Prediction of medication adherence in clinical trials using machine learning

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Introduction

Patient non-adherence to study medication in a clinical trial can lead to negative results for potentially promising treatments.

Selection of patients who are most likely to demonstrate high adherence throughout a trial can facilitate the accurate measurement of the therapeutic effects of a compound.

In the current investigation, we apply machine learning-based forecasting models to assess their ability to predict future patient adherence based on patterns observed in patients' behavior.

The ability to identify patients at risk of low or non-adherence will allow clinical site staff to engage in **proactive interventions** that can *prevent* medication non-adherence prior to the occurrence of repeated low or non-adherence.

Similarly, such algorithms can allow studies to avoid enrolling low or non-adherent patients prior to randomization when utilizing a lead-in period.

Methods

Records of medication adherence were accumulated from 4,182 patients enrolled in clinical trials for at least 3 weeks or longer, demographics of which are visualized to the right.
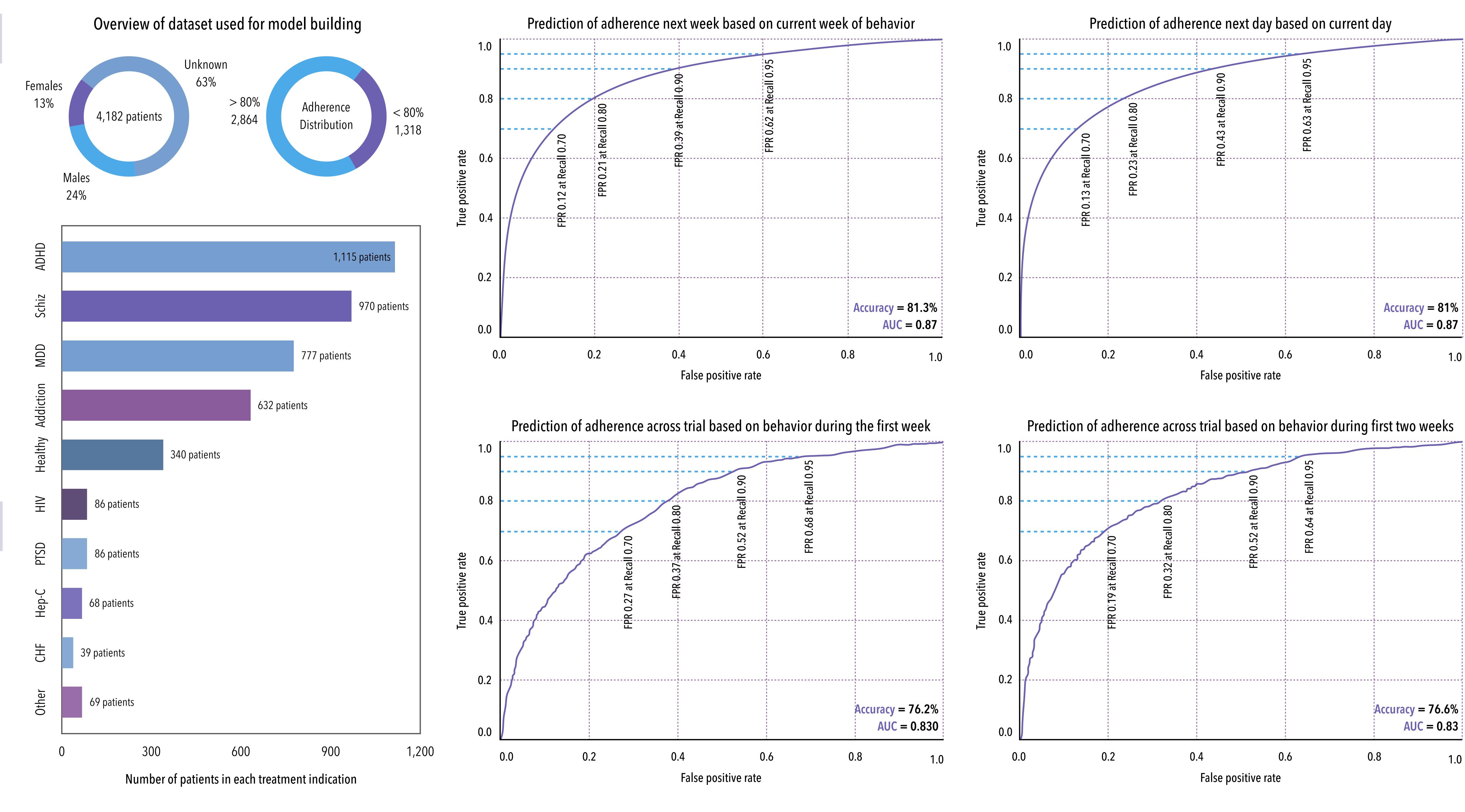
All patients were grouped into two adherence classes; patients with >80% adherence rate were labeled as adherent, while patients with <80% adherence rate were labeled as non-adherent.

The patients' treatment indication, trial length, clinician interventions, micro-reimbursements, dose delay, and dose length were included in the dataset as predictive features.

XgBoost classification models were built using 5-fold cross validation with training and testing datasets of 3,345 patients (80%) and 836 patients (20%) respectively. The following models were trained and tested:

1. Using one week's worth of behavior to predict overall adherence the following week
2. Using one day's worth of behavior to predict adherence the following day
3. Using the first week's behavior to predict adherence for the rest of the study
4. Using the first two week's behavior to predict adherence for the rest of the study

Overview of dataset used for model building

Results

Prediction of future medication adherence based on current and past adherence in addition to behavioral measures is highly accurate in estimating levels of medication adherence on the next day (Accuracy 81.0%, AUC 0.87), the next week (Accuracy 81.3%. AUC 0.87), and for the remainder of a study (Accuracy 76.2%, AUC 0.80 based on one week; Accuracy 76.6%, AUC 0.83 based on two weeks).

Implementation of real-time prediction of future medication adherence in conjunction with real-time monitoring of adherence can prove immensely advantageous in allowing clinical sites to ensure high levels of medication adherence are maintained over the course of a clinical trial.

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