Factors Affecting Mobile Health Application for Chronic Diseases

Fatima Zahra, Azham Hussain, Haslina Mohd
Human-Centered Computing Research Lab, School of Computing,
Universiti Utara Malaysia, 06010, Kedah, Malaysia.
azham.h@uum.edu.my

Abstract—**M-health has changed the conventional delivery system of health-care, permitting continuous, pervasive Health-care anywhere, anytime. Chronic disease apps are increasing, as many health workers, patients and clinicians already embracing smartphones in their comprehensive and diverse practices. This paper also mentions the current high end and open challenges in emerging field of smartphone-based healthcare applications. One of the M-health's biggest fears and technical barriers is the security and privacy of the personal information. While the usability testing and evaluations of chronic disease apps have not yet touched the accuracy level of other web-based applications. This study is being conducted to learn about challenges of m- health apps and to identify the factors that affect the usability of such applications.**

Index Terms—**Chronic Disease; M-Health; Mobile Apps; Usability.**

I. INTRODUCTION

M-health is the use of handheld devices which can create, store, retrieve, and transmit data in real time between users to improve the quality of care and patient safety (Vital Wave Consulting 2008). There is a total of 5 billion mobile phones in the world of which more than 1.08 billion are smartphones, 80% of the world population owns a mobile phone [1]. The mobility and functionalities of m-health have a powerful impact on classical remote monitoring, healthcare warning and alert, administrative and clinical data collection, records maintenance of patients, delivery programs of health-care, medical awareness, disease detection, and prevention, drug-forging and theft [2]. The health care providers or organizations can reduce their cost of communication and treatment by reducing the number of hospital visits and hospital stays and enhancing the productivity and availability of staff.

According to the study of Institute for Healthcare Informatics (IMS) [3], the figure of apps about health-care and medicine crosses 97,000 if we add Google play store and other platforms [4]. Thus, after utilities and games medical apps are fastest increasing category, and it has expected that there will be 23% increase in next five years [5]. There are some enhanced m-health apps to manage a number of chronic diseases, like hypertension, diabetes and stroke; education about health care information; and to collect accurate information and to store this data on a central server available to professional physician caregivers. Although chronic disease applications help to improve patient-provider communication and assist in disease management [6]. Patients are actively taking part in their health care by accessing information about health care and keeping themselves in touch with healthcare workers through smart devices [7].

Daily use of the M-Health platform is feasible and acceptable to people with the chronic obstructive pulmonary disease for reporting daily symptoms and medication use, and to measure physiological variables such as pulse rate and oxygen saturation. Features to support self-management such as video clips, self-management plans and respiratory nursing messaging were accessed by the majority of patients [8]. Author [9] suggested that to evolve healthcare is to let it go mobile because health care needs much information and smartphones can be the best solution.

II. BACKGROUND OF CHRONIC DISEASE MOBILE APPLICATIONS

Chronic disease applications have been developed for older patients suffering from chronic diseases such as heart failure, diabetes, asthma and chronic obstructive pulmonary disease (COPD). There is a need to understand the requirements and challenges as well factors affecting these mobile devices and applications. However, issues such as limited internet connectivity, high power consumption rate, small screen sizes, and limited input modalities need to be given careful consideration when designing application for small and portable devices [10]. The goal of chronic disease apps is to help users to have easy access when they need to find accurate information such as X-ray results or prescription refills. The main point of having an application is to facilitate users in viewing and/or managing their medical records in one place. Such features in applications may help increase patient healthcare outcomes as well as medication safety [11]. Reference [12] mentions key challenges for chronic disease mobile health apps. These challenges comprise the following:

- A vigorous technique is required to check the credibility of applications.
- Applications design and content should involve health professional and end-user.
- Applications should guarantee their reliability since it influences their usability;
- Attending all security and privacy concerns is important.
- Applications need to mention all conflicts of interest that will expose all bias provided through information including particular treatment.
- Applications should integrate with the information system of hospital regarding patient portals, care, and EHR.

Hence, it will facilitate the maturity of m-Health applications, but guidelines are still required to address such

applications.

Zhang [13] also discuss the significant challenges associated to the health apps.

- It's hard to Select valuable health apps that comprise of extensive possibilities [14]
- Users with low understanding and literacy need to be considered during the development and design of health apps [15]
- Information should be accurate and precise provided by health apps [16]
- Privacy and security need to take in account and consideration [17]
- Evaluation models are not available for m health apps [14]
- There is no guidance provided for the patients regarding use and download of specific apps [18]
- Usability limitations should be addressed [19].

Moreover, well-established and rigorous usability strategies should be engaged during performing usability studies in the healthcare field [20]. Adoption of usability engineering in the development of m-health apps decrease the rate of user errors that lead to the incorrect diagnosis and accordingly harm patients [21]. Usability is the significant issue of m-health systems, as it is the main factors assisting their success [22].

Although majority of chronic disease applications show similar functionalities. There is fusion of only one or two functions in one application. Future applications should involve both patients and healthcare provider during development and designing. The author notes that applications with multifunction show poor performance, regarding usability uni-functional and bi-functional applications [23].

III. METHODOLOGY

Besides literature studies, requirements and challenges for the chronic disease mobile application have also been identified through interview. Interviews had been conducted with 10 chronic disease mobile application users that were recorded as video outputs and analyzed using Nvivo. Besides that, due to chronic disease that willing to participate in the interview, thus, this study considered the minimum number of user. Chosen participants for the interviews are age ranged from 30 to 50 years old. All of them are mobile phone users. The purpose of the interview conducted with the patients is to understand the need and their feeling as well as experience in using mobile applications in daily life. Participants were interviewed with open-ended questions to gather information regarding their needs for mobile applications and the challenges faced during usage of an application.

During the interview, interviewees shared their experiences and obstacles they are facing in terms of mobile application usage. Through the interview, chronic disease requirements and challenges have been identified which contribute towards the identification of the specific requirement and factors affecting these mobile applications. Interview conducted were analyzed thoroughly using the Nvivo software. Literature has been identified discussed on chronic disease mobile application requirements that was done precisely through evaluation and interview conducted by those studies. The requirement that been gathered from literature such as self-tracking, user feedback, issues faced by novice users and

last but not least security and privacy threats are matched with the findings from the interview conducted earlier. There are four requirements that were identified to be most mentioned in the total of 30 studies on chronic disease which are considered to be basic needs that have to be included in an application. These requirements are considered the most needed aspects that were to be given extra consideration so that application meant for chronic disease are able to be utilized by these community in ease. According to the literature analyzed, lacking some or all of these aspects could lead towards unusable application that are mostly being scanted after development. This has also been proved true by the real user through the interview conducted. Table 1.1 below shows the requirement that were gathered through interview conducted that matches with the literature studied.

Table 1
Matched requirement

Requirement from interview	Requirement matched from literature	Percentage (%) of answer from interview
More images, Simple to Easy alert	Video, animation, graphic	100%
More multimedia, Easy alert	Self-tracking and reminder	100%
Easy to understand, Simple to use	Medication adherence or self-management	70%
Communication with peers	Feedback or online networking	60%
Simple to use, secure	Easy privacy and security features	60%

IV. DISCUSSION AND FACTORS AFFECTING CHRONIC DISEASE APPLICATIONS

A major challenge for health systems globally is to develop innovative solutions for the prevention and control of chronic diseases [24]. Mobile health platforms can offer significant opportunities for improving diabetic self-care, but only if adequate usability exists [25]. Current healthcare systems fail to provide an appropriate quality of care without additional healthcare costs [26]. Despite the increasing availability of self-management tools, many of the patient-operated mobile applications are still deficient regarding usability [25]. The main usability factors affecting the chronic disease health apps include:

A. Health Tracking or Self-Monitoring Tasks.

The commonly used types of chronic disease apps are for health tracking or self-monitoring tasks, for example, diabetics applications record blood glucose levels, insulin levels, and medication use [27]. The self-management unit of the m-Health apps facilitate the users with a daily symptom diary to keep them updated and aware regarding their health. Which includes questions about their general wellbeing to monitor and interpreted their physiological data. However, results of existing studies employ a variety of self-management strategies are mixed, and it remains unclear which forms of self-management are suitable for individual patients, or how they are best placed [8]. However, self-management also confirms some difficulty during evaluation [12]. In future of mobile health technologies, self-management strategies have great potential to come over chronic disease applications issues. That would be a significant milestone in health care.

B. Clinical Effectiveness of Chronic Disease M-health apps

Many studies have been conducted to assess the effectiveness of chronic disease apps for youngsters, but very few studies meet the criteria. However, the findings suggest there is a need for well-designed trials of apps which resonate with the real life, to determine apps acceptability and effectiveness studies should involve patient and health professionals at all stages of app development and evaluation [28]. If the mobile health apps are not clinically effective and poorly developed without standard guidelines. Regardless the increase of available health apps. Thousands of apps are unable to provide the appropriate effectiveness and meet the required criteria, for instance, a lot of patients are notable to select suitable apps for their need, that is worst if the app is misused and wrongly selected. However, there is no proper guidelines are available about the proper use of health applications and downloads without the help of health expert [18]. There is clear need to focus on the importance of content and information provided for chronic disease applications rather than only concentrate on building the useless application [23].

C. Issues Face by Novice Users of Chronic Disease Mobile Apps

The growing popularity of m-Health apps embraces great capacity for accomplishing worldwide access to trustworthy health information. However, the effect of technology on clinical outcomes and patients assistance would reduce when apps are not designed and developed for users belonging to different health literacy level. It is necessary that usability and health literacy policies should follow during the development of m-Health apps [25]. The people with lower health literacy are unable to obtain prevention services [29]. Increasing mobile health literacy will promote self-efficacy, and use of health apps [30]. It is necessary to overcome low literacy issue to facilitate patients with more rich features of health apps Health apps should put information first and use simple language with displaying precise content. Chronic disease apps need to engage users due to the long-term cure of disease by including friendly tools, simple controls and buttons [29]. This issue is mostly faced with the motivation and help of patient compliance with managerial requests and disease controlling [26]. Patient education could be influenced by enabling easier access to information and by increasing patient networks. Although some health applications showed better results when text messages used for patients with high literacy rate [31].

D. Potential threats to safety and privacy

Security and privacy are the key factors of the functionality of any m-health system, but unfortunately, most of the times these important areas are neglected development teams of m-health systems. However, the majority of currently available m-health applications, impart little or no security [11]. Some of the modern applications, which retain personal health records, do not even provide a password for security. As the adoption of the m-Health application by patients and health care providers has increased, several studies have investigated regulation and concerns/challenges related to privacy and security [11], [32], [33]. Moreover, a major hazard to m-health applications is data security and privacy, concerning patient identification and confidentiality of medical information. There are several issues have not been addressed yet, for example there is a clear need to improve the design and structure of m-health systems to fulfil the medical and ethical standards [34]. Urgent research is required regarding secure the collection, handling and distribution of personal health information through the Internet [26].

E. Usability Issues.

Usability and productivity issues have increased with the lack of system integration and security. The key factor to the failure of m-health systems is considered as usability. On the other hand, the increase of medical device problem reports directly link to user error, indicating that better consideration of usability and human factors will help to improve this situation [22]. Moreover, at present, no research data is available regarding the usability of m-Health applications, and about 95% of applications have not experienced usability testing. Thousands of m-Health applications need to evaluate and grade thoroughly according to performance. Usability of such applications needs to assess by autonomous and reliable organizations and researchers [23].

Academics believe that there are several factors that cause disappointment including; understanding of latest technology, usability (size, weight, and other basic features), medical application and lack of adaptation for patients need [34]. Moreover, Consumer health systems and applications in m-Health should be evaluated for usability as well as medical adequacy [25]. There is clear need to consider the usability and learnability of medical devices as the main challenge to the increase of health apps [35]. Usability is a significant issue for mobile health systems, as it is one of the key dimension to their success [23]. If usability is continuously neglected and not considered, m-health could face unexpected, negative results, such as higher number of medical errors and problems with communication between patient and doctor [36]. Scientifically adopting usability engineering in the design and development of m-health applications can reduce the number of bugs that lead to the wrong diagnosis and consequently harm patients [21], [23].

F. Lack of personal feedback.

Mobile health applications have become a tool for both communication and information, especially for chronic disease. Health care providers often fail to realize the intended effects due to lack of user response and attitude towards these applications [37]. One study demonstrates that diabetes chronic disease apps show a lack of personal feedback and usability issues [29]. Regardless the faith that the combination of m-health help to improve the excellence of patient care and supervision, literature shows the medical staff show negative feedback that need to take in account while designing the health app [38]. Studies reveal a very limited literature on user feedback towards chronic disease applications. Therefore, there is a need to focus on the assessment of user behavior and feedback with paying attention to usability of apps [39]. An app that can provide feedback about the interactions between an individual's conditions and treatments could help to develop effective strategies for managing their health in a more holistic fashion [40].

In this paper, authors discussed some key hindrances, which are preventing the adoption of m-health apps by healthcare providers. A number of challenges and requirements are there that need to be addressed to eliminate

and avoid the design problems and curtail potential frustration of end users. The proposed factors of chronic disease mobile applications can be used as a guide for mobile app's developers. On the other hand, there is a need to overcome technological limitations to meet the legal requirements of patient's privacy. In addition, some studies concluded that the lack of standardization, validation, and positive patient outcome are the key reason to slow adaptation of m-health. From the common health app user's and patient's perspective, it seems that the major issue is the scarcity of usability evaluation and guidance when facing the vast number and huge variety of health apps currently available. By integrating usability evaluation and testing during the design process, the apps very likely will be more handy and functional and satisfying to the user.

V. CONCLUSION

A number of literature related to chronic disease applications in mobile health settings were reviewed in this paper. Author witnessed insufficient care and effectiveness in mobile apps used by chronic disease patients. The Mobile health technology could be stretched to provide highly customized remotely controlled healthcare services to people with chronic diseases living in aged care facilities. This paper also mentions the current high end and open challenges in emerging field of smartphone-based healthcare applications. One of the M-health's biggest fears and technical barriers is the security and privacy of the personal information. Once these technical barriers are resolved, m-health technology will emerge as a reliable and trustworthy technology across many health domains as predicted by a majority of clinicians, patients (users) and manufacturers. However, the current study highlights the fact that there are still challenges and issues that need to be resolved for such systems to become more applicable to real-life situations and to be accepted by patients and healthcare professionals as reliable, multifunctional, easy-to-use, and cost-effective technology that can enhance their quality of living.

The proposed usability factors can be used as guidelines for implementation in current and future research on mobile health apps. Future research can be conducted for assessing and resolving challenges for appropriate design and use. A usability evaluation model can be developed to validate the recommended list of factors. The said model might help in developing more effective m-health applications.

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