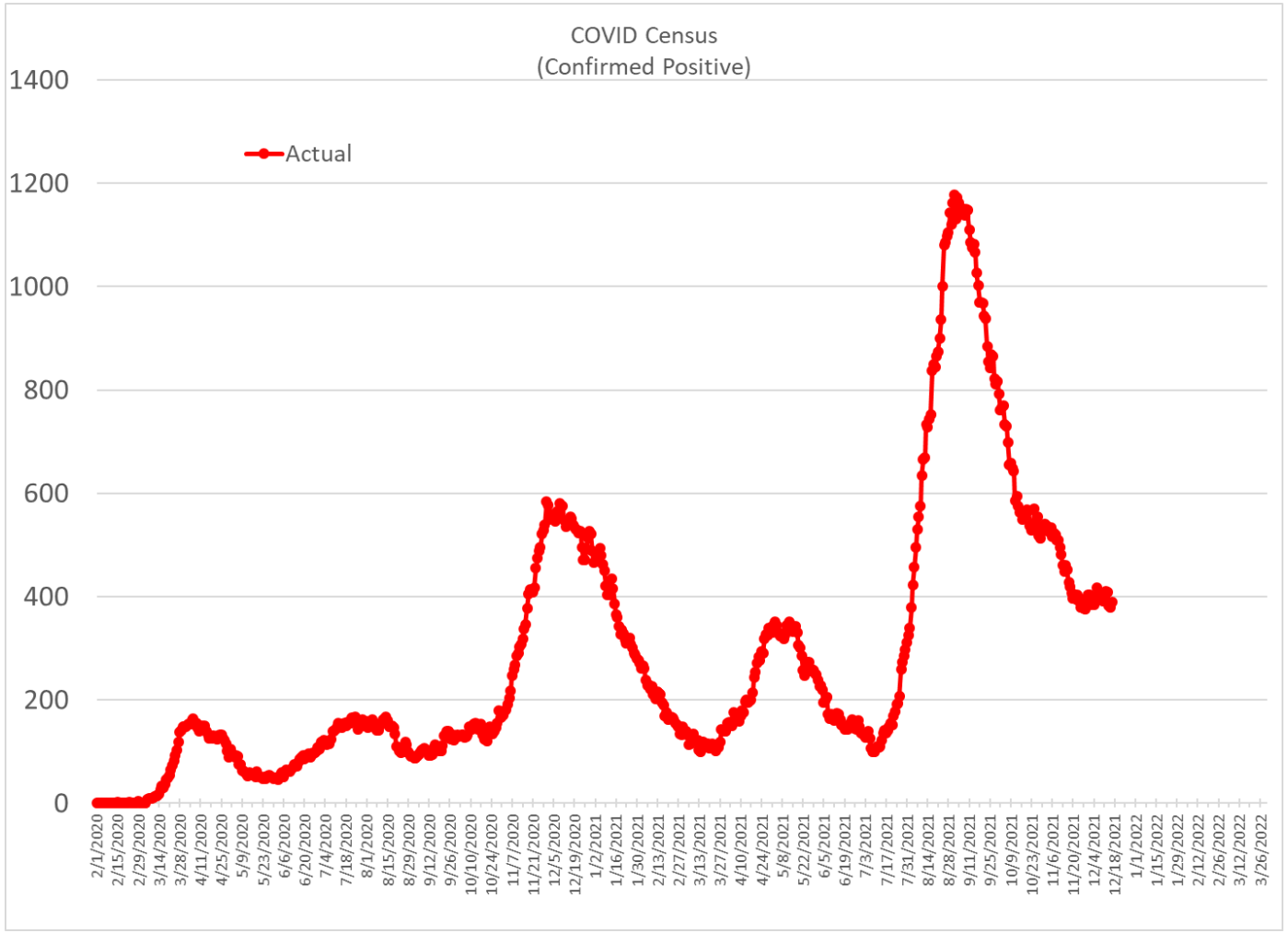
Additional Factors Not Included

- Targeting high risk of hospitalization with boosters or intervention
- Alternative settings for hospitalized patients that are less severe
- Capacity constraints from hospital staff illness
- Impact of antivirals

Key Outcomes

Hospitalized Patients

As of 12/16/2021, the statewide census was 389.



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

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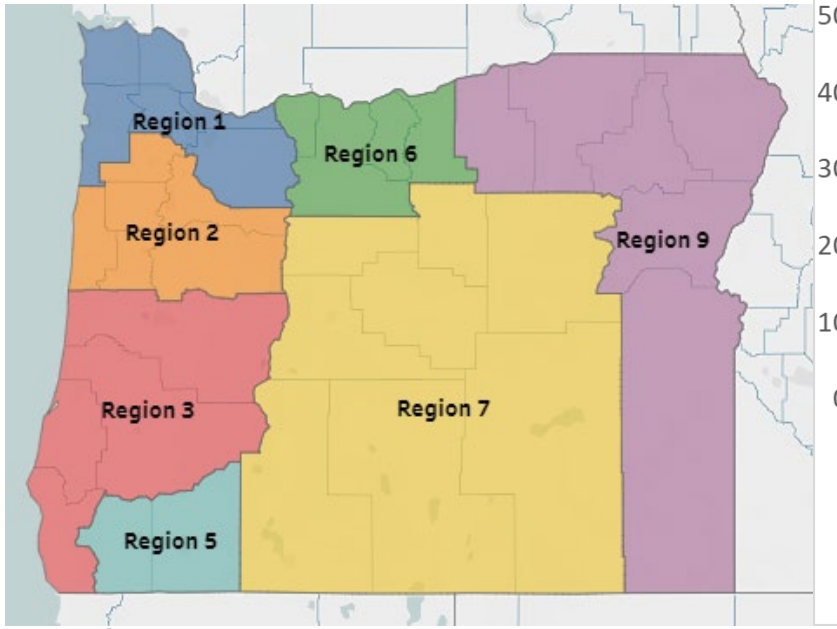
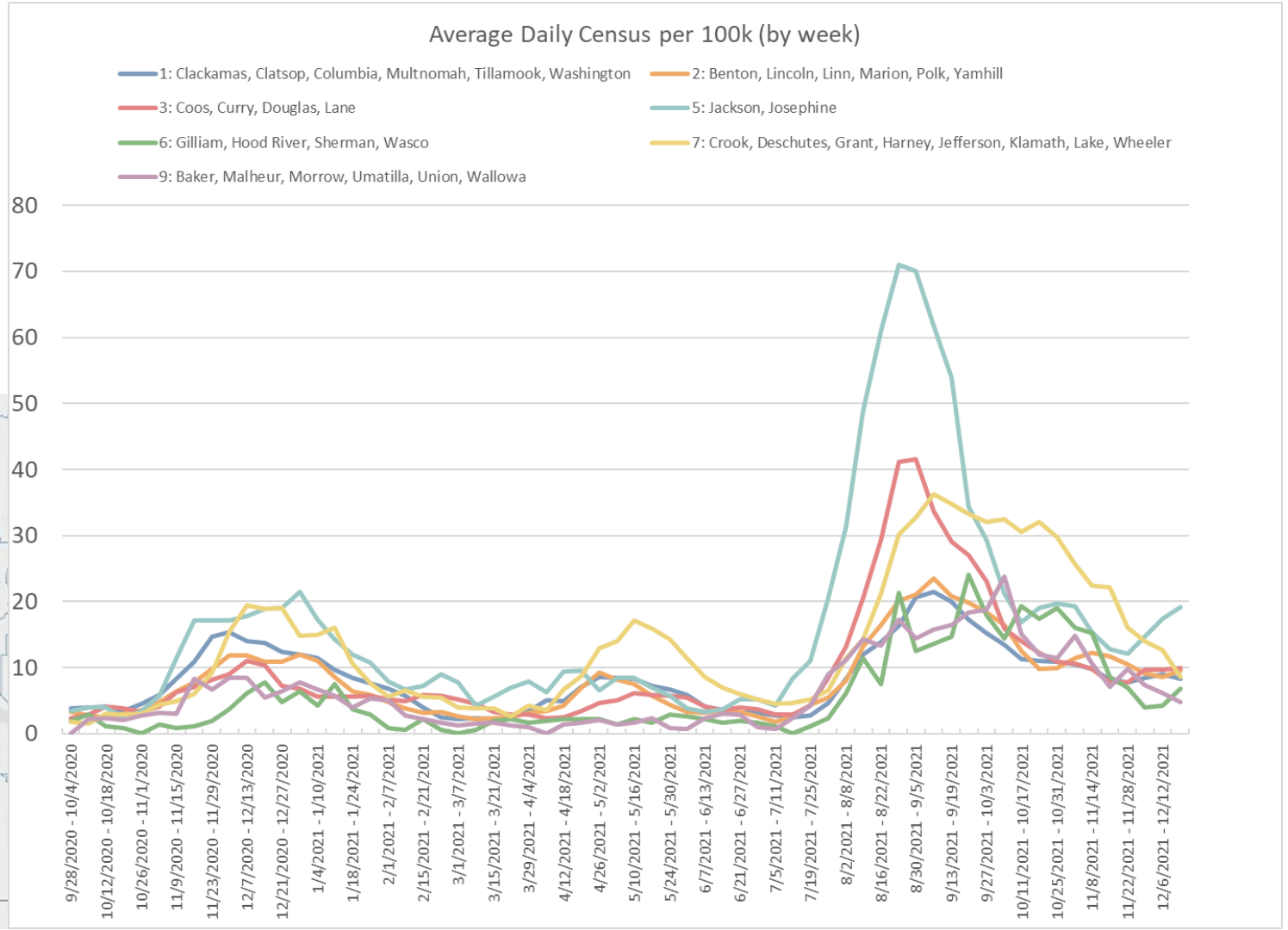
Regional Hospital Census

Region 5 is showing continued increase. Other regions are flat or declining.





Source: https://public.tableau.com/profile/oregon.health.authority.covid.19#!/vizhome/OregonCOVID-19HospitalCapacity/BedAvailabilitybyRegion

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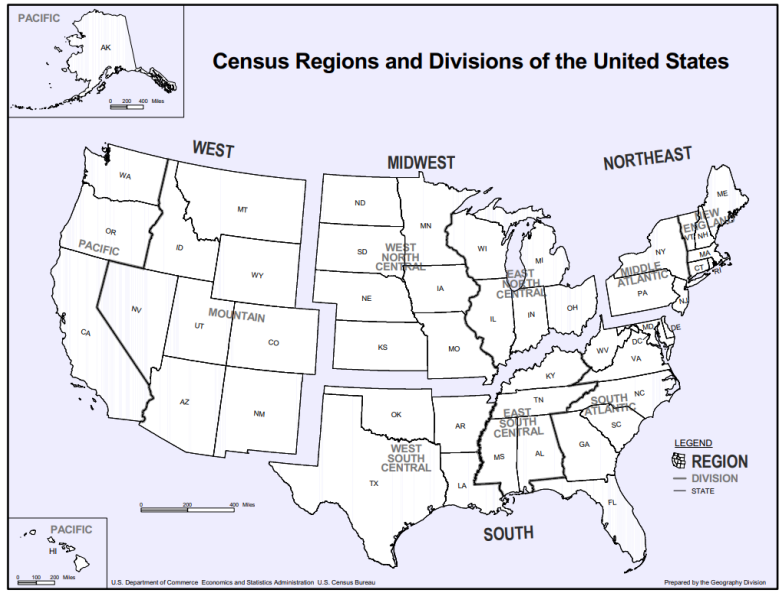
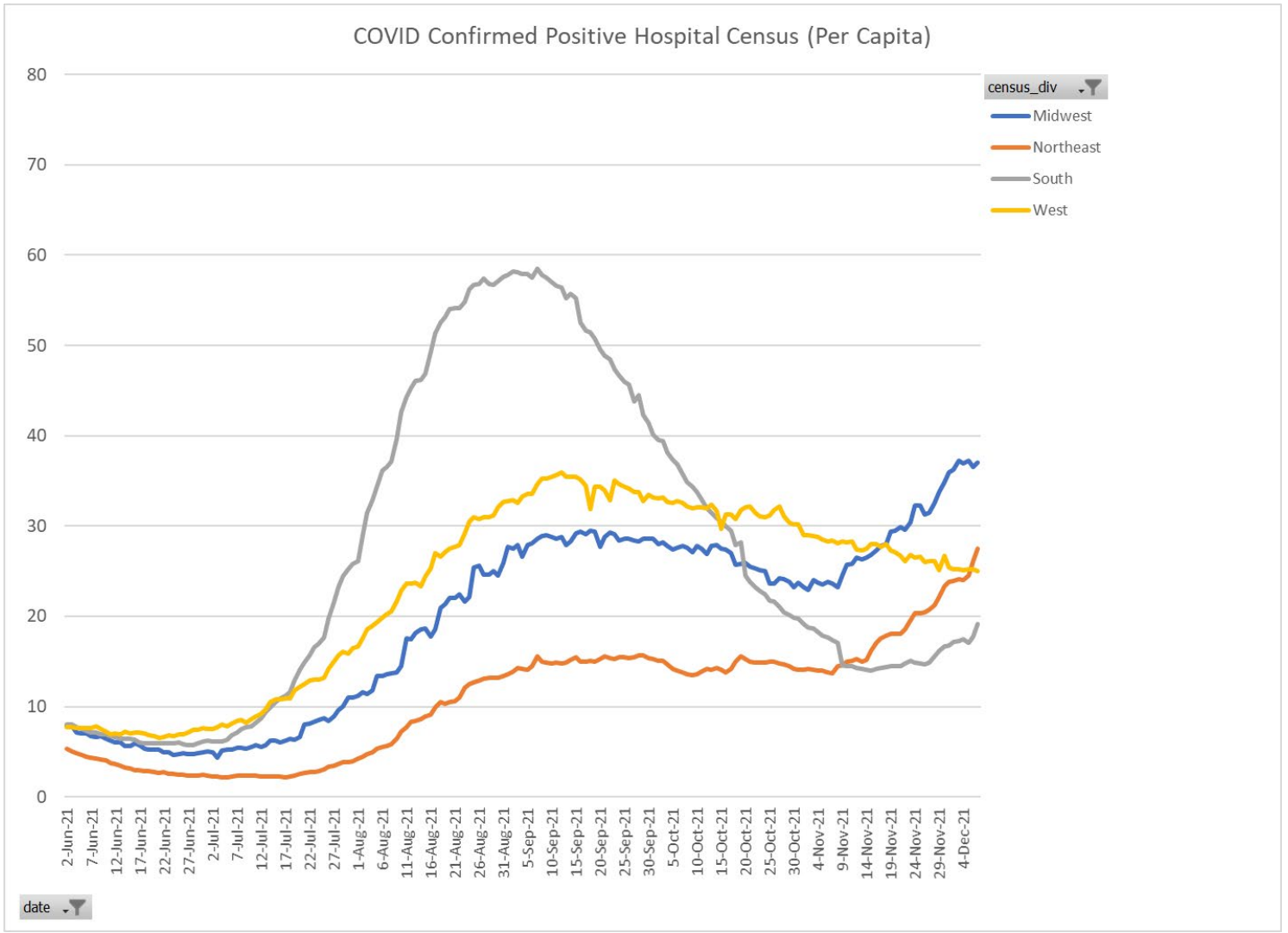
Hospital Census by US Region

The Midwest and Northeast are experiencing modest increases. The West and South are decreasing or flat.





Source: https://carlsonschool.umn.edu/mili-misrc-covid19-tracking-project

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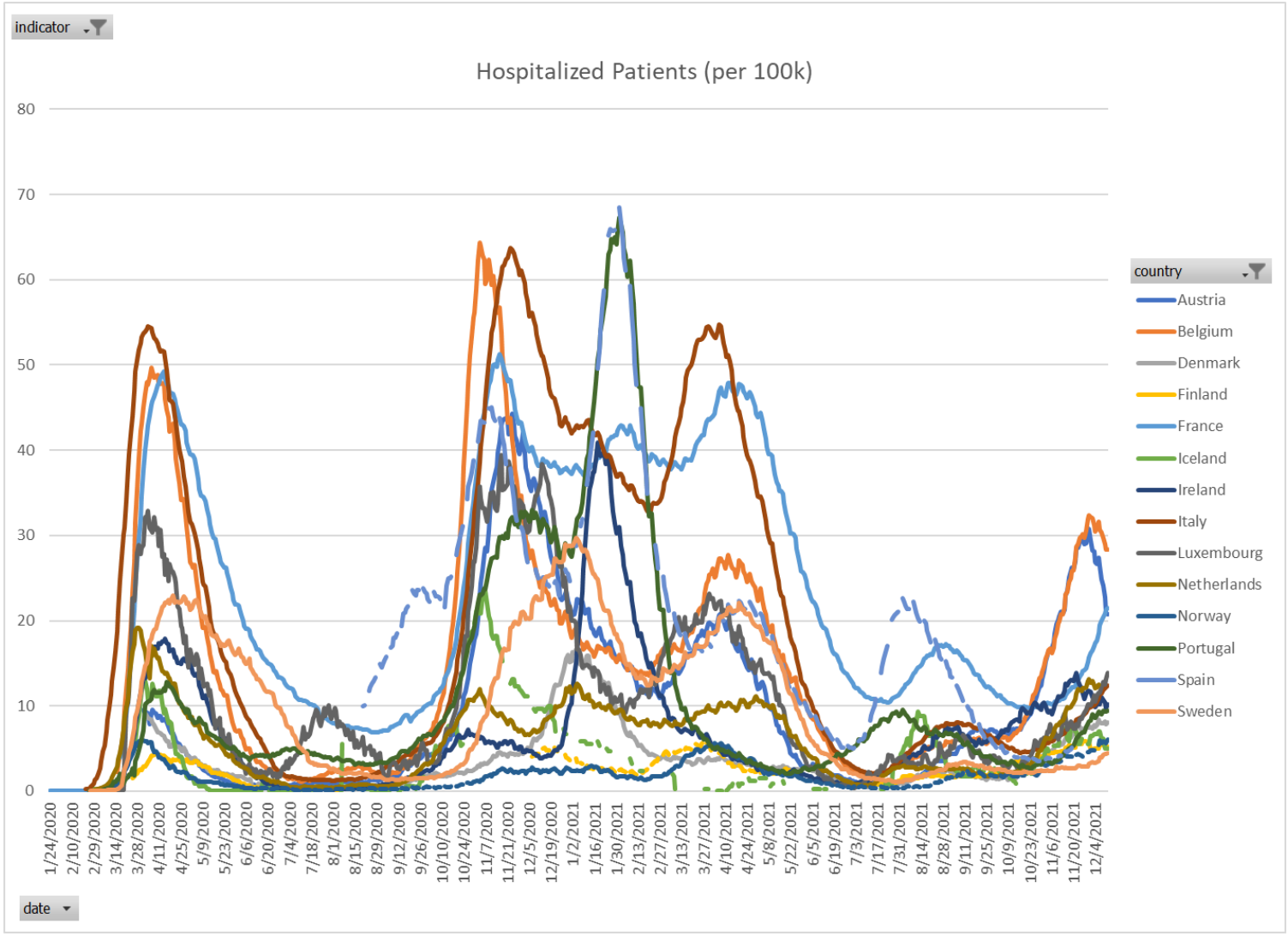
Hospitalizations in Europe

The hospitalization rate across Western European countries is shown. The list of countries includes: France, Spain, Italy, Belgium, Portugal, Austria, Netherlands, Sweden, Ireland, Finland, Denmark, Norway, Luxembourg, Iceland.

Belgium and Austria peaked and are declining. France is accelerating. Most others are stable.



Source: https://www.ecdc.europa.eu/en/publications-data/download-data-hospital-and-icu-admission-rates-and-current-occupancy-covid-19

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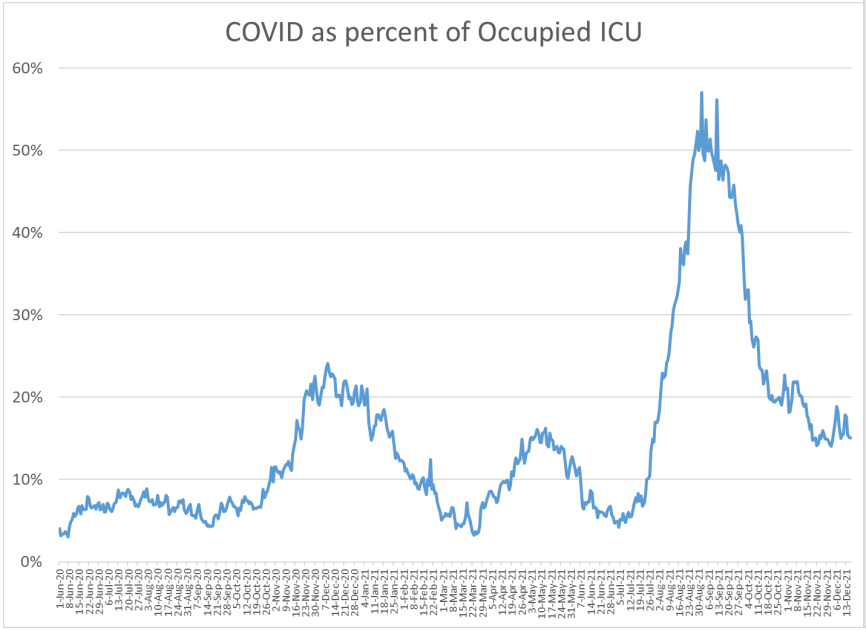
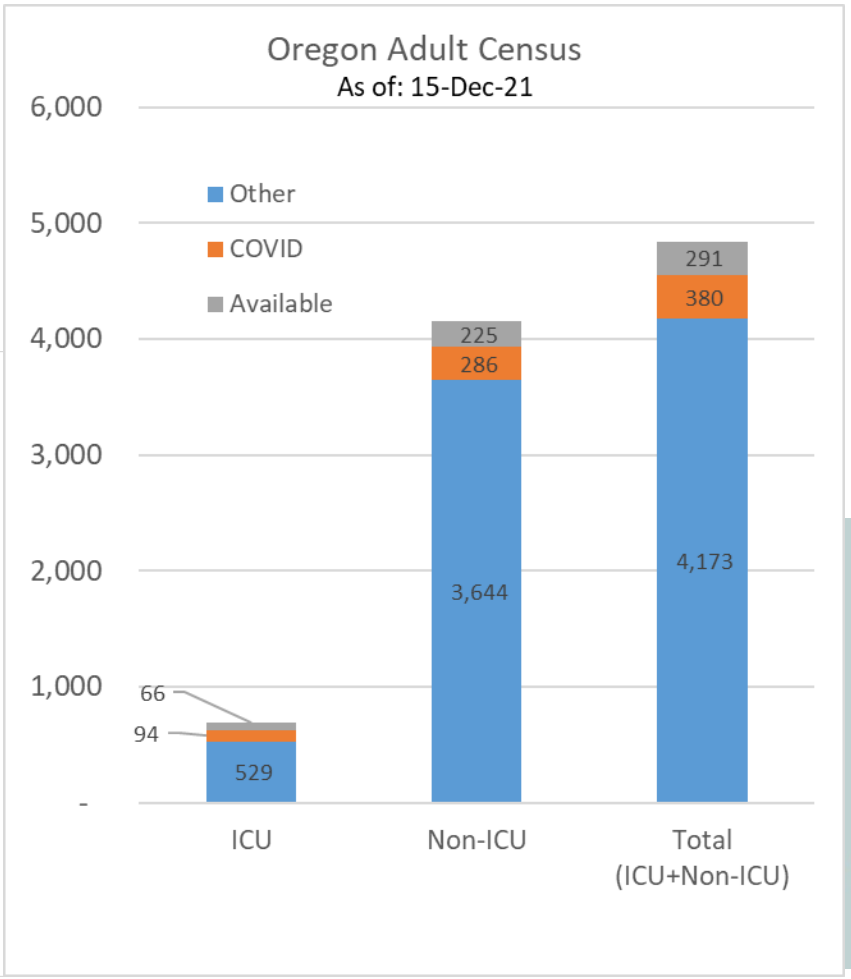
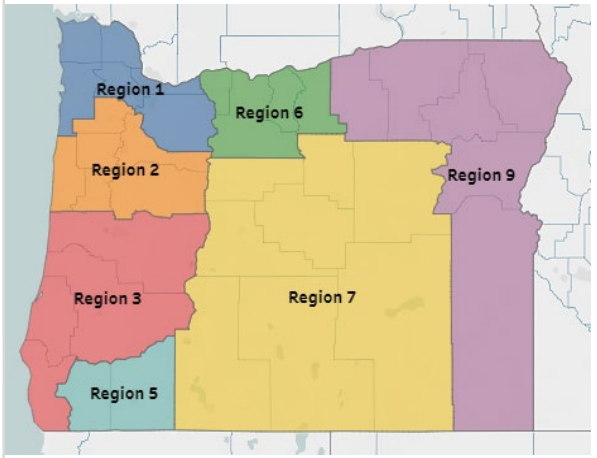
Oregon Hospital Capacity

As of 12/9, 15% of occupied ICU beds are filled with COVID patients.





Region	Share of Occupied ICU	w/COVID Non-ICU	Total
1	11%	6%	7%
2	17%	12%	13%
3	13%	9%	9%
5	40%	8%	12%
6	13%	9%	10%
7	14%	5%	6%
9	20%	5%	7%
Total	15%	7%	8%



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

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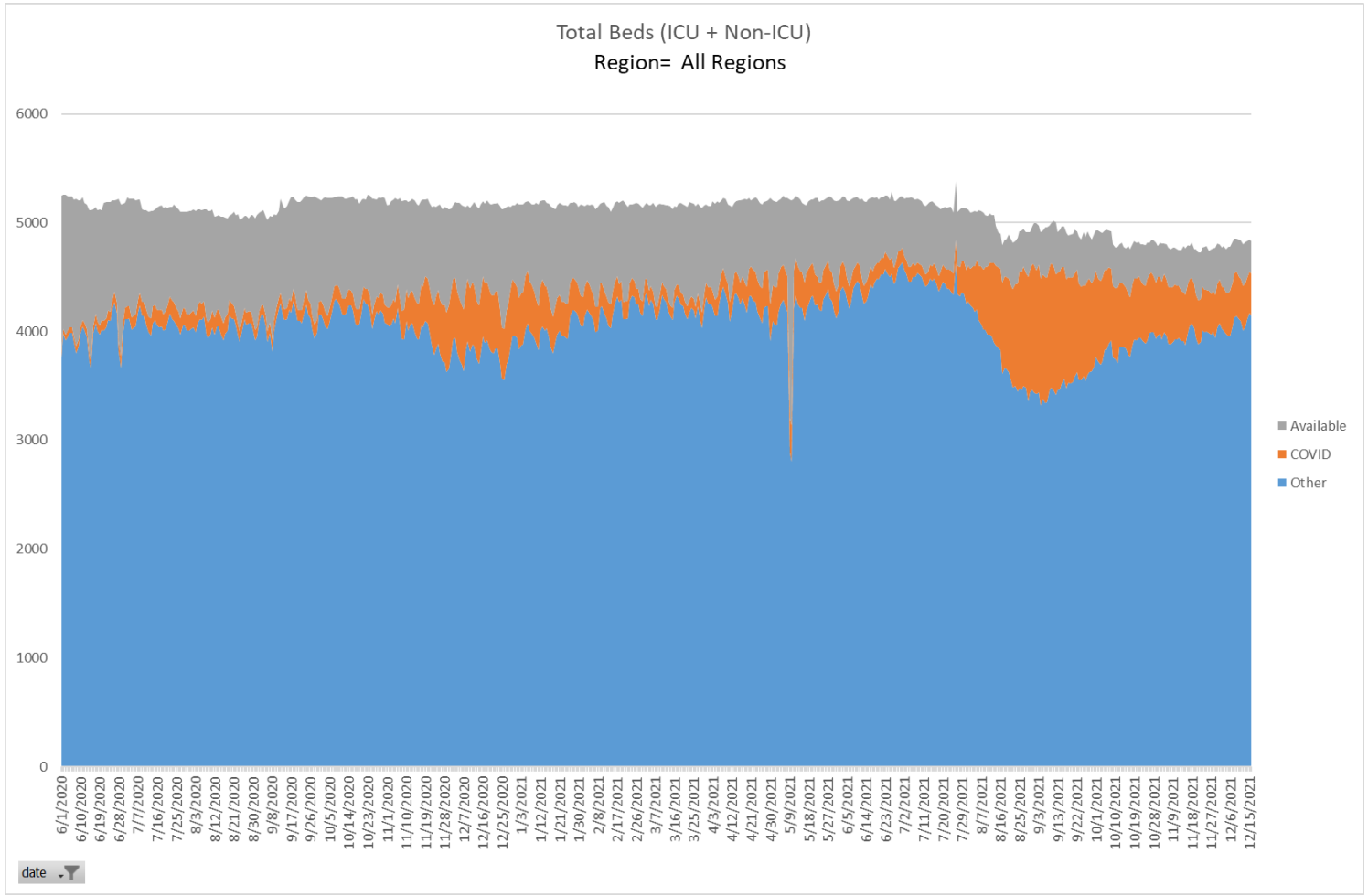
Oregon Hospital Capacity

These data are based on HOSCAP reports of individuals infected with COVID.



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

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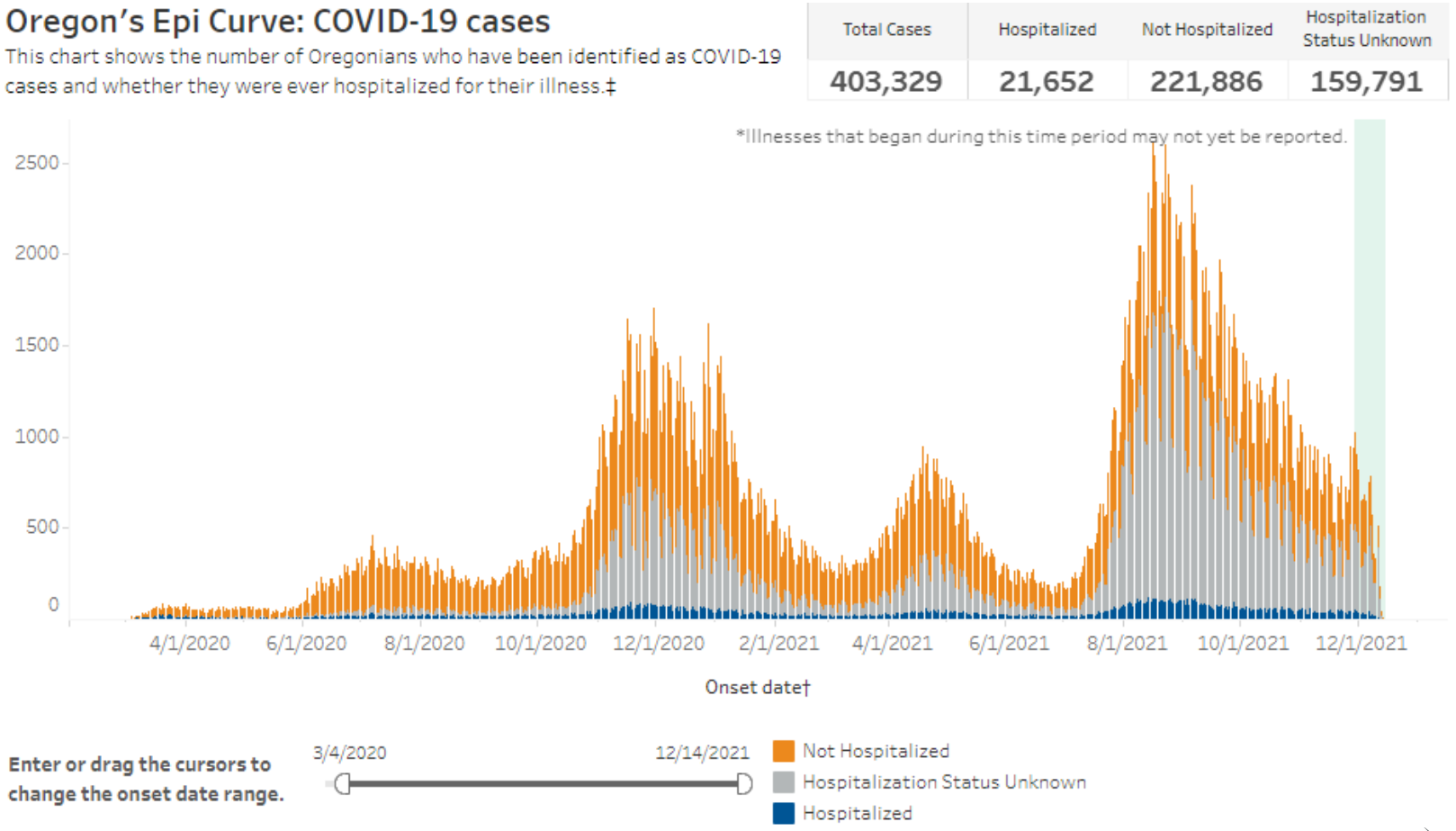
New Cases per Capita

Case rates continue to decline. Some increase in cases was expected following Thanksgiving.

Oregon is the 9th lowest in the US in the number of new cases per day.



Source: https://public.tableau.com/app/profile/oregon.health.authority.covid.19/viz/OregonHealthAuthorityCOVID-19DataDashboard/COVID-19EPICases

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Cases by Vaccination Status

As of 12/16, general declines in case rates in both populations are evident.

Observed vaccine effectiveness remains steady.

Note: The vaccine effectiveness chart reflects revisions to data in the breakthrough report.

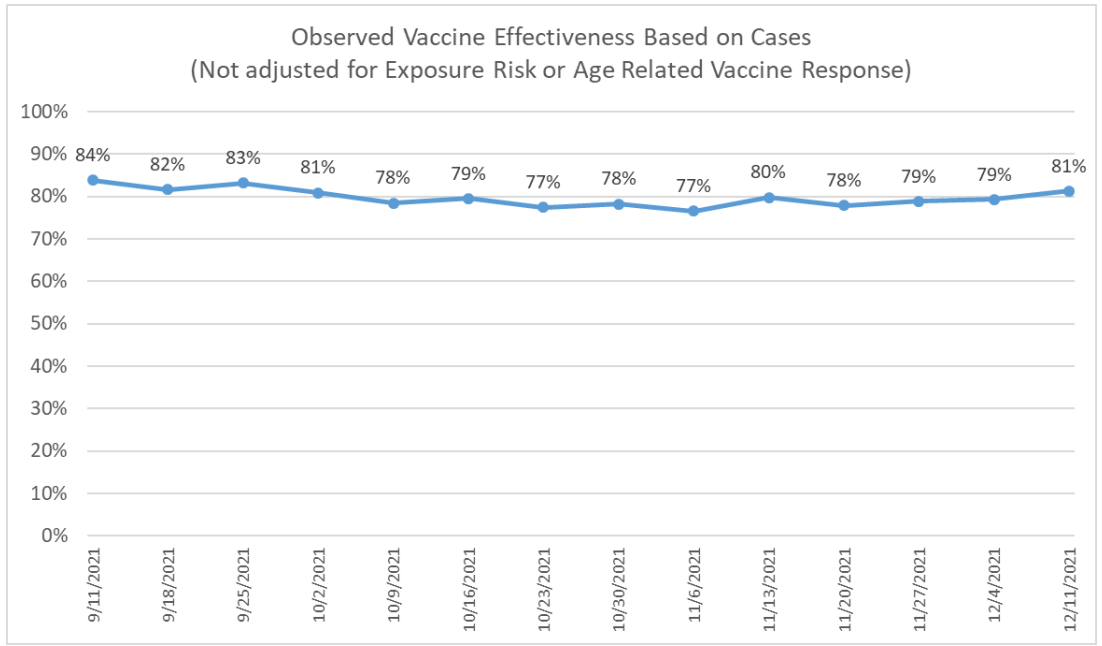
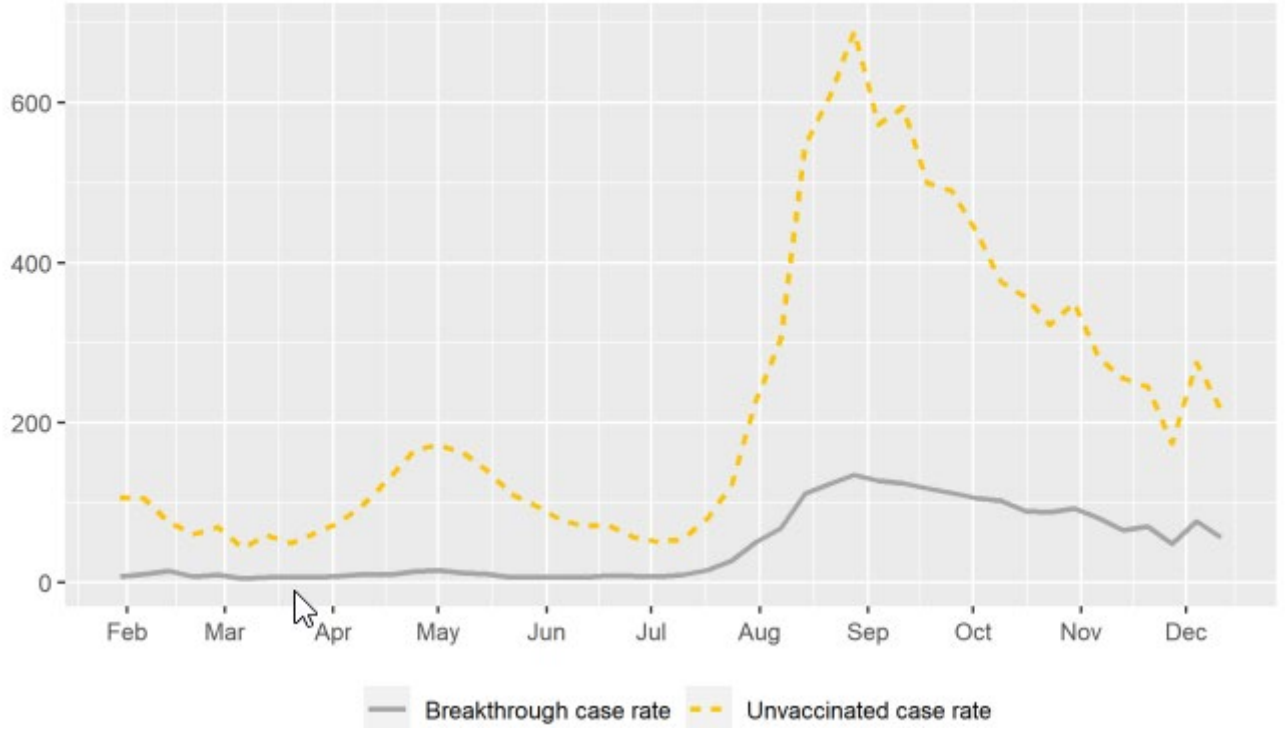


Figure 1. COVID-19 cases per 100,000 per week, by vaccination status



Note: Observed Vaccine efficacy is calculated as 1-(CasesVac/CaseUnvac)*(PctUnvac/PctVac)

Source: https://www.oregon.gov/oha/covid19/Documents/DataReports/Breakthrough-Case-Report.pdf

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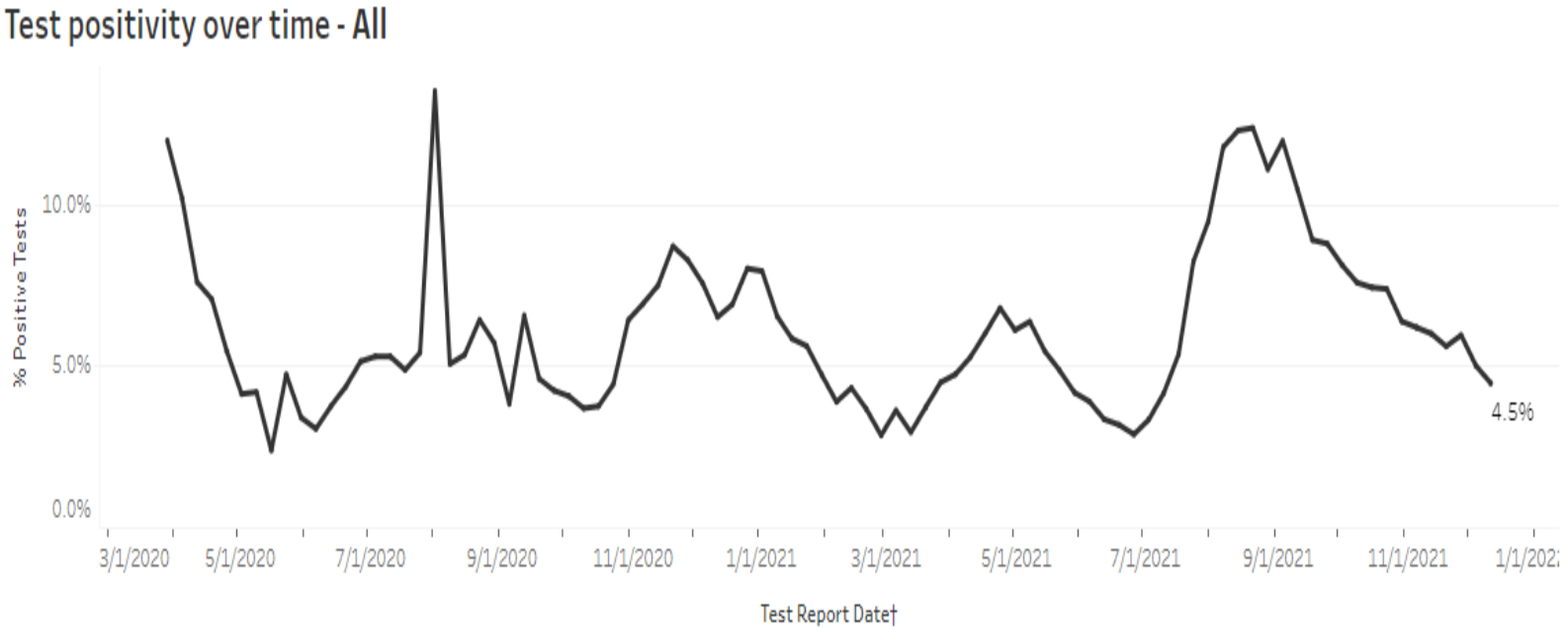
Test Positivity

The most recent complete week (12/5-12/11) had a test positivity of 5.0%.



Source: https://public.tableau.com/profile/oregon.health.authority.covid.19#!/vizhome/OregonHealthAuthorityCOVID-19DataDashboard/OregonsCOVID-19ELRsOverTime

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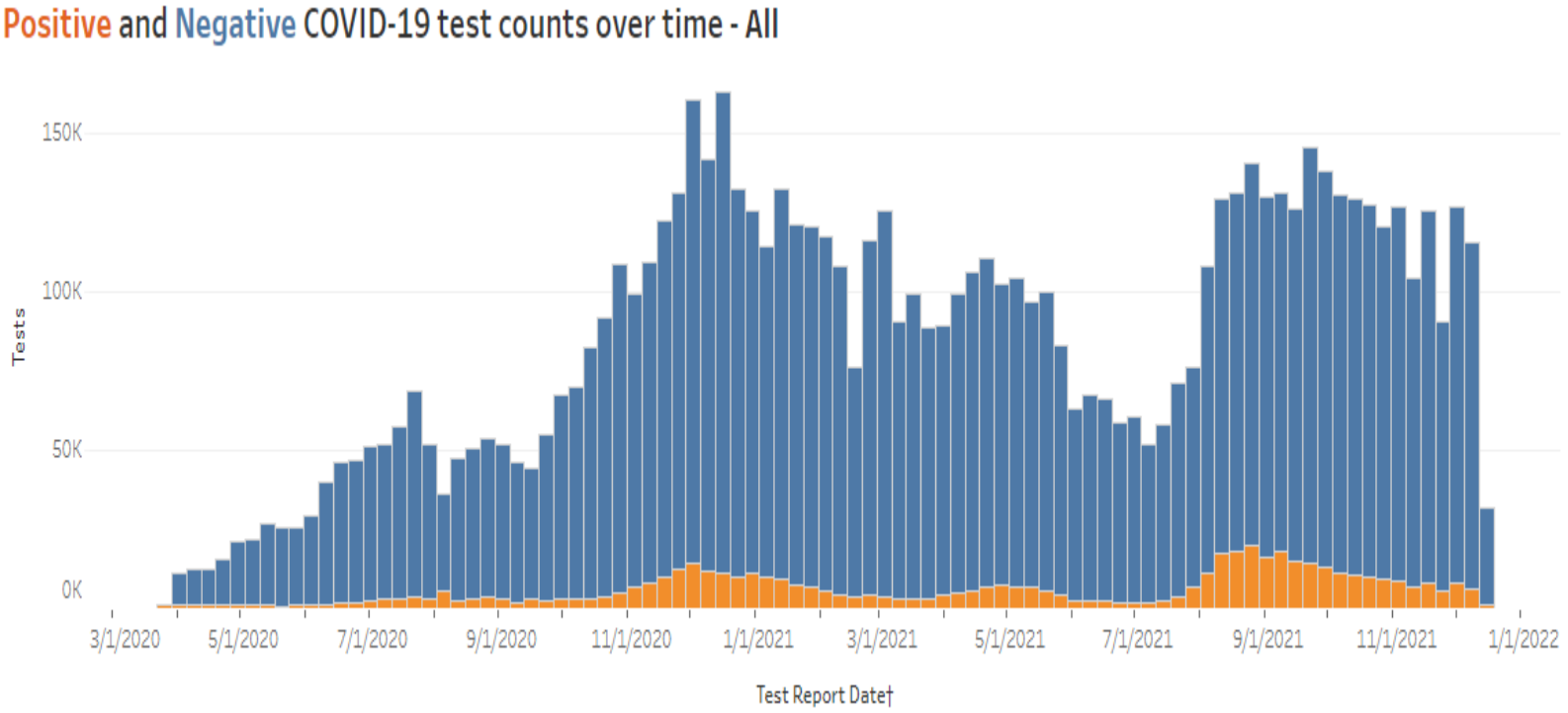
Total Tests

Testing levels remain at similar levels seen throughout Delta surge.



Source: https://public.tableau.com/profile/oregon.health.authority.covid.19#!/vizhome/OregonHealthAuthorityCOVID-19DataDashboard/OregonsCOVID-19ELRsOverTime

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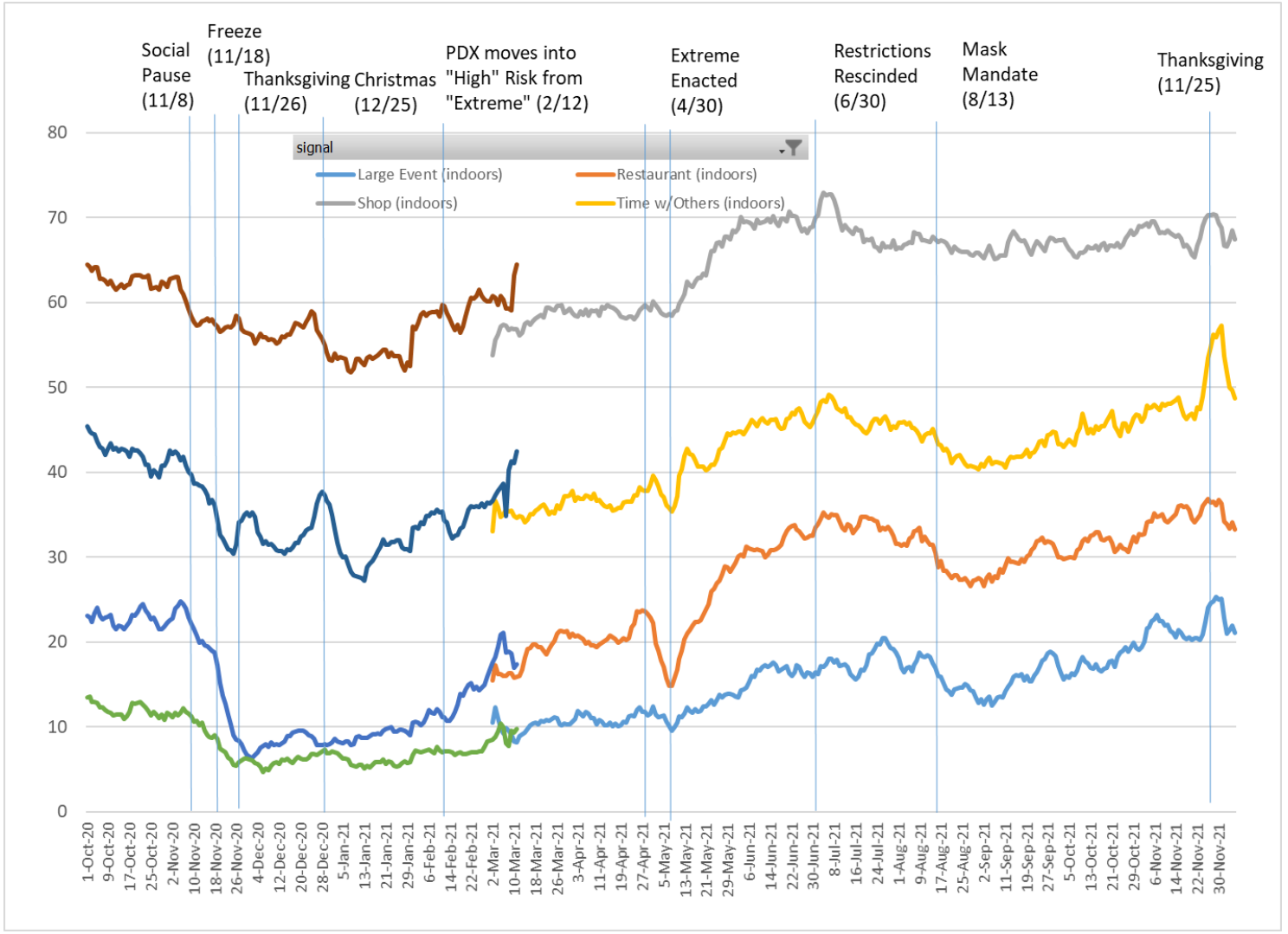
Review of Leading Indicators

Higher Risk Behaviors

Time with others returned to Pre-Thanksgiving levels. Other metrics remained flat.



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

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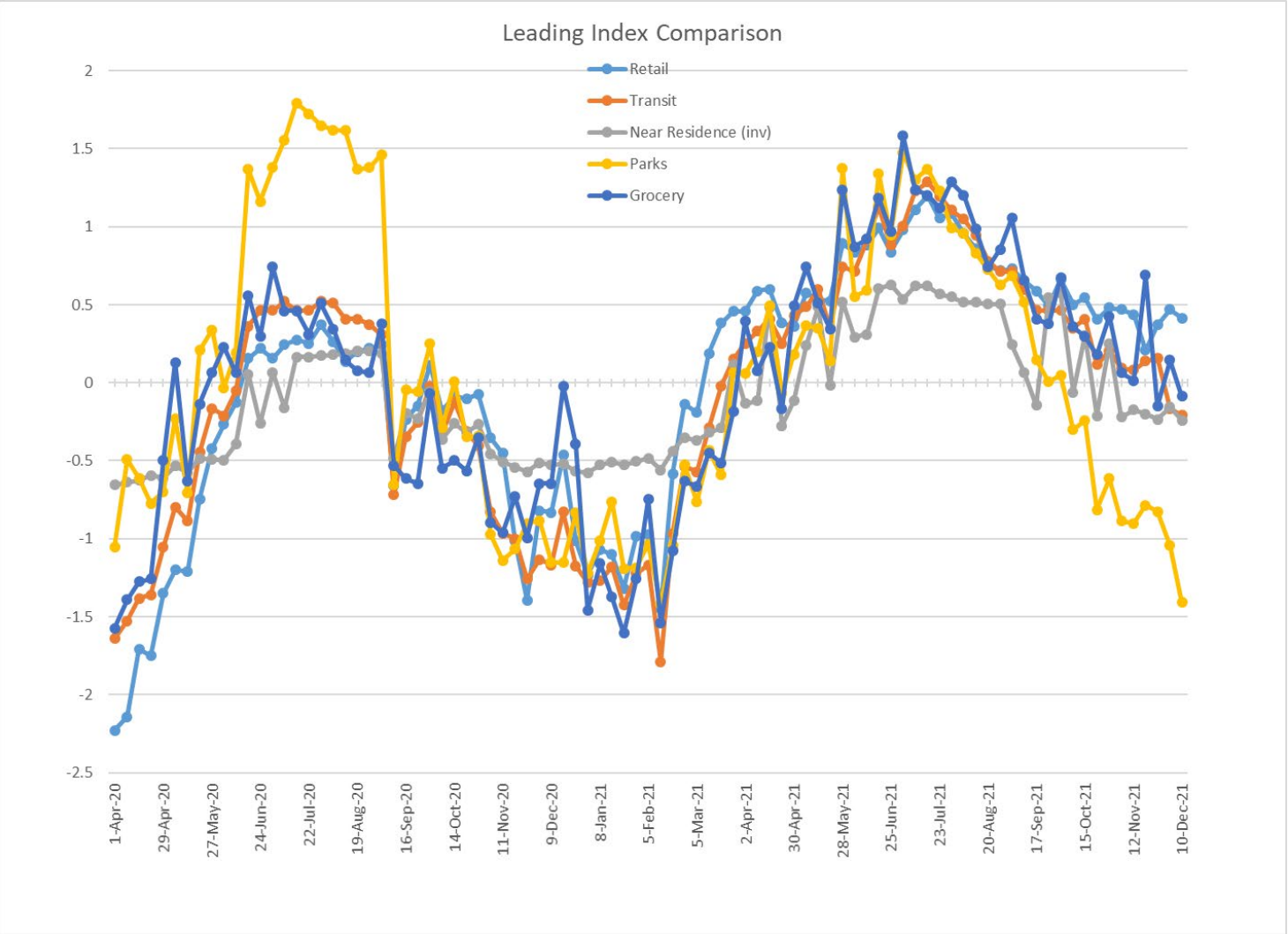
Google Mobility Metrics

Grocery trips increased during Thanksgiving week. Other metrics continue a seasonal decline.



Source: Google mobility reports from https://www.google.com/covid19/mobility/

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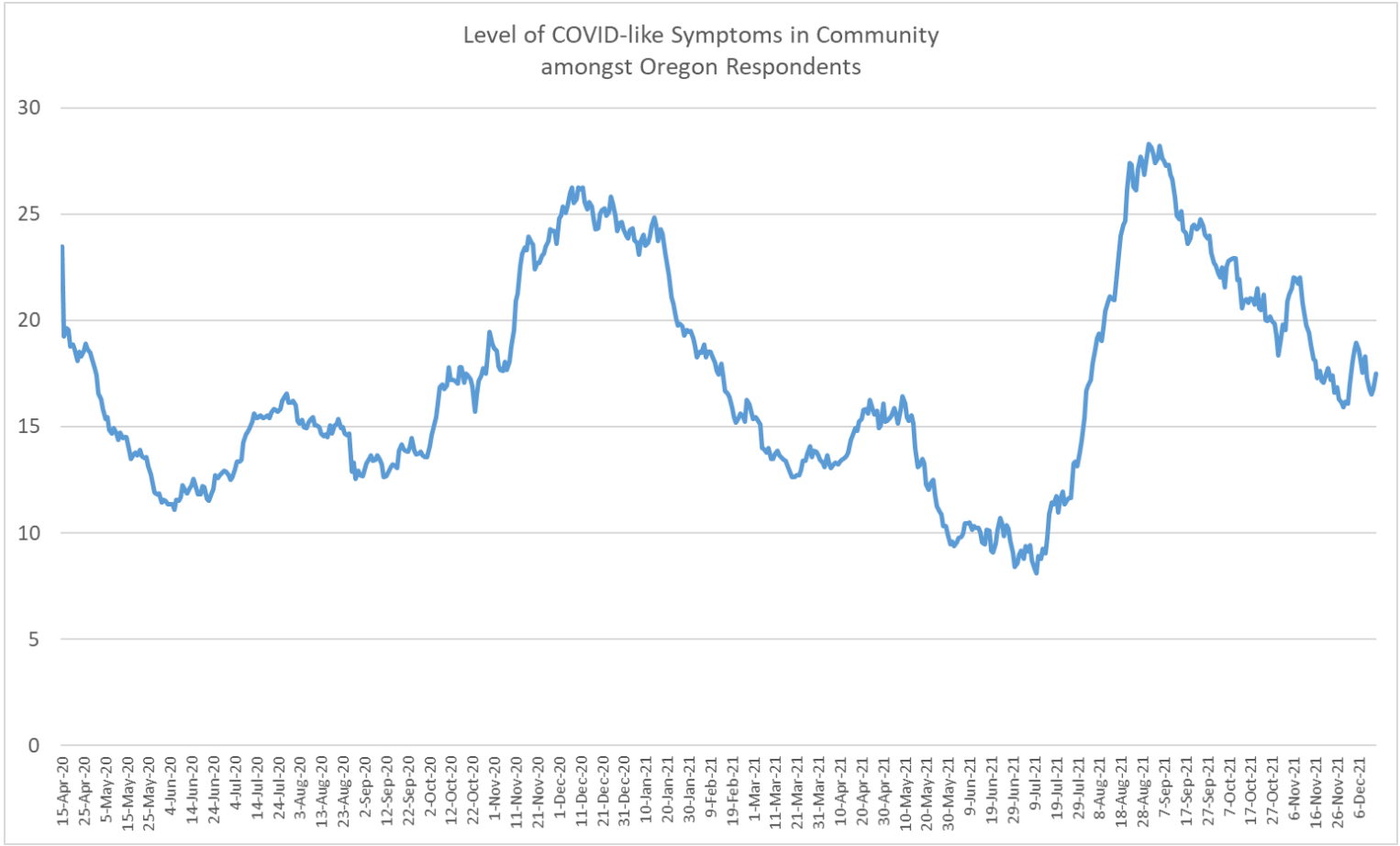
Symptoms

Symptoms bounced up in last week though may not be a trend unless they continue for another week.

Note: “Symptoms” refer to community reports of COVID-like symptoms through Facebook surveys.



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

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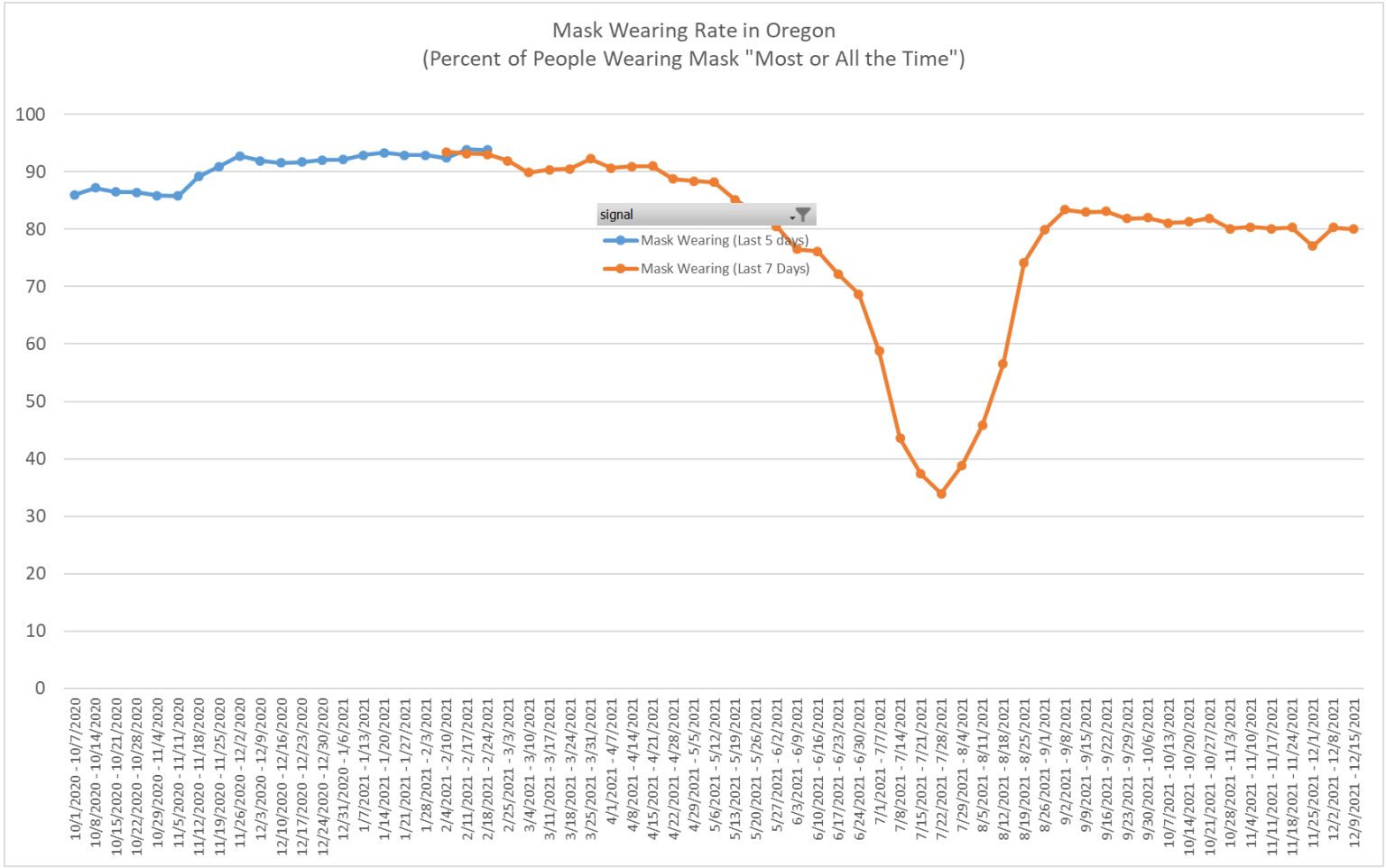
Mask Wearing

Mask wearing remains high.



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

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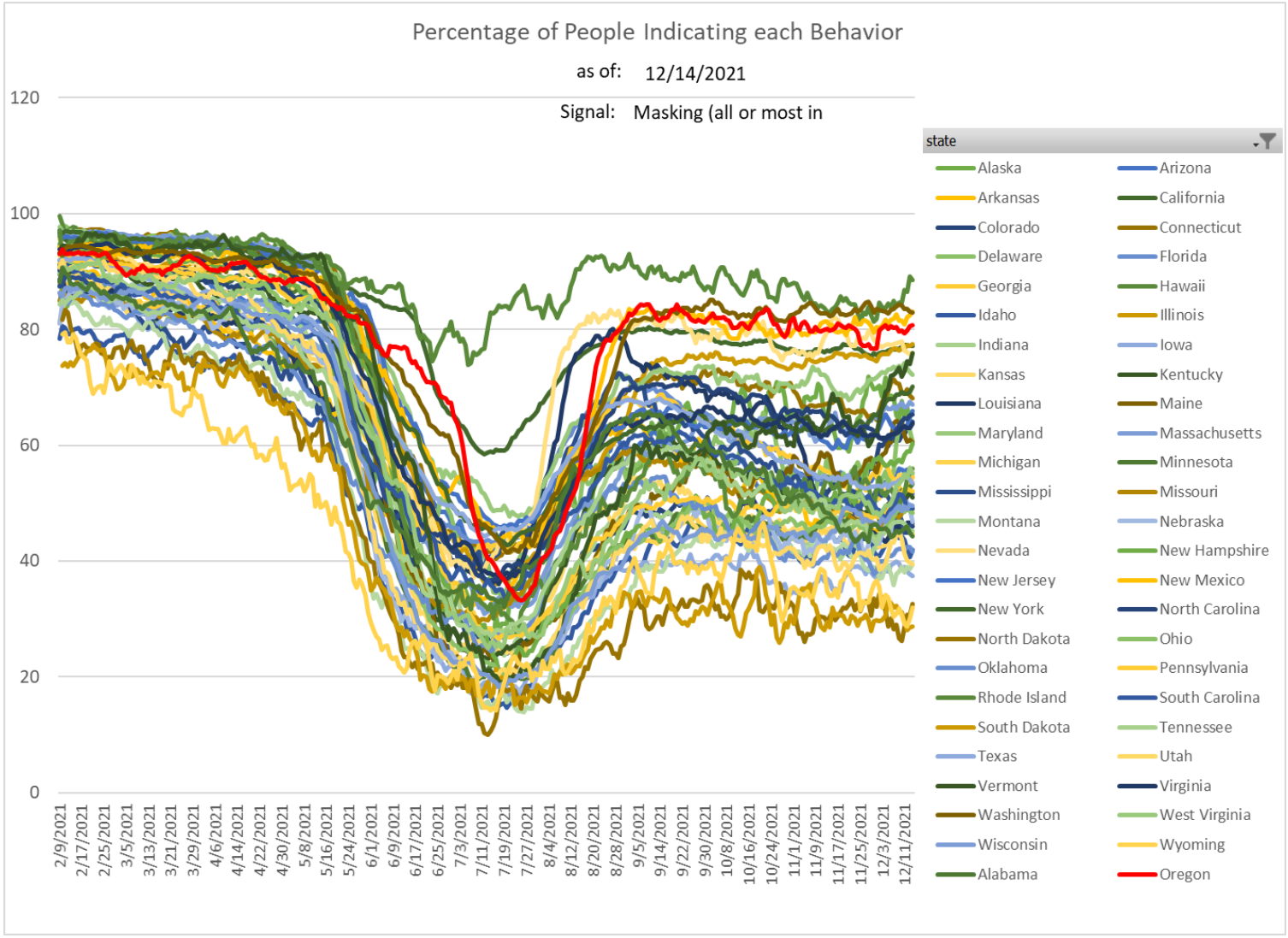
Masking Wearing by State

Oregon has the 4th highest masking rate in the country.



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

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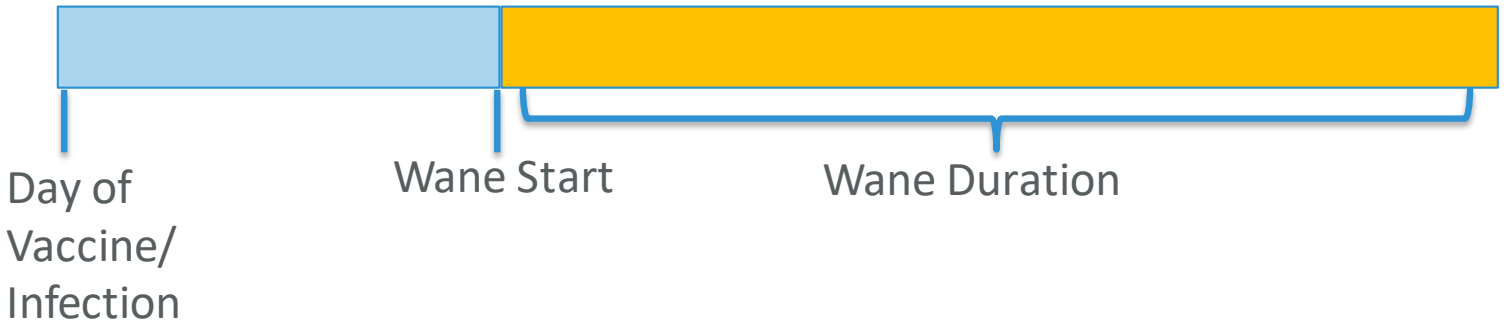
Statewide Forecast

Model Assumption-Waning Immunity

In order for the model to account for waning immunity of previous infection or vaccine, certain assumptions are needed. This model uses a basic structure which indicates:

1) Wane Starts: How many months after infection/vaccine waning begins.
2) Wane Duration: How long until waning is complete.
3) Wane Share: Percent of people who will not get boosters to prevent waning.



Scenario	Standard		Short	
Parameter	Vaccine	Infection	Vaccine	Infection
Wane Start (months)	12	12	9	9
Wane Duration (months)	24	24	12	12
Wane Share	35%	50%	35%	50%

Source: OHSU Forecast Model, https://www.thelancet.com/journals/lanmic/article/PIIS2666-5247(21)00219-6/fulltext

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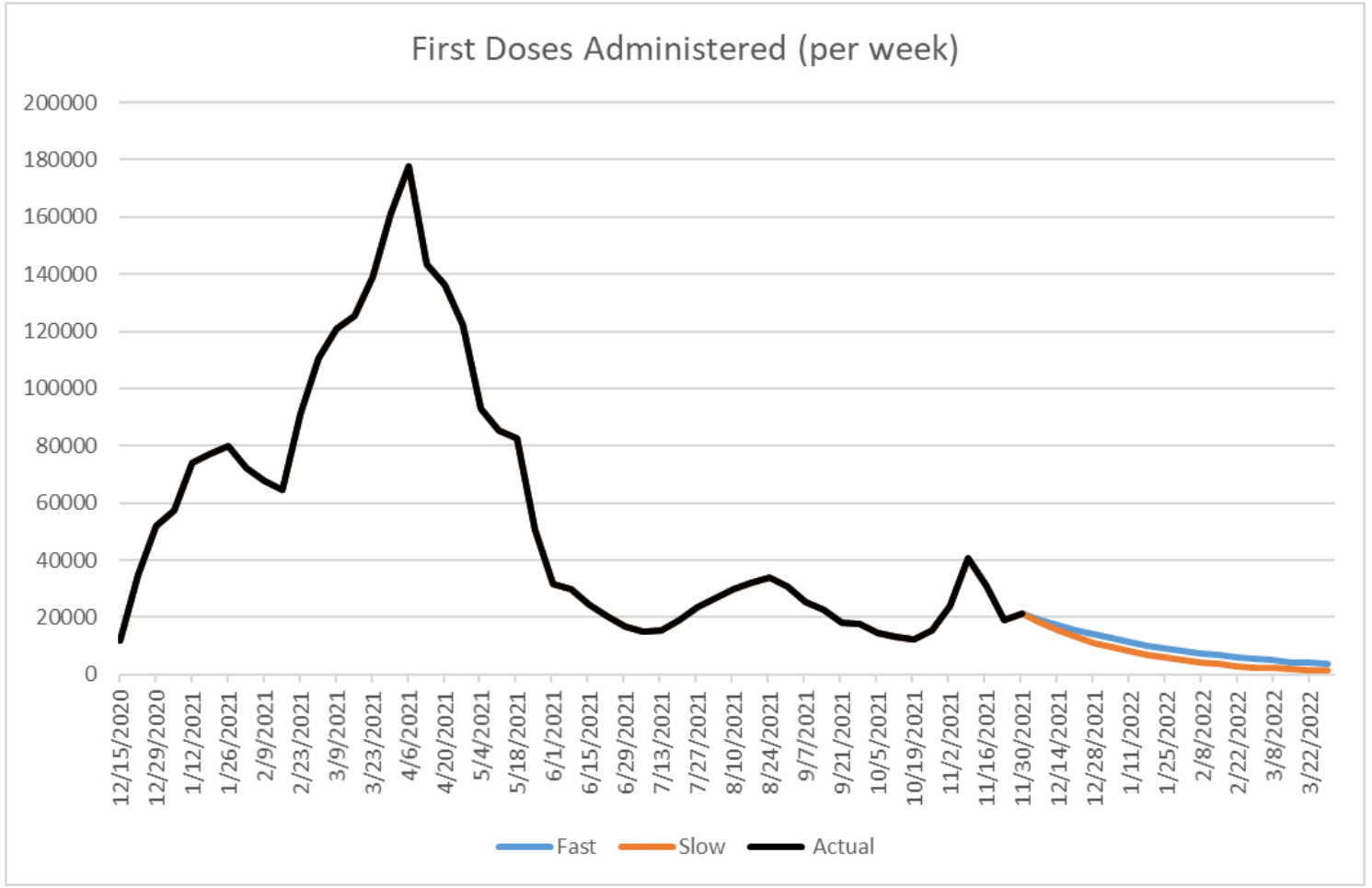
Model Assumption-Vaccine Volume

First dose vaccinations decreased after peaking at 40k per week.

First dose vaccination are expected to decline as the newly eligible age group (ages 5-11) reaches the 55% expected level of vaccination.



Source: https://public.tableau.com/profile/oregon.health.authority.covid.19#!/vizhome/OregonCOVID-19VaccinationTrends/OregonStatewideVaccinationTrends, Projections by OHSU using Weekly Dose Projections from OHA.

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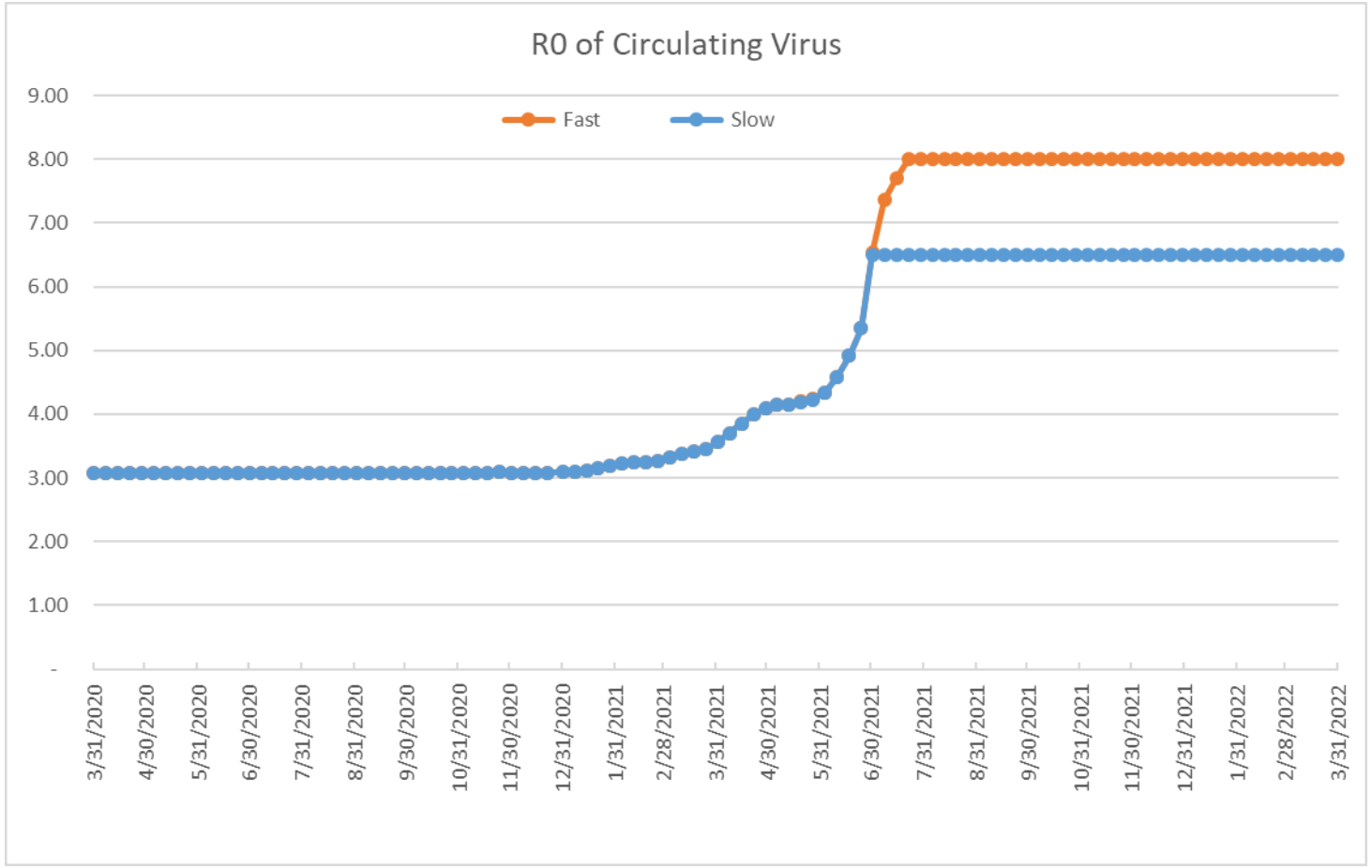
Model Assumption-Virus Spread Rate

With no new variants measured in Oregon, the transmission rate is driven by the estimated transmission rate of the Delta variant.

The “Fast” scenario assumes delta variant has an R0 of 8.0.

The “Slow” scenario assume R0=6.5



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

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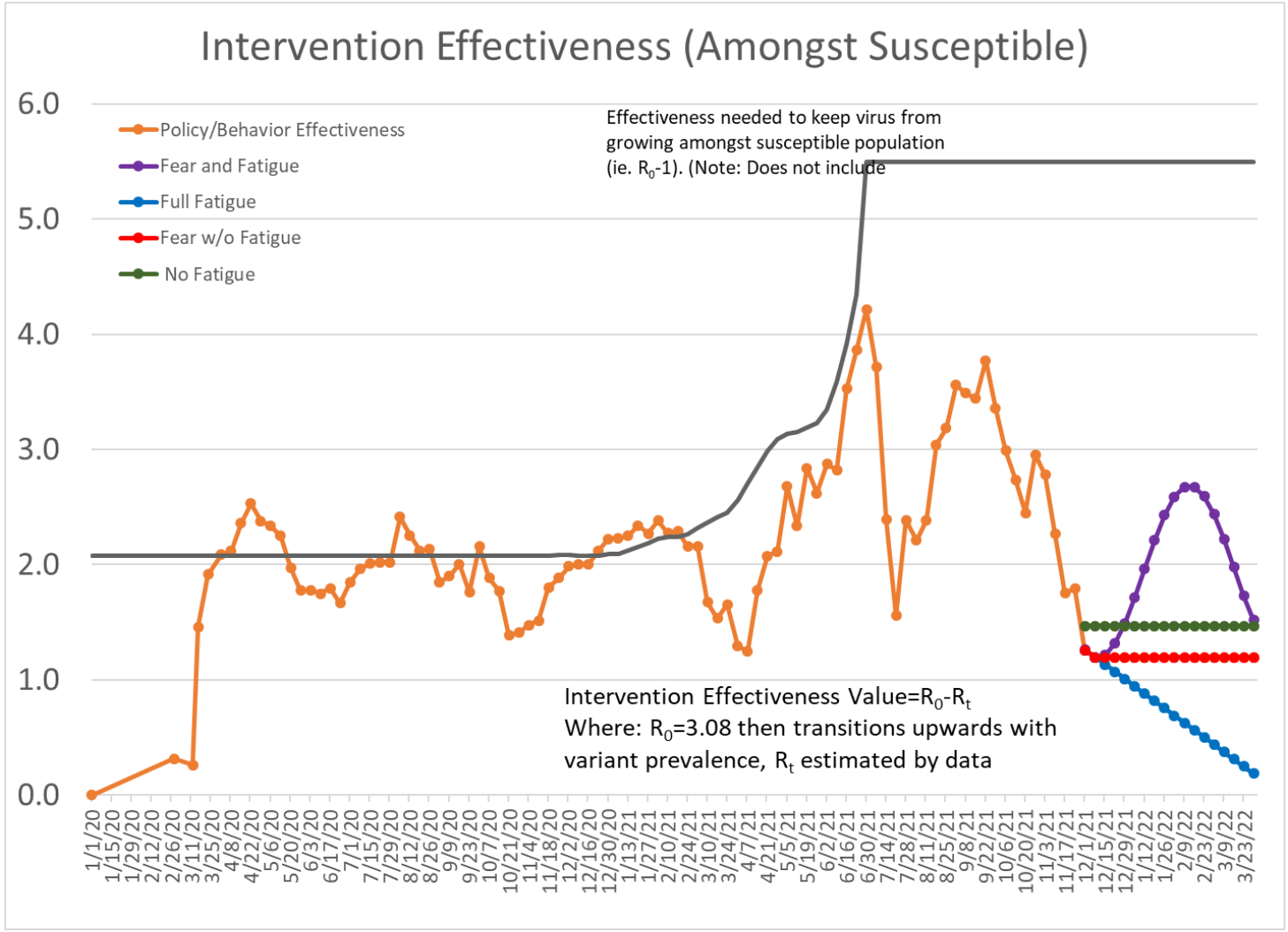
Model Assumption- Policy/Behavior

The most recent week shows continued fatigue pattern of declining effectiveness.

Four scenarios are constructed to show possible paths.

1) Fear and Fatigue: this is a full cycling through forecast period.
2) Fatigue without Fear: this shows what happens if no new fear cycle begins
3) Full Fatigue: This shows what happens if fatigue continues
4) No Fatigue: maintains effect level



Source: OHSU COVID Forecast Model

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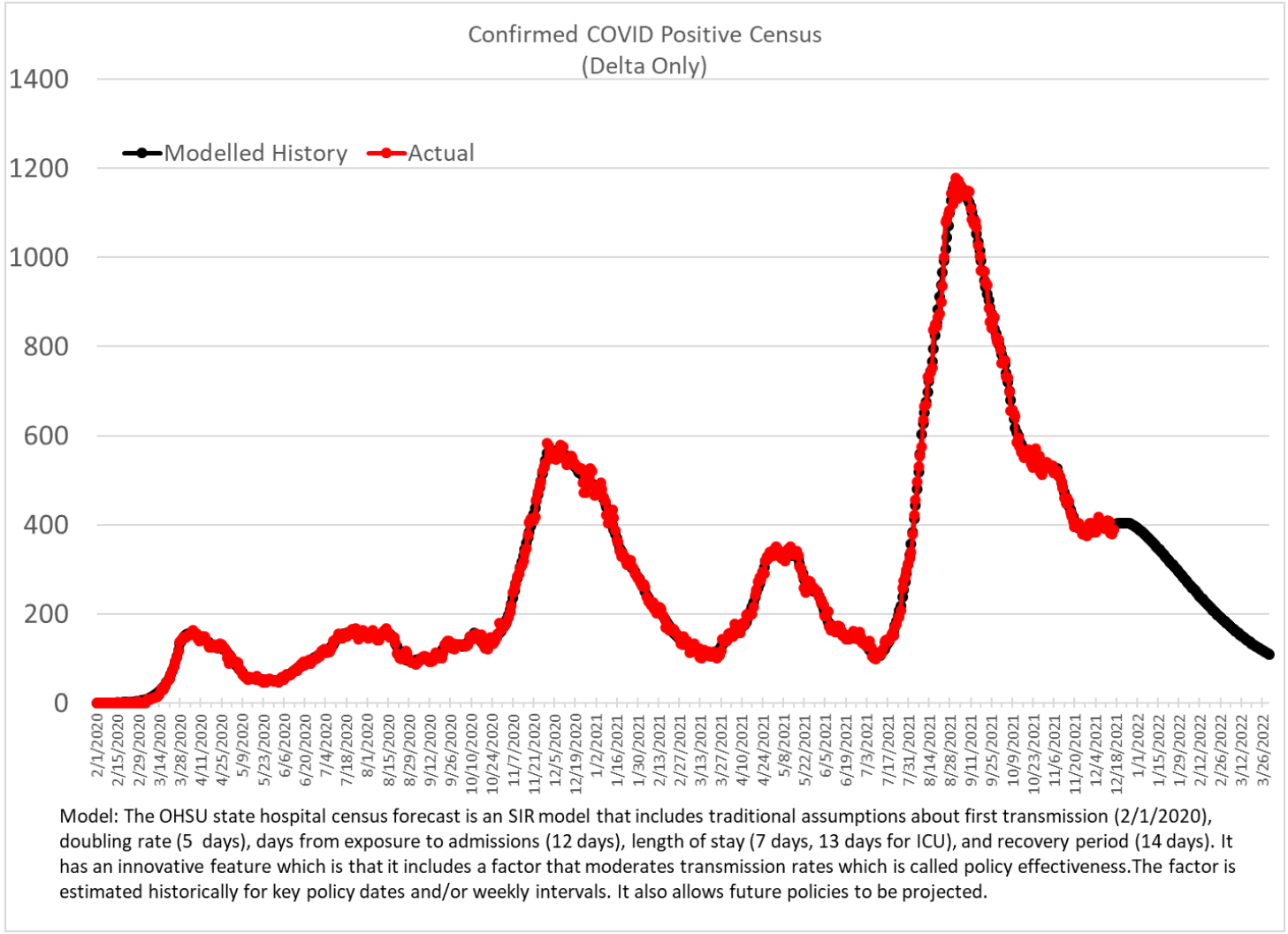
Census Forecast-Primary Scenario

The forecast shows a flatter period before further declines in census.

The primary scenario is

- "Fatigue w/o Fear" intervention effect
- Slow Variant (Delta R_0=6.5)
- High hospitalization rate for Delta (2X original)
- Vaccine efficacy=87%
- Standard waning immunity assumptions



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 (7 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.

Source: OHSU COVID Forecast Model

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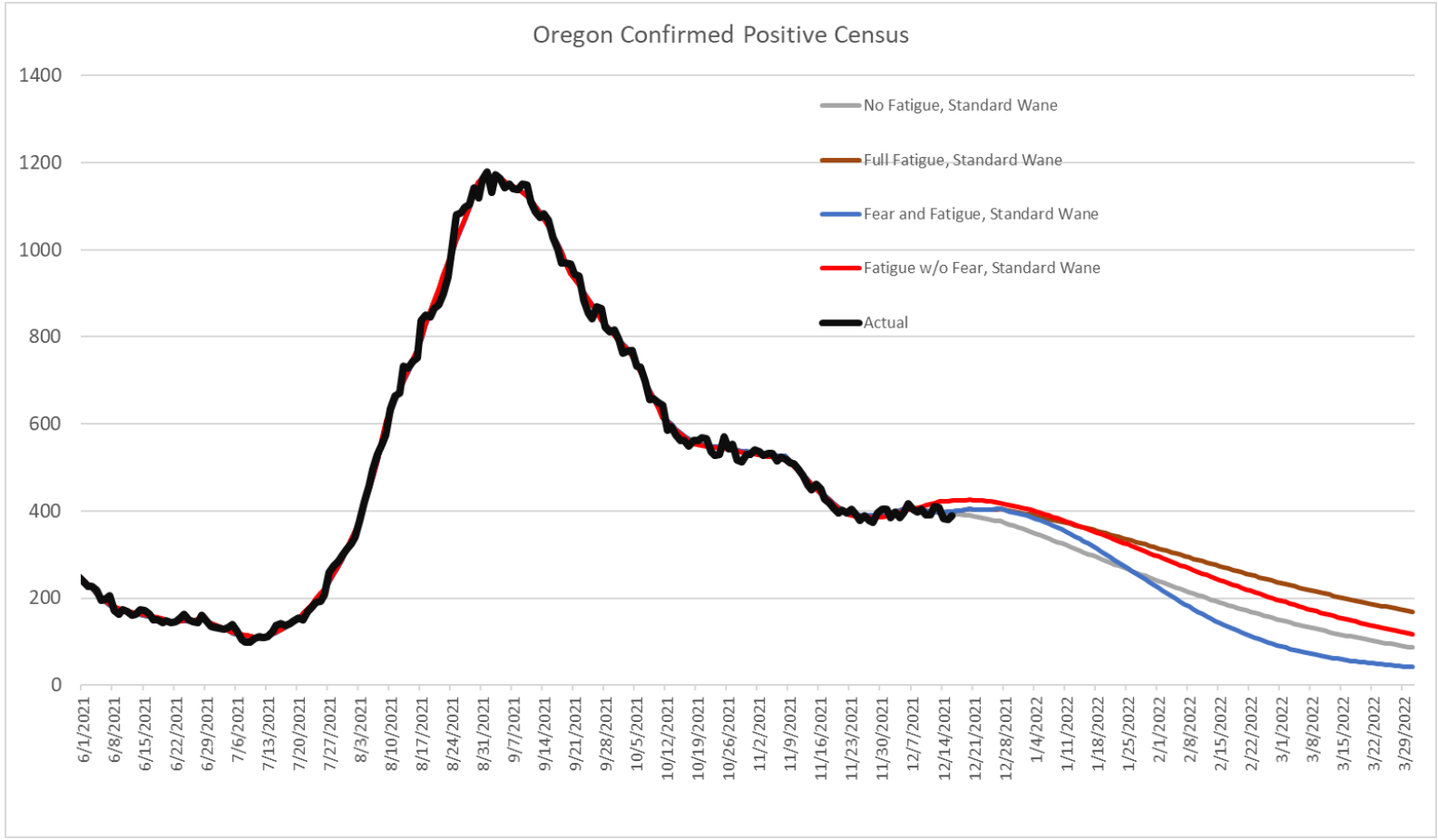
Census Forecast-Alternative Scenarios

Short wane scenarios not available this week.



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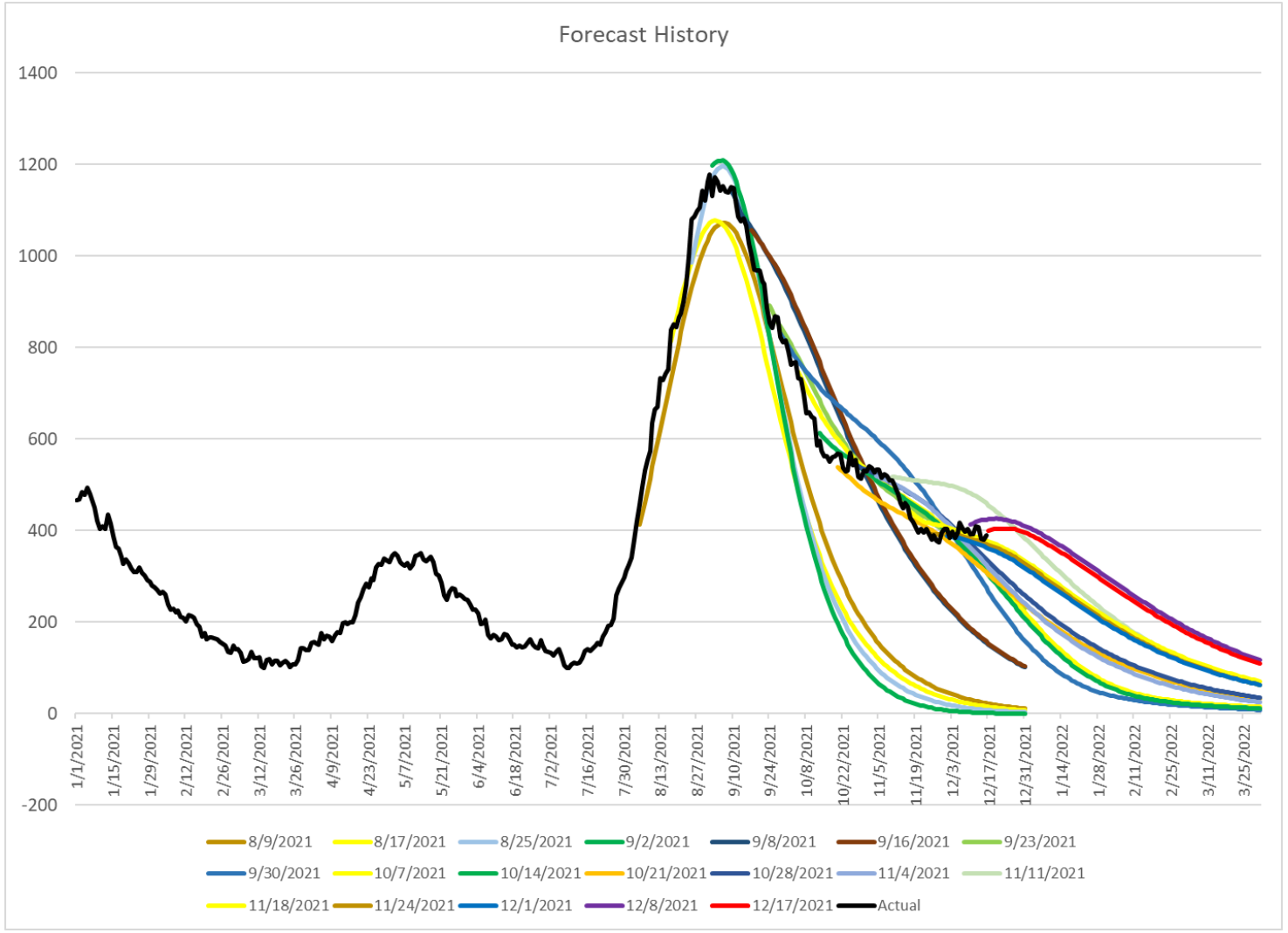
Previous Forecasts

The last 19 weeks of forecasts are shown.



Source: Primary scenario for each week is used

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Model-Herd Chart (Delta Only)

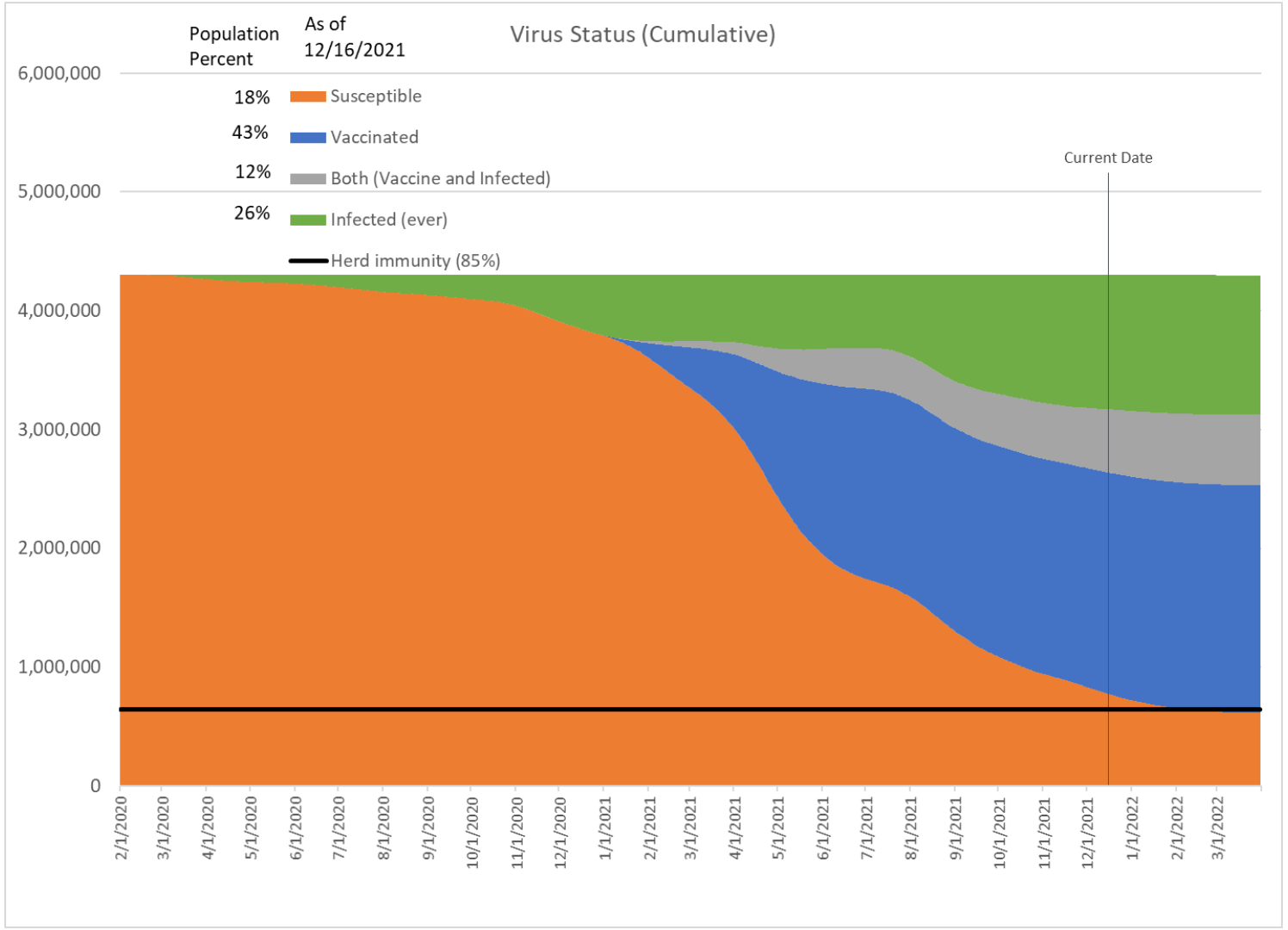
As of 12/16, the estimated population proportions are:

Susceptible: 18%

Vaccinated: 43%

Vaccinated & Infected: 12%

Infected: 26%



Source: OHSU COVID Forecast Model

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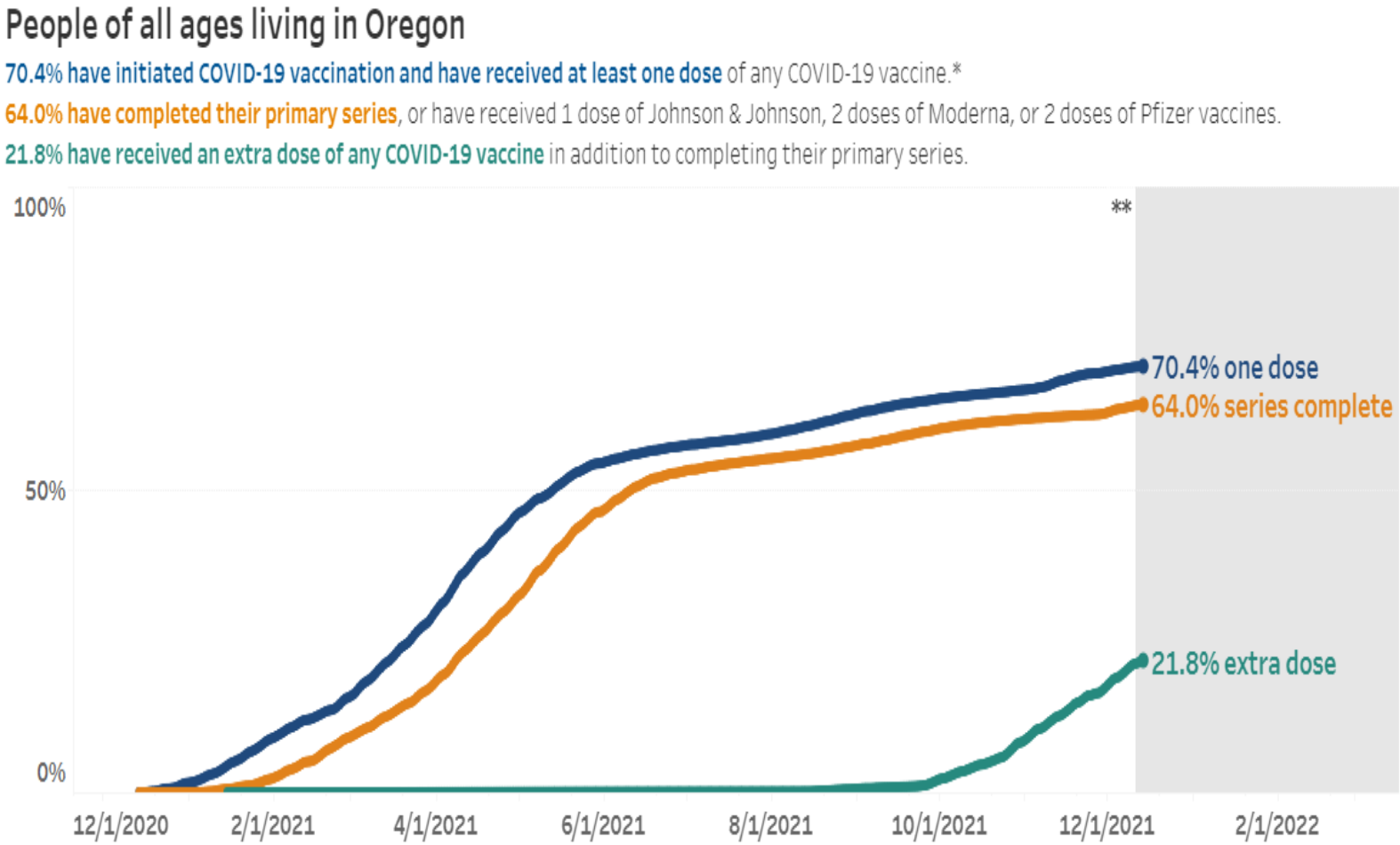
Policy Issues

Vaccination Rates

19.2% of the total population has received an extra dose (sometimes called a “booster”)



Source: https://public.tableau.com/app/profile/oregon.health.authority.covid.19/viz/OregonCOVID-19VaccineEffortMetrics/StatewideProgress

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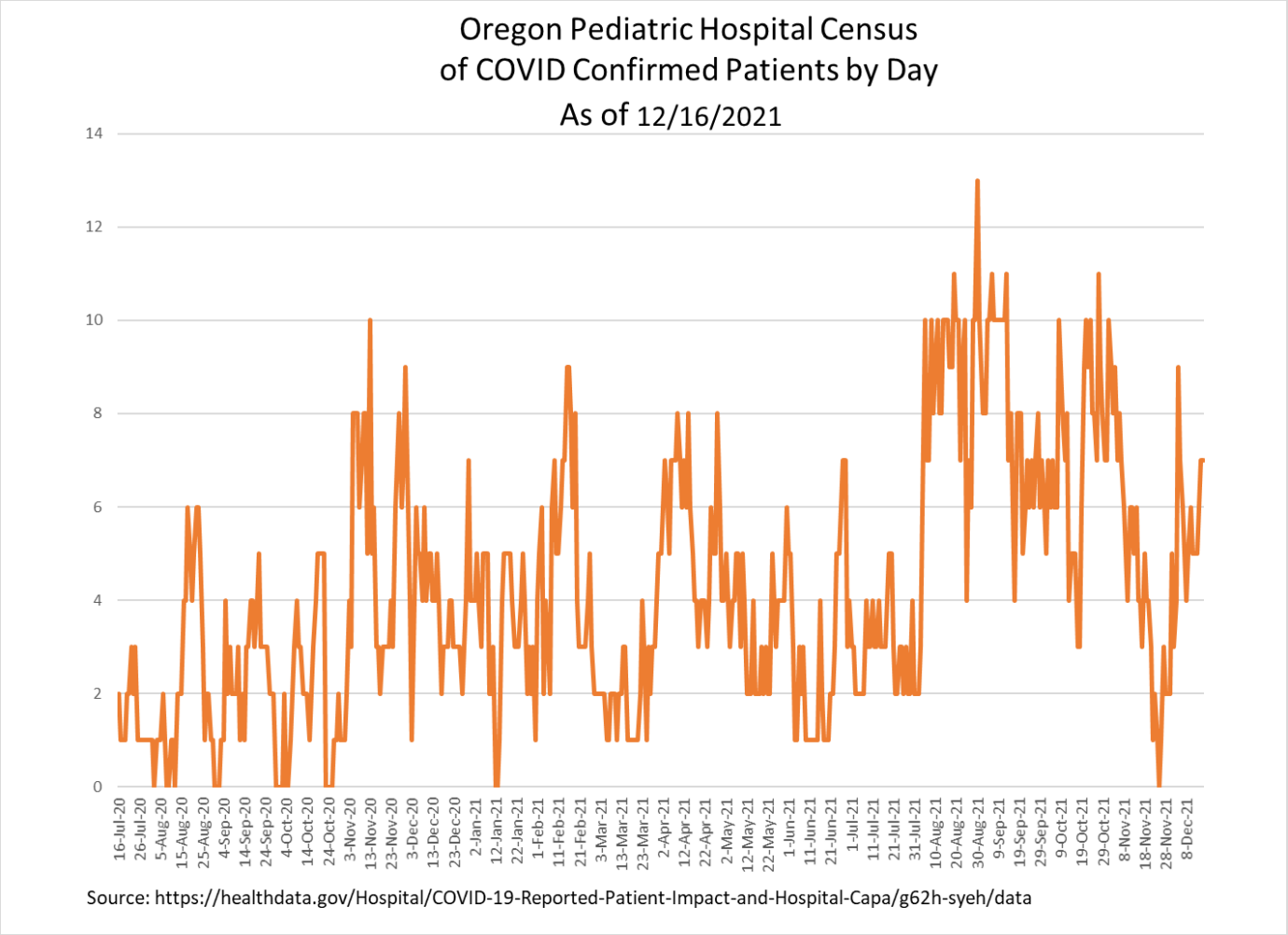
Pediatric Census in Oregon

The pediatric census level in Oregon for confirmed positive patients under age 18 is 7 as of 12/16.



Source: https://healthdata.gov/Hospital/COVID-19-Reported-Patient-Impact-and-Hospital-Capa/g62h-syeh/data

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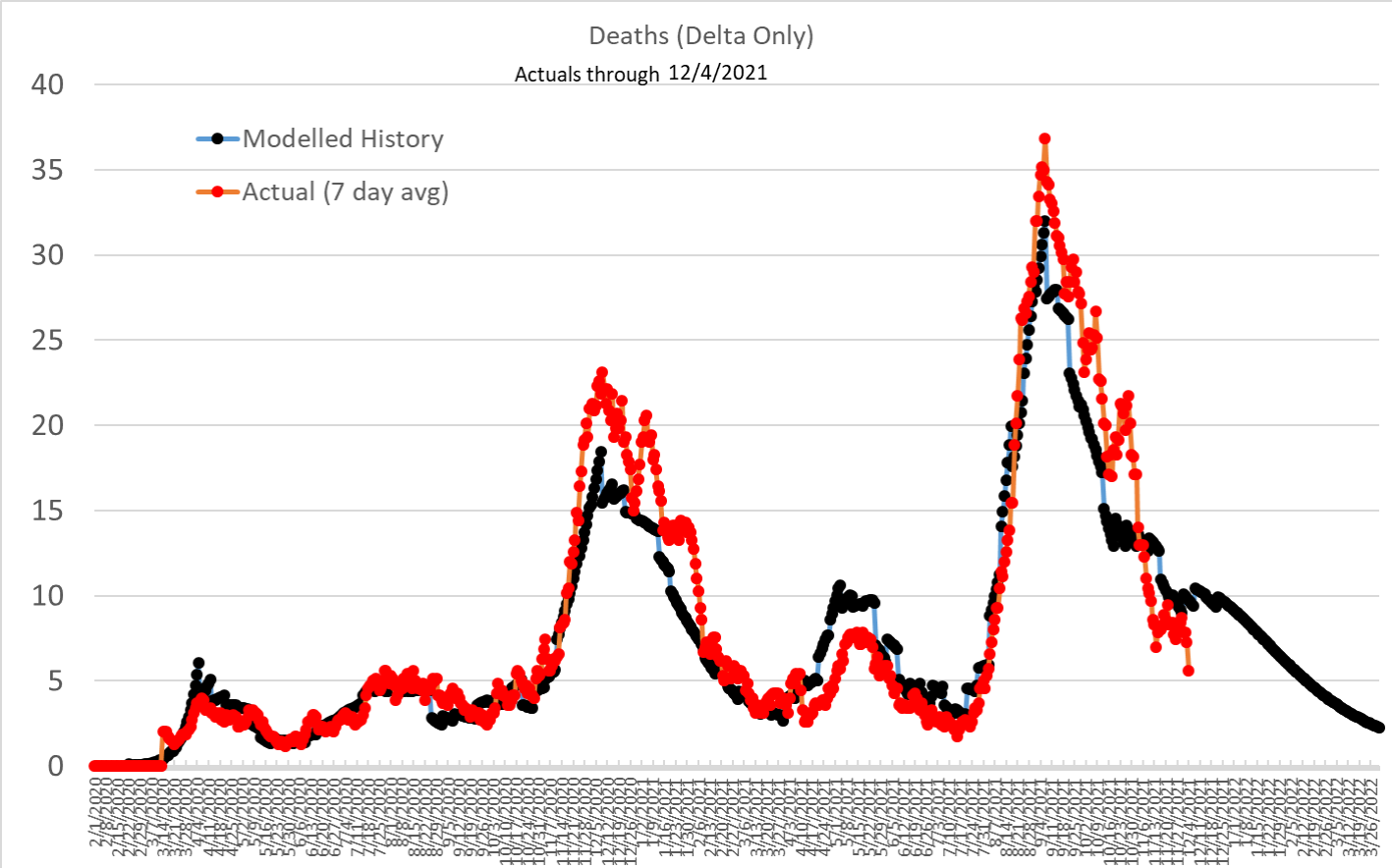
Death Forecast

Data reported by date of death

Assumptions to project deaths from infections/hospitalizations:

1) Deaths lag infections by an average of 21 days.
2) There are 4.0 COVID hospitalizations per death from COVID.



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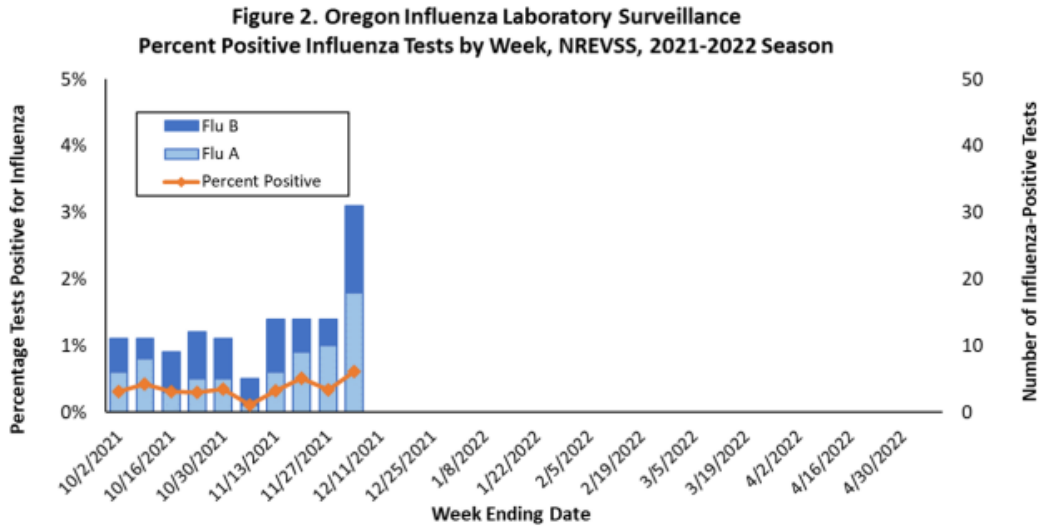
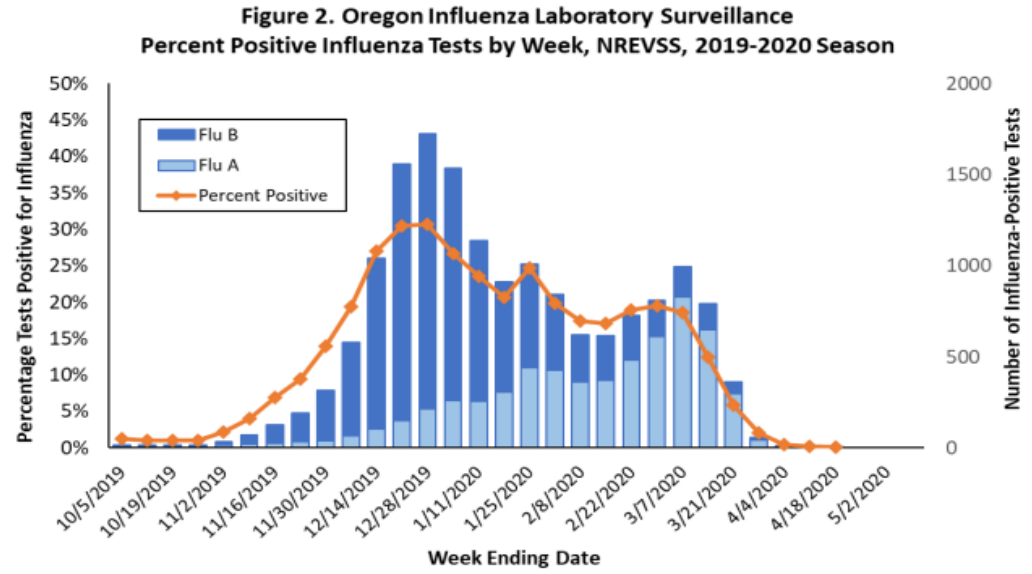
Source: OHSU COVID Forecast Model, OHA

Influenza in Oregon

The most recent week had 31 positive tests for influenza.

During the 2019-2020 season the same flu season week number had 304 positive cases.





Source: https://www.oregon.gov/oha/PH/DISEASESCONDITIONS/COMMUNICABLEDISEASE/DISEASESURVEILLANCEDATA/INFLUENZA/Documents/data/Season2021-2022.pdf, https://www.oregon.gov/oha/PH/DISEASESCONDITIONS/COMMUNICABLEDISEASE/DISEASESURVEILLANCEDATA/INFLUENZA/Documents/data/Season2019-20.pdf

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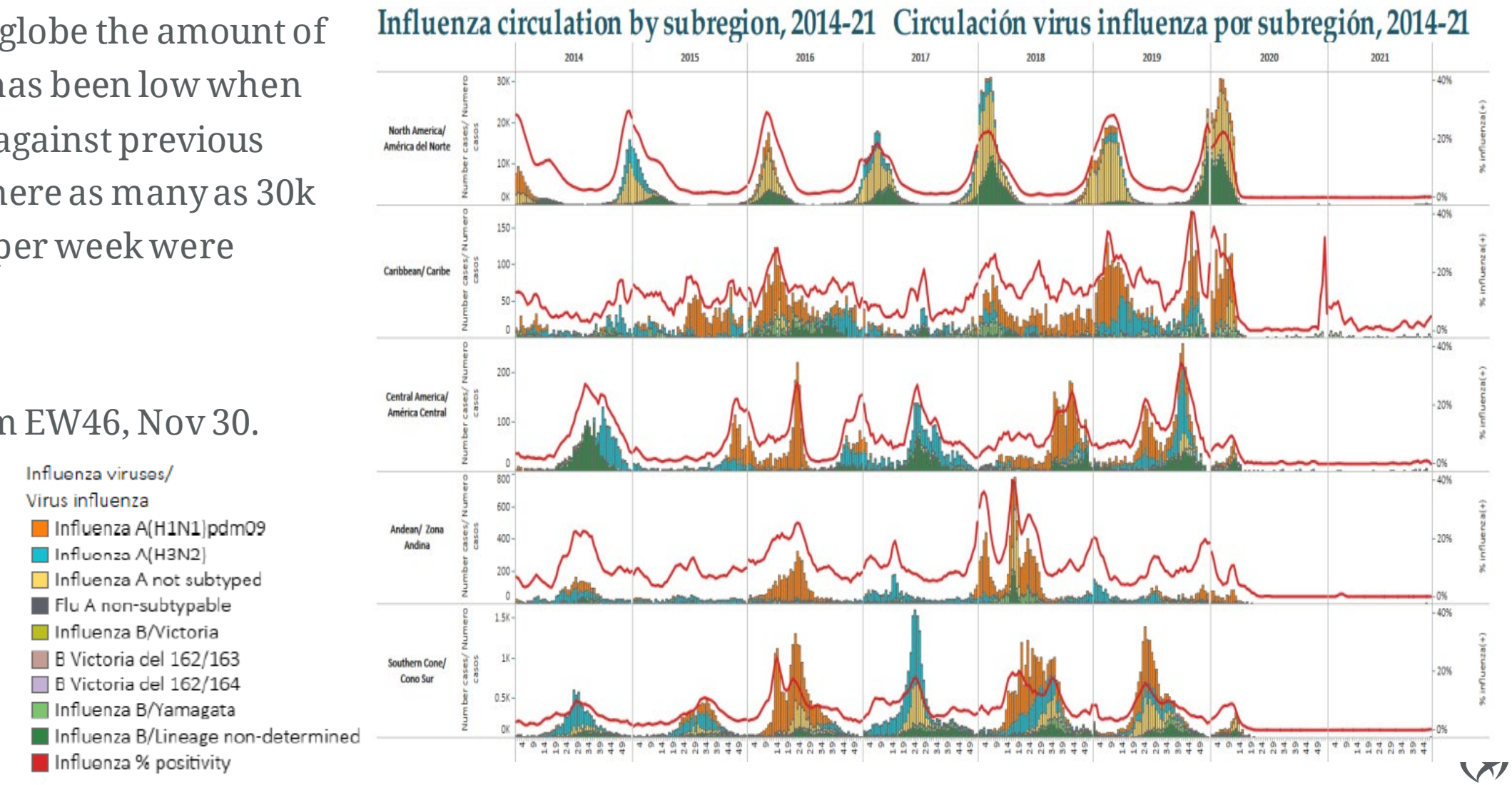
Influenza Trends

Across the globe the amount of influenza has been low when measured against previous seasons where as many as 30k infections per week were detected.

Figure from EW46, Nov 30.



Source: https://www.paho.org/en/influenza-situation-report

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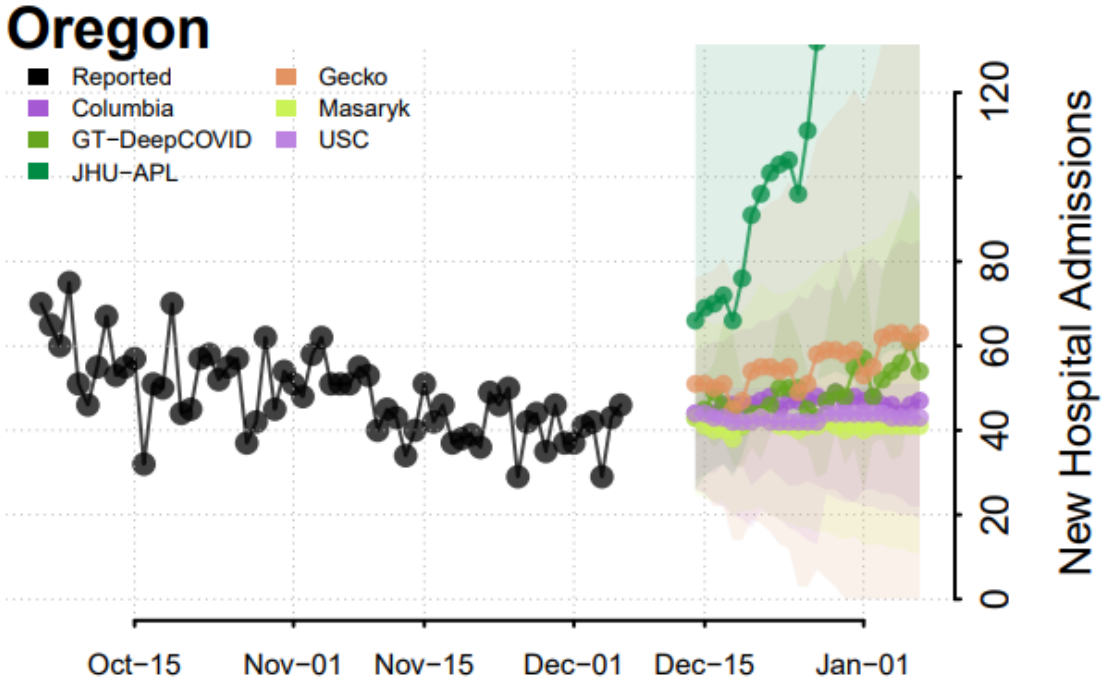
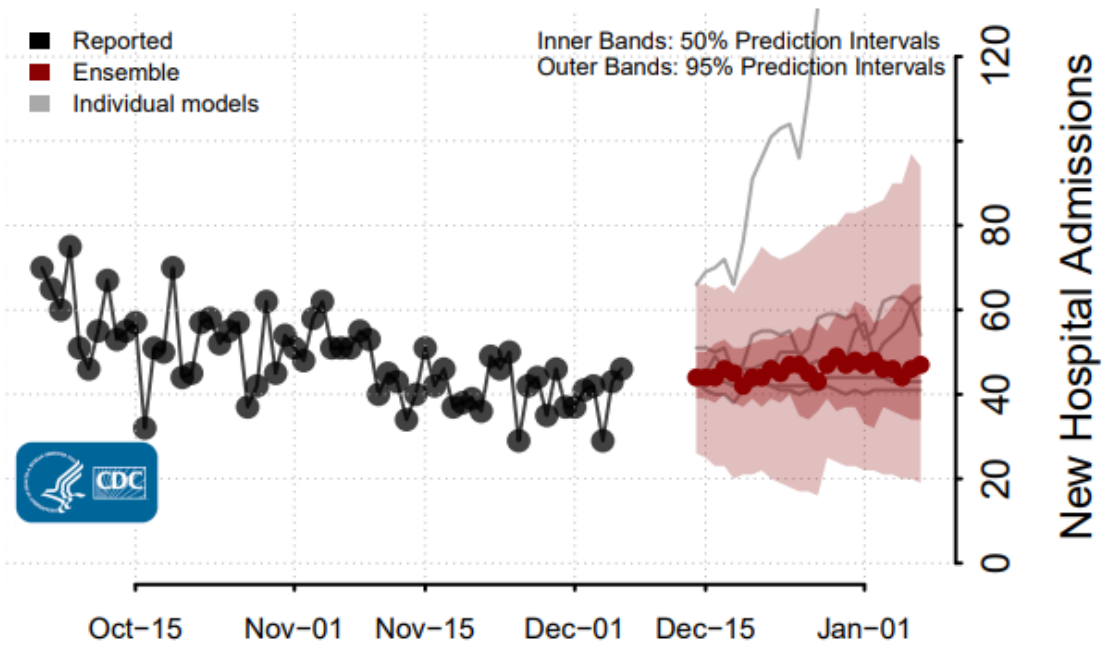
Appendix

CDC Forecast-Ensemble

CDC forecasts flat number of admissions over the next 3 weeks. But there are two forecasts showing distinct increases.





Source: https://www.cdc.gov/coronavirus/2019-ncov/science/forecasting/hospitalizations-forecasts.html

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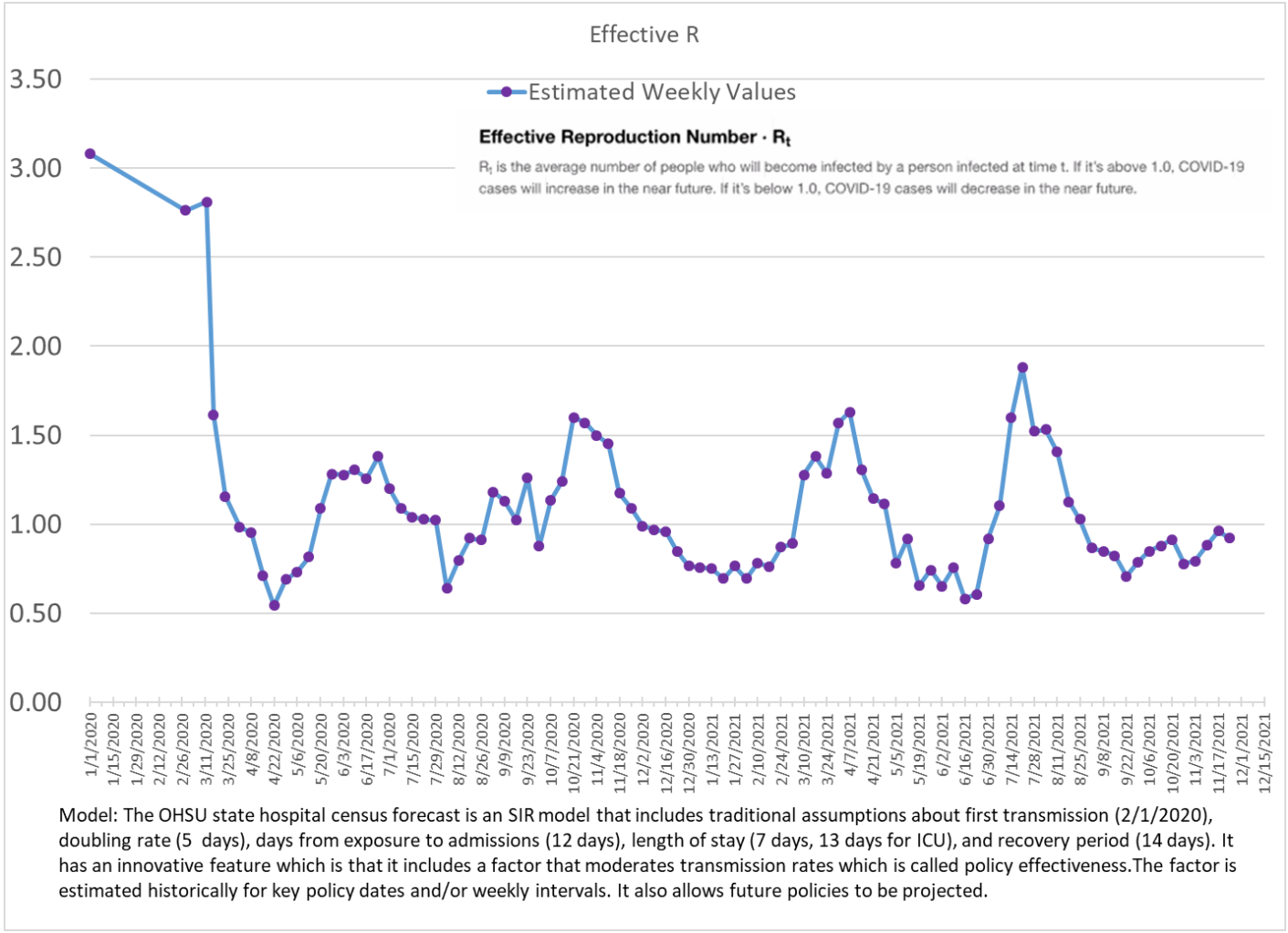
Effective R Estimate



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 (7 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.

Source: OHSU COVID Forecast Model

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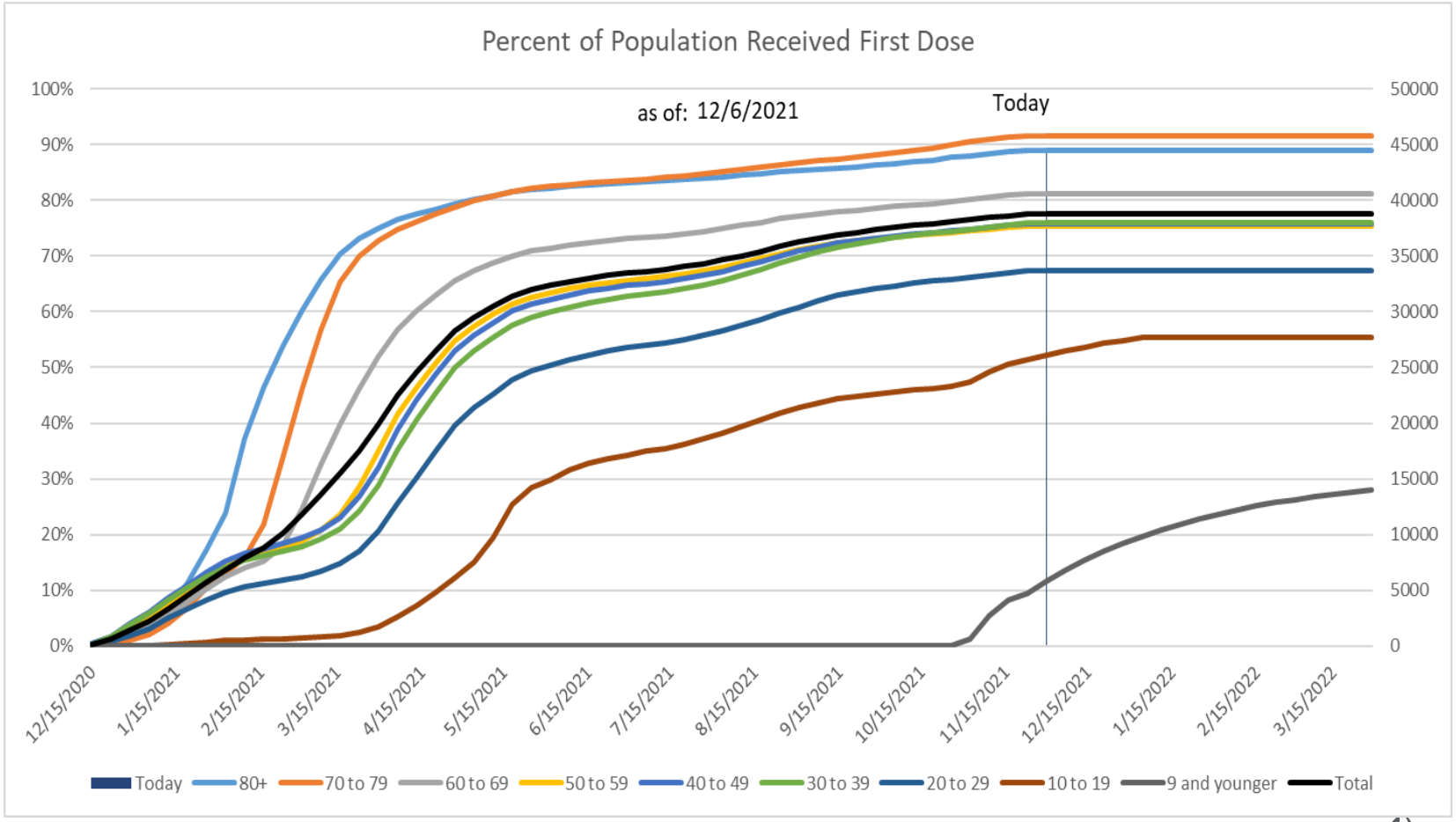
Vaccine Projections

Younger age groups are expected to increase but reaching levels lower than adults. (50% for <9 and 55% for 10-19).



Source: OHSU COVID Forecast Model

Acknowledgments

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I would like to thank Dr. William Messer for his assistance in understanding waning dynamics, 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.

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Thank you!

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