Retrospective Forecasting of COVID-19 Hospitalizations in New York State: Does Wastewater Data Improve Forecast Performance?

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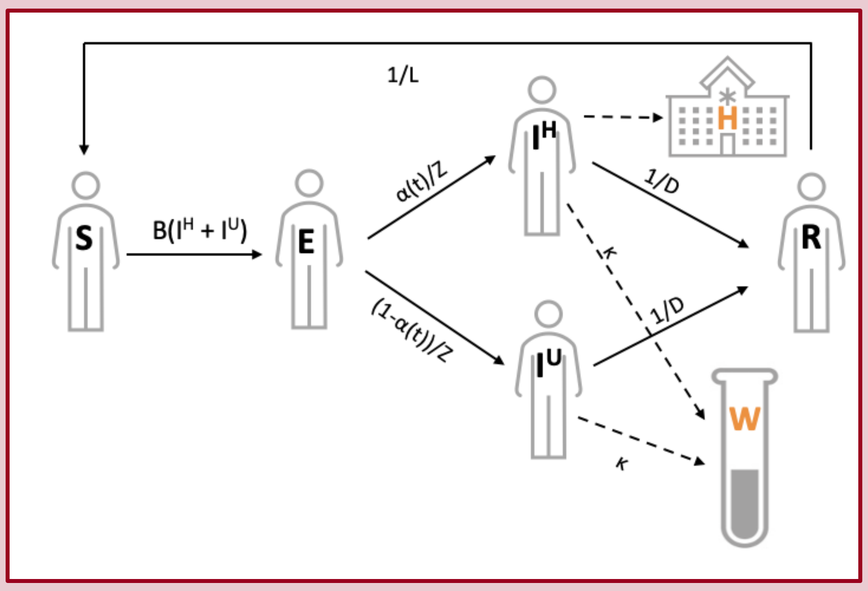
Intro

- Wastewater surveillance is a promising supplement to clinical surveillance approaches. Wastewater data can also be noisy, with many sources of variability.
- We want to know: **Can wastewater data improve our ability to dynamically forecast COVID-19 hospitalizations in New York State?**
- To find out, we retrospectively forecasted COVID-19 hospitalizations in NYS using models both with and without wastewater data to explicitly compare their performance.

Model

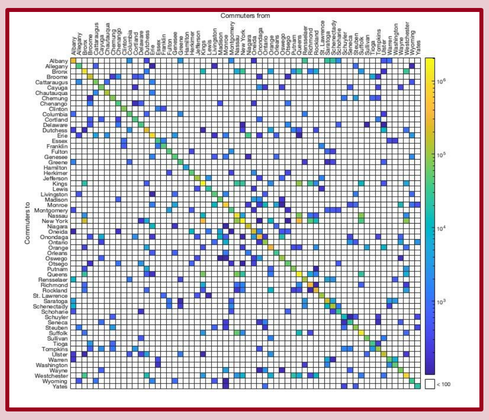
SEIR model variation



Transmission is modeled via an SEIR model, where I^H are the infected individuals who will be hospitalized and I^U are the infected individuals with will not be hospitalized.

Metapopulation model structure

Movement between subpopulations is based on inter-county commuting



Data

Hospitalization data: collected from NYS facilities by the New York State Health Electronic Response Data System (HERDS) from 2023-2024, aggregated to a county-week sum

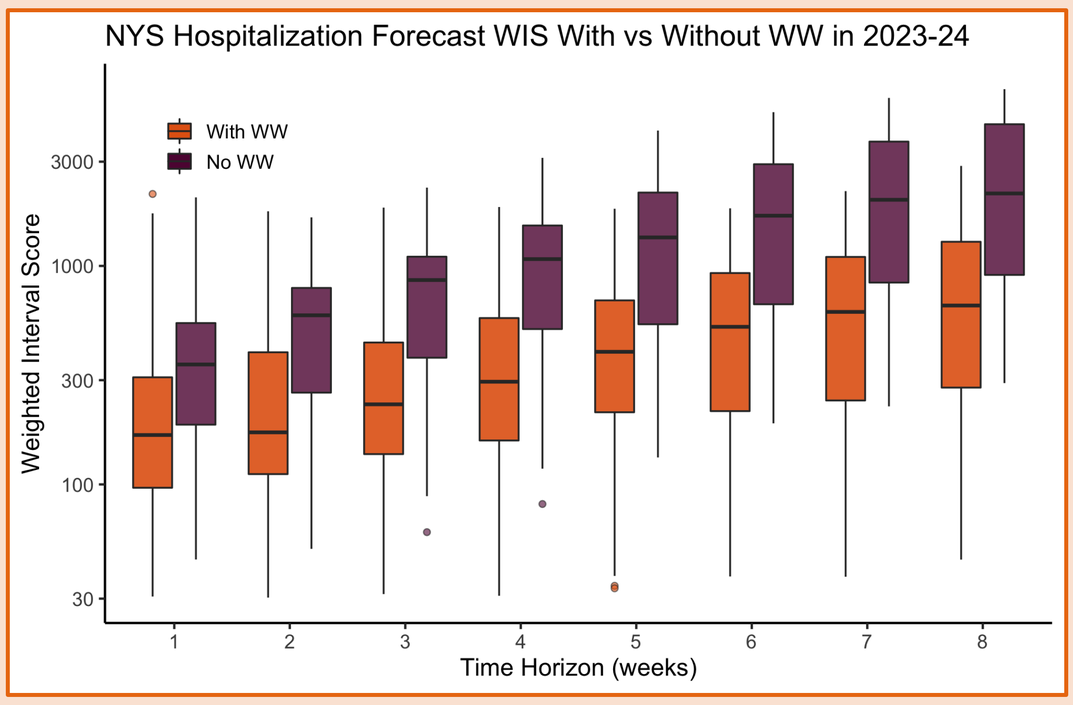
Wastewater data: concentrations of SARS-CoV-2 RNA from the NYS wastewater surveillance network from 2023-2024, aggregated to a county-day weighted average

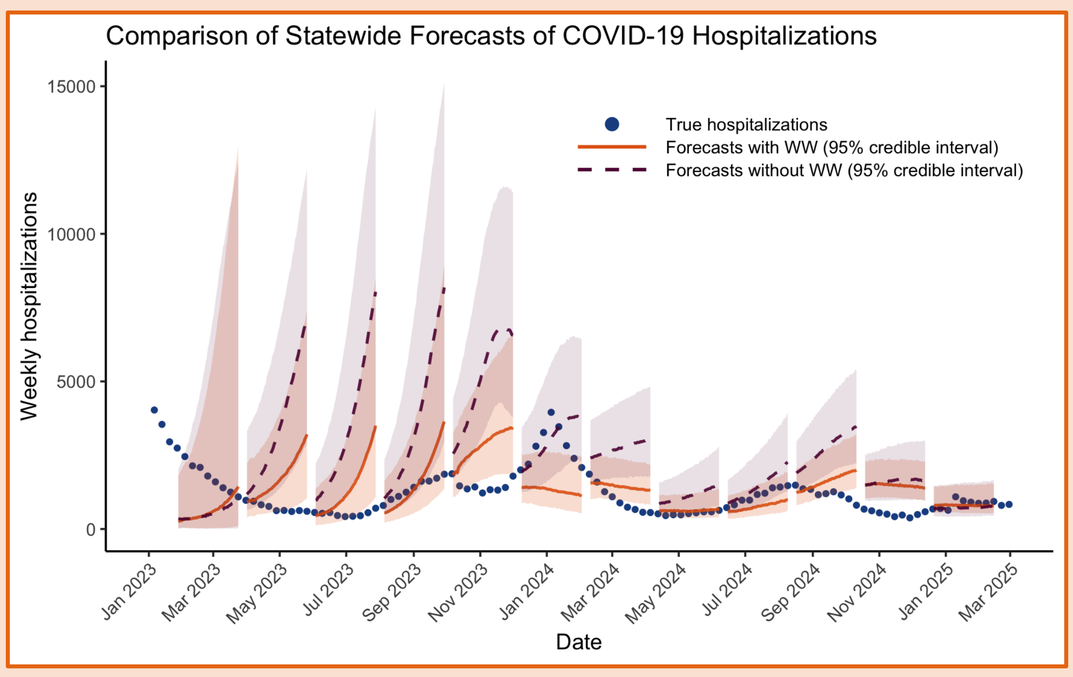
Inference Method

- Ensemble Adjustment Kalman Filter (EAKF)
- Adjusts select model parameters (transmission rate β, infection-hospitalization ratio α, and wastewater parameter κ) and state variables (S, E, I^H, I^U and R) at the time of each new observation
- Updates repeatedly as new data are observed, allowing parameters to vary over time

Preliminary Results

Forecasts were produced weekly throughout 2023-2024 and forecasted hospitalizations 1-8 weeks in the future. **Statewide forecasts informed by both wastewater and hospitalizations outperformed forecasts produced by hospitalizations only at every time horizon.**





Statewide forecasts informed by hospitalizations only (without wastewater) often overestimated hospitalizations and anticipated false surges.

County-level forecasts were more varied. In some counties, forecasts with wastewater performed better while in others forecasts informed only by hospitalization data performed better.

Let's Discuss!

- Have you worked on a similar forecasting approach or modeling project with wastewater? How did your findings compare or contrast?
- What county characteristics might lead to variability in relative performance of wastewater and non-wastewater forecasts across counties?
- How do you think this forecasting approach would work in different stages of an epidemic or endemic transmission, or with wastewater surveillance of different pathogens?

Conclusion

In NY statewide forecasts from 2023-2024, forecasts informed by both wastewater and hospitalizations outperformed forecasts produced by hospitalizations only at every time horizon. Performance across counties varied and will be the focus of ongoing research.

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