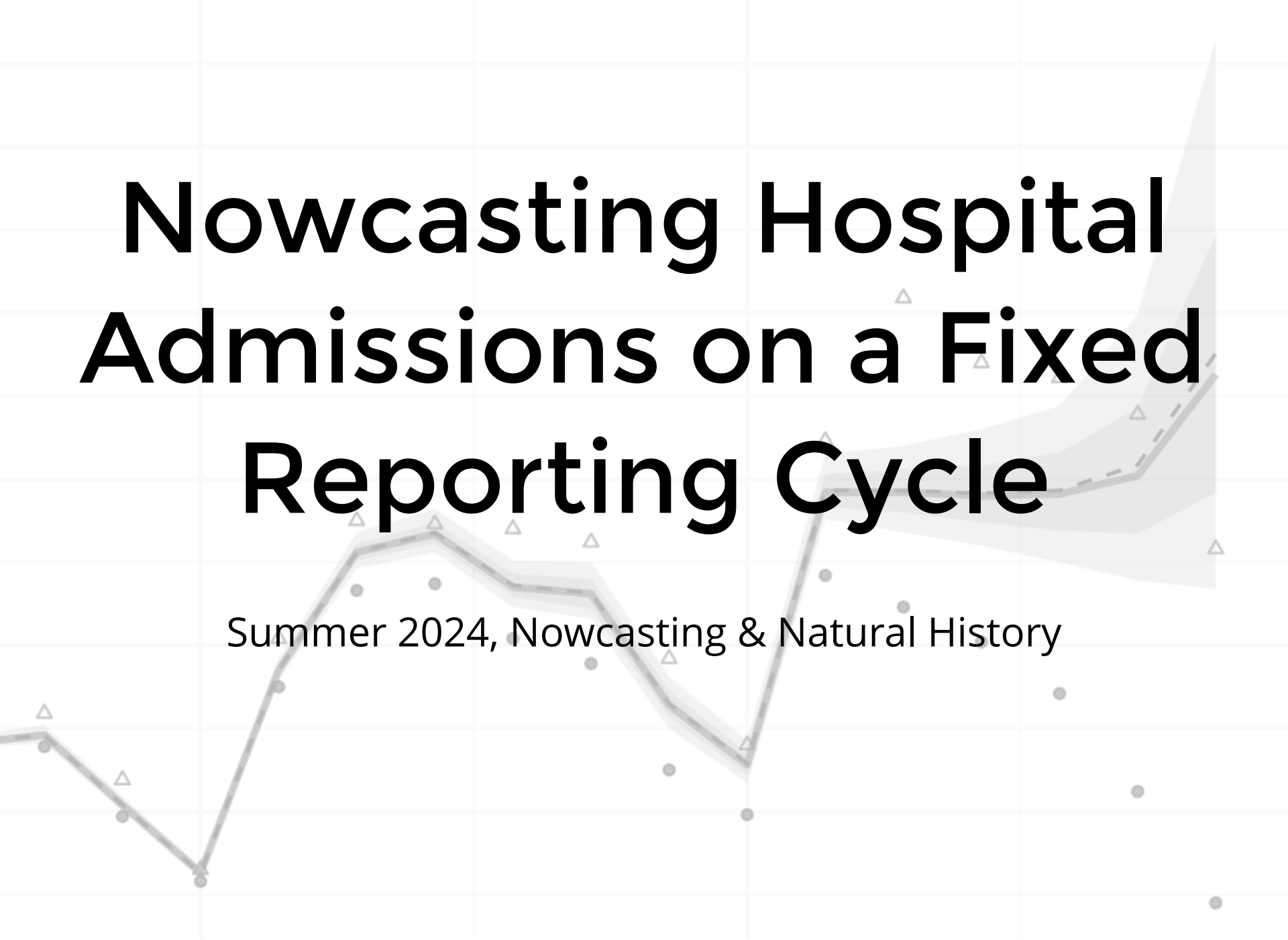
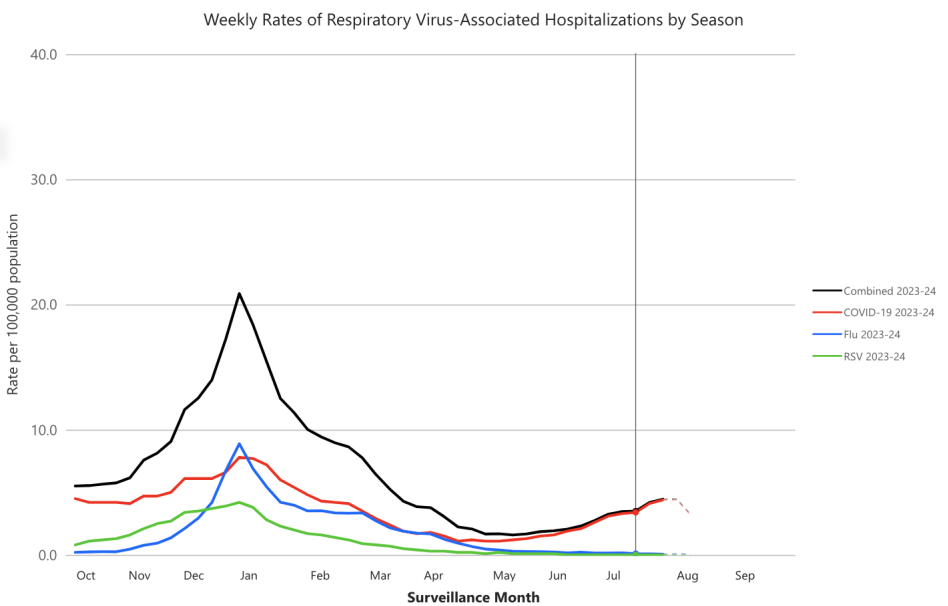
# Nowcasting Hospital Admissions on a Fixed Reporting Cycle

Summer 2024, Nowcasting & Natural History



# The Data

- Lab-confirmed flu, COVID, RSV hospital admissions
- Counties in 12-14 states, accounting for ~10% of US pop
- Use this to estimate how many individuals admitted to these hospitals each day for each pathogen, accounting for administrative reporting delays

# The Problem

(Fake) example data:

| Admit Dt | Age | Race | County | State | Sex | Onset Dt | Case ID |
|---|---|---|---|---|---|---|---|
| 10/05/2023 | 70 | 4 | SANTA FE | NM | 1 | | XXXXXXX |
| 10/02/2023 | 74 | 4 | MULTNOMAH | OR | 1 | 09/25/23 | XXXXXXX |
| 10/06/2023 | 5 | NA | SALT LAKE | UT | 1 | | XXXXXXX |
| 10/03/2023 | 66 | 99 | DENVER | CO | 2 | 10/01/23 | XXXXXXX |

- Admission dates = given
- Report dates = ?
  - Set report date = day we receive the data: once per week on Tuesday
- Currently NNH aggregates admit dates to weekly scale and performs weekly nowcast

# Project Goals

- Explore and compare impact of reporting structure, testing several techniques to handle the fixed cycle
  - **Can we perform daily nowcasts at all with these data? How well?**
- Build functionality to *explicitly* handle a fixed reporting cycle and implement it into `epinowcast`

| | **Daily/Daily** | **Daily/Weekly** | **Weekly/Weekly** |
|---|---|---|---|
| **Admission times** | Daily resolution | Daily resolution | Weekly resolution |
| **Report times** | Daily resolution | Weekly resolution | Weekly resolution |
| **`epinowcast` functionality** | ✅ | ❓ | ✅ |

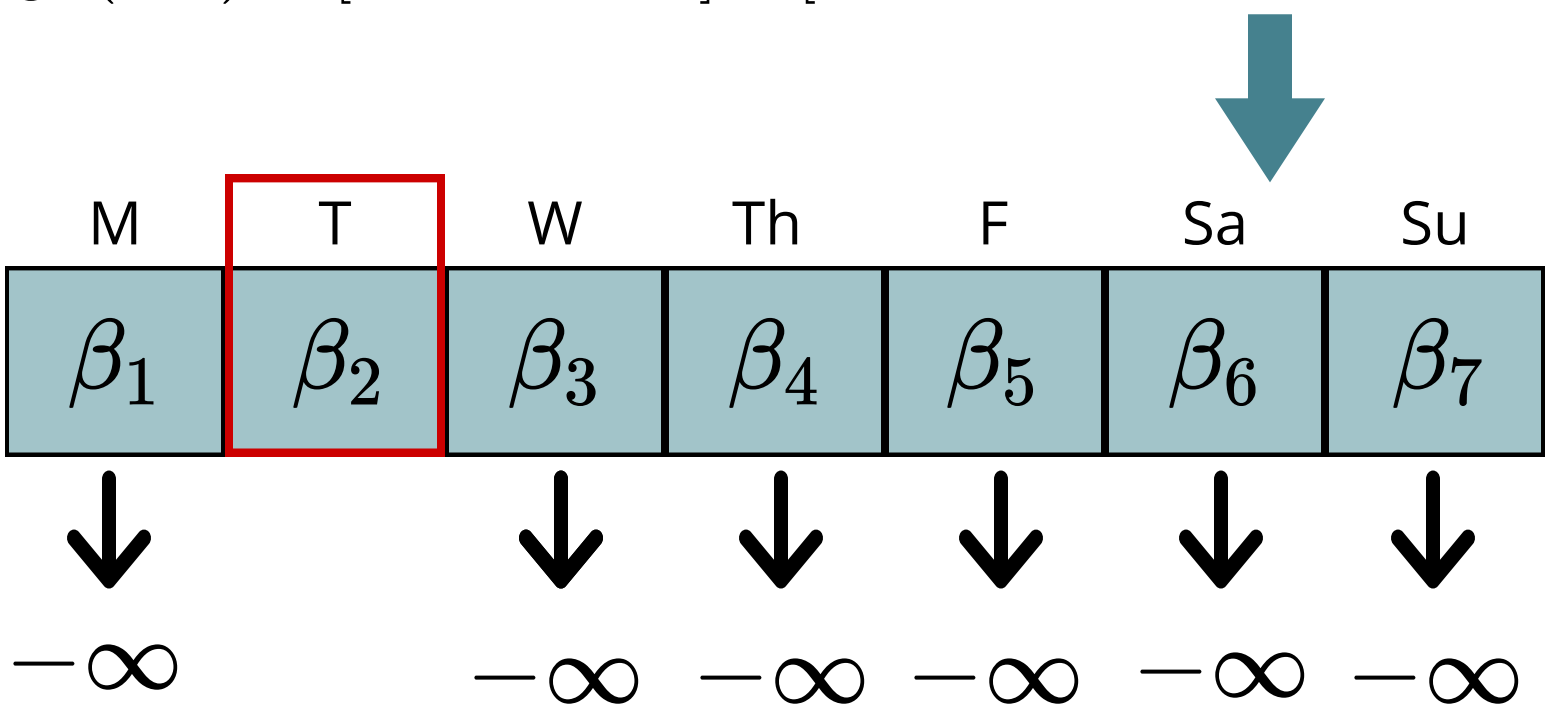
# Project Breakdown

- Methods for handling the weekly reporting cycle:
  1. Day-of-week reporting effect
  2. Hardcode the reporting hazard
  3. Aggregate reporting probabilities (❌)
- Apply these to simulated data (compartmental model) and FluSurv-NET data
  - So far: one simulated scenario and one influenza hospital admission dataset

# 1. Day-of-Week Reporting Effect

`epinowcast` parameterizes reporting delay probabilities with a discrete-time hazard model:

$$\text{logit}(\text{hzd}) = [\text{baseline hzd}] + [\text{linear combo of covariates}]$$



# 2. Hardcode the Hazard

`epinowcast` parameterizes reporting delay probabilities with a discrete-time hazard model:

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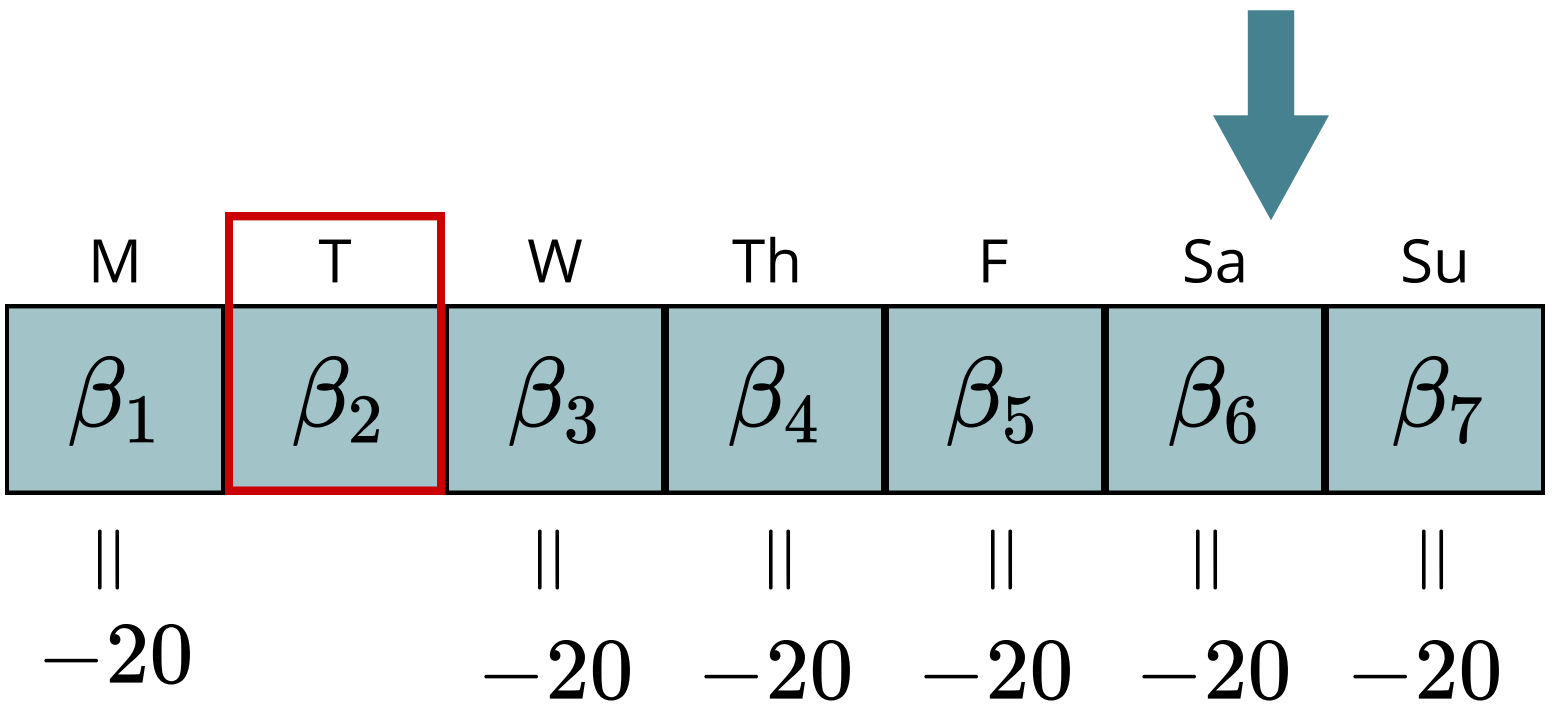
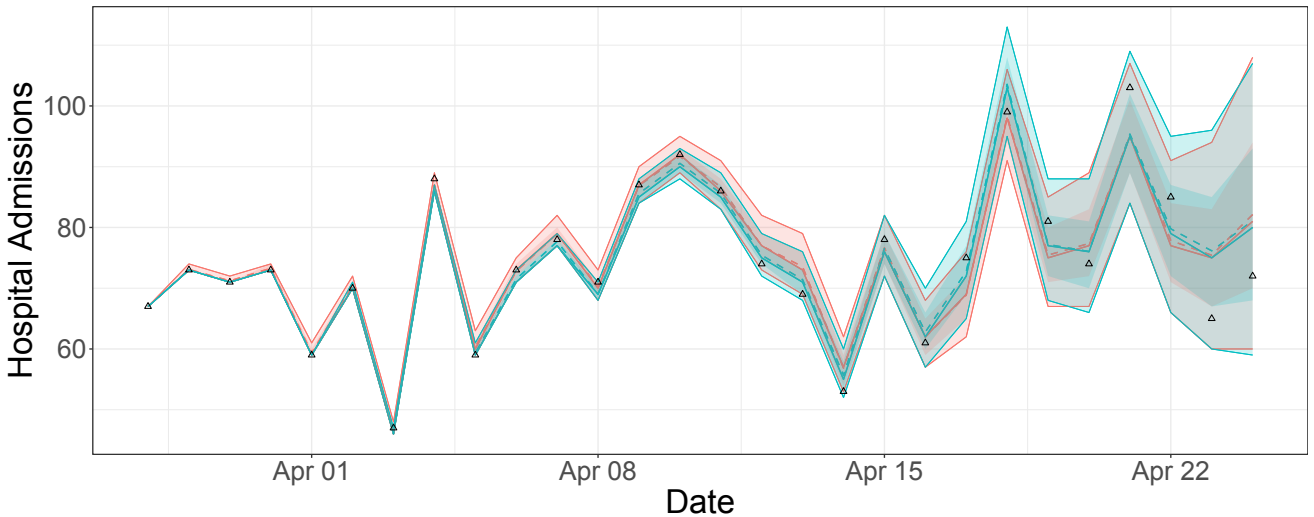
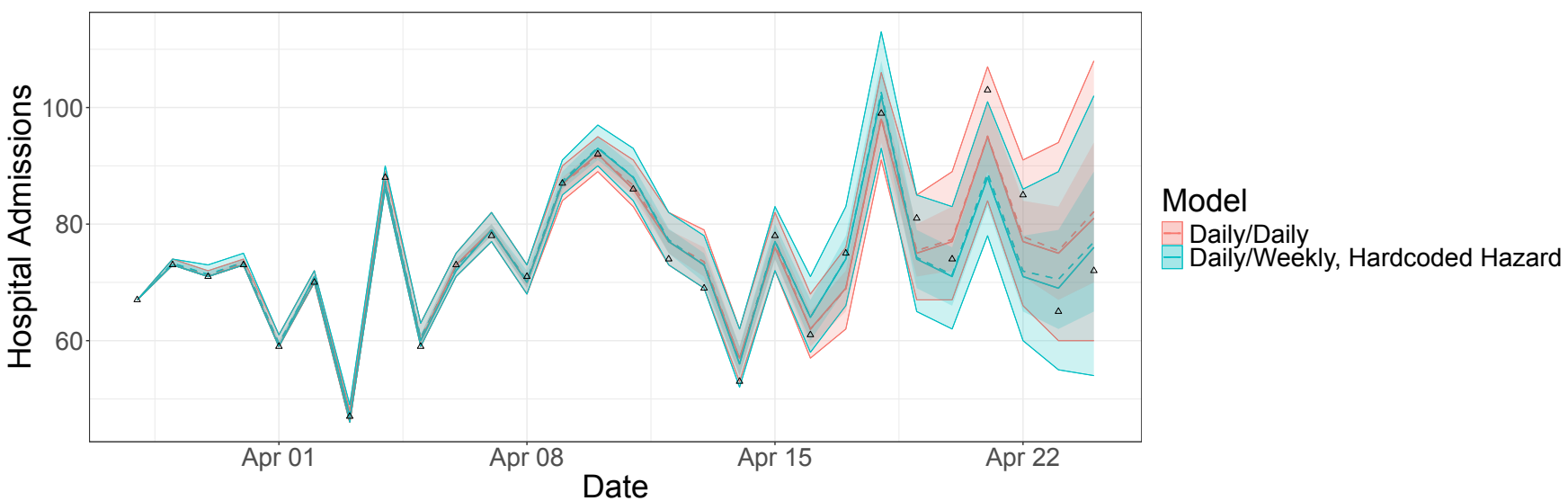


# Simulated Dataset

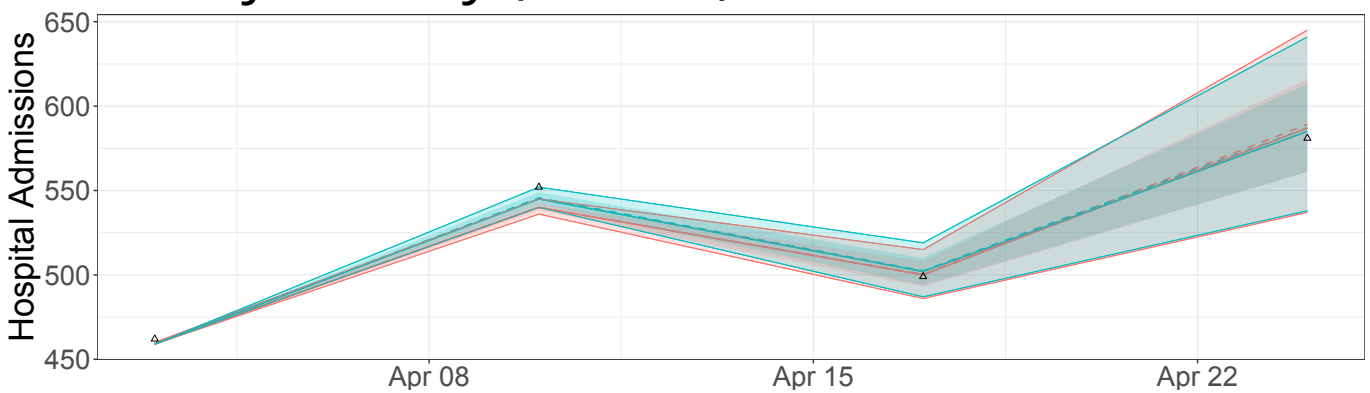
Models with Daily/Weekly data perform comparably to Daily/Daily!

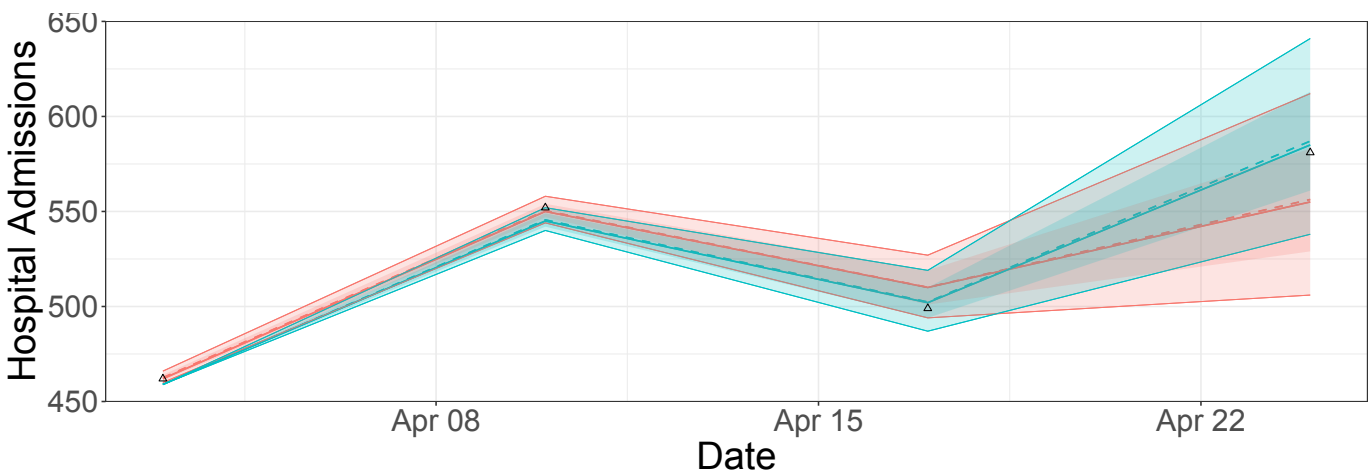


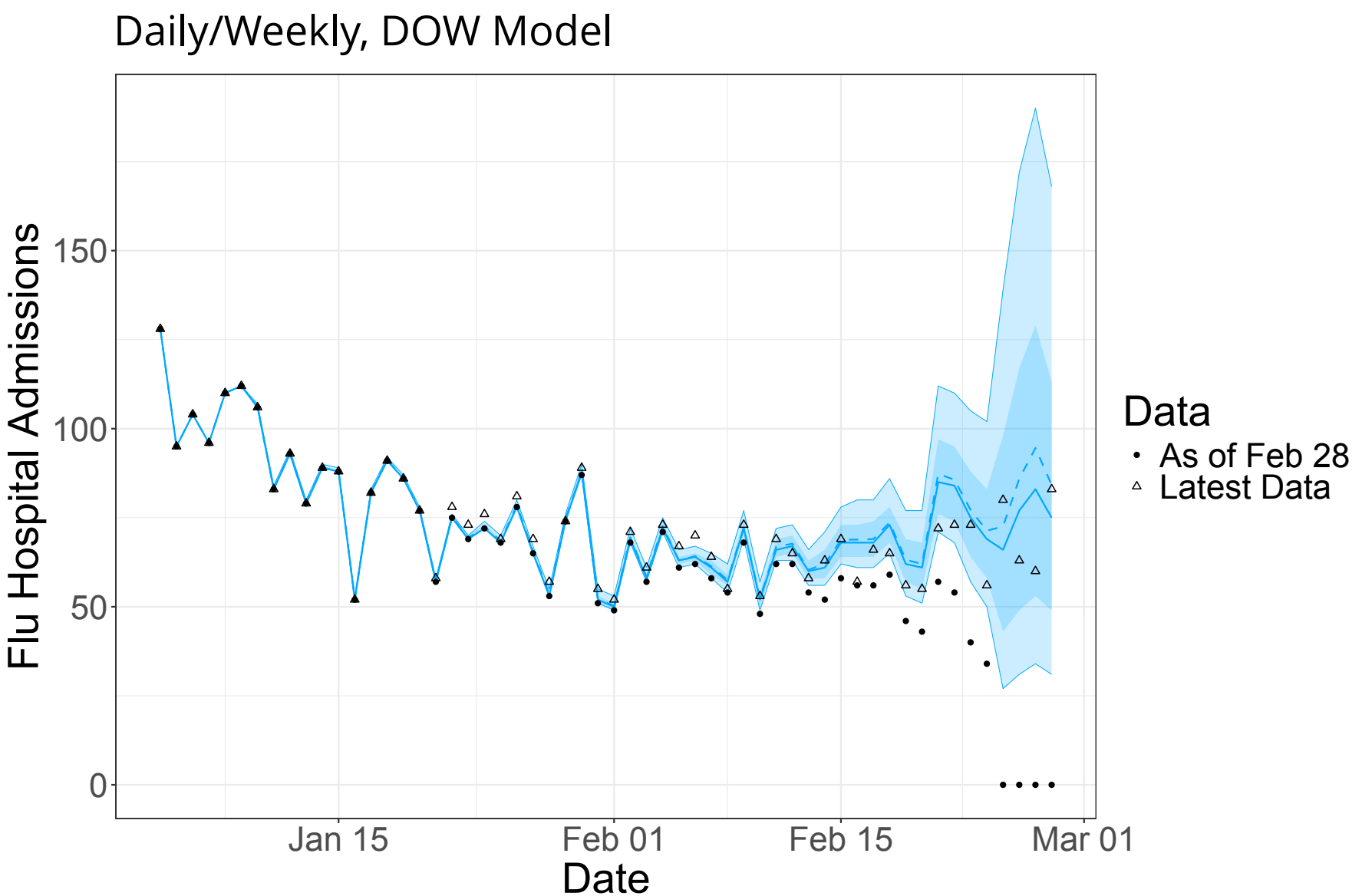
# Daily Nowcasts Aggregated to Weekly

Models with Daily/Weekly data perform comparably to Weekly/Weekly (kind of)



# Real Data (FluSurv-NET)



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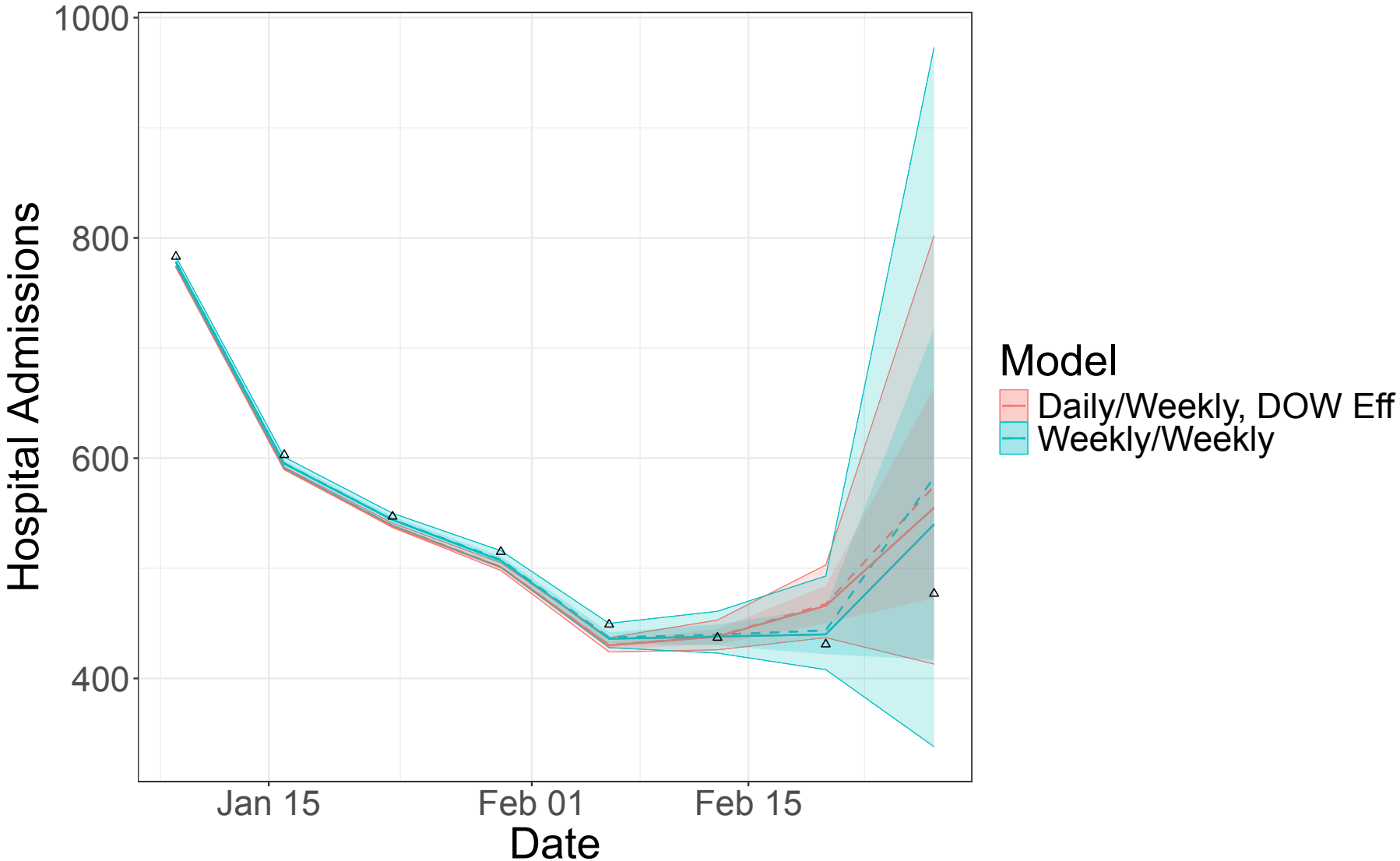
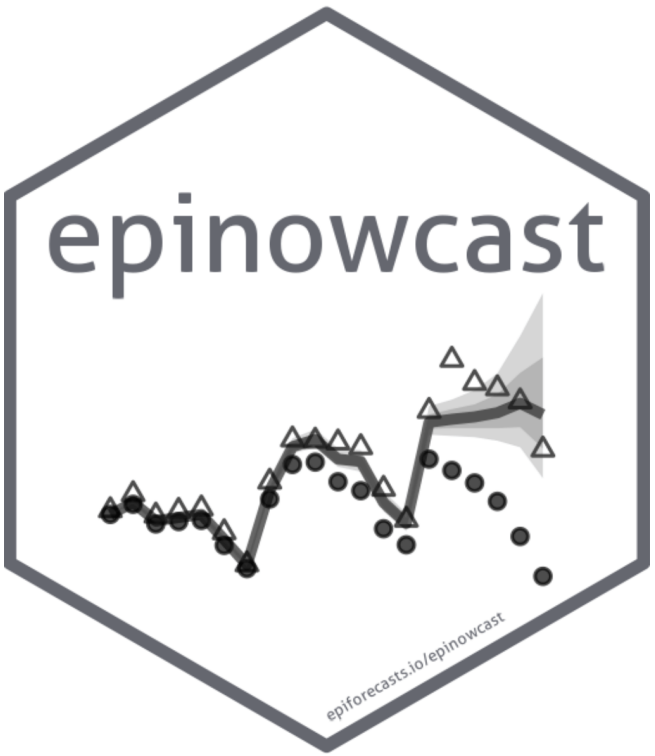


# Summary

- Nowcasting with daily resolution seems possible with the reporting cycle data
  - Possibly even good!?
  - Caveat: model run on one simulated dataset, and on one flu set
- Why does this matter?
  - During key periods in an outbreak, decision-makers may want finer resolution than weekly
  - Daily nowcasts useful for things like monthly summaries
  - *If* the Daily/Weekly models aggregated to weekly nowcasts do better, there's a clear benefit

# Next Steps

- Basic scoring of nowcasts
- Run nowcasts on large number of dates to test generalizability
- Finish implementing the probability aggregation method into `epinowcast`



# Thank you!

Special thanks to:
Katie Gostic,
Sam Abbott,
The NNH team

# *Appendix:* Aggregate Reporting Probabilities

Reporting hazard is ultimately converted back to reporting probability to be used in the likelihood

| M | T | W | Th | F | Sa | Su |
|---|---|---|---|---|---|---|
| | | | $p_{t,0}$ | $p_{t,1}$ | $p_{t,2}$ | $p_{t,3}$ |
| $p_{t,4}$ | $p_{t,5}$ | $p_{t,6}$ | $p_{t,7}$ | $p_{t,8}$ | $p_{t,9}$ | $p_{t,10}$ |
| $p_{t,11}$ | $p_{t,12}$ | $p_{t,13}$ | $p_{t,14}$ | | | |

# *Appendix:* Aggregate Reporting Probabilities

Reporting hazard is ultimately converted back to reporting probability to be used in the likelihood

| M | T | W | Th | F | Sa | Su |
|---|---|---|---|---|---|---|
| | | | $0$ | $0$ | $0$ | $0$ |
| $0$ | $\sum_{i=0}^{4} p_{t,i}$ | $0$ | $0$ | $0$ | $0$ | $0$ |
| $0$ | $\sum_{i=5}^{11} p_{t,i}$ | $0$ | $0$ | | | |
| | $\sum_{i=12}^{14} p_{t,i}$ | | | | | |