Precision Medicine mHealth Data Standardization with OMOP CDM V5.0

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Abstract

Precision Medicine is focused on personalizing healthcare by integrating diverse datasets for research, specifically clinical, genomic, and mobile health data. However, the rapid growth of mobile and wearable technologies has outpaced the capabilities of existing standardization initiatives for Precision Medicine. Guided by OMOP CDM Version 5.0, we created the first iPhone app focused on mobile health data standardization for Precision Medicine research.

Introduction

Precision Medicine is focused on personalizing healthcare by integrating diverse datasets for research, specifically clinical, genomic, and mobile health (mHealth) data[1,2]. Mobile health is a critical part of this initiative, with an emphasis on leveraging data from mobile and wearable sensors to both supplement clinical data and provide new insights into personal health[3,4]. However, the rapid growth of mobile and wearable technologies has outpaced the capabilities of existing standardization initiatives for Precision Medicine[1,5].

With a data network exceeding 500 million patients worldwide, the Observational Medical Outcomes Partnership (OMOP) Common Data Model (CDM) is capable of accommodating the large observational datasets that will likely be part of the practice of Precision Medicine. At the individual level, Apple's HealthKit framework for the iPhone provides a central location to aggregate user information from diverse sensor technologies, offering a rich source of mHealth data applicable to Precision Medicine research as well. The goal of our project is to make the iPhone "data-enabled" for Precision Medicine by building an informatics pipeline that standardizes user HealthKit data using the OMOP Common Data Model.

Methods

Through Apple's native iPhone Health app, HealthKit collects and aggregates a broad array of potential datapoints, including demographics, body measurements, lab results, and vital signs. While users can manually enter information, HealthKit also passively collects data from a number of sensors and wearable devices (e.g. FitBit, Apple Watch, etc.). As a first step towards building a comprehensive database of mHealth data for Precision Medicine, we focused on 2 major categories: 1) core data normally collected during clinical encounters (e.g. vital signs, demographics), and 2) passively-collected sensor data commonly generated by a growing number of mobile and/or wearable technologies (e.g. walking/running distance, step count, flights climbed).

We created an iPhone app that leverages an informatics pipeline to standardize HealthKit data relevant for Precision Medicine. More specifically, we adapted OMOP CDM Version 5.0 for the HealthKit framework, and developed the app and informatics pipeline using the Swift programming language, Apple's iOS SDK 8.4, and Xcode Version 6.4. The app was reviewed, approved, and officially released to the App Store on August 10, 2015.

Results

The data standardization app works as follows: A user 1) visits the Apple App Store and downloads/installs the Precision Medicine Data Donation app for iPhone, 2) opens the app on their device, 3) presses the "Donate Data" button, and 4) grants the app permission to access the HealthKit data they feel comfortable sharing for research. The user maintains fine granular control over their data, and must explicitly approve/deny access to each data element from the displayed list of Precision Medicine variables. Only after access is granted will health data be extracted from the encrypted HealthKit database, standardized into structured files consistent with OMOP CDM V5.0, and sent to research organizations of the user's choosing. A privacy policy further explains the app does not collect, analyze, or store any data, but simply allows users to donate standardized health data for research purposes. Organizations for which standardized mHealth data would be valuable for Precision Medicine research include 1) academic organizations with Precision Medicine initiatives, 2) institutions researching Precision Medicine treatments, and 3) health, fitness, and life sciences companies building innovative analytics tools.

Conclusion

To our knowledge, this is the first iPhone app focused on mHealth data standardization for Precision Medicine research. The OMOP Common Data Model V5.0 is capable of effectively integrating the diverse observational datasets being used in Precision Medicine research, including those from electronic health records and mobile devices. If robust data standards and models are leveraged correctly, mobile technologies such as the iPhone will be well positioned over time to be a critical source of user-centric mHealth data for the growing number of Precision Medicine initiatives.

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Author declares no conflicts of interest. Apple, the Apple logo, and iPhone are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc.

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