Expected COVID-19 hospitalizations methodology

Disclaimer: This information is based on available data as of 10 a.m. March 20, 2020

These projections use a basic exponential growth model to capture the expected number of cases, hospitalizations, and daily bed counts absent interventions. This is a simplified version of compartmental models commonly used to study disease transmission. The model inputs, or parameters, were obtained from recent work and published literature. Details on the model and parameters, including references, are provided below. Using this information, the results can be recreated using public facing websites or user calculations. The code was developed in Stata 15.0 but could be replicated using Microsoft Excel or other software.

Functional form: The model uses a simple exponential growth model where the number of cases at time t is $y_t = 1 * 2^{(Days\ since\ Exposure/Doubling\ Period)}$.

Days since exposure: The number of days since the Start Date (see below).

Start date: The first date of Oregon residents' exposure to the virus is assumed to be 2/1/2020. The actual start date is unknown; this is an estimate based on the date of the first positive test (2/28/2020), recorded in the Portland metropolitan area. It also accounts for the period of time presumed infection prior to a positive test result and the likelihood of multiple transmission prior to the first case. While 2/28/2020 was the date of the first positive test in Oregon, but was found in Portland area, there were likely to have been additional cases present across the state at that time. To account for this, the number of cases is increased by 40% at start.

Doubling period: The number of days it takes for the count of infected people to double. The model uses the estimate of 6.2 indicated based on patterns from China.[1] The assumed doubling period greatly impacts the number of infected people at any point in time.

Hospitalization rate: The hospitalization rate represents the percentage of all people *testing positive* who require hospital services. The estimate used for the projections is 19%.[2,3] Note that this is not the same as the percentage of all people *infected* who require hospitalization. Since the number of people infected exceeds the number of people testing positive, the hospitalization rate is lower when calculated as a percentage of all infected individuals. Hospitalization is expected to begin five days after symptom onset.

[1] Wu, J. T., Leung, K., & Leung, G. M. (2020). Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study. The Lancet, 395(10225), 689-697. Found at: https://www.sciencedirect.com/science/article/pii/S0140673620302609

[2] Wu, Z., & McGoogan, J. M. (2020). Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. Jama. Found at: https://jamanetwork.com/journals/jama/fullarticle/2762130

[3] Guan, W. J., Ni, Z. Y., Hu, Y., Liang, W. H., Ou, C. Q., He, J. X., ... & Du, B. (2020). Clinical characteristics of coronavirus disease 2019 in China. New England Journal of Medicine. Found at: https://www.nejm.org/doi/pdf/10.1056/NEJMoa2002032?articleTools=true

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ICU rate: The rate of intensive care unit (ICU) services is based on estimates in the literature. A study of Chinese cities in JAMA showed a critical care rate of 5% of infected individuals. A recent study from Italy indicated an ICU rate of 16%[4]. This model uses an estimate of 10% as the approximate midpoint.

Length of stay (LOS): To arrive at a count of beds by type, each admission requires an estimate for the number of days spent in the hospital. This model uses an estimate of 14 days for patients only needing acute care services and 22 days for patients requiring some time in the ICU. For ICU patients, the model assumes 50 percent of the time is spent in acute care and 50 percent of the time is spent in the ICU. This allows for the expected progression of care paths.

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[4]Grasselli G, Pesenti A, Cecconi M. Critical Care Utilization for the COVID-19 Outbreak in Lombardy, Italy: Early Experience and Forecast During an Emergency Response. JAMA. Published online March 13, 2020. doi:10.1001/jama.2020.4031 Found at: https://jamanetwork.com/journals/jama/fullarticle/2763188
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OHSU Health: Expected COVID-19 hospitalizations

The estimated number of people likely to need hospital services at OHSU Health, including Hillsboro Medical Center and Adventist Health.
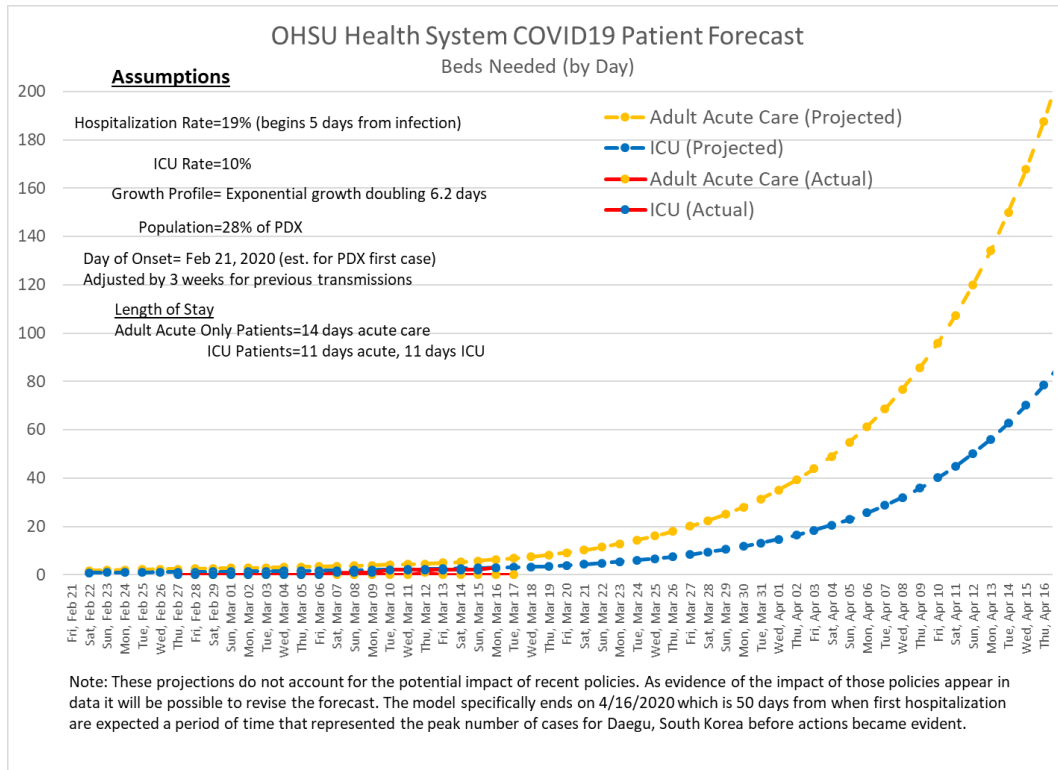
Key points

- OHSU modeling assumes the number of cases in Oregon doubles every 6.2 days, in accordance with the state's modeling.
- This analysis shows that OHSU will need 200 beds in adult acute care and another 80 beds in the intensive care unit (ICU) for COVID-19 patients by April 16.
- OHSU Hospital has 79 ICU beds on Marquam Hill, 25 at Adventist, and 10 at Hillsboro. Our inpatient occupancy currently operates at 95% capacity, meaning our hospital beds are already full.
- OHSU would need to double its available ICU beds within a few weeks based on this COVID-19 forecast.

Key assumptions

- **Hospitalization rate:** 9% of people requiring acute care beds and another 10% requiring intensive care.
- **First case date:** The doubling rate requires a start date. While the first case testing positive was on February 28, 2020, due to investigation of transmission lines, this model assumes the first case and doubling begins on February 1, 202

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Portland metro area: Expected COVID-19 hospitalizations

The estimated number of people likely to need hospital services within the Portland metro area

Portland Hospital Forecast
Beds Needed (by Day)

Assumptions

Hospitalization Rate=19% (begins 5 days from infection)

ICU Rate=10%

Growth Profile= Exponential growth doubling 6.2 days

Population=Portland (2.2M)

Day of Onset= Feb 21, 2020 (est. for PDX first case)
Adjusted by 3 weeks for previous transmissions

Length of Stay
Adult Acute Only Patients=14 days acute care
ICU Patients=11 days acute, 11 days ICU

- Adult Acute Care (AAC) Beds
- ICU Beds
- Adult Acute Care (Actual)
- ICU (Actual)

Note: These projections do not account for the potential impact of recent policies. As evidence of the impact of those policies appear in data it will be possible to revise the forecast. The model specifically ends on 4/16/2020 which is 50 days from when first hospitalization are expected a period of time that represented the peak number of cases for Daegu, South Korea before actions became evident.

Key points

- OHSU modeling assumes the number of cases in Oregon doubles every 6.2 days, in accordance with the state's modeling.
- This analysis shows that the Portland metro area will need 700 beds in adult acute care and another 300 beds in the intensive care unit (ICU) for COVID-19 patients by April 16.
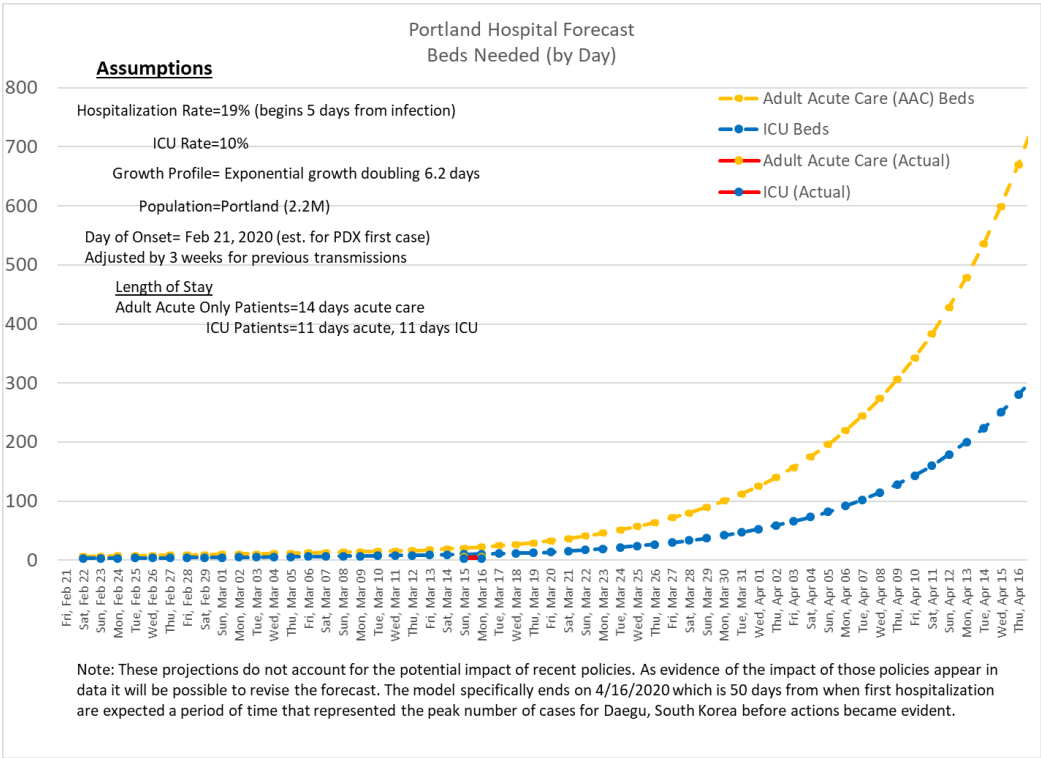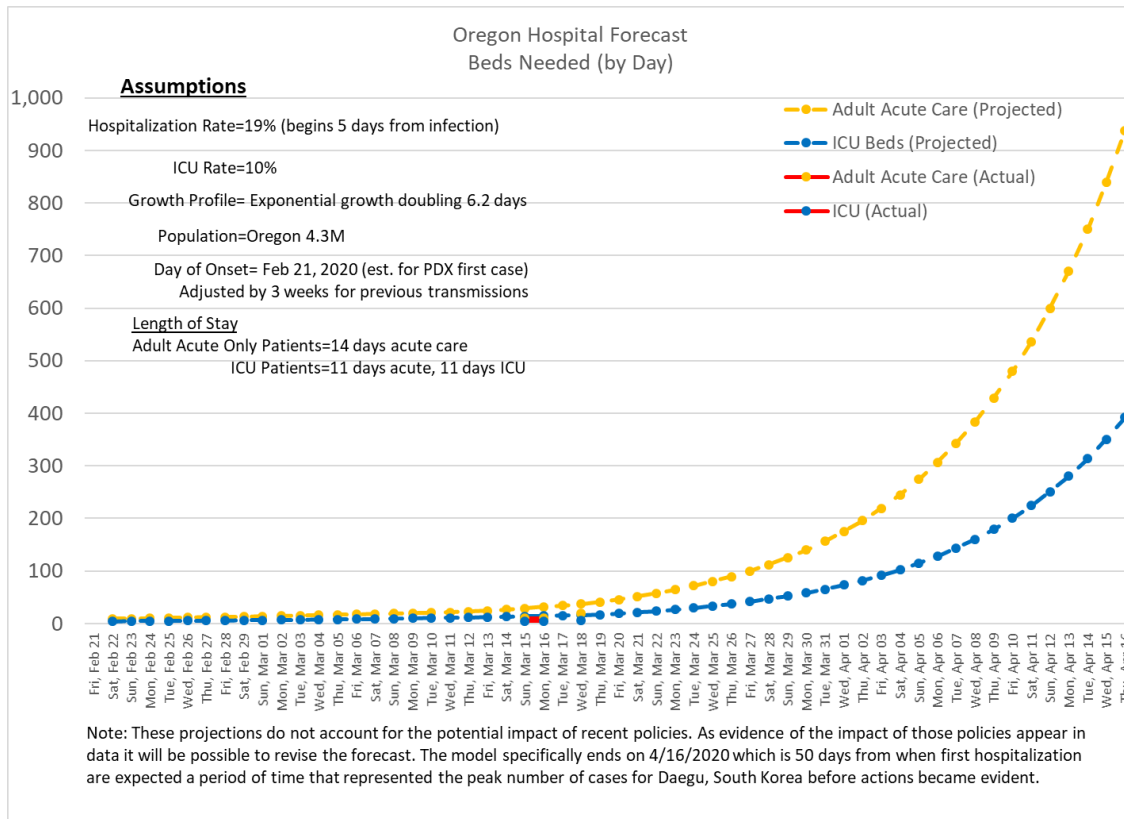- Metro area hospitals currently have a total of 3,313 hospital beds and 281 ICU beds.

Key assumptions

- **Hospitalization rate:** 9% of people requiring acute care beds and another 10% requiring intensive care.

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Oregon: Expected COVID-19 hospitalizations

The estimated number of people likely to need hospital services in the state of Oregon

Oregon Hospital Forecast
Beds Needed (by Day)

Assumptions

Hospitalization Rate=19% (begins 5 days from infection)

ICU Rate=10%

Growth Profile= Exponential growth doubling 6.2 days

Population=Oregon 4.3M

Day of Onset= Feb 21, 2020 (est. for PDX first case)
Adjusted by 3 weeks for previous transmissions

Length of Stay
Adult Acute Only Patients=14 days acute care
ICU Patients=11 days acute, 11 days ICU

- Adult Acute Care (Projected)
- ICU Beds (Projected)
- Adult Acute Care (Actual)
- ICU (Actual)

Note: These projections do not account for the potential impact of recent policies. As evidence of the impact of those policies appear in data it will be possible to revise the forecast. The model specifically ends on 4/16/2020 which is 50 days from when first hospitalization are expected a period of time that represented the peak number of cases for Daegu, South Korea before actions became evident.

Key points

- OHSU modeling assumes the number of cases in Oregon doubles every 6.2 days, in accordance with the state's modeling.
- This analysis shows that the state of Oregon will need 1,000 additional beds in adult acute care and another 400 intensive care beds for COVID-19 patients by April 16.
- The state of Oregon currently has 6,821 acute care hospital beds and 655 intensive care beds.

Key assumptions

- **Hospitalization rate:** 9% of people requiring acute care beds and another 10% requiring intensive care.

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