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Features and usability assessment of a patient-centered mobile application (HeartMapp) for self-management of heart failure☆,☆☆,★

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ABSTRACT

Background: Mobile health technologies have emerged as a way to actively engage patients in their healthcare decision-making process. One who is well informed and motivated is thought to engage in self-management activities. Thus, the conceptual framework included "information, motivation, and behavioral change" model, with patient engagement as a mediator in the development and assessment of a mobile health application "HeartMapp" for chronic heart failure (CHF) self-management.
Purpose: To describe the development and features of the HeartMapp and preliminary assessment of the usability of HeartMapp.
Method: A descriptive survey design was employed. A total of 37 participants (25 patients with CHF and 12 health care workers) navigated the HeartMapp and completed self-confidence and usability questionnaires.
Results: More than half of the patients used mobile phones to obtain health information. Patients reported moderate self-confidence (mean 26.60 ± 12.18) in using HeartMapp. One in five patients reported a lack of confidence in using the chest-worn Bluetooth device. The observational data indicated that all patients completed the task of navigating the HeartMapp with little or no help. The health care members ($n = 12$) demonstrated high confidence in recommending HeartMapp to patients (mean 4.58 ± 0.67) and in utilizing data from HeartMapp for clinical decision making (mean 4.50 ± 0.67). The self-confidence and usability questionnaires showed good reliability in this sample.
Conclusion: Having access to CHF symptom monitoring and education readily available in a mobile app may motivate individuals to engage in the prescribed self-management skills to ultimately attain desired outcomes, which warrants further exploration.

1. Introduction and background

Chronic heart failure (CHF) is a major public health problem affecting 5.1 million Americans, predominantly older adults (Mozaffarian, Benjamin, Go, et al., 2015). People with CHF are living longer but with disabling symptoms, particularly dyspnea and fatigue that impede quality of life (Zavertnik, 2014). Management of CHF requires patients to actively engage in complex self-management tasks to preserve physiological stability. Common self-management tasks expected of patients with CHF include: daily weighing, assessing CHF symptoms, adherence to complex medication regimen, a low salt diet, and participation in physical activity (Yancy, Jessup, Bozkurt, et al., 2013). Patients are also expected to use sound decision making in response to symptoms while on their own, which may be challenging for older adults (Moser et al., 2012). Recently, among 287 patients with systolic CHF, 58% were readmitted within 3 months and the researchers reported a

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significant relationship between CHF readmission and self-care management (ß = 1.6, odds ratio (OR) = 2.66; $p = 0.006$) and self-care confidence (ß = 0.9, OR = 2.01; $p = 0.02$) (Sahebi, Mohammad-Aliha, Ansari-Ramandi, & Naderi, 2015). Readmission rates are used as a quality indicator and health care metric for accountability and pay for performance by the Centers for Medicare and Medicaid Services (Kociol, Liang, Hernandez, et al., 2013). More recently, the "Get with the Guideline Program" of the American Heart Association demonstrated only a 1.4% reduction in CHF-related readmission (from 24.7% to 23.3%) in 30 days over a four-year period, indicating that significant reductions in CHF readmissions may be outside the reach of current management approaches (Bergethon, 2015).

Advances in telecommunication and mobile health technologies have created new opportunities to provide telemedical care as an adjunct to medical management of patients with CHF (Anker, Koehler, & Abraham, 2011). However, the results of these technologies have not proven to be beneficial. Compared with usual care, a physician-led remote telemedical management program showed no significant effect on all-cause mortality (hazard ratio, 0.97; $p = 0.87$) or HF hospitalization (hazard ratio, 0.89; $p = 0.44$) (Koehler, Winkler, Schieber, et al., 2011). Similarly, a telephone-based interactive voice response system (Pharos Tel-Assurance system) (Chaudhry, Barton, Mattera, Spertus, & Krumholz, 2007), use of an electronic scale and computer-based individualized symptom response system (the Alere DayLink monitor) (Soran, Pina, Lamas, et al., 2008), and weight and activity (WANDA) assessment utilizing the Ideal Life system showed inconsistent results and lack sustained benefits in improving CHF outcomes (Suh, Chen, Woodbridge, et al., 2011). In addition, a recent systematic review on remote telemonitoring (Kitsiou, Pare, & Jaana, 2015), the Heart Smart symptom training intervention (Jurgens, Lee, Reitano, & Riegel, 2013), the large COACH study (n = 1023) on intense disease management (Jaarsma, van der Wal, Lesman-Leegte, et al., 2008), motivational interviewing (MITI-CHF) (Masterson Creber et al., 2015), transitional care (Feltner, Jones, Cene, et al., 2014), and a nurse-led cognitive behavioral intervention (Cockayne, Pattenden, Worthy, Richardson, & Lewin, 2014) have demonstrated no difference in CHF outcomes. Recently, however, the Kettering Health Network reported that increasing patient and family engagement reduced readmission rates by 20% (Sholder, Barrington, & Conklin, 2015). Therefore, health care providers and organizations are looking for technological breakthroughs to better manage the complex care of these patients by partnering with them to curtail costly readmissions (Heidenreich, 2013; Lainscak, Blue, Clark, et al., 2011).

Currently, 77% of adults aged 65 or older in America own a mobile phone, 58% of those are smartphones, and 52% use mobile phones to get health information (PewInternet, 2015). African Americans and Latinos are 50% more smartphone-dependent, compared to Whites (PewInternet, 2015). In a national survey (N = 5000) by Qualcomm, 76% of mobile phone users reported being constantly connected by technology (QualComm, 2015). Older adults with no experience in technology have reported using mobile phones to manage daily self-management of chronic diseases (McCleary, 2013; Seto et al., 2012). Thus, mobile health (mHealth) applications hold the potential to transform treatment adherence through improved self-management by being available to individuals in real time. The rapidly advancing community access and adaptation to mHealth technology provided an avenue for us in designing a patient-centered mHealth application (HeartMapp) for engaging patients in self-management, adherence to medication, diet, and physical activity in patients with CHF. The purpose of this paper is to describe the development and main features of the HeartMapp, as well as the results of self-confidence and usability assessment of both patients with CHF and health care workers.

2. Conceptual framework in the development of HeartMapp

The validated information-motivation-behavior (IMB) model was utilized as a comprehensive framework in the development and testing of HeartMapp to bring the desired behavior change of CHF self-management (Fisher, Fisher, & Harman, 2003). The IMB model posits a trilogy which includes: information about ones' health and/or ways to change unhealthy behavior; motivation includes personal or intrinsic motivation and social motivation from support of family and friends to change the unhealthy behavior; and adopting or acting out healthy behavior skills that results in desired behavior change (Fisher, Fisher, Bryan, & Misovich, 2002). The IMB model was successfully used as a framework in HIV behavior interventions (Amico, Barta, Konkle-Parker, et al., 2009; Fisher, Fisher, Amico, & Harman, 2006; Starace, Massa, Amico, & Fisher, 2006), diabetic care (Mayberry & Osborn, 2014; Osborn & Egede, 2010), self-breast examination (Misovich, Martinez, Fisher, Bryan, & Catapano, 2006), and an application for chronic medical conditions (Rivet Amico, 2011).

Essentially, one who is well informed and motivated is thought to engage in activities that enhance knowledge and skills necessary to perform the focused behavior skills and is likely to reap greater health benefits (Fisher et al., 2003). Therefore, our conceptual framework used information (CHF knowledge), motivation (daily reminders and feedback in HeartMapp are proposed to act as a health care buddy/coach to enhance intrinsic and social motivation), to engage in or adherence to required behavioral skills (CHF self-management skills) that translate to behavior change of persistent CHF self-management (Fisher et al., 2003). (See Fig. 1.)

Patient-centered mHealth technologies have emerged as a way to actively engage patients in their healthcare decision-making process. Patients who are engaged as decision-makers in their care tend to be healthier and have better outcomes (Anonymous, 2015). Therefore, the conceptual framework included Carmen's multidimensional framework of patient engagement as a key mediator for behavior change in patients with CHF (Carmen, Dardess, Maurer, et al., 2013; Fisher et al., 2003). Despite upfront challenges faced by older adults who often resist using mobile technology, once they join the online world, mobile technology often becomes an integral part of their daily lives (Seto et al., 2012). Mobile phones are relatively small and convenient for people to carry on their person as they go about their daily lives and thus are available when needed. Interventions provided via mobile phones may offer support beyond the standard treatment context during everyday lives, as compared to being delivered only during discrete times (e.g., office visits). The automated coaching and feedback provided by key evidence-based interventions, known as the ecological momentary intervention, in the mobile phones may potentially empower patients to get engaged in self-management (Heron & Smyth, 2010). Persistent engagement had shown to improve the overall health and wellbeing of older adults (Saranummi et al., 2013).

3. HeartMapp features

The HeartMapp is an easy-to-use non-pharmacological, non-invasive mobile application that is patient-centric and functions independently of the health care system. The HeartMapp utilizes a Bluetooth sensor and wireless networks that consist of an Android application, tested on the Nexus 4 and Nexus 5 running the Android 4.4.0 platform. A Bluetooth sensor from Zephyr BioHarness™ 3 and/or BioPatch with an open application program interface (API) that connects to the Android phone is used to transmit real-time data on vital signs onto patients' mobile devices (Kokonozi, Astaras, Semertzidis, et al., 2014). HeartMapp is proposed to serve as a personal health buddy that includes five main features: 1) assessment, 2) exercises, 3) vital signs, 4) chronic heart failure educational information (CHF info), and 5) statistics (stats). (See Fig. 2.)

3.1. Assessment

The assessment feature allows patients to enter weight and answer CHF symptom questions. While symptoms are the hallmarks of CHF