Journal of the American Society of Hypertension 9(2) (2015) 130–136

Research Article

A content analysis of smartphone–based applications for hypertension management

Nilay Kumar, MD[a,*], Monica Khunger, MBBS[b], Arjun Gupta, MD[c], and Neetika Garg, MD[d]

[a]*Department of Medicine, Cambridge Health Alliance, Harvard Medical School, Cambridge, MA, USA;*
[b]*Department of Medicine, All-India Institute of Medical Sciences, New Delhi, India;*
[c]*Department of Medicine, University of Texas Southwestern Med Center, Dallas, TX, USA; and*
[d]*Division of Nephrology, Department of Medicine, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA*

Manuscript received October 2, 2014 and accepted December 2, 2014

Abstract

Smartphone–based medical applications (apps) can facilitate self–management of hypertension (HTN). The content and consumer interaction metrics of HTN–related apps are unknown. In this cross–sectional study to ascertain the content of medical apps designed for HTN management, we queried Google Play and Apple iTunes using the search terms ''hypertension'' and ''high blood pressure.'' The top 107 apps were analyzed. Major app functionalities including tracking (for blood pressure [BP], pulse, weight, body mass index), medical device (to measure pulse or BP), general information on HTN, and medication adherence tools were recorded along with consumer engagement parameters. Data were collected from May 28 to May 30, 2014. A total of 72% of the apps had tracking function, 22% had tools to enhance medication adherence, 37% contained general information on HTN, and 8% contained information on Dietary Approaches to Stop Hypertension (DASH) diet. These data showed that a majority of apps for HTN are designed primarily for health management functions. However, 14% of Google Android apps could transform the smartphone into a medical device to measure BP. None of these apps employed the use of a BP cuff or had any documentation of validation against a gold standard. Only 3% of the apps were developed by healthcare agencies such as universities or professional organizations. In regression models. the medical device function was highly predictive of greater number of downloads (odds ratio, 97.08; $P < .001$) and positive consumer reviews (Incidence rate ratios, 1204.39; $P < .001$). A large majority of medical apps designed for HTN serve health management functions such as tracking blood pressure, weight, or body mass index. Consumers have a strong tendency to download and favorably rate apps that are advertised to measure blood pressure and heart rate, despite a lack of validation for these apps. There is a need for greater oversight in medical app development for HTN, especially when they qualify as a medical device. J Am Soc Hypertens 2015;9(2):130–136.

Keywords: High blood pressure; Internet; mobile health; self-management.

Introduction

Hypertension (HTN) is a highly prevalent and growing public health problem in the United States and worldwide. There are approximately one billion people with HTN worldwide, and an estimated one in three Americans is hypertensive.[1,2] In up to one–third of these patients, blood pressure (BP) may remain uncontrolled despite the addition of three or more agents, with greatly elevated risk of cardiovascular morbidity and mortality compared with patients with controlled BP.[3] Self–monitoring of BP (SMBP) can be an effective means of reducing blood pressure in such high–risk patients.[4] SMBP, along with an additional form of support such as medication adjustment algorithms and educational materials, has been shown to achieve greater BP reduction compared with usual care alone.[5] Mobile–health (m–health) technologies can be effective means of providing such additional support to promote HTN self–management.[6] M–health essentially refers to the use

Disclosures: The authors do not have any disclosures, financial or otherwise, to report.

Funding and study oversight: No funding was required for this study. Our study was exempt from Institutional Review Board approval since no patients were involved in the study.

*Corresponding author: Dr Nilay Kumar, MD, Department of Medicine, Cambridge Health Alliance, 1493 Cambridge St, Cambridge, MA 02139. Tel: 205 540 1971; Fax: 617 665 1671.

E-mail: nilaykumar83@gmail.com

1933-1711/$ - see front matter
http://dx.doi.org/10.1016/j.jash.2014.12.001

of mobile devices such as smartphones and tablets for diagnosis, treatment, or health management functions, predominantly carried out via a software interface known as an application or app.

Recent surveys show that 58% of US adults now own a smartphone.[7,8] A growing number of patients with chronic health conditions such as hypertension are turning to the Internet and m–health technologies for assistance with health management and education. A recent Pew Internet survey showed that 52% of smartphone owners are users of m–health technologies, a sharp increase of almost 2–fold between 2010 and 2012. While Internet and smartphones can greatly facilitate effective management of HTN, a recent study by our group showed that up to one–third of all information on video sharing websites to be inaccurate but highly popular.[9] According to some observers, an estimated 1.7 billion m–health users (23% of the world's population) are projected by 2018. While this could represent unprecedented opportunities for expanding healthcare delivery and reducing health disparities, the near absence of regulation and standardization of m–health technology could pose significant risks to public/patient safety.

A number of smartphone–based BP measuring devices are currently commercially available. These include automated inflatable cuffs that measure BP using the oscillometric method[10,11] and cuffless BP measurement using pulse wave signals detected by smartphone cameras.[12–14] However, extensive validation studies for smartphone–based BP measurement have not been conducted. A recent preliminary analysis of the wireless BP monitors (manufactured by Withings and ihealthlabs) showed poor accuracy when compared with auscultatory readings.[15] There are no large–scale validation studies for BP measurement by apps that utilize pulse wave signals detected by smartphone cameras to measure BP. The proportion of smartphone apps that include a function for BP measurement is unknown.

Given the absence of data on the content and popularity of smartphone applications for HTN and the enormous public health importance of HTN control, we conducted this cross–sectional study of the two most popular smartphone platforms (Google Android and Apple iPhone) to ascertain the functional characteristics and consumer interaction metrics for m–health technologies currently available for HTN management.

Methods

Search Strategy

We screened the two most popular mobile platforms, Apple iTunes for iPhone and Google Play for Android smartphones respectively. We used the search terms "hypertension" and "high blood pressure" to screen the top 50 search results. The search algorithms for Apple iTunes and Google Play are proprietary but do include app popularity and number of downloads in the algorithm. Since users are most likely to pursue the top search results, only the top 50 apps for each search term were included in the analysis. Apps repeated in the results of the two search terms were included only once. A total of 200 apps were screened in this manner and 107 unique apps were included in the analysis. All applications in English that contained information or tools to manage systemic HTN were eligible for analysis. All data were collected in May 2014.

Consumer Interaction Parameters

We recorded data on total number of reviews for all versions of the app using publically available data on Apple iTunes and Google Play. Cumulative number of one, two, three, four, and five stars along with the average rating of the app on a scale of one to five, with five being the best, was recorded. The total number of downloads are reported only by Google Play in the form of an ordinal variable with nine different categories ranging from 50–100 to 1 million–5 million; this download information was available for a total of 50 apps included in the study.

Functional Characteristics of the App

We recorded major functional characteristics of each app in the following non–mutually exclusive domains including hypertension education, tracking function, tools to promote medication adherence, whether the app can transform the smartphone into a medical device, and whether access to support groups and patient forums was facilitated. These were further subcategorized as shown in Table 1. Additionally we recorded any documentation of healthcare agency (such as universities or professional organization) in the app development process.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation for normally distributed variables and median (interquartile range) for variables with a skewed distribution. Categorical variables were expressed as proportions or percentages. Differences in continuous variables were assessed using linear regression for continuous variables with a normal distribution and the Kruskal–Wallis test for those with a skewed distribution. Differences in proportions were tested using the χ^2 test.

In order to test the functional characteristics of an app that are associated with a higher number of downloads, we built an ordinal logistic regression model with app functionalities and price as categorical predictors. The outcome variable (number of downloads) was available only for the Google Android platform, with the data provided as an ordinal variable ranging from 50–100 (smallest category)