Mariah Salcedo

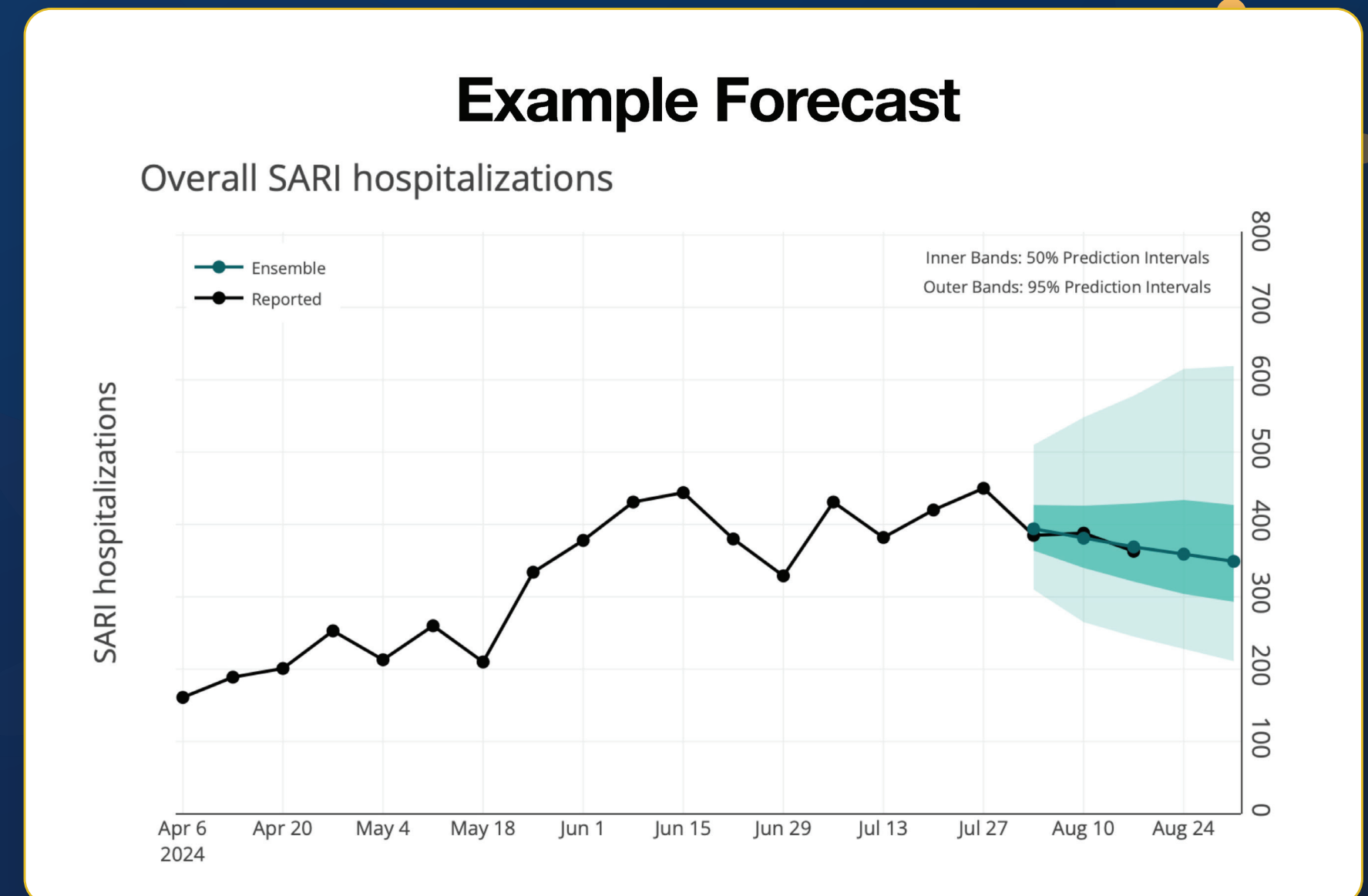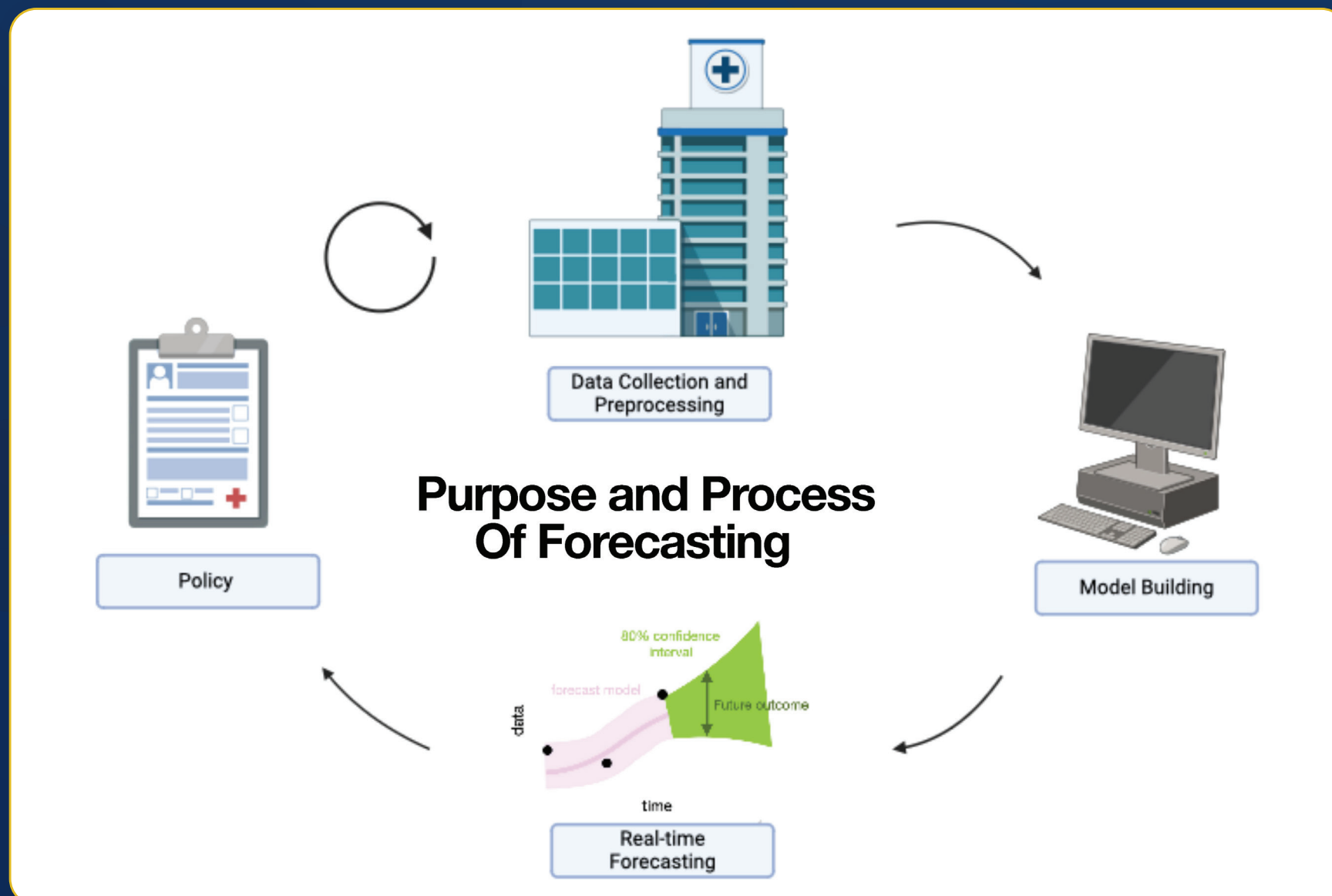**Herz Global Impact Award**
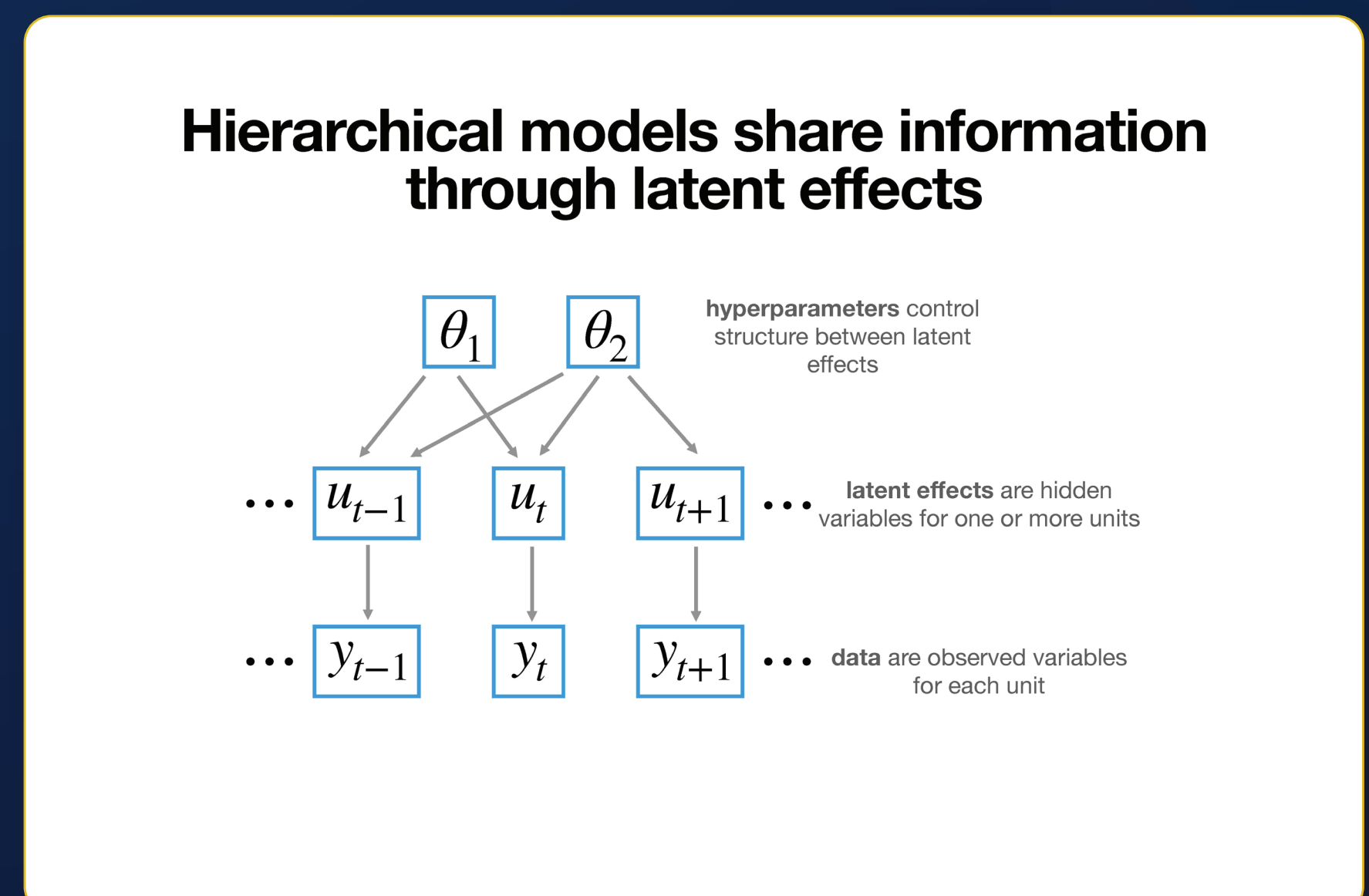*Ph.D. Student, Bioinformatics*
Third Year ARCS Scholar

Mathematical Modeling for Disease Forecasting

Utilizing a Bayesian Hierarchical Model for Forecasting Respiratory Diseases in both the United States and Paraguay to aid in public health response.

Purpose and Process Of Forecasting

Example Forecast

Overall SARI hospitalizations

We developed 3 models designed to do different things

historic pattern matching	**copycat** weighted sample of previous segments most similar to current time series
additive latent effects	**INFLAenza** seasonal and short-term effects capturing correlations across time and other groups
mechanistic	**SIRSea** interacting susceptible and infectious populations with time-varying transmission rate

Hierarchical models share information through latent effects

hyperparameters control structure between latent effects

latent effects are hidden variables for one or more units

data are observed variables for each unit

Forecasting requires posterior prediction of unobserved latent effects

- $\widehat{\mathbf{u}}$ is constrained by data **only** through the joint posterior $P(\mathbf{u}, \boldsymbol{\theta} \mid \mathbf{y})$

- As t increases, $\widehat{\mathbf{u}}$ behaves more like a prior

observed units   unobserved units

INFLAenza combines separate seasonal and short-term latent effects

| Weekly-age specific effect | Autocorrelation coefficient (AR2) | SIRI cases relate week to week for different age groups |
| Seasonal effect | Random Walk (RW1) | SIRI cases relate on a periodic time scale |