Smart Asthma Management (SAM) 

Motivation and Objectives
- **Motivation**
  - Asthma is a common lung disease impacting on a large number of people
  - Smart Asthma Management (SAM) system makes the patient-centered chronic asthma care possible

- **Objectives**
  - Patient condition modeling and estimation at population level
  - Patient condition model updating and individualized prognosis
  - Clinical decision support using partially observable Markov decision process

Research Approaches

Rescue Inhaler Usage Prediction using Joint Mixed Effects Logistic Regression Model

I. Joint Modeling Framework

II. Joint Mixed Effects Logistic Regression

- \[ \text{logit}[\pi_i(t)] = a_{i,0} + a_{i,1} t + a_{i,2} x_i(t) \]

- **Response**: \((\logit \text{ transformed}) \) Probability of rescue inhaler use at time \( t \) for the \( i \)th patient (individual probability)

- **Separate model for the time dependent covariate**
  \[ x_i(t) = x_i^*(t) + \epsilon_i = z^T(t)b_i + \epsilon_i \]

III. Individualizing the Model

1. **Updating the time-dependent covariate model**

2. **Updating the logistic regression model**

   - \[ x_i(t) = a_{i,0} + b_i t + \epsilon_i \]

   - **Learn**
     - Historical Database (Population)
     - Population-wise Distribution for patient \( p \)
   
   - **Update**
     - New observations from patient \( p \)

Accomplishment & Future Work

- **Progresses**
  - Datasets from Propeller Health and Project HealthDesign. Some will be publicly available in ICPSR for use by other investigators.

- **Future work**
  - Underlying asthma condition change detection method based on individual rescue inhaler usage profile
  - Optimal clinical intervention decision making algorithm based on the patient-level statistical models

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