Data Science at the Mayo Clinic

Implementation of the Discovery, Translation, and Application (DTA) Framework in Outpatient Palliative Care Practice

Shusaku Asai

The Kern Center for the Science of Health Care Delivery

SDSS (June 3-5, 2020)

MAYO CLINIC

The DTA Framework

Discovery

1. **Define the Problem and the Proposed Solution**

A clinical need must motivate the data science solution. Collaborate with clinical champions to determine a practice intervention.

2. **Establish Integration and Evaluation Plan**

Identify and partner with individuals necessary to integrate the solution into practice. Create an intervention plan.

Translation

3. **Create a Retrospective Dataset**

Pull, clean, and integrate clinically relevant data sources to create a training dataset. Ensure data cleaning behavior is mirrored in eventual production environment.

4. **Build a Predictive Model**

Train and validate the statistical model on retrospective data

Application

5. **Productionize the Model**

Turn the model into an API or a cron job. Present model output into a GUI for clinical practice.

6. **Evaluate the Production Data**

Validate the model on production data

7. **Practice Integration and Evaluation**

Conduct a pragmatic clinical trial to assess practice impact.

Data Monitoring and Model Maintenance

MAYO CLINIC

Discovery

Problem:

- A large gap exists between patients who would benefit from Palliative Care (PC) and who actually receive a PC consult. Less than half of all hospital admissions that could benefit from PC actually receive it.

Proposed Solution:

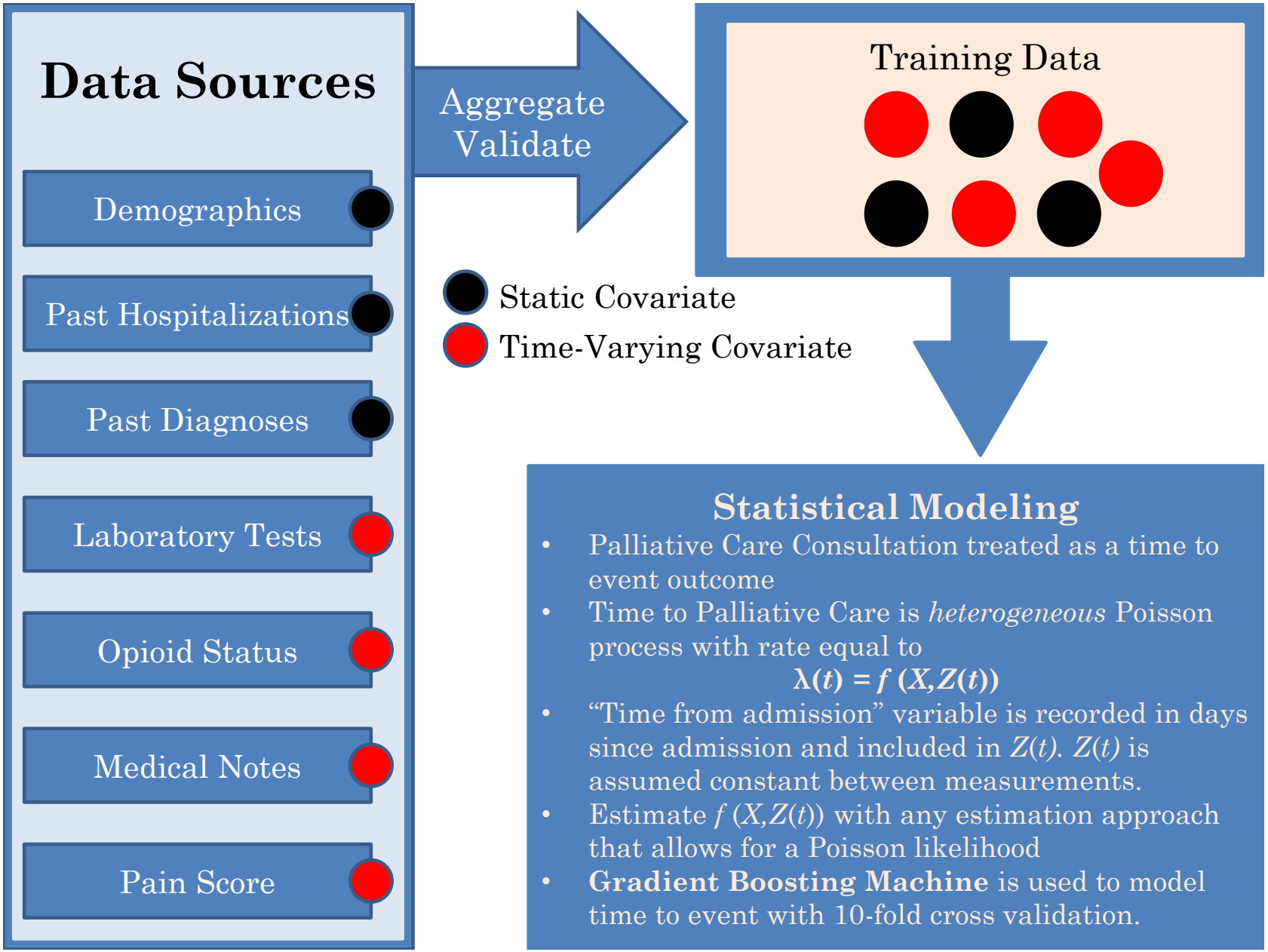
- Build a central analytics center that houses a predictive model to identify patients most likely to benefit from a PC consult.

Integration and Evaluation Plan:

- Designate Control Tower Operators (CTO) who are presented with high risk patients with unmet needs from the model. The CTO then forwards appropriate candidate patients to specific care providers.

MAYO CLINIC

Translation



Statistical Modeling

- Palliative Care Consultation treated as a time to event outcome
- Time to Palliative Care is *heterogeneous* Poisson process with rate equal to

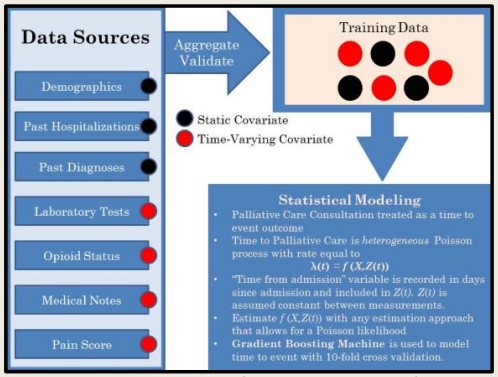
$$\lambda(t) = f\,(X, Z(t))$$

- "Time from admission" variable is recorded in days since admission and included in $Z(t)$. $Z(t)$ is assumed constant between measurements.
- Estimate $f\,(X, Z(t))$ with any estimation approach that allows for a Poisson likelihood
- **Gradient Boosting Machine** is used to model time to event with 10-fold cross validation.

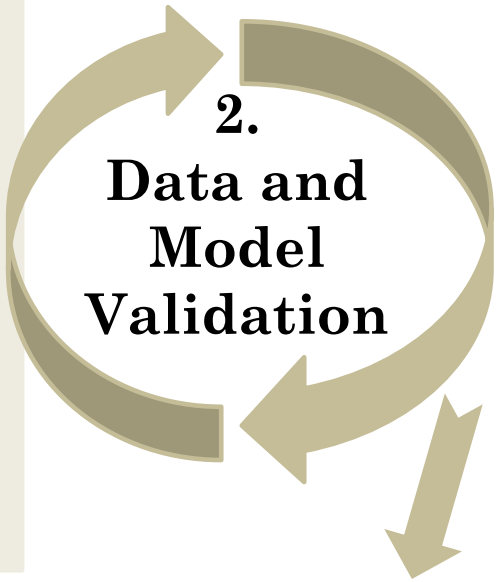
MAYO CLINIC

Application

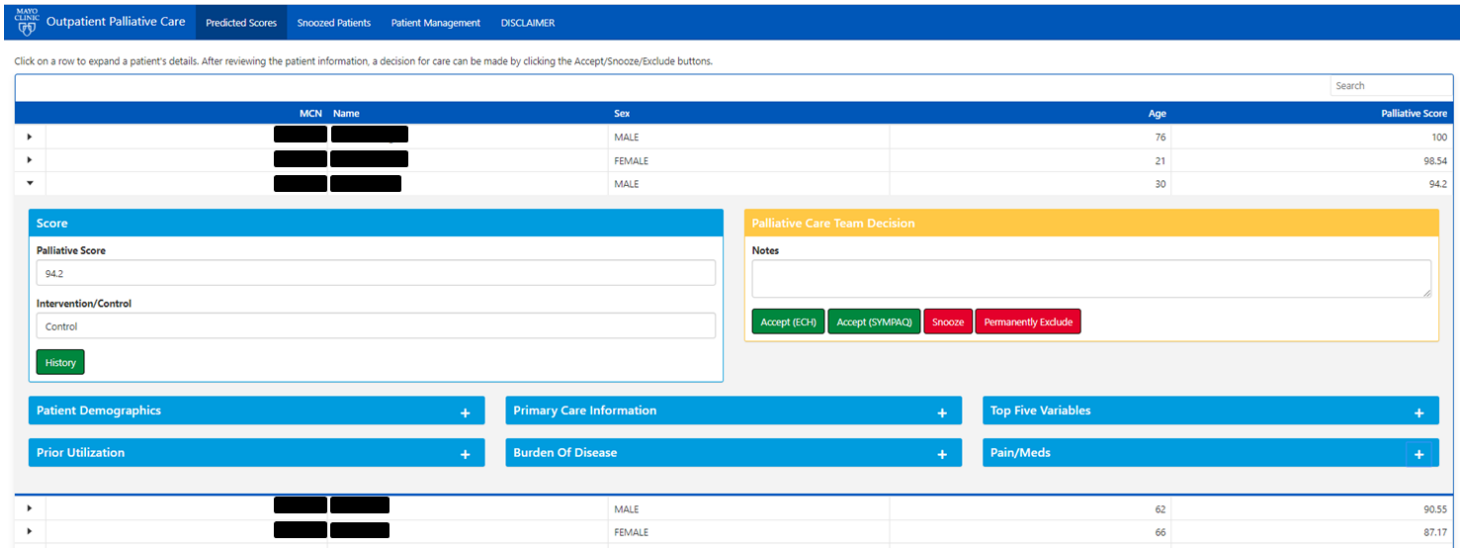
1. Productionize: Cron Job



Create an automated process that extracts, aggregates, and prepares data for real-time modeling.



3. Validated model results are then fed into and presented in an RShiny GUI for Control Tower Operators.



4. Conduct a pragmatic clinical trial to assess practice impact.

MAYO CLINIC