Clinical Informatics in Physiatry

Consumer Mobile Health Apps: Current State, Barriers, and Future Directions

Cheng-Kai Kao, MD, David M. Liebovitz, MD

Abstract

This paper discusses the current state, barriers, and future directions of consumer-facing applications (apps). There are currently more than 165,000 mobile health apps publicly available in major app stores, the vast majority of which are designed for patients. The top 2 categories are wellness management and disease management apps, whereas other categories include self-diagnosis, medication reminder, and electronic patient portal apps. Apps specific to physical medicine and rehabilitation also are reviewed. These apps have the potential to provide low-cost, around-the-clock access to high-quality, evidence-based health information to end users on a global scale. However, they have not yet lived up to their potential due to multiple barriers, including lack of regulatory oversight, limited evidence-based literature, and concerns of privacy and security. The future directions may consist of improving data integration into the health care system, an interoperable app platform allowing access to electronic health record data, cloud-based personal health record across health care networks, and increasing app prescription by health care providers. For consumer mobile health apps to fully contribute value to health care delivery and chronic disease management, all stakeholders within the ecosystem must collaborate to overcome the significant barriers.

Introduction

Mobile devices, especially smartphones, have revolutionized people's lives, including the way they seek medical information. According to a global survey in 2015, 72% of all U.S. adults owned a smartphone [1], up from 63% in 2012, and 62% had used their smartphones to look up information for a health condition, up from 53% in 2012 [2]. The penetration rate of smartphone continues to increase. It is estimated by 2020, there will be 6.1 billion smartphone users globally, comprising approximately 80% of the world's population [3,4].

The term "app," short for "application," refers to a self-contained program or piece of software that is designed to fulfill a particular purpose and usually optimized to run on mobile devices, such as smartphones, tablet computers, and some wearable devices like smart watches. Mobile health (mHealth) apps are health-related applications that aim to improve patients' health though multiple different functionalities and designs. There are currently more than 165,000 mHealth apps (including free and paid) publicly available in major app stores, and some academic medical centers also are developing apps on their own [5]. The mHealth market now embraces about 45,000 app developers, and more than 3 billion mHealth apps were downloaded in 2015 [6]. By 2017, it is projected that 50% of the mobile phone users will have downloaded at least one mHealth app [7].

The mHealth apps have the potential to provide low-cost, around-the-clock access to high-quality, evidence-based health information to end users on a global scale and improve compliance with treatment protocols via behavior change models [8]. The impact of mHealth apps can be enormous on many important health-related domains, including chronic disease management, mental health, and patient education and empowerment. The high hope for mHealth is to strengthen the iron triangle of health care—enhance quality, decrease cost, and improve access [9]. However, the accuracy of the health information contained in most of these apps is not scrutinized by regulatory bodies, which could compromise users' health and safety [10]. Literature regarding the efficacy of mHealth apps is still evolving. Because of the lack of formal vetting processes and well-established clinical evidence

of their effects, health care providers have been hesitant to recommend or "prescribe" mHealth apps to their patients [11]. Thus, the mHealth app market today still sits in the hype phase and remains mostly patient-driven, with its unlimited potentials yet to be realized. Therefore, it is vital for today's health care professionals to learn the current state, barriers, and future directions of mHealth apps and eventually take the leading role to drive the change.

Current State

The vast majority of mHealth apps on the market are designed for consumers [5]. The proliferation of smartphones and consumer interest in taking a more active role in personal health has fueled this growth. Among all stakeholders in the health care industry, patients are the ones for whom mHealth apps show the biggest impact today [6]. Currently, the top 2 categories of consumer-facing mHealth apps are wellness management (such as fitness, lifestyle modification, and diet and nutrition), and chronic disease management (such as mental health, diabetes, and cardiovascular diseases) [5]. The other categories include self-diagnosis, medication reminders, and electronic patient portal apps. Apps specific to physical medicine and rehabilitation also are reviewed. Table 1 [12-19] provides examples of the types of mHealth apps that currently are available.

Wellness Management Apps

Wellness management apps, including fitness, lifestyle modification, and diet and nutrition apps, account for about two thirds of all consumer-facing apps [5]. These apps often use smartphone features to automatically collect data, such as global positioning system (ie, GPS) to track jogging distance, and built-in camera to allow photo diaries of daily food and drink. A significant amount of the wellness management apps are connected with external devices (such as digital weight scales, blood pressure monitor, and heart rate monitor), which collect, record, and transmit patient data automatically, reflecting the growing consumer interest in the use of mobile devices for the purpose of health. A high percentage of these apps provide a mechanism for social networking to increase motivation. Of the top mHealth apps, 65% connect to social media, underscoring the importance of this feature for consumer engagement [5].

By providing tools for monitoring diet and physical activity while instructing and encouraging healthy diet and physical activity, the fitness and lifestyle modification apps show a positive impact on promoting a healthy lifestyle to consumers [20]. Many of these apps have a favorable consumer rating. The diet and nutrition apps provide functions such as counting calories, creating food diaries, tracking exercise, and documenting weight.

Currently, there are mixed results regarding the efficacy of the wellness management apps. In a review of apps, Rivera et al [21] found that commercial mHealth apps for weight management lack important evidence-based features, do not involve health care experts in the development process, and have not undergone rigorous scientific testing. Some systemic reviews revealed an overall advantage to using these apps but also called for more high-quality controlled trials to test the efficacy of specific app features to distinguish effective from ineffective components [22,23].

Disease-Management Apps

Nearly one quarter of mHealth apps focus on disease management, such as diabetes, asthma, and mental health diseases, reflecting the growing interest in the use of mHealth apps for chronic disease management. Diabetes mellitus is one of the earliest developed and most studied areas of mHealth applications. There are hundreds of diabetes apps offering a variety of functions, including home blood glucose recording, medication or insulin administration logs, prandial insulin reminders and dose calculators, and integrated communication between patients and health care providers. For example, several diabetes apps can remind the patient to check and log their blood sugar (BS) in the morning, then give patients instructions such as drinking juice if the BS is low or guidance to self-administer a recommended dose of insulin if the BS is high, and then remind the patient to check the BS again to ensure it has improved. The app also may collect information like weekly weights, food diary entries with calorie counts, medication compliance, and physical activity. Health care providers with access to these diaries can later formulate personalized feedback to the patient.

Welldoc's BlueStar [13] is the first mobile prescription-only app for type 2 diabetes and has a randomized controlled trial that included 163 patients and showed the mean declines in HbA1c were 1.9% in the treatment group versus 0.7% in the usual-care group, a difference of 1.2% ($P < .001$) over 12 months [24]. This result is a significant one, especially considering its low cost (compared with the cost of new drug development) and broad access (accessible to anyone with a smartphone). Some insurers had agreed to reimburse for use of WellDoc's mobile-enabled diabetes management program [25].

In patients with medical diseases characterized by life-threatening flares, disease management apps allow patients to keep a symptom diary and track the frequency of the usage of rescue medications, along with geographical data if needed. For example, in patients with asthma, monitoring respiratory symptoms and the trend of peak flows can alert patients and providers to