MISQ Archivist

Data Analytics Framework for Smart Asthma Management Based on Remote Health Information Systems with Bluetooth-Enabled Personal Inhalers

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Abstract

Asthma is a prevalent respiratory chronic disease affecting a large portion of the global population. Patients diagnosed with asthma may experience significantly reduced quality of life if their asthma is not properly controlled. To facilitate better asthma self-management, asthma specialists and engineers have developed the smart asthma management system. This new health information system provides Bluetooth-enabled inhalers and collects timestamps of every rescue inhaler use. Such detailed inhaler usage logs, which are crucial for investigating patterns of inhaler usage, were not available in traditional clinical trials because clinical trials acquire data only periodically. Due to the low data collection resolution of clinical trials, quantitative asthma studies based on trial data have been focusing mainly on capturing the increasing trend in the number of rescue inhaler uses. Taking advantage of the patient monitoring capability of the SAM system, we developed a data analytics framework for detecting abnormal inhaler use that is out of the patient's normal usage pattern. The new statistical model developed in this paper can address the key features of the data collected from the SAM system such as the heterogeneous impact of environmental factors on inhaler usage behavior and the correlation structure governed by the patient's repetitive routines. We showed the satisfactory performance of our data analytics framework through rigorous comparison with various benchmark methods. Furthermore, we give an in-depth discussion on our contribution to the information systems (IS) knowledge base and practical implications of our analytics framework to data-driven asthma management practice.

Keywords: Smart asthma management, design science, healthcare data analytics, health IT, health information system