Breakout Session 4: Track A

PREcision Care In Cardiac ArrEst - ICECAP (PRECICECAP)

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PREcision Care In Cardiac ArrEst - ICECAP (PRECICECAP)

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Department of Neurology, Stanford University

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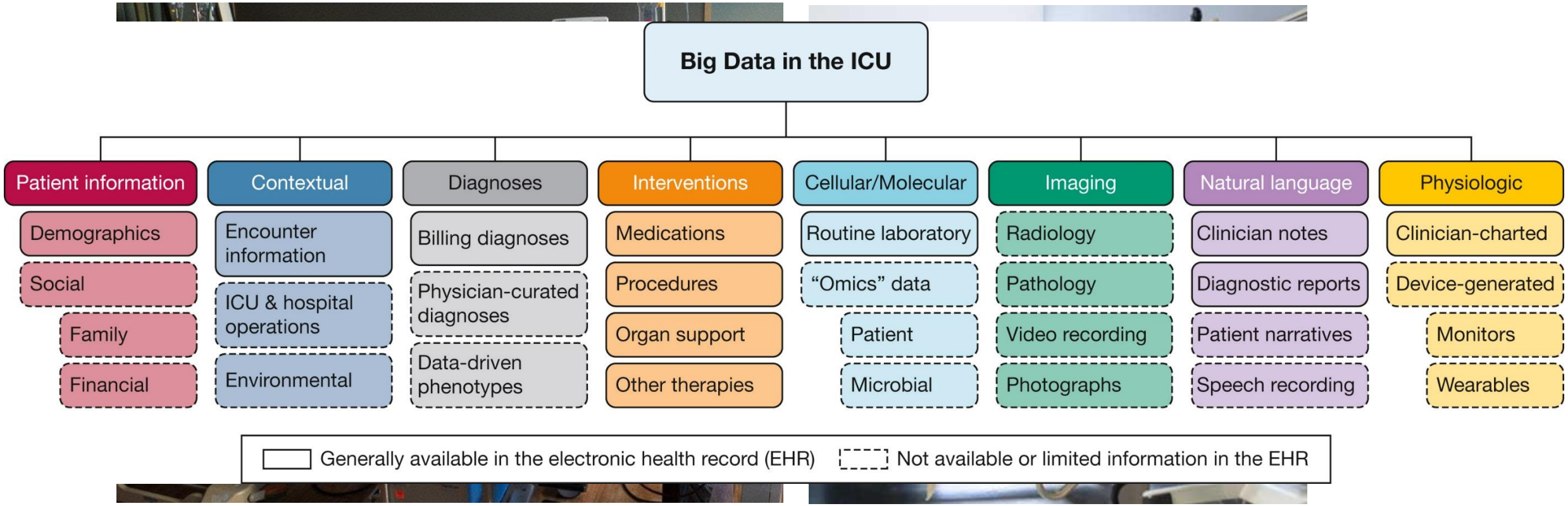
Departments of Emergency Medicine and Neurology, University of Pittsburgh

Critically Ill Patients Generate LOTS of Data



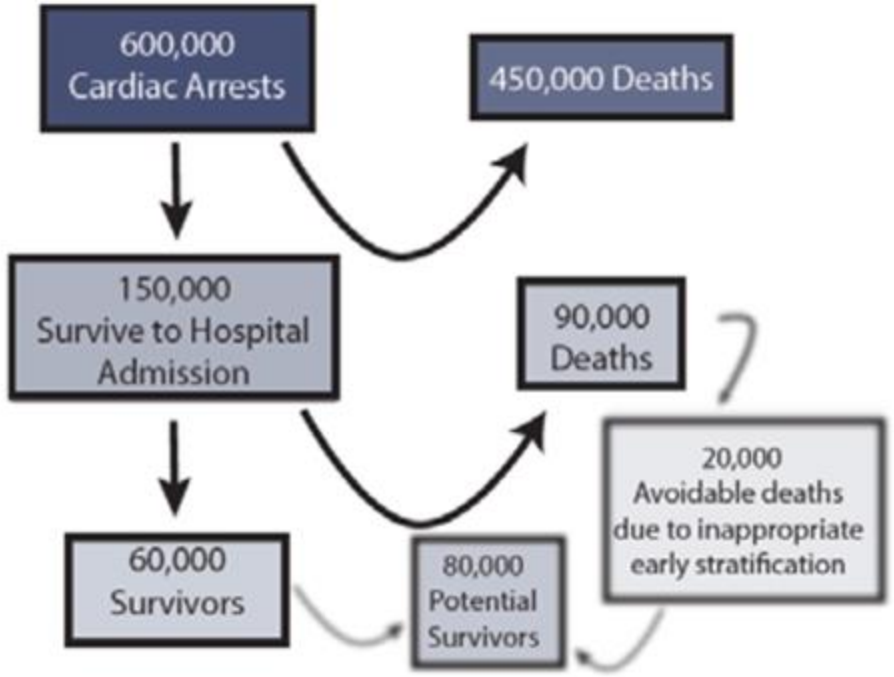
Sanchez-Pinto et al. Big Data and Data Science in Critical Care. 2018

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

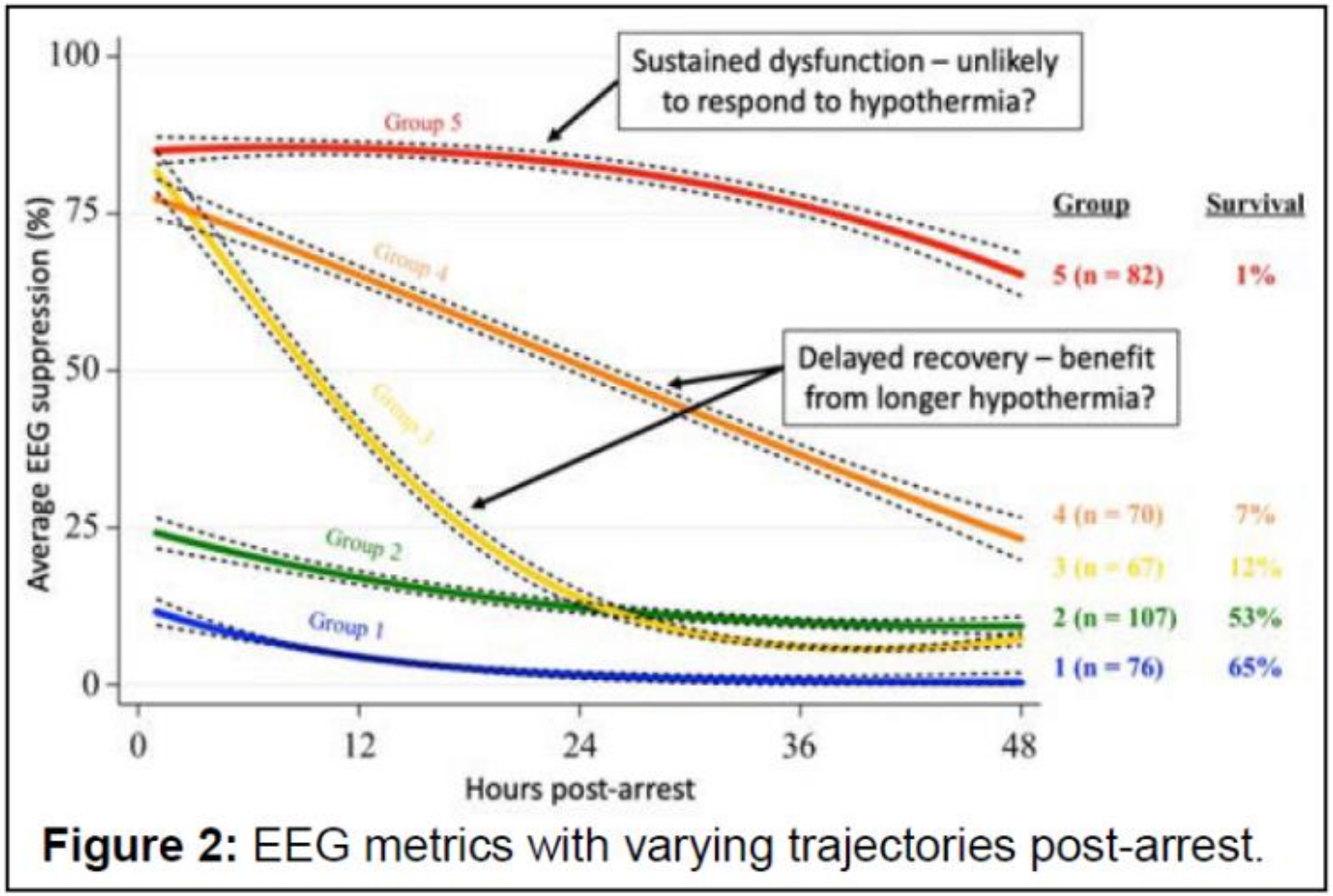


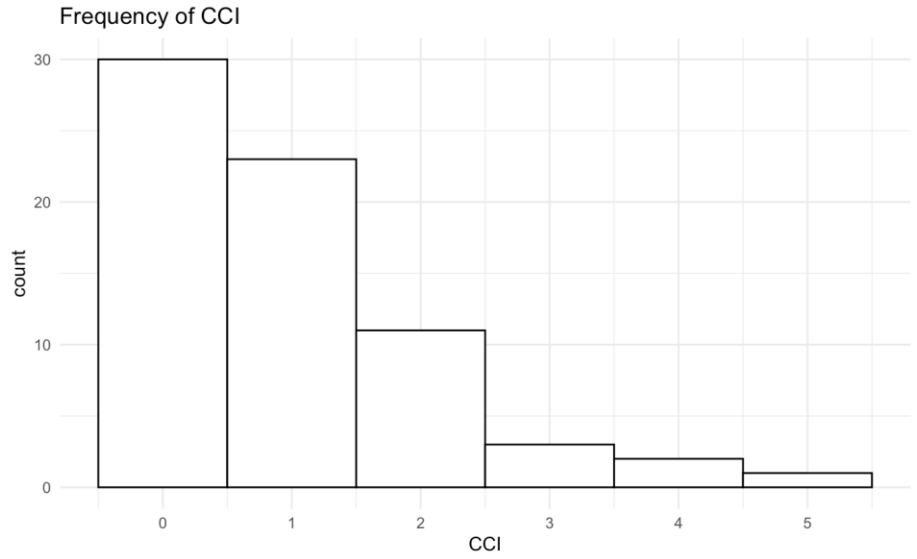
Figure 2: EEG metrics with varying trajectories post-arrest.

Elmer J. Resuscitation. 2020 Aug; 153:154-160

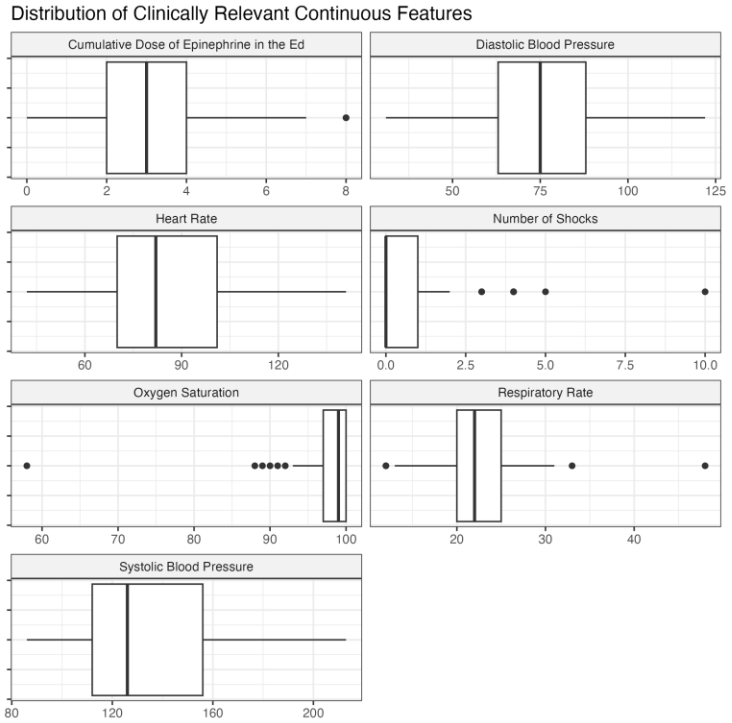
Available Data

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

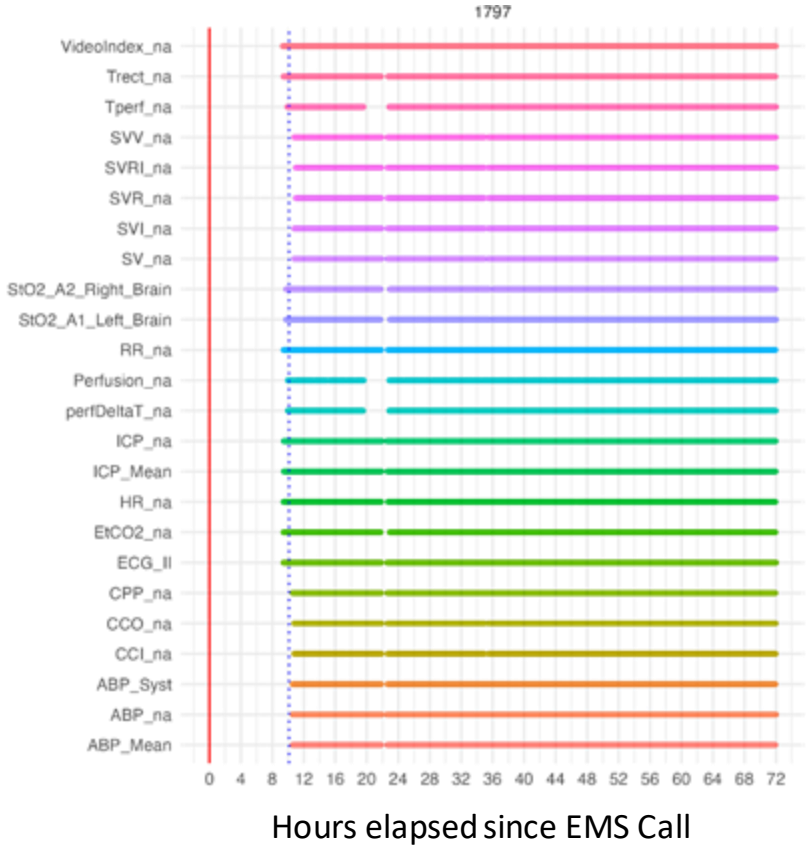


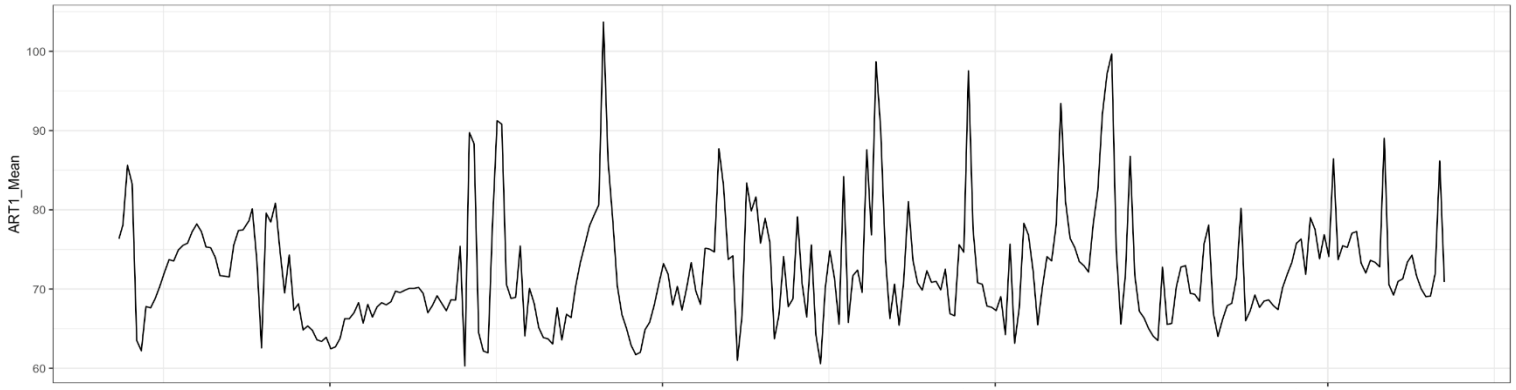
Time-invariant variables are the most critical variables for the initial prediction of survival and optimal hypothermia duration prior to waveform data recording.

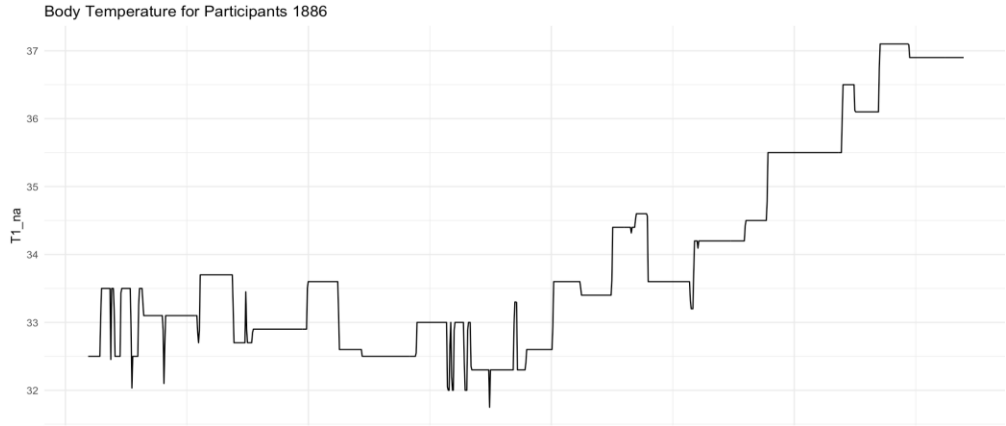
Available Data

Two types of variables

II. Time-varying variables with longitudinal trajectory



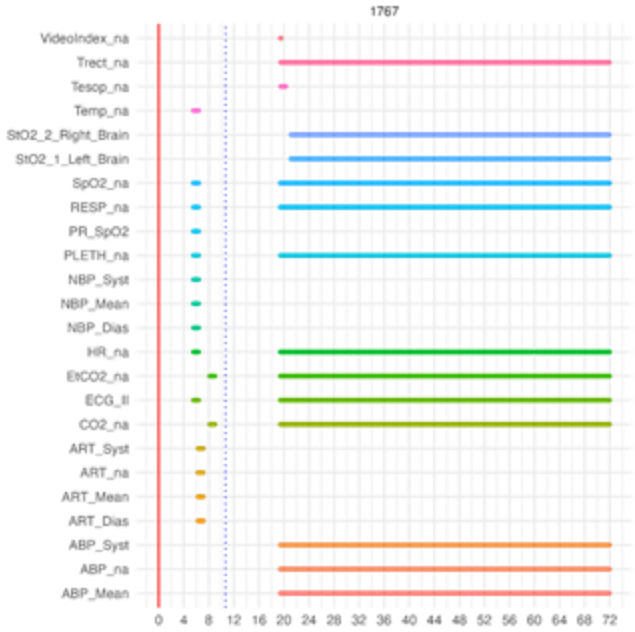


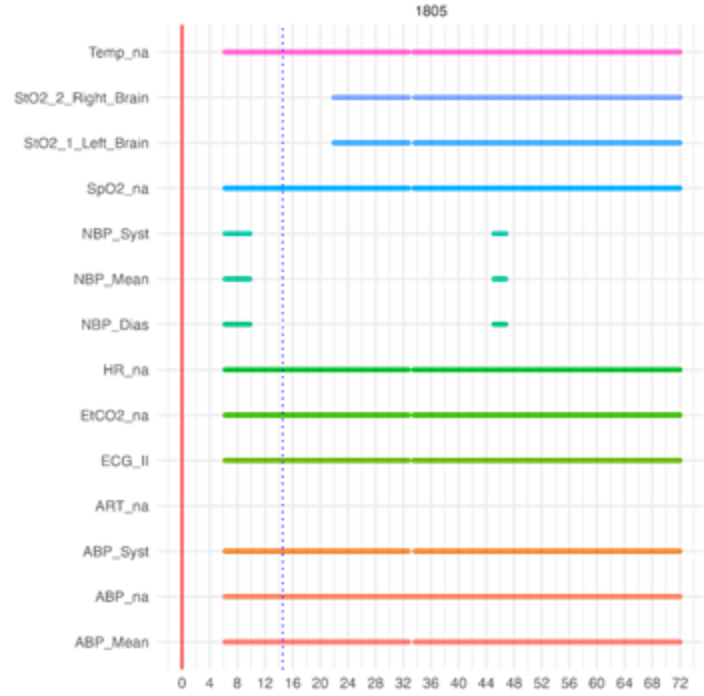


These can be used to update the initial prediction on an hourly or six-hour basis.

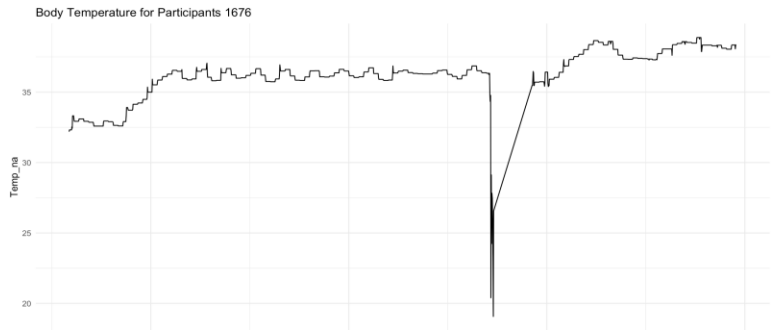
Available Data

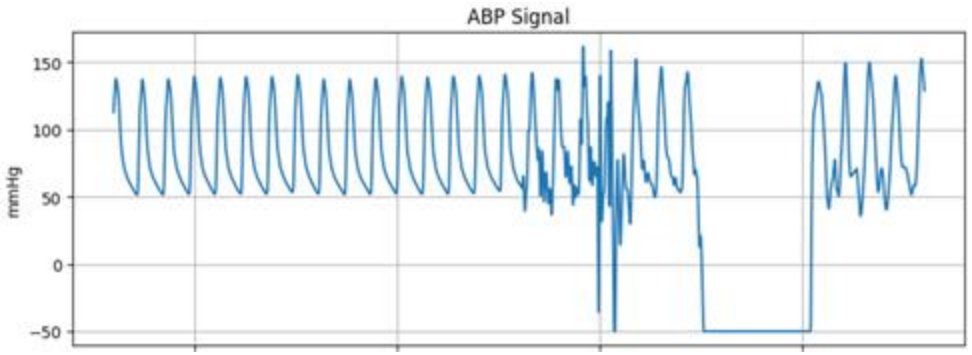
- Time-varying variables heterogeneous availability across participants:



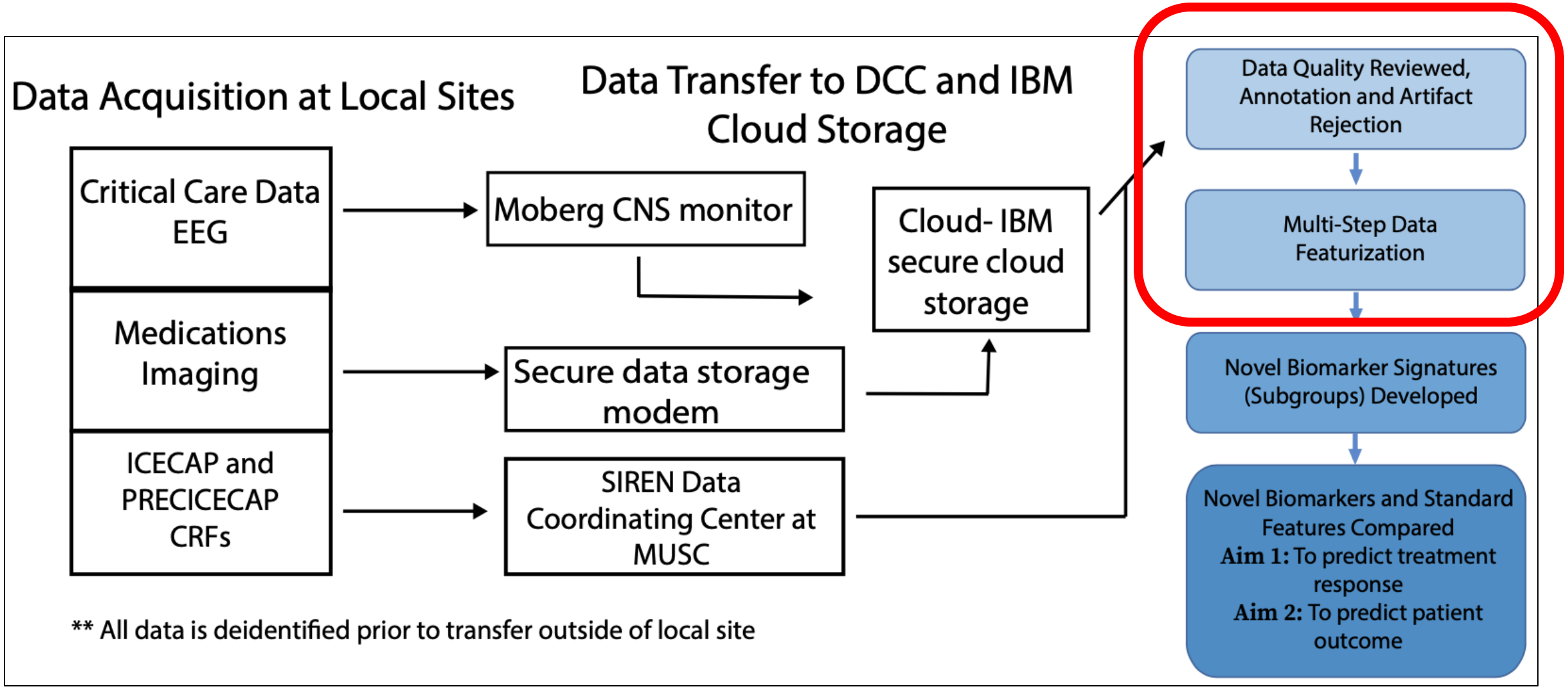


- And artifacts



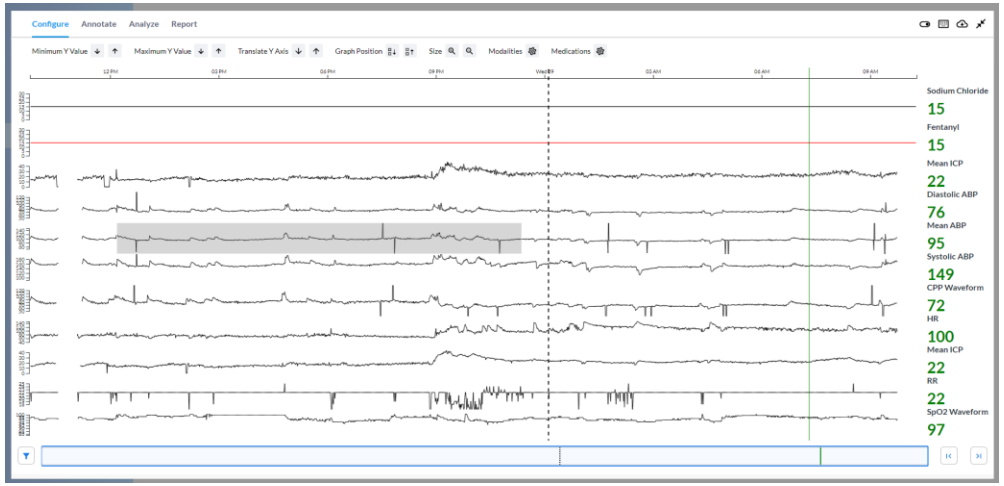


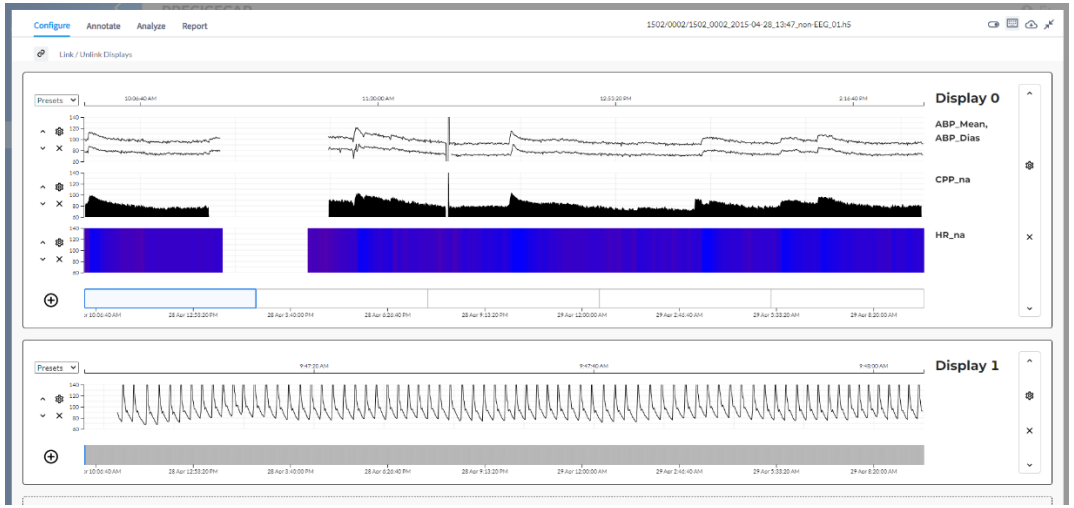
Data Acquisition pipeline



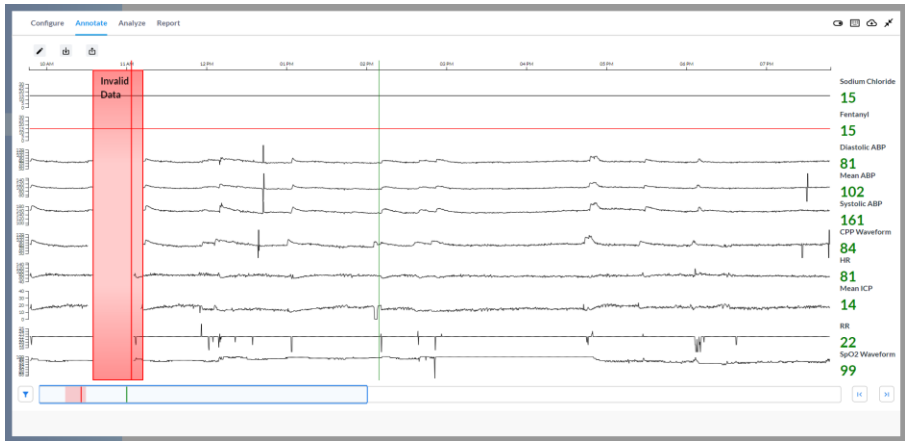
Artifact Annotation Pipeline

Moberg visualization platform





Algorithmic guided and manual annotation



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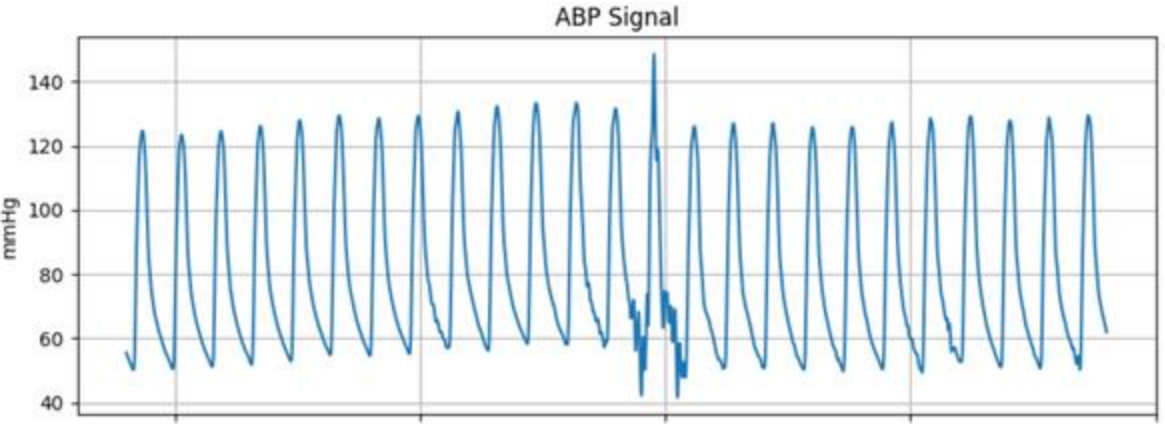
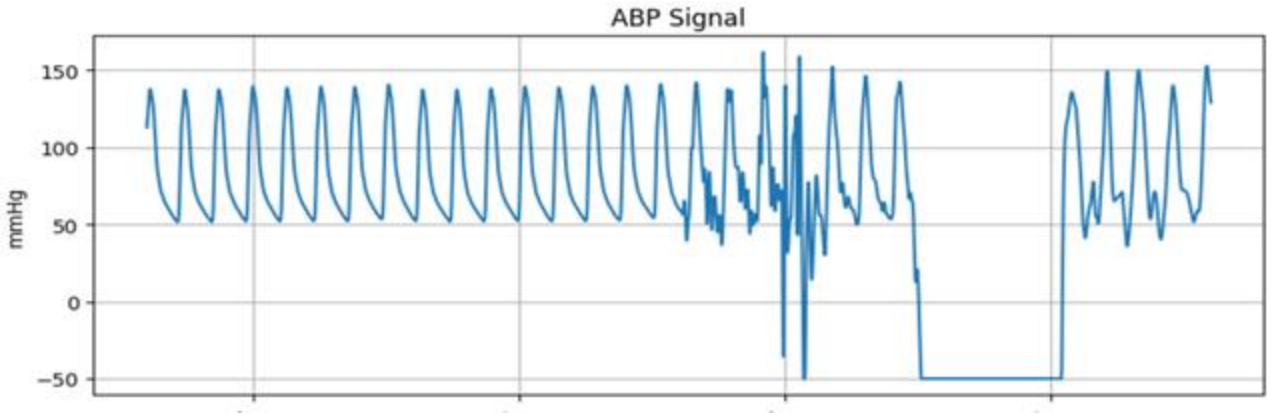
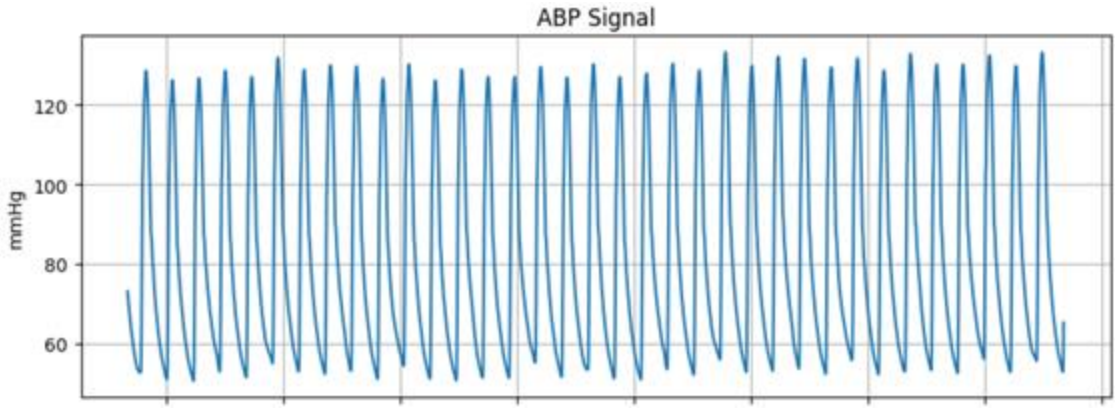
Artifact Annotation Pipeline

Example of artifacts on the Arterial Blood Pressure signal





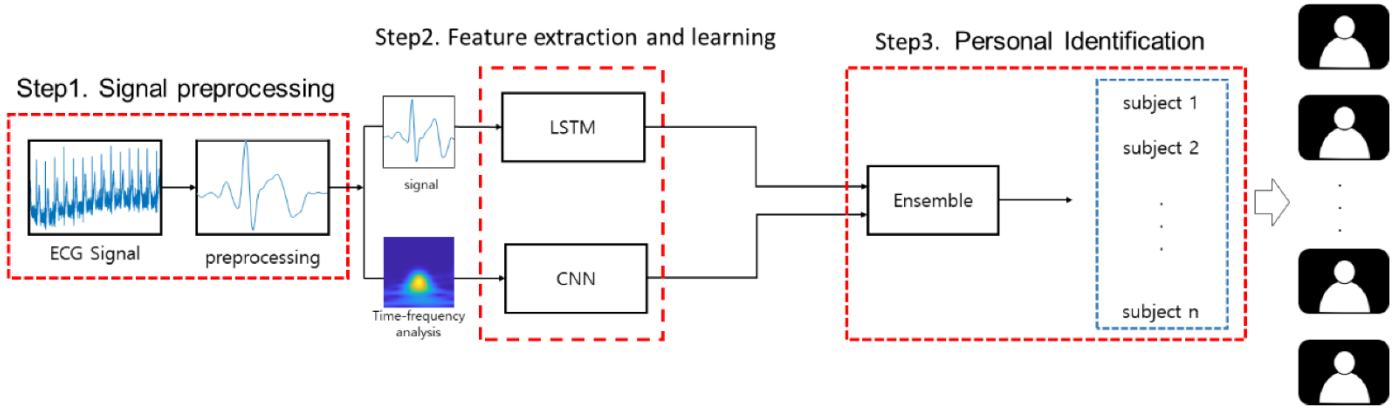
Expected Arterial Blood Pressure signal

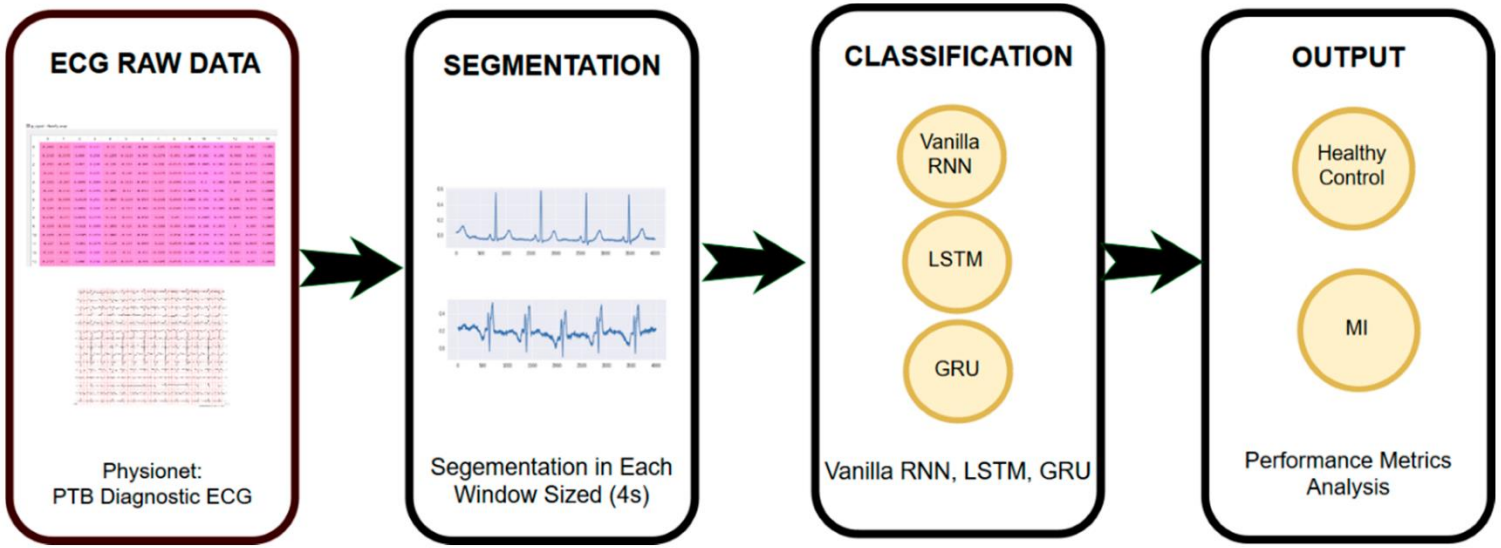


Long Short-Term Memory - RNN model

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

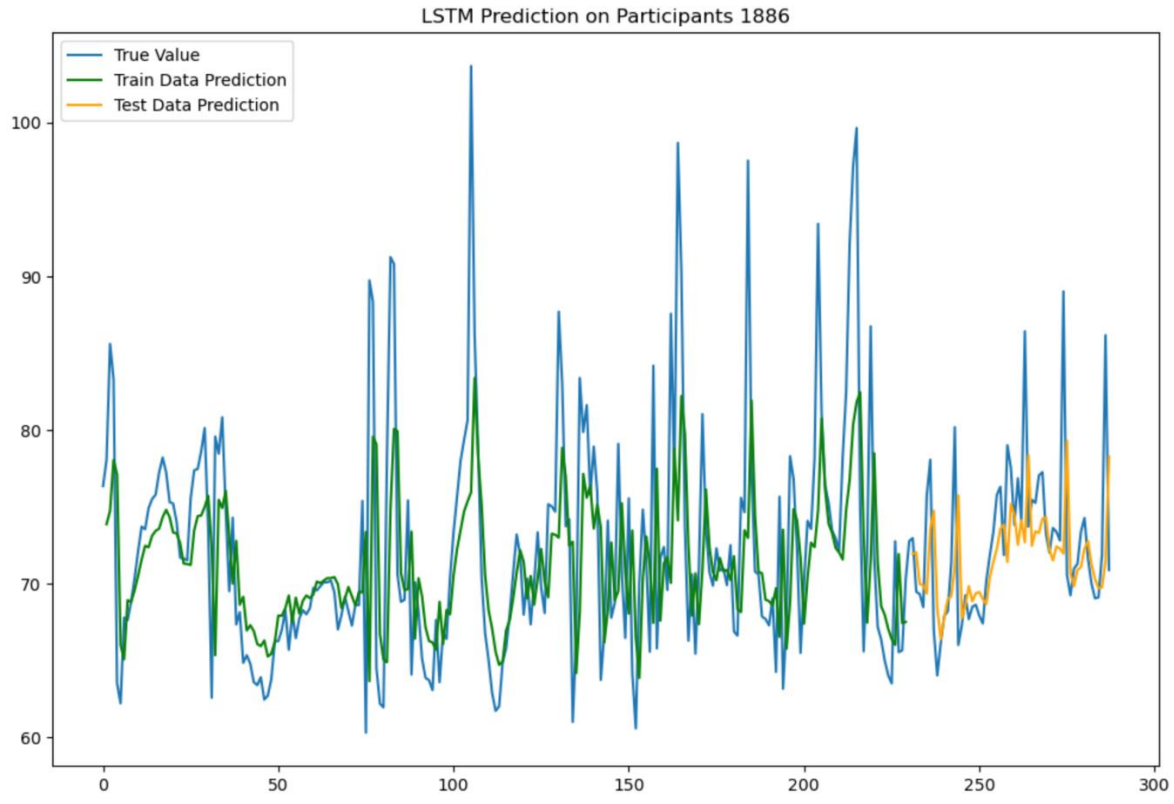
Classification: Classify and predict the participants group.

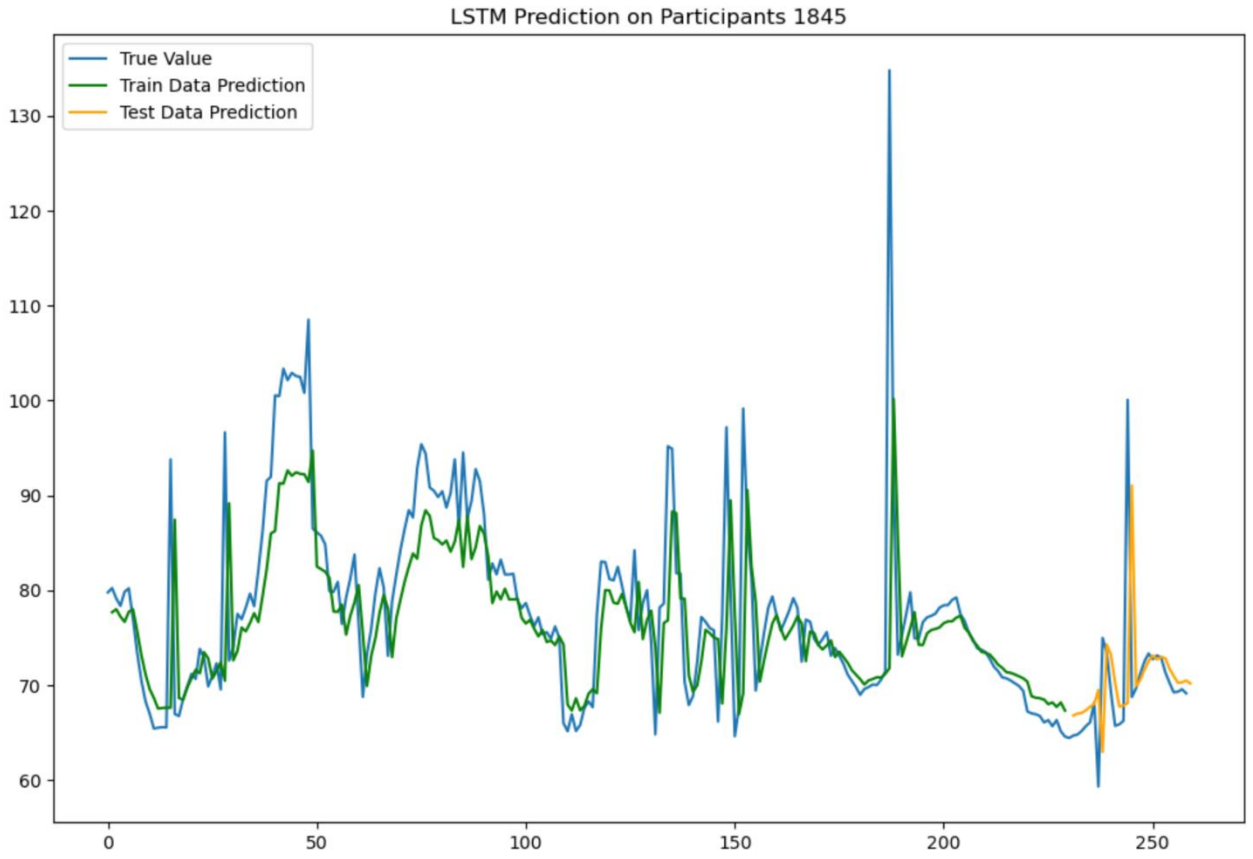




Long Short-Term Memory - RNN model

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





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

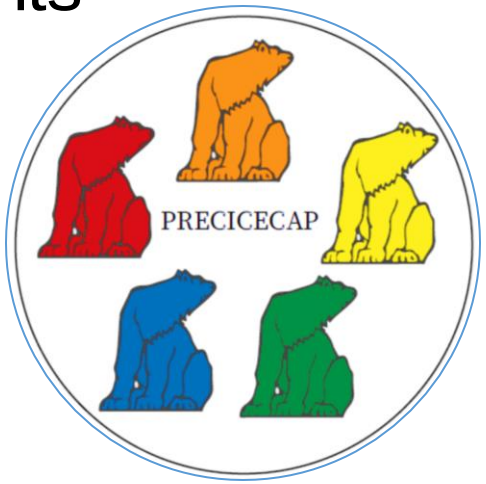
ii. Waveform data artifacts annotation and imputation

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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