

Breakout Session 4: Track A

PREcision Care In Cardiac ArrEst - ICECAP (PRECICECAP)

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Presenter: Yann Le Guen, PhD, MS, Assistant Director
Quantitative Science Unit, Department of Medicine, Stanford University

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Department of Neurology, Stanford University

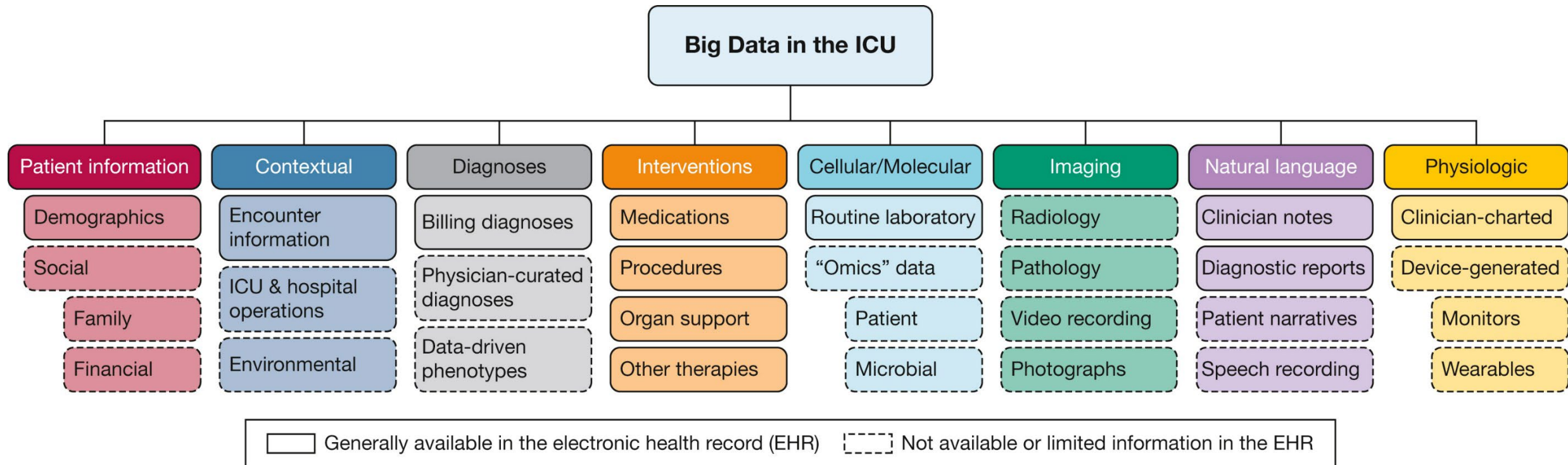
Co-PI: Jonathan Elmer, MD, MS, Associate Professor
Departments of Emergency Medicine and Neurology, University of Pittsburgh



Critically Ill Patients Generate LOTS of Data

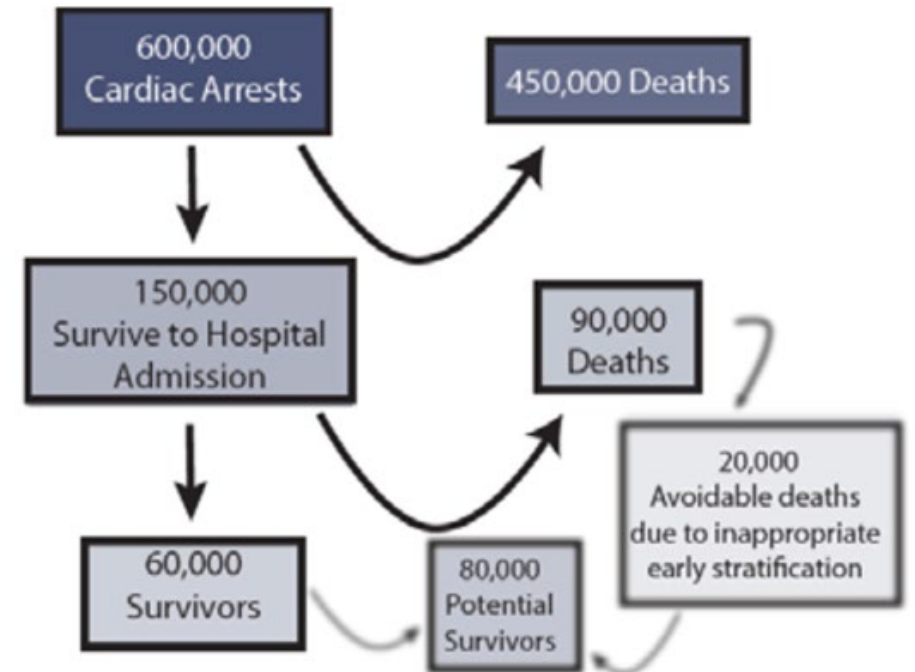


Critically Ill Patients Generate LOTS of Data



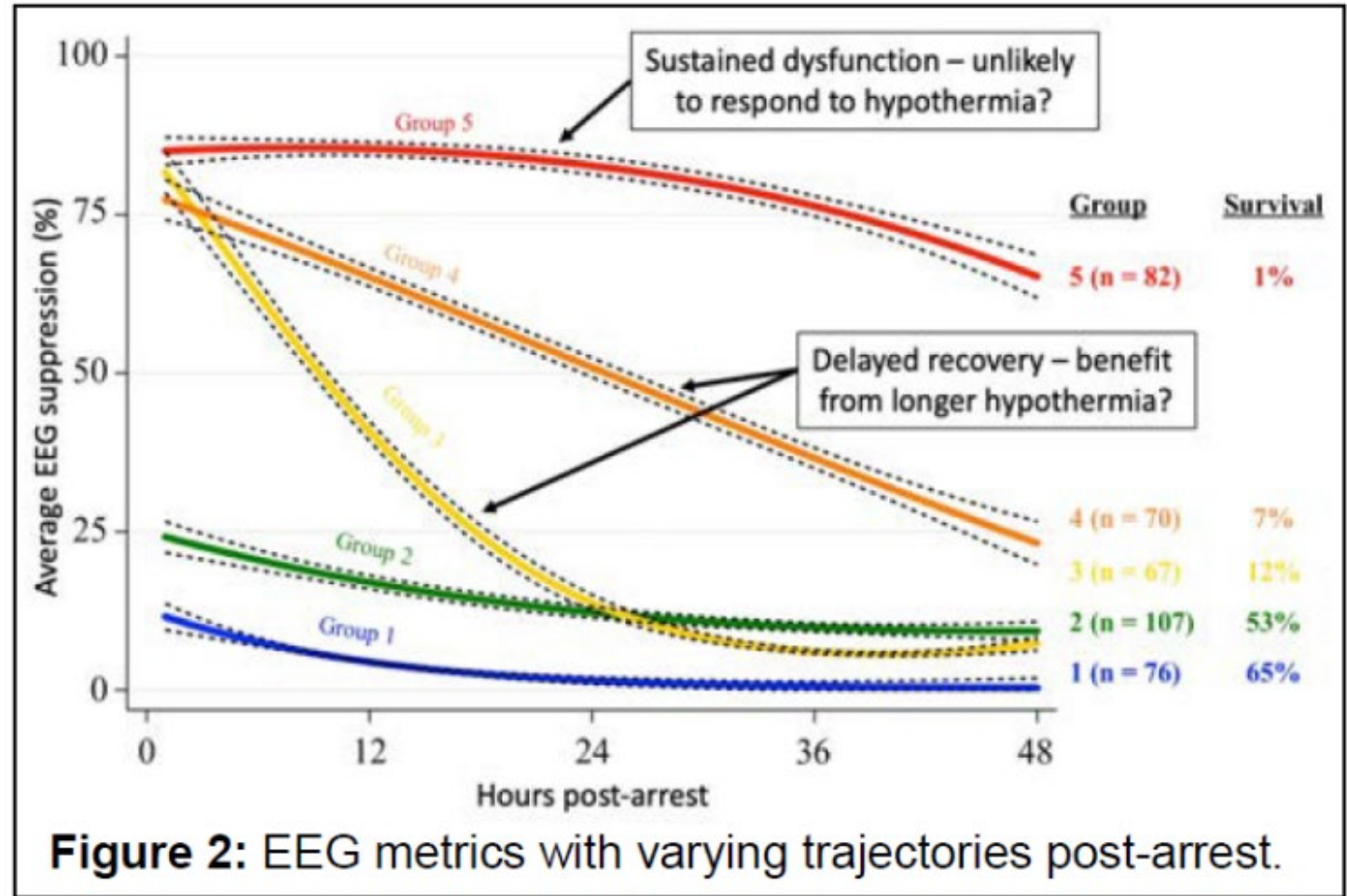
Current Treatments Lack Precision

- Parent clinical trial: ICECAP aims to find optimal cooling duration for all patients
- Most cardiac arrest trials of effective interventions are neutral
- Little effort to target interventions to likely responders
- What are we trying to predict/improve?
 - Survival (likeliness to be discharged alive)
 - 90-day function/prognosis
- Variables specific to cardiac arrest
 - Patient and arrest characteristics
 - Cardiopulmonary physiology
 - Neurophysiology (EEG)
 - Imaging
 - Response to treatment





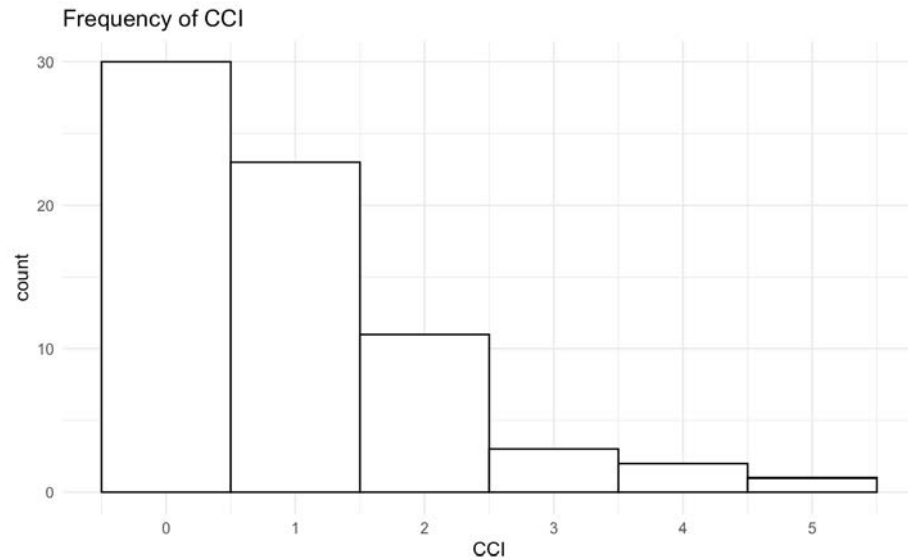
Stratified treatments



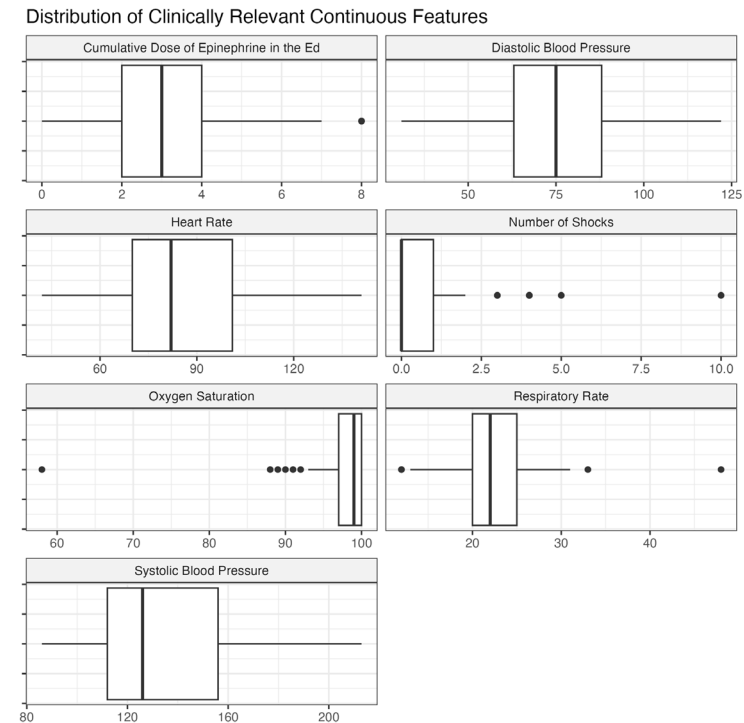
Available Data

Two types of variables

I. Time-invariant variables from baseline data collection (categorical & quantitative)



Charlson Comorbidity Index (CCI)
Aggregating categorical variables in a score used in ER

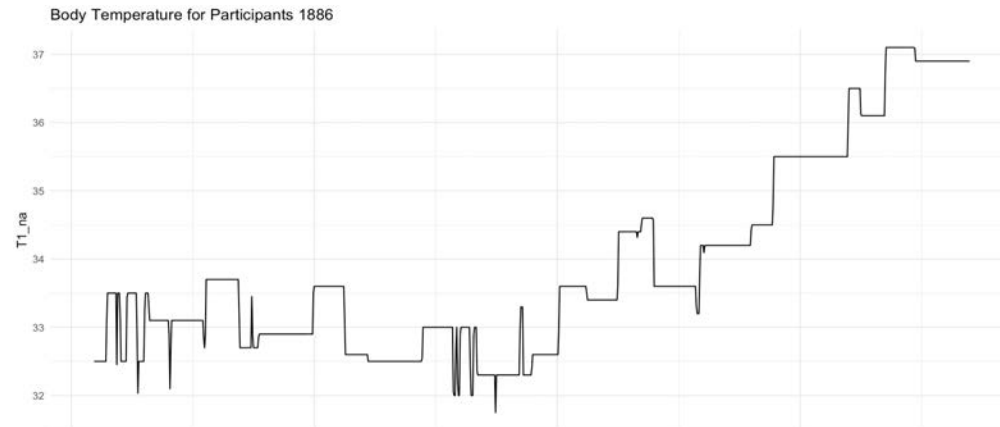
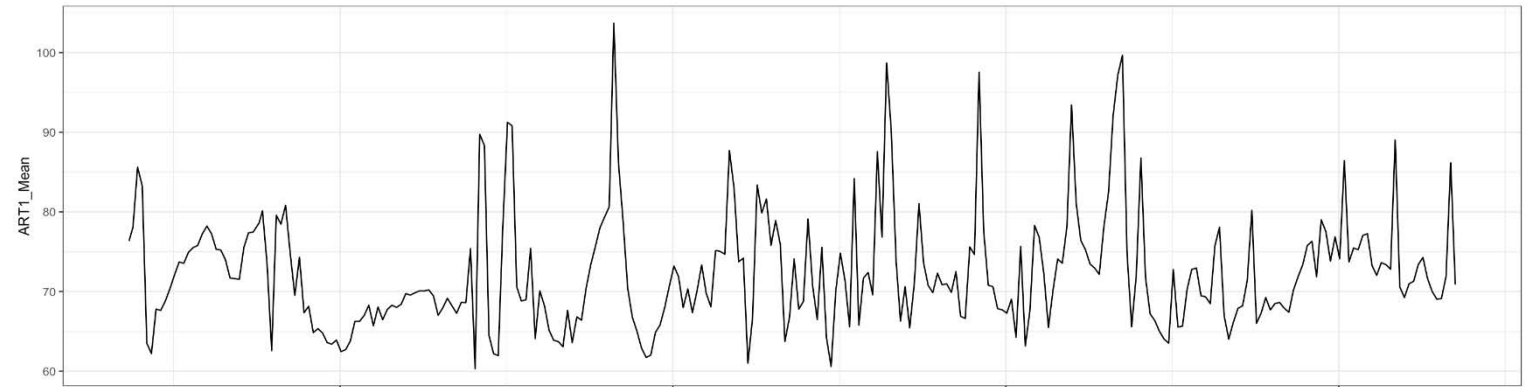
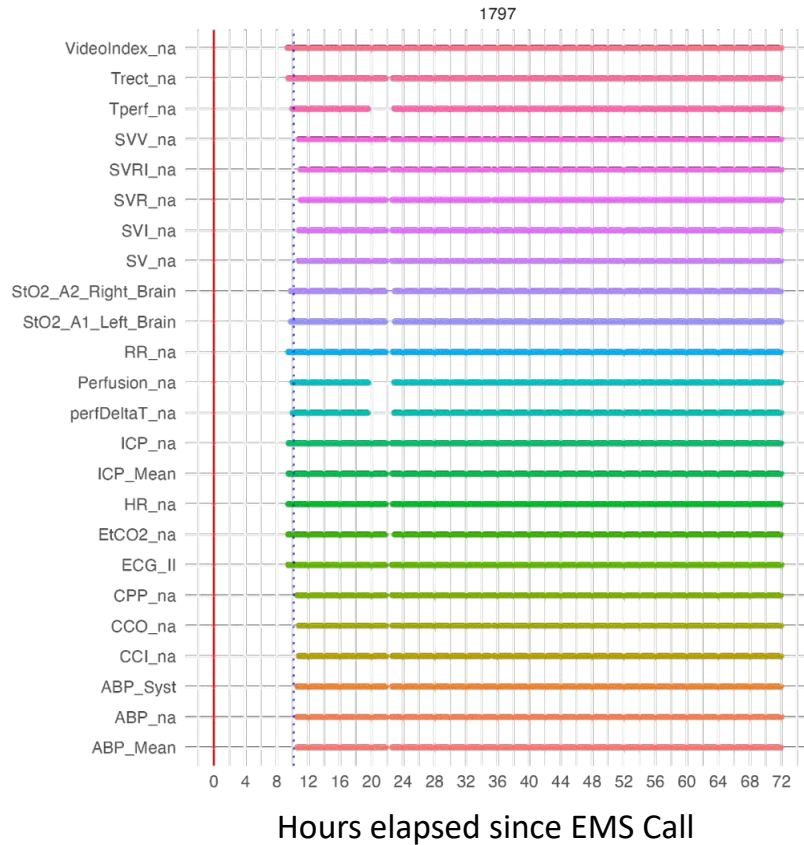


Time-invariant variables are the most critical variables for the initial prediction of survival and optimal hypothermia duration prior to waveform data recording.

Available Data

Two types of variables

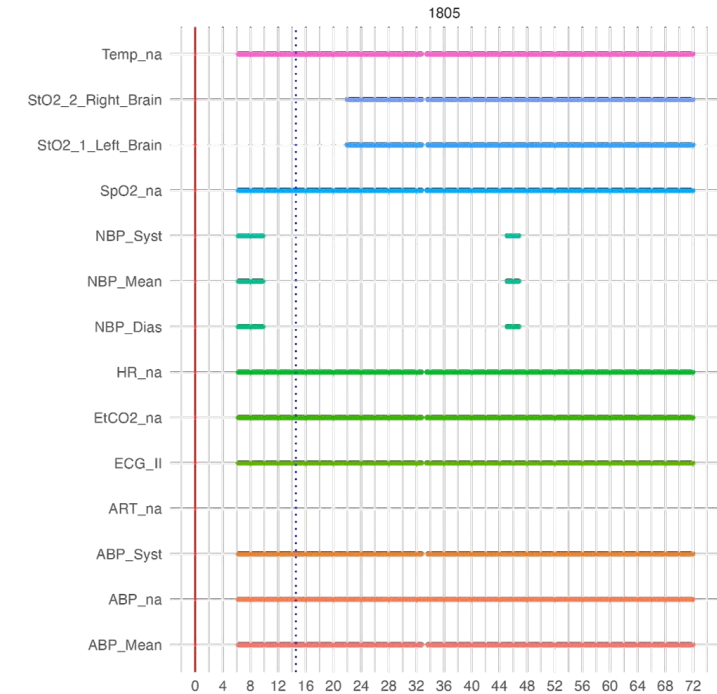
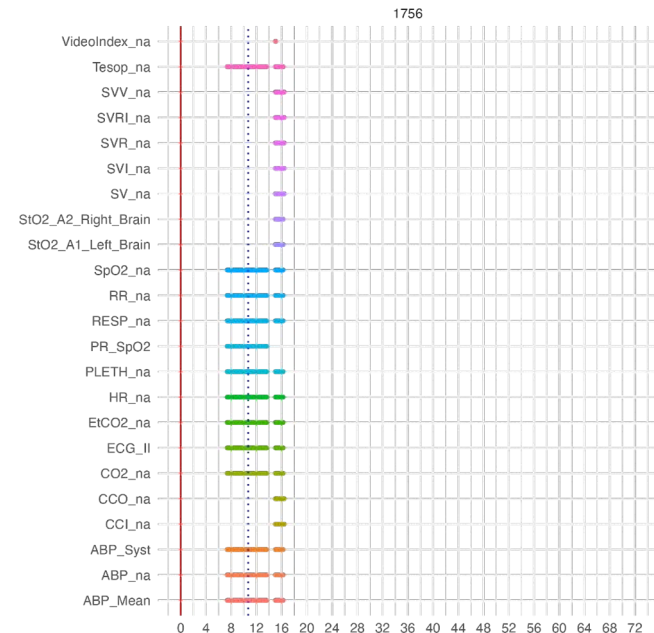
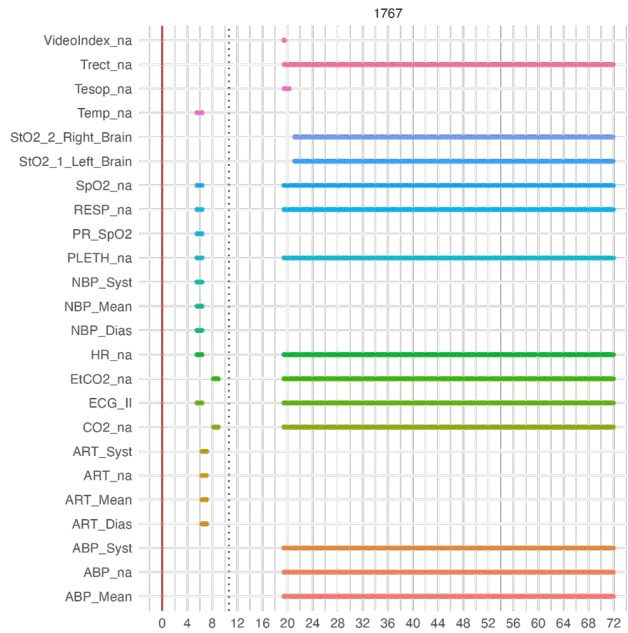
II. Time-varying variables with longitudinal trajectory



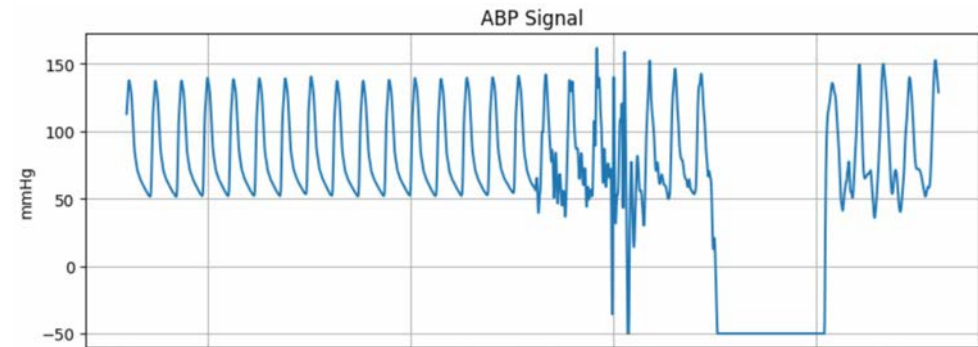
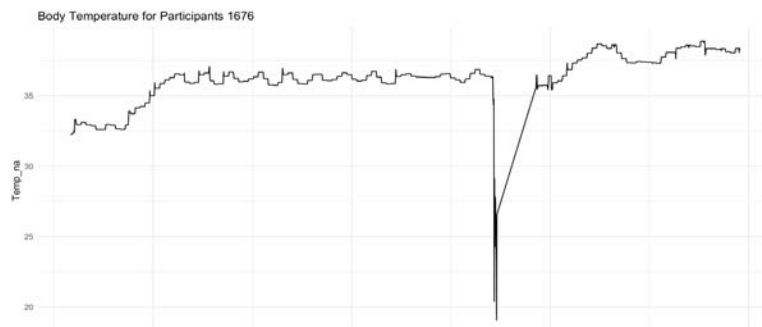
These can be used to update the initial prediction on an hourly or six-hour basis.

Available Data

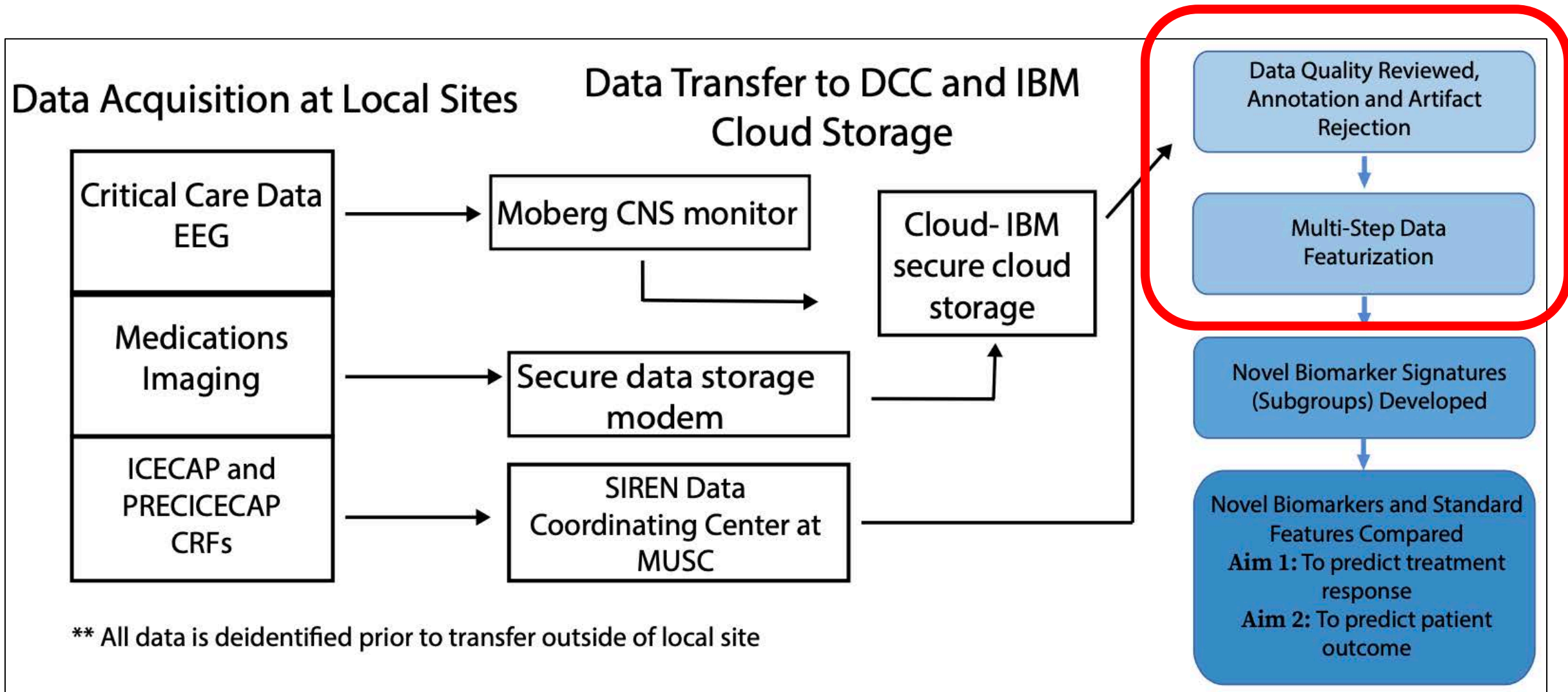
- Time-varying variables heterogeneous availability across participants:



- And artifacts

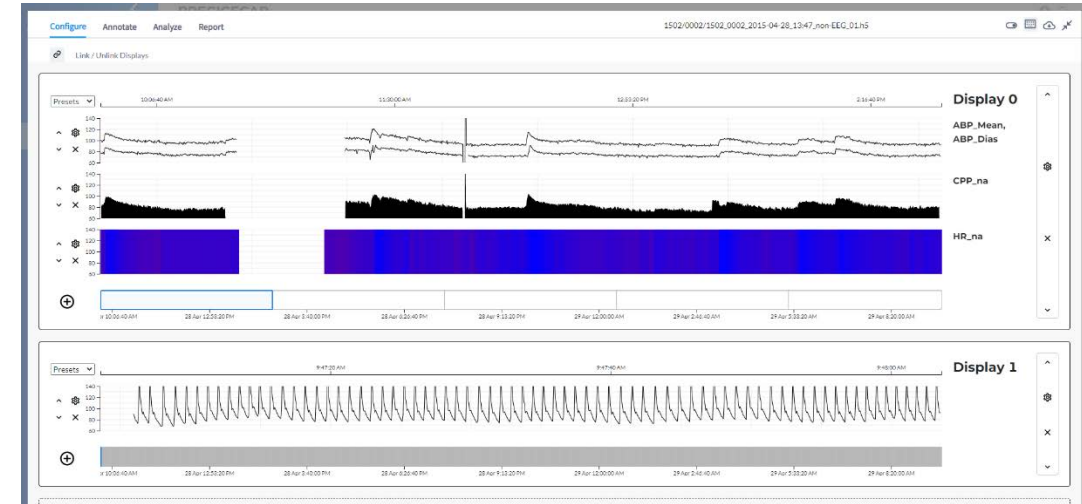
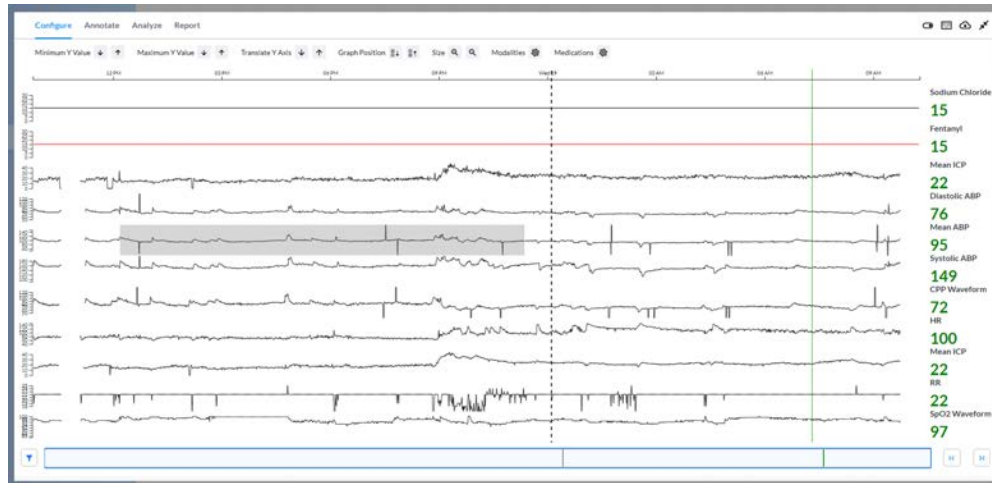


Data Acquisition pipeline

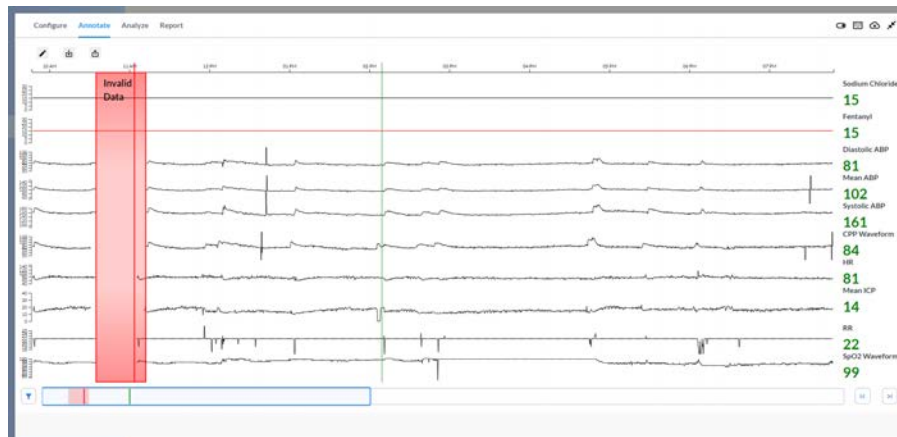


Artifact Annotation Pipeline

Moberg visualization platform

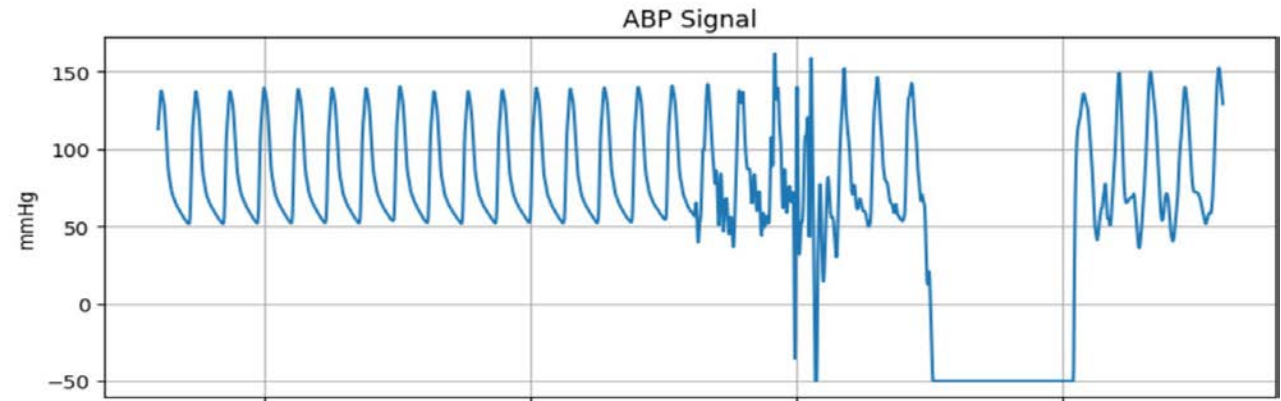
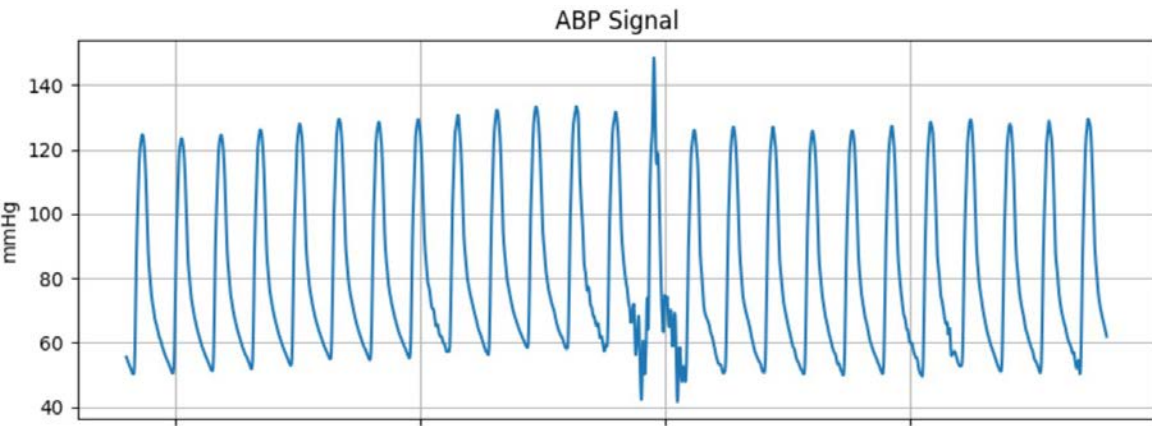


Algorithmic guided and manual annotation

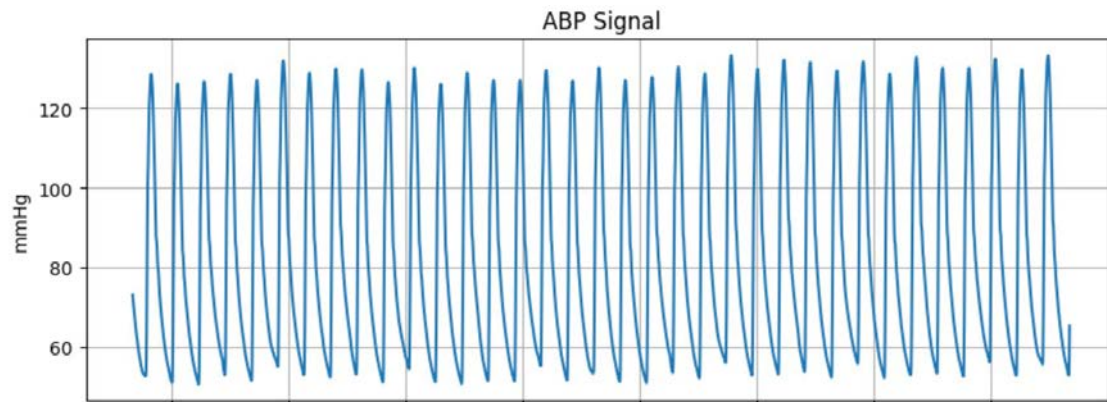


Artifact Annotation Pipeline

Example of artifacts on the Arterial Blood Pressure signal



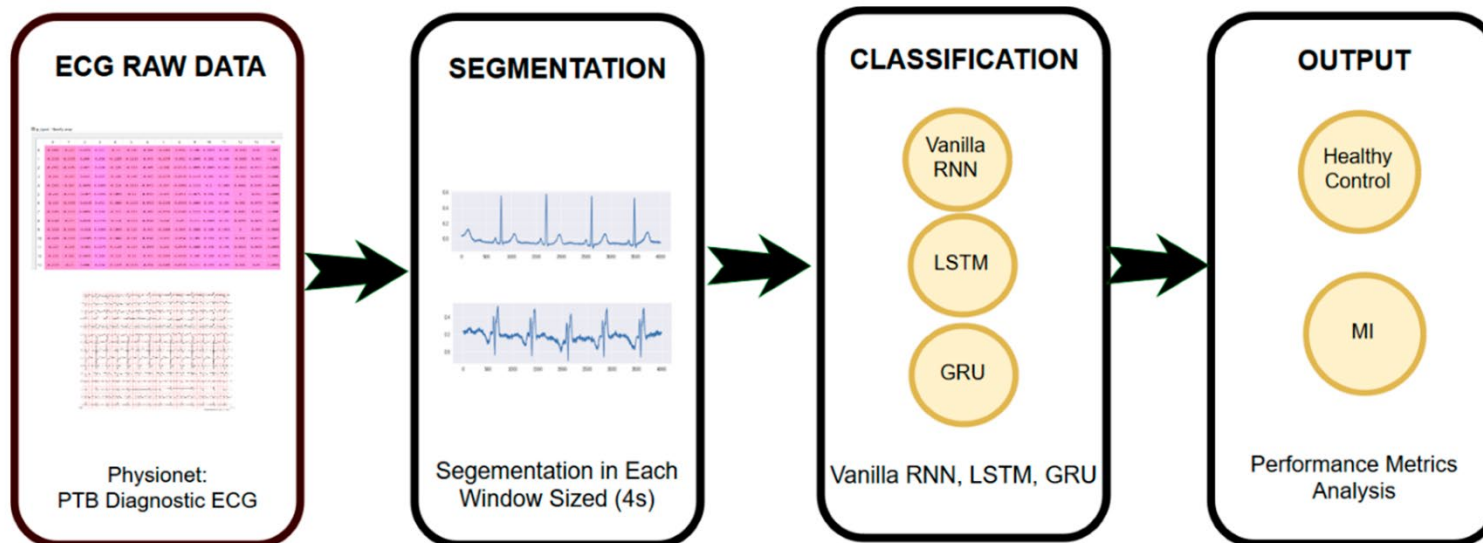
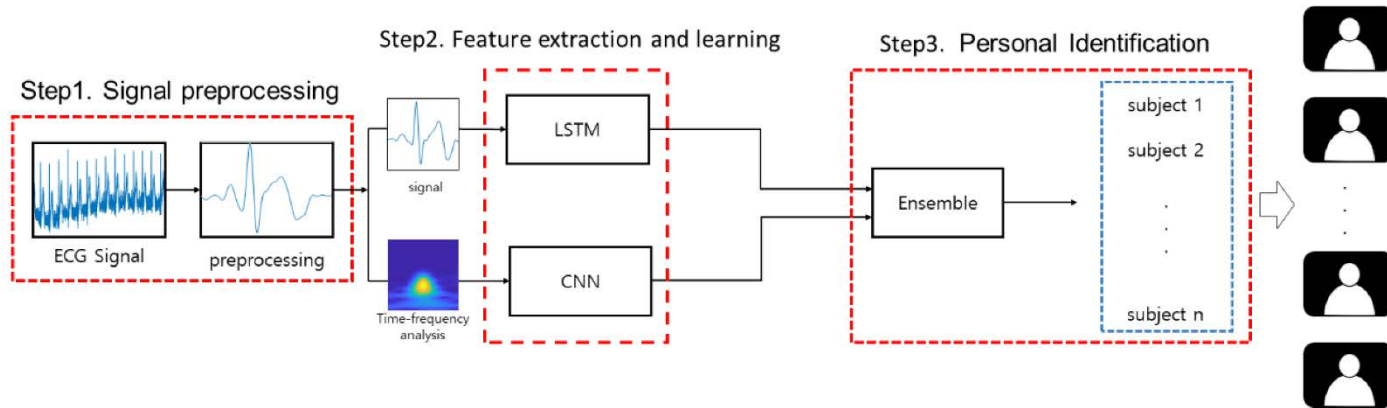
Expected Arterial Blood Pressure signal



Long Short-Term Memory - RNN model

Predictions: Predict patterns in the next time intervals (used for imputation and prognosis).

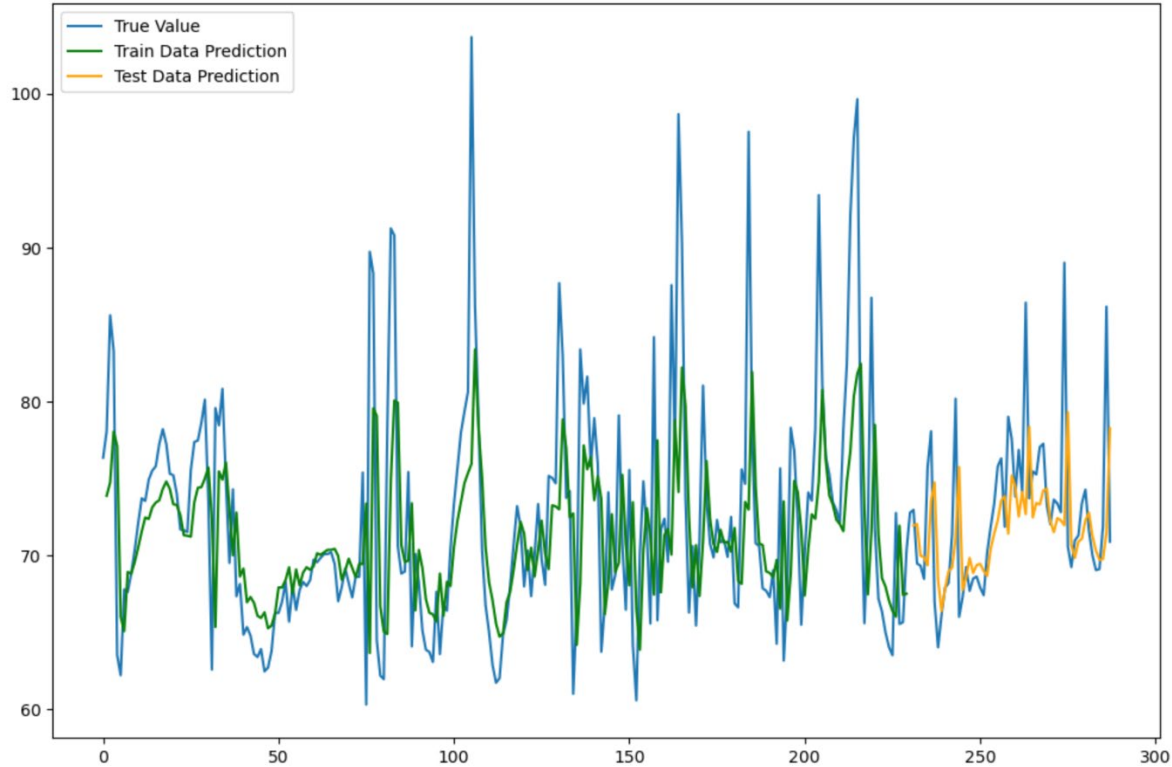
Classification: Classify and predict the participants group.



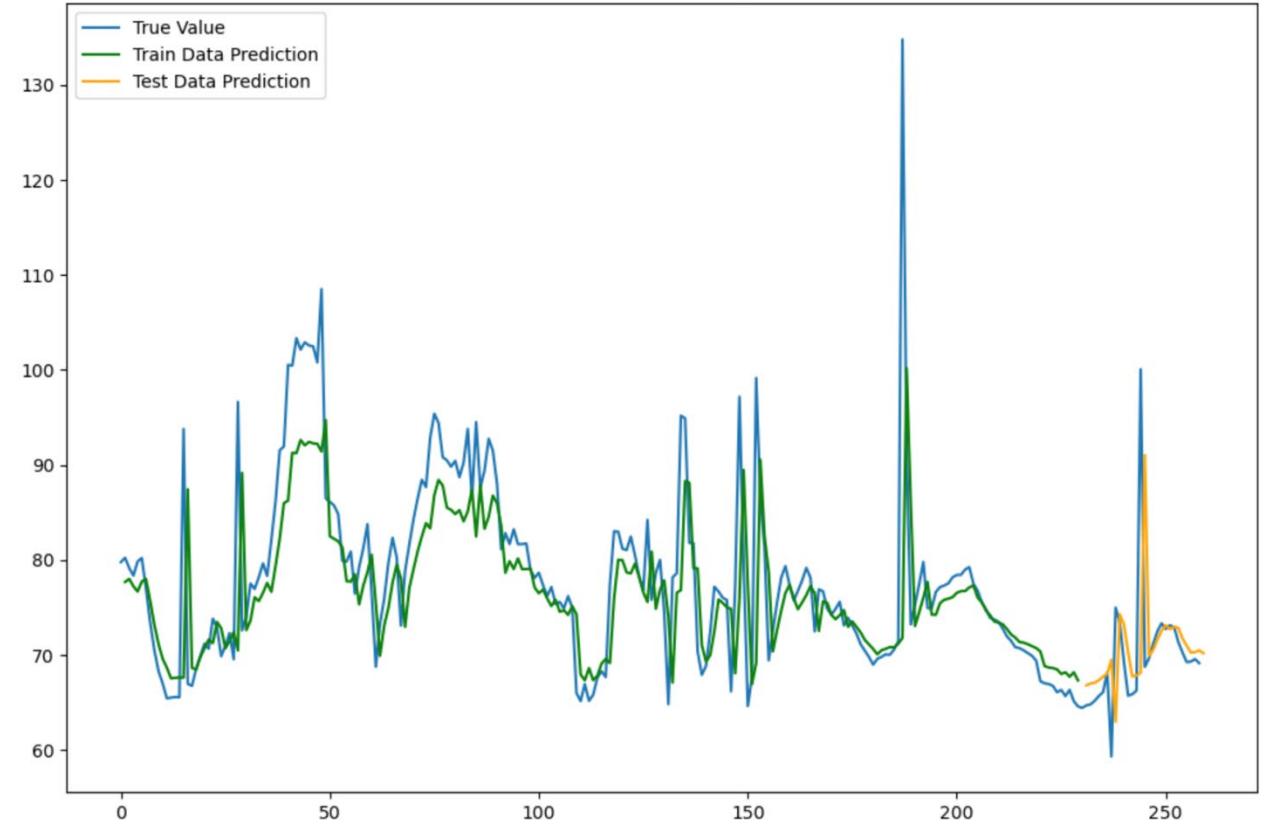
Long Short-Term Memory - RNN model

Example of imputation on Arterial Blood Pressure mean, subsampled on 5-min windows

LSTM Prediction on Participants 1886



LSTM Prediction on Participants 1845



Summary to make variables AI/ML ready

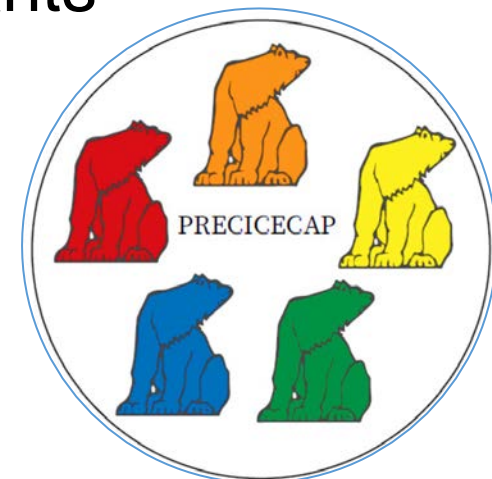
- 100 participants enrolled and collected as part of PREICECAP
 - target 300+ participants

In progress:

- i. Harmonization and quality check of baseline variables across sites
- ii. Waveform data artifacts annotation and imputation
- iii. Waveform data featurization
- iv. Strategies to co-register raw waveforms across participants

TO DO:

- Harmonization of medications/treatments across sites



Reflecting on potential predictions

- 100 participants enrolled and collected as part of PREICECAP
 - target 300+ participants

Note that body cooling duration and outcomes (survival and 90-day prognosis) are currently blinded by the parent clinical trial (ICECAP).

At baseline, using time-invariant variables, predict:

- Participants most likely to survive, optimal cooling duration, and tailored treatment strategy.

During treatment, using time-varying variables, predict:

- Whether continuing body cooling is beneficial or not;
- Whether additional treatments could improve outcomes.



Thank you!

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