OKLAHOMA
State Department
of Health

OSDH Transmission Dynamics Model

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Executive Summary

We customized standard SEIR methodology to forecast how the COVID-19 pandemic would occur in Oklahoma. It was last updated April 8, 2020 and makes projections through May 1, 2020.

We forecast the following key metrics:

Date of Peak: April 21, 2020

Number of New Cases at the Peak: 436 cases

Cumulative Number of Cases by May 1, 2020: 9,300 cases

Number of Deaths at the Peak: 22 deaths

Cumulative Number of Deaths by May 1, 2020: 469 deaths

Number of New Hospitalizations at the Peak: 131 new hospital admissions

Number of People in the Hospital for COVID-19 at the Peak: 915 people in the hospital

Number of People in the ICU for COVID-19 at the Peak: 458 people in the ICU

Figure 1. The Modeled Epidemic Curve of Observed Cases of COVID-19 in Oklahoma through May 1, 2020.

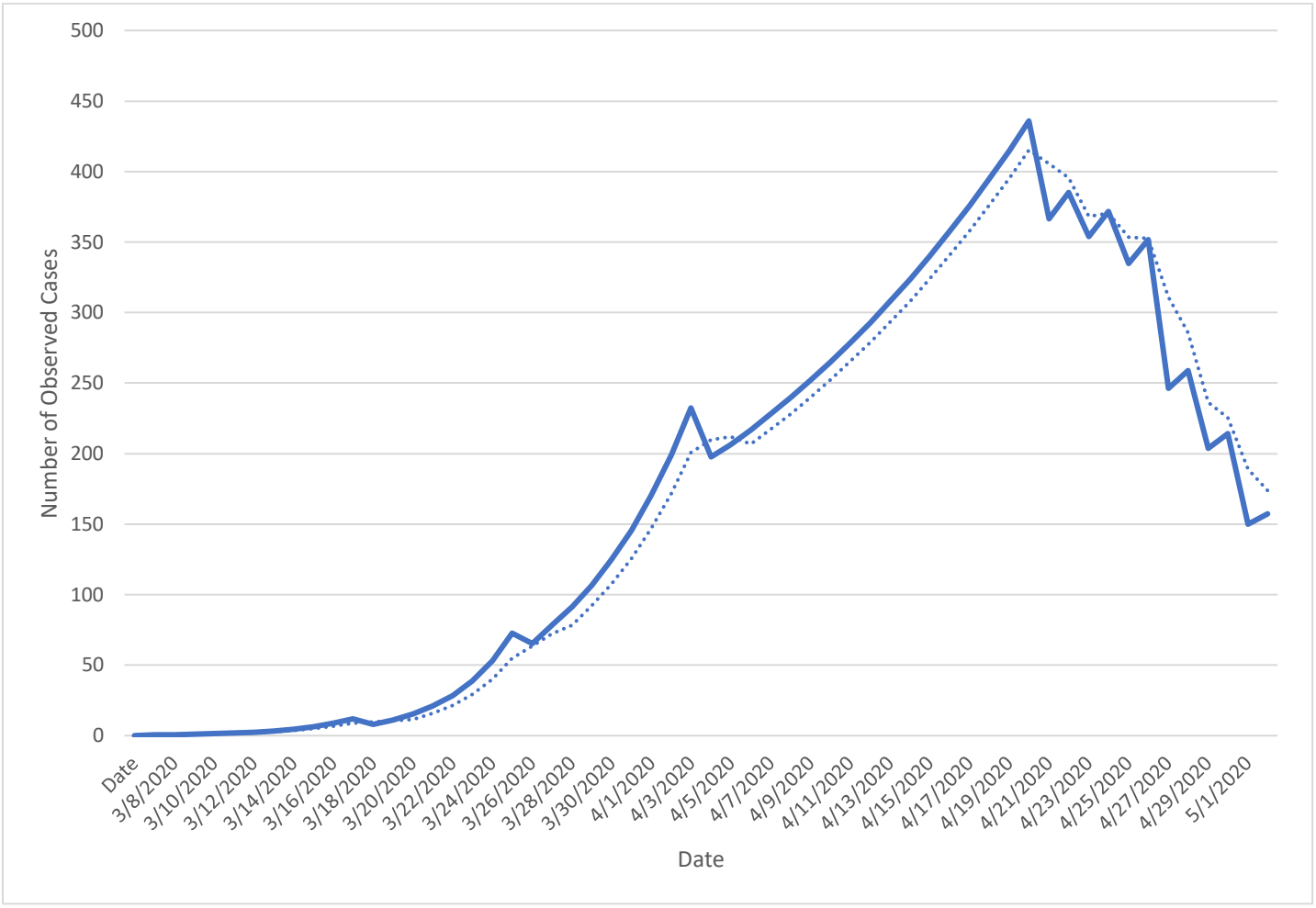


Figure 2. The Modeled Number of Deaths Caused by COVID-19 in Oklahoma through May 1, 2020.

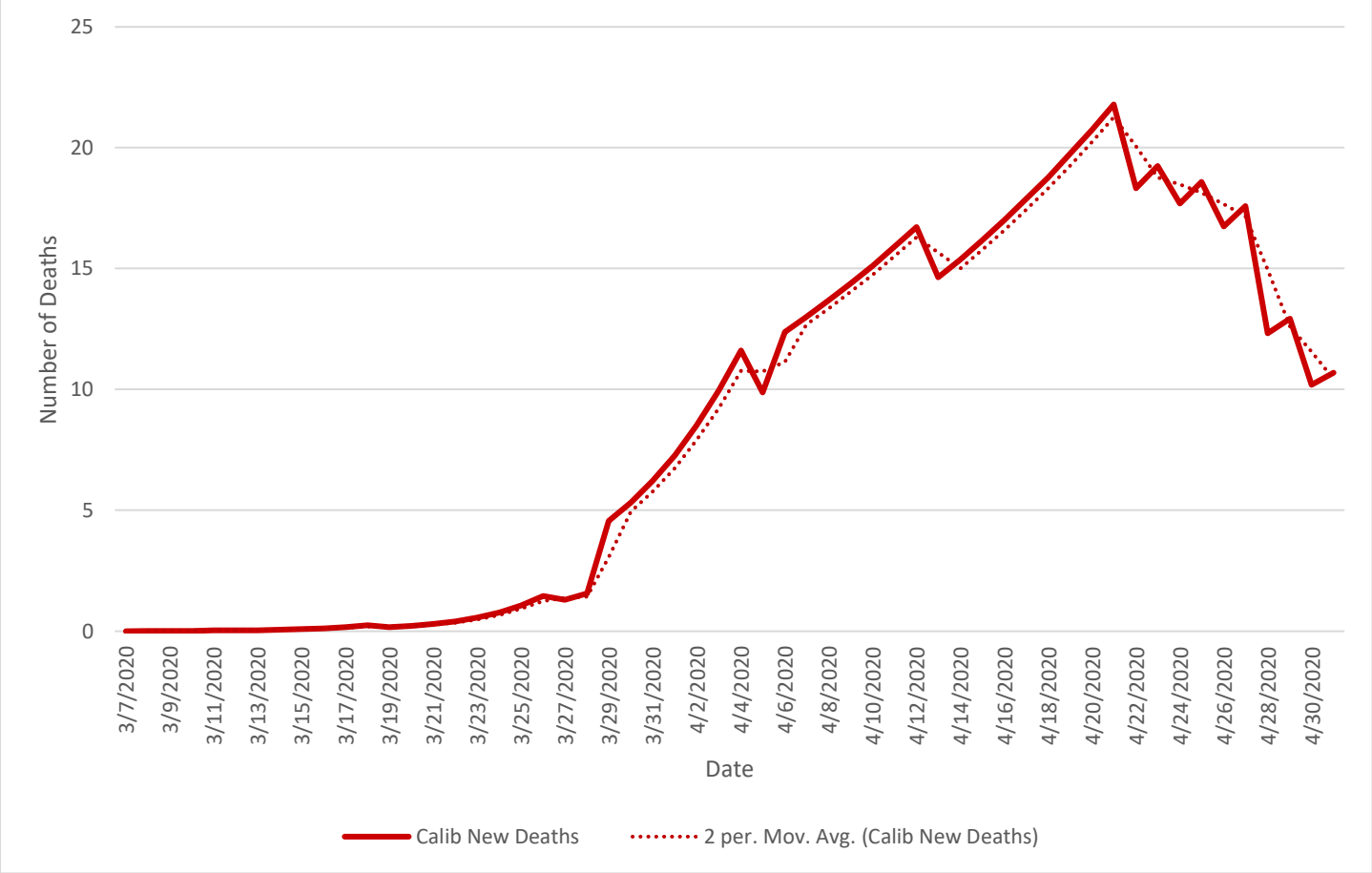
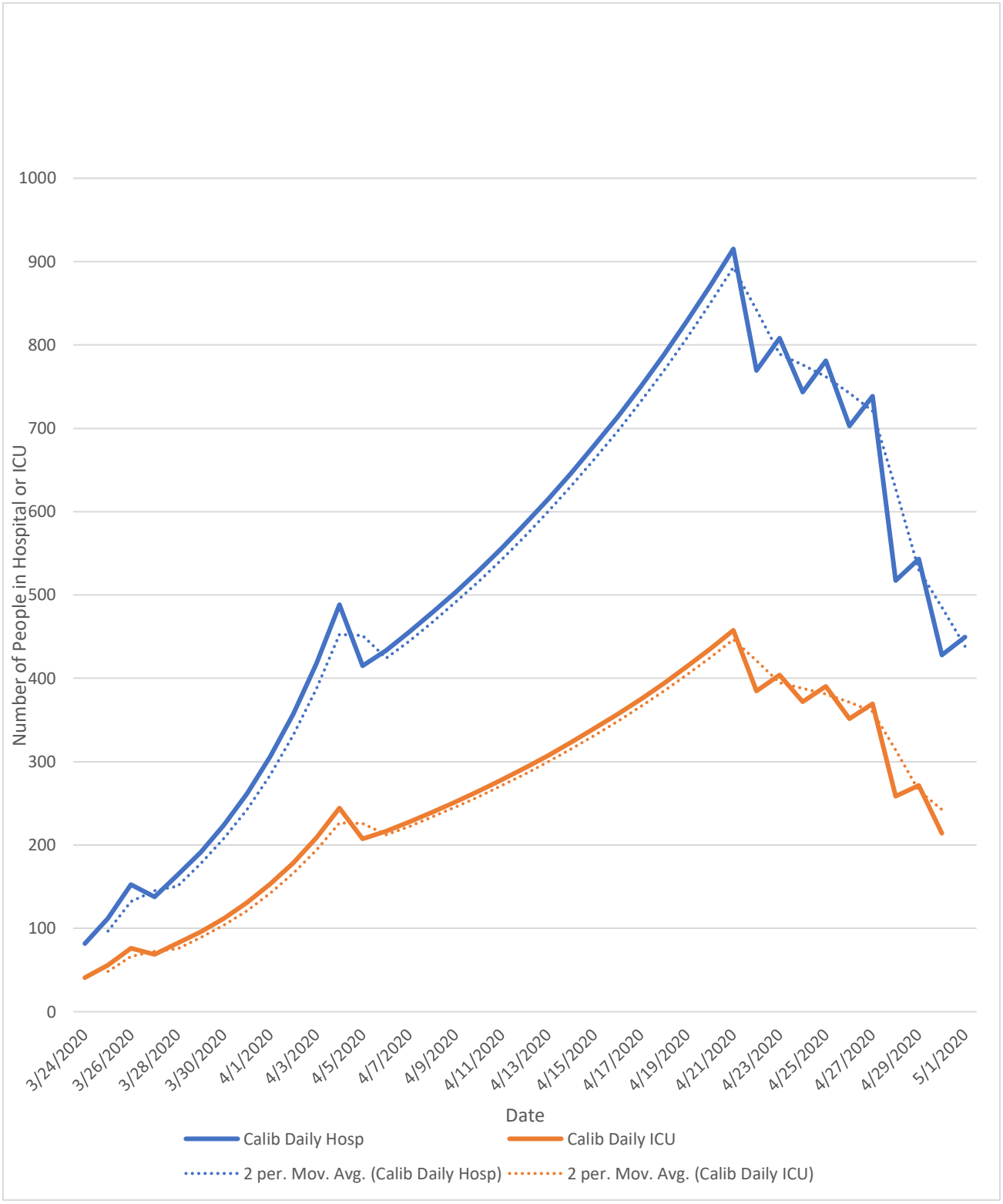


Figure 3. The Modeled Number of People Hospitalized and in the ICU by Date in Oklahoma through May 1, 2020.



Methods and Assumptions

We used R statistical software to write a model for an SEIR compartmental model, where S: susceptible, E: latently infected, I: infectious to others, R: recovered people. We used observed data to inform our model assumptions. Our initial parameters were:

R_0 (Rate of transmission in a totally susceptible population): 3.82

Average Latent Period (time from infection to infectious): 1.5 days

Average Duration of Infectiousness: 4 days

To account for social distancing, we used R=2.1 beginning on March 26, 2020. We assumed a 10 day lag period following the start of Spring Break (March 16, 2020). We again reduced R =1.3 beginning on April 4 (assuming a 10 day lag following the Governor's Safer at Home Order). The lag periods are necessary to account for the time it takes for transmission to occur, symptoms to manifest, the disease to be diagnosed, and reported to OSDH.

Further, we fit SEIR models to South Korea, Italy, China, Germany, New York State, California, and Oregon. We then modeled the difference between the SEIR models and the reported data for each of these locations. From these models, we calculated a composite calibration factor, and applied it to our Oklahoma-specific SEIR model. Using this calibration factor, we identified the peak number of expected cases. We then imposed R values <1 following the modeled peak.

To model deaths, after fitting the modeled data to the observed data, we used a range of case fatality rates between 2% and 5%. We used a similar approach to model hospitalizations and ICU admissions. The calibration factors were heavily weighted to achieve the best model fit to the observed data. Furthermore, we imposed subject matter expertise on the model to account for the limitations of most SEIR models to account for changes in human behavior.

This model assumes continued compliance with social distancing practices by the Oklahoma population through May 1, 2020.

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