### Prescriptive Analytics in Stroke Rehabilitation

### Mary Free Bed Rehabilitation





# **Prescriptive Analytics**

- Use of data to determine an optimal course of action
- Support decision-making
- Personalized (precision) medicine is
  - A tailored approach to health care
  - That accounts for individual variability in the genes, environment, and lifestyle of each person.
- In post-acute care
  - Patient outcomes include activities of daily living and mobility, among others
  - · Recovery may take months to years
  - Many live with permanent impairments, activity limitations, and participation restrictions.



# **Prescriptive Analytics Project**

- Post-acute care (PAC) implementation project
  - Plan post-acute care (PAC) paths
  - Based on predicted trajectories for recovery from stroke
  - AM-PAC Basic Mobility and Daily Activities domains
- Based on prior work
  - Prototype prognostic models for stroke recovery [Kozlowski et al., 2023]
  - Care Navigation implementation project [Kozlowski et al., in preparation]
- Grant application under review with the Michigan Health Endowment Fund



### **Logic Model**





# **Care path Planning**



- Post-acute care path (PAC) planned in acute hospital
- Predicted trajectory based on patient's characteristics
- Parameters estimate
  - Baseline T-score
  - Plateau magnitude and timing
  - Recovery rate
- Algorithm recommends
  - Sequence of PAC services
  - Timing of transitions
- Adjusted for
  - · Observed recovery
  - Clinical judgment
  - Service logistics, e.g., available bed



# **Prognostic Accuracy**

- Sample represents target population
  - Research samples: sampling bias explicit or implicit
  - Clinical samples: routine outcome measurement
- Model building
  - Outcome variable
    - Meaningful patient outcome □ AM-PAC
    - Feasible for collection across patient's recovery to plateau
    - · Produces valid scores at all time points
  - Predictor variables
    - Associated with outcome
    - Complete and clean data
- External validation evidence





### Prognostic Models AM-PAC Basic Mobility

- Prototype model [Kozlowski 2023]
- Mixed effects longitudinal model
- Predict patient-level mobility recovery
- Group-average trajectory (red) with individual variability (grey) on parameters for
  - Baseline T-score at day of stroke
  - Asymptote to plateau
  - Non-linear negative exponential rate\*
- N=115
- · Predominantly moderate severity stroke
- Probable selection bias

\*Prototype model does not reflect individual variation on rate





### Care Navigation Following Stroke Implementation

- 2-year pilot
- Auto enroll from inpatient rehabilitation
- Follow-up at days 1, 7, 14, 21, 30, 60, 90
  - AM-PAC Basic Mobility
  - Needs assessment
  - Support and referral
- N=885 patients enrolled; AM-PAC at Day
  - 1 n=632 (71%)
  - 30 n=545 (62%)
  - 60 n=423 (48%)
  - 90 n=403 (46%)





### **Logic Model**





# **Learning Health System**

#### • Learning Community

- Patients and caregivers
- Clinical: physicians, therapists (physical, occupational, speech), nursing
- Services: acute hospital, inpatient rehabilitation, outpatient, home care
- Administrative: service managers, case managers, C-suite
- Information Technology: Epic<sup>®</sup> and Decision Support analysts
- Steering Committee
- Focus groups: pre- and post-implementation



# **Learning Health Cycles**



#### Cycle 1 - Baseline

- P2D: Practice to data
  - AM-PAC Basic Mobility
  - Predictors EMR
  - Care paths
- D2K: Data to Knowledge
  - Trajectory model v1.0
  - Care path algorithm v1.0
- K2P: Knowledge to Practice
  - Dashboards v1.0

#### Cycle 2

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- P2D: Practice to data
  - AM-PAC Basic Mobility
  - Predictors EMR
  - Care paths
- D2K: Data to Knowledge
  - External validation v1.0
  - Trajectory model v2.0
  - Care path algorithm v2.0
- K2P: Knowledge to Practice
  - Dashboards v2.0



# **Care Path Algorithm**

- Pre-plan PAC care path based on
  - Predicted recovery
  - Early observed recovery
- Adjust based on
  - Clinical judgment
  - Service logistics, e.g., bed availability
  - Changes in observed recovery
- Forecast service utilization on care path aggregate





















# **Dashboard - Patient**

- Predicted trajectory
- Observed recovery
- AM-PAC interpretation
- Care Path
- Timeline (dates)





# **Dashboard - Clinician**

- Single patient view similar to Patient Dashboard
- Multiple patient view individual trajectories for multiple patients
- Aggregate patient view
  - Averaged trajectory for previous patients seen by clinician
  - Average trajectory for all other patients
  - I visual comparison of clinician's patient outcomes to program
- Self-evaluate outcomes to identify strengths and weaknesses



# **Dashboard – Program Manager**

- Similar to Clinician Dashboard
- Aggregate patient view
  - Averaged trajectory for previous patients seen by each clinician
  - visual comparison of each clinician's patient outcomes to program
- Evaluate outcomes for clinicians and program
- Current and future predicted aggregate census



## Learning Health System Implementation

- Knowledge products developed from clinical data
  - Prognostic trajectory models
  - Care path algorithm
- Identify and engage all stakeholder groups
  - Steering committee
  - Focus groups and structured interviews
- Iterative learning health cycle
  - Refine and validate knowledge products
  - Stakeholder perspectives on implementation



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# References

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