iMHere 2.0: Self-Management Support App for Youth with Brain and Spinal Cord Anomalies
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Abstract

Secondary complications can easily occur in the youth population with brain and spinal anomalies if these individuals do not have the skill to manage their own condition. However, learning and applying self-management skills from their healthcare providers/caregivers may not be straightforward manners due to their environment. Currently, iMHere, an mHealth app with the goal to assist individuals with Spina Bifida in learning self-management skills have been developed. This platform, however, is very limited in its scope (only targeting Spina Bifida), is tied to only one mobile platform (Android), and lacks an in-depth educational features. This proposal describes an approach to improve iMHere with the aim of making it available in multi platform and expanding the target audience to youth with brain and spinal anomalies. By including individuals with brain and spinal anomalies in the redevelopment process, iMHere has been revised to include education, personal health record, accessibility, personalization, and gamification. The redesign and redevelopment process of the system aims to improve the usability, ease of use, satisfaction, and user engagement of iMHere 2.0.

Introduction

Persons with chronic condition and disabilities (PwDs) typically need to manage their daily symptoms that affect their health and quality of life. Self-management skills play an important role to improve health outcome and independence in activities of daily living for PwDs [1]. PwDs who have impaired self-management skills are susceptible to secondary complications. The accumulation of secondary complications during developmental stages and the transition to adulthood can have major impact on all aspect of person’s health including: negative impact on body structure and function, activity limitations, and participation restrictions. Population of PwDs that might experience this circumstance is individuals with developmental brain and spinal-cord anomalies (BSA), including individuals with Spina Bifida (SB) and Cerebral Palsy (CP).

Many secondary complications are preventable with appropriate self-management [2]. However, it may not always be easy for PwDs to learn self-management skills and apply them in their daily life. Different home and/or work environments can introduce barriers to apply the skills learned in the clinic [3]. In fact, these natural environments are familiar places for them and they would live for the rest of their life.
One possible way to deliver rehabilitation service to PwDs in a natural environment is through mobile technology [4]. The penetration of mobile technology is high within individuals with disabilities, with some individuals with disability carrying more than one mobile platform anywhere they go. Having self-management tool installed in their mobile phones is an ideal way to help them with their self-management skills in their natural environments. One important feature of this approach is the opportunity to deliver “just-in-time” intervention, even though it is not performed in the clinic or laboratory settings [4]. There are several mobile applications supporting healthy behaviors in persons with chronic conditions, which include diabetes, cancer, and heart disease ([5], [6], [7]).

iMHere, interactive Mobile Health and Rehabilitation, is an mHealth system that supports self-management for individuals with complex and chronic condition. iMHere system consist of mobile app and web clinician portal which are linked with two-way secure communication. This system, however, was designed specifically for adult people with Spina Bifida (SB) [8] and limited only for android phones. The difference in target population requires iMHere to be revised into a version that addresses the characteristics of adolescents with developmental brain and spinal-cord anomalies (BSA). In addition, making the app to be available for other platform is important, especially iOS, since both Android and iOS are the top two smartphone platforms in the US with respectively 52.4% and 42.6% market share by March 2015 [9].

**Problem Statement**

Since the tool is designed for person with developmental brain and spinal cord anomalies (BSA) specifically Spina Bifida (SB) and Cerebral Palsy (CP), which are mostly adolescents, issues related to this targeted population is needed to be addressed. The tool should:

1. Be able to help the user performs self-care activities.
2. Be able to be used anywhere and anytime and meet user’s unique self-management needs.
3. Address the accessibility and scalability issue related to the user’s conditions.
4. Be able to blend with the user’s environment, meaning that the tool available for multi-platform device.
5. Maintain the user engagement for long-term use.

**Design & Development**

The goal of this project was to develop an improved version of self-management mHealth app for PwDs, which is called iMHere 2.0 (Figure 1). In designing the new version of the app, several groups of individuals in target population have been invited to review the previous version of the app and to give suggestions and feedbacks to revise and improve the system.

Key core features of the previous version are retained in the new version, including: medication management, bowel (BMQs) and bladder (TeleCath) management, mood, skin
breakdown (SkinCare), reminder management, as well as secure messaging between user and clinician. Several modules are shown on Figure 1.

The first major improvement to the system is the ability to support multi-platform devices. Due to the limitation of the previous version, the new version was redeveloped entirely using a different technology. Cordova as a mobile application development framework is used as the base of the project. Cordova uses web technology to minimize coding for different platforms; it uses one code environment for all platforms, which is JavaScript. AngularJS (angularjs.org) and Ionic (ionicframework.com) are used on top of Cordova to develop multi-platform iMHere 2.0. The architecture of iMHere 2.0 is shown in Figure 2.

Observations from the focus groups told that PwDs, especially adolescents, do not understand well about their conditions. They do not know detailed information about their condition. They also do not know what information to provide when they meet their clinician. Education and learning module (Figure 3a) and personal health record (Figure 3b) are added into the app to resolve these issues.
The design of the new version also addresses better accessibility options, personalization, and gamification features. Implementing appropriate accessibility options may improve the ease of use of the app. For accessibility, the interface of the app is designed to have more contrast color in text, buttons, and background. The touch area of the clickable items in the app is made to be larger. Modules are also designed in color-coded manner, so the users can easily know which module of the app they are in. Overall interface will be simpler, easier to see, and easier to interact with. Comparison between previous iMHere and iMHere 2.0 can be seen in Figure 4.

The second feature that was designed into iMHere is the capability to personalize the content. The target population of iMHere has different and unique needs. To accommodate their personalized needs, we designed an ability to have different modules in iMHere for different user. A user might have catheterization module in their app but another user that doesn't need it can have the app without catheterization module. We also designed a preference setting that enable the users to choose their own preferred text, buttons, and images size.
The third feature that was designed into the new version of iMHere is gamification. Gamification is developed to improve the user adherence in using the app for long term by making it more engaging and fun to use. Users' interaction with the app is tracked to calculate their achievement. Goal can be set and will be evaluated using their achievement. With this gamification, users will be engaged to use the app for a long term while also helping making self-management fun and interesting.

Cost

The cost of iMHere can be divided into two: cost of app research and development and cost of app maintenance. Due to the use of open-source and free software to develop the app, the cost of research and development can be considered minimal. The cost of app maintenance will primarily be focused on creating updates and patches as well as paying the fee to publish the app in Apple Store and Google Play platform. Apple store will require $99/year and Google Play will cost $25 for one developer account.

Evaluations and Results

Prototype of iMHere 2.0 was shown to target population in two focus groups. The prototype didn't have complete functionality yet, but they could see the interface and use the app to navigate around modules inside it. They gave positive feedbacks on the app. Their first impression when using iMHere 2.0 was that the app looked more interesting to use. The color-coded module and icons helped them to navigate inside the app. They also looked at the achievement module which is part of gamification feature in iMHere 2.0. Participants felt that the feature can improve their interest in using the app for long term.

Discussion and Conclusion

Study from the first version of iMHere showed the effectiveness in supporting self-care and promising to reduce health care cost [8]. Based on the feasibility study performed by Dr.
Dicianno et al. on the first version of iMHere in Spina Bifida population for about 1 year of care for one person, they found the estimation cost of care reduced from $28,225 into $12,708 that include total outpatients wounds, ED visits and hospitalization [8]. With improvements in iMHere 2.0, we aimed to increase the effectiveness of the app in supporting self-care and reducing health care cost. iMHere 2.0, which is a multi-platform app, can be used by people using different kind of smart phones. That means that more PwDs can access the benefit of this app.

iMHere 2.0 is expected to be easier to use for PwDs with its accessibility features. They can navigate in and use the app easier. Users with different needs will also benefit from personalization feature in iMHere 2.0. They can set their preferences in the app to better meet their needs. And, the gamification features will engage users in using the app for a long-term use. The improvement in iMHere 2.0 will make it a useful, easy, and interesting mHealth self-management app to use.

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References