Facilitators of and Barriers to mHealth Adoption in Older Adults with Heart Failure

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Abstract

The purpose of this descriptive, exploratory study was to assess the perceptions of older adults with heart failure regarding the use of mobile technology and to identify potential facilitators of and barriers to mHealth adoption. Semistructured interviews were used to collect data. Transcripts were analyzed using qualitative content analysis. The findings indicated that older adults do not base their intention to use mHealth solely on perceived ease of use and perceived usefulness, as outlined in the Technology Acceptance Model. The following themes emerged from the content analysis: facilitators included previous experience with mobile technology, willingness to learn mHealth, ease of use, presence of useful features, adequate training, free equipment, and doctor's recommendation; barriers included lack of knowledge regarding how to use mHealth, decreased sensory perception, lack of need for technology, poorly designed interface, cost of technology, and limited/fixed income. Overall, the findings suggest that older adults are willing to use mobile health technology, albeit with reservations. Future researchers who seek to implement mHealth-based interventions should address person-related, technology-related, and contextual barriers, and simultaneously capitalize on the influence of potential facilitators, such as a physician's recommendation, to promote mHealth adoption.

Keywords

mobile health; mobile technology; gerontechnology; heart failure; self-management

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Heart failure (HF) is prevalent in the older population. It is estimated that 80% of the 5.7 million people with HF are 65 years of age or older [1]. Effective HF self-management is key to preventing hospitalizations, which is very common in the HF population [2]. However, HF self-management can be complex; it involves symptom monitoring, medication management, dietary modifications, and activity adjustments to achieve symptom control [3,4]. In addition, older adults often have other comorbid conditions, which adds to the complexity of their treatment regimens [5,6]; hence, nonadherence to the recommended treatment regimen

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is quite common in this population [7]. One promising solution is the use of mobile technology in HF self-management.

While a consensus definition of mHealth has yet to be reached, mHealth is commonly defined as the use of mobile and wireless devices, such as mobile phones, tablet computers, patient monitoring devices, and mobile applications (apps), to support the achievement of health objectives.[8] The popularity and increasing capabilities of these mobile devices have made them an ideal medium to deliver health interventions. Current uses of mobile technology in chronic disease management interventions include: text-based appointment reminders [9,10], medication reminders [10], motivational health messages [10,11], electronic medication tracking [12], and remote symptom monitoring [13–15]. In HF, mHealth-based interventions have been associated with improved HF self-management [10,16], improved quality of life [16,17], and lower mortality [18]. Despite the potential of mHealth to revolutionize HF self-management, its efficacy ultimately relies on adoption and sustained use by its intended users. And while the use of mobile devices is increasing among the older population, older adults continue to lag behind their younger counterparts when it comes to technology adoption [19]. Therefore, it is essential to explore the perceptions of older adults toward mHealth in order to identify potential facilitators of and barriers to its adoption.

Although there has been a steady increase in the number of studies exploring technology adoption/acceptance among older adults [20,21], few have focused on mobile technologies, [22–24] and even fewer have explored the acceptability of mobile technology use for health-related purposes [25,26]. Furthermore, none of the studies examined older adults' perceptions of mHealth for HF or chronic disease self-management. A better understanding of the facilitators and barriers that might influence older adults' intention to adopt mHealth for HF self-management could guide the development and implementation of future mHealth-based HF interventions. The purpose of this study was to identify potential facilitators of and barriers to the use of mobile and/or wireless devices (mHealth) among older adults with HF.

Methods

Sample and Setting

The Johns Hopkins Institutional Review Board approved the study. A purposive sample was selected from participants enrolled in a larger mixed-methods study. A description of the larger study is published elsewhere.[27] Purposive sampling was used to ensure variation in terms of intention to use mHealth, based on participant responses to the Technology Acceptance Model-Intention to Use subscale (ie, high/moderate/low intention to use mHealth), smartphone ownership, and demographic characteristics (gender, race, educational attainment, and income). The participants were recruited from the inpatient population of a large urban teaching hospital. Patients were eligible to participate if they were 65 years of age or older, had a history of HF, able to communicate in English, cognitively intact (screened using the Mini-Cog [28]), and did not reside in a nursing home prior to hospital admission.

Data Collection

After informed consent was obtained, trained research assistants (KWL and SY) conducted individual in-depth interviews with the participants in their private hospital rooms. The interviews started with questions intended to elaborate on the participants' response to the quantitative survey (e.g. *You indicated that you would consider using mobile technology to help manage your HF, could you tell more about that? You indicated that mobile technologies are too difficult to use, what is it about them that makes them difficult to use?*). In addition, broad questions regarding potential facilitators of and barriers to mHealth adoption were asked (e.g. *What would you say would make older people start using mobile technology to help manage their health? What do you think keeps older people from using mobile technology?*). Next, the participants were shown a video of an mHealth monitoring system and a health-related app, and were then asked follow-up questions (e.g. *Do you think this technology/app would be easy to use, what makes it easy/hard to use? Do you think this technology/app would be useful, what makes it useful/not useful?*). The video showed a typical monitoring system composed of a weighing scale, blood pressure cuff, and pulse oximeter, all with wireless connections to a mobile device. The video presented information about the way a typical mHealth monitoring system worked in a straightforward, objective manner (i.e., non-advertising manner); it was selected to avoid influencing the participants' perceptions. Finally, the participants were presented with an app that is designed to track dietary salt intake. The app was chosen because it was a free download and its features were typical for a "tracker/counter" app (thus providing a good starting point for discussion). In addition, the purpose of the app (dietary salt intake monitoring) is relevant to HF self-management. After a demonstration by the research assistant, participants were asked to use the app while sharing their thoughts. This is called the think-aloud technique and is extensively used in the field of usability testing. This technique not only allows the interviewer to elicit the user's thoughts and preferences, but also the reasoning behind them. The participants were shown the mHealth video and app in order to give them an idea of how mobile technology can be used in disease self-management, thus allowing for a more in-depth discussion of their perceptions of mHealth. Clarification and elaboration probes were used throughout the interviews as needed. Interviews lasted from 25 to 45 minutes and were audio recorded and transcribed verbatim. Transcriptions were routinely reviewed to assess for data saturation; data collection stopped when no new data emerged from the interviews. The participants received a total of $25 for participating in the study ($10 for completing the survey + $15 for participating in the interview).

Data Analysis

The transcripts were reviewed to verify their accuracy before coding began. The transcripts were analyzed using qualitative content analysis following the core steps outlined by Cho and Lee.[29] The analysis process included the following steps: (1) each transcript was read in its entirety to gain a general sense of the content; (2) phrases or passages were coded either as a facilitator (*defined as any attribute, condition, or occurrence that aids or facilitates the adoption of mHealth*) or a barrier (*defined as any attribute, condition, or occurrence that hinders or prevents the adoption of mHealth*); (3) coded phrases or passages were categorized as 'person-related factors' (i.e. *factors inherent to the individual*), 'technology-related factors' (i.e. *characteristics or features related to mobile technology*), and 'contextual

factors' (i.e. *all other factors that were not person- or technology-related*); and (4) each was then examined to identify themes. The first three steps of the analysis process were performed independently by two trained research assistants (KWL and SY) and then discussed with the first author. Steps 1 through 3 followed the deductive approach, wherein predetermined codes (facilitator/barrier) were used and then classified using a predetermined organizational matrix. The last step of the analysis process followed the inductive approach. The first author developed the preliminary themes, which were then discussed and revised by the authors together. Representative quotes are presented to increase the credibility (truth value) of the study findings [29]. The use of purposive maximum variation sampling was intended to help increase the transferability (applicability) of the study findings, while multiple coders were employed to increase reliability [30]. Finally, an audit trail was maintained to increase the dependability (consistency) of the findings [29].

Results

Sample Description

Half of the 10 participants expressed intention to use mHealth while the rest either had no intention to use mHealth (n=2) or were uncertain (n=3). Six of the participants were smartphone owners. The participants ranged in age from 66 to 83 years; seven were male; half identified themselves as white and the other half as black; and five were married. As far as educational attainment, two had a Master's degree, two had a Bachelor's degree, two attended college but did not graduate, three were high school graduates, and one attended primary school but did not finish. Three participants had annual household income of less than $15K, two had $35–50K, one had $50–70K, three had $75–100K, and one had annual household income of more than $100K.

Person-related Factors

Lack of knowledge—The most frequently mentioned barrier was a lack of knowledge about how to use mobile technology. Whether it was the participant's own lack of knowledge or what they perceived was the lack of knowledge among older adults in general, the participants believed that not knowing how to operate mobile devices kept older adults from using such technology.

> "I think they're good, but I just don't know how to use, to work it. I just don't have the knowledge on how to work it."

> "I think the first thing is the lack of technical know-how is one of the barriers."

Furthermore, the participants stated that this lack of knowledge could sometimes lead to fear of doing something wrong and potentially ruining the device. As a result, older adults tended to hesitate to use mobile technology.

> "Well, for one thing, when you use a technology, you got to know what that feature is used for. And if you don't know what that feature is used for then if you touch it and it goes the wrong way, then you're in trouble."

> "Uh, probably fear of not being able to do it and the fact that these technologies were not available (clearing throat) when an older person was younger. They have

to learn something new, and I think it scares them. Like they're gonna, you know, like I remember when we started getting computers, older people would be afraid they'd do something to ruin the computer."

Similarly, the participants reported that as they got older they found it more difficult to keep pace with all the new technology, which led some to feel reluctant to even try to use mobile technology.

"As I get older and more technology comes out, you know, you sort of start falling behind. I try to keep up but…"

"You know, my feeling is, I mean like, there were things when I was younger that I would do, but now, as I age I keep doubting myself and I wouldn't even try it now."

Decreased sensory perception—Another potential barrier to mHealth adoption is a decline in sensory perception (i.e. sight, hearing). A decrease in visual acuity would make interacting with the mobile device interface difficult for older users. Similarly, older adults with hearing impairment would find it hard to hear audio prompts or alerts.

"Once you start going to the older generation, there are the people who are likely to have these heart problems, also be visually impaired and hearing impaired, if you do not have the two systems it could be a barrier."

Lack of need for technology—Not as frequently mentioned as the other barriers, but equally noteworthy, was the lack of need for mobile technology. As one participant stated, being able to manage one's heart failure without the aid of mobile technology offers little reason to start using it.

"Many of these things I do already and I don't see the necessity for having to use technology to get there. I mean, I record my weight everyday; I record my blood pressure using a pencil and paper. And I, uh, I record my blood pressure when I go to the doctor. So it's all written, not computerized."

Previous experience with mobile technology—On the other hand, having previous experience with mobile technology was mentioned as a facilitator of mHealth use. Participants whose previous occupation involved working closely with mobile technology expressed more confidence in learning how to use it for health-related purposes.

"You know I worked for ABC communications*, so whenever the smartphone technology came out, we're the first ones to get it." [Interviewer: So would you say it is easy for you to learn how to use mobile health technology?]

"Any kind of new technology." (*changed to protect participant anonymity)

Similarly, having previous experience with mHealth through one's work also facilitated one's intention to use mobile technology to manage their health.

"Uh, well I haven't been doing any volunteer nurse practitioner work, but I've used uh, a couple medical apps, just to look up medication, side effects, or treatment

modalities for patients that I'd be taking care of." [Interviewer: Would you consider using a health-related app if it would help you to manage your health?] "Yes."

Willingness to learn—For participants without previous experience with mobile technology, having the willingness to learn how to use mobile devices can facilitate mHealth adoption.

"Yeah, I'd definitely be willing to learn, you know, even at my age, I would still like to learn."

Technology-related Factors

Overall ease of use—Most of the participants reported that they would be more likely to adopt mHealth if it were easy to use. For the participants, ease of use meant that it required only a few simple steps to operate the device.

"I like it, it's easy (laughs). It doesn't have many steps to it," in reference to the mHealth monitoring system

"You don't have to do a lot, all you got to do is read it [the display]," in reference to the mobile app

Presence of useful features—The participants also pointed out several features of the mHealth monitoring system that they found useful. In particular, they appreciated the large display, audio feedback, and automatic data transfer.

"Well, you got a nice large display, and you got audible functionality."

"The oral, uh, reading is helpful."

"Well the transference of the, the results to, to the, uh central unit, and, and put in the memory is one that seems to me the most useful."

Another feature of the mHealth monitoring system that participants found useful was the instant feedback. As one participant pointed out, instant feedback from the mHealth device could be a form of encouragement or motivation for patients to better manage their HF.

"Well, I think the feedback is more useful. If the result is known to the person, I think that feature, the instant feedback, interactive, this is what it is today, therefore tomorrow I need to improve or something, that feedback to the patient is what you want to achieve results."

When asked if they could improve the design of the mHealth device, one participant suggested a reminder feature.

"Something to remind me so that I won't forget to take my medicine, something that goes 'beep beep' and lights up, it's got to light up because I can't hear."

Poorly designed interface—Given their decreased visual acuity, the participants found the size of icons and texts on the mobile app hard to read and suggested that their size be increased or to at least increase the contrast between the text and the background.

> "These little icons are too small."

> "Make the font a little bigger or if you don't make it bigger at least make it more noticeable, like dark, darker."

Cost of technology—Besides the hard-to-see interface, the only other technology-related barrier that was mentioned was the perceived high cost of new technology. Participants stated that, while they were willing to use mHealth, they believed that it would cost too much, and that they would rather wait for the price to drop.

> "I might want to have one but it's not in my price range."

> "When new technology comes out it's expensive. Yeah because like I've watched automatic blood pressure cuffs really come down in price. So I think initially it might be too expensive for me."

Contextual Factors

Adequate training—In relation to the expressed lack of knowledge about mobile technology, the majority of participants stated that if they were provided with adequate training they would be willing to use mobile technology to help manage their HF.

> "Teach them how to use it, that would be the main thing. Because what sense in purchasing it and you don't know how to use it? At least give them education on the first time or I say at least four or five times give them, you know, give them education on how to use it."

> "If you provide the training then I think people would be more apt to use the technology."

Physician's recommendation—Similarly, the participants said that they would be willing to use mHealth if their physicians recommended it. The trust that patients have in physician advice could facilitate mHealth adoption.

> "If my doctor recommended something like this, and my doctor, mind you, is very very very concerned with her patients, and, you know, anybody that you think the world of is not going to lead you wrong, you know, and that's the reason why I would consider using one if my doctor recommended it."

Free equipment—In relation to the perceived financial cost of mHealth, participants expressed their willingness to use mHealth if the equipment were provided to them for free.

> "I would consider using this kind of technology only if it were given to me."

> "Well, I tell you like this, if they gonna pay for me to use one, then I will use one for my health, because I feel that if they just was confident in this machine and they is willing to give it to me and take care of the bill and everything of it, I'm willing to try."

Limited/fixed income—Finally, older adults see the perceived high cost of mHealth technology as a deterrent given that most of them are retired and have fixed incomes. Some

of the participants considered the cost of acquiring an mHealth device as an additional expense that would further stretch their already limited budgets.

> "Because most of the people who would be in this situation have had problems normally at their age when they are on a fixed income or retirement or something. So it depends, unless a person is really wealthy. Because it used to be paycheck to paycheck, and now you're in retirement and now you have to take care of additional medical bills, this extra addition of expenditure could be a factor."

> "It's going to come down to cost, like I said, I'm on Social Security so that's a big factor. It would depend upon the amount of money really, if I can afford it or not is the key question. I mean, I would certainly be willing to buy all of these things if I could afford them."

Discussion

The results of this study indicated that older adults do not base their intention to use mHealth solely on perceived ease of use and perceived usefulness, as outlined in the Technology Acceptance Model. The qualitative findings provided additional insight on what older adults perceived as facilitators of and barriers to mHealth adoption. It is worth noting that while these facilitators and barriers were organized into three categories (person-related, technology-related, contextual), they were related to each other in one way or another (e.g. a contextual facilitator might address a person-related barrier, or a person-related barrier could be addressed by a technology-related facilitator). The following themes emerged under the category person-related factors: lack of knowledge, decreased sensory perception, and lack of need for technology (barriers), previous experience with mobile technology and willingness to learn (facilitators). Under technology-related factors, the following themes were identified: poorly designed interface and cost of technology (barriers), overall ease of use and the presence of useful features (facilitators). Finally, under contextual factors, the following themes emerged: limited/fixed income (barrier), adequate training, physician recommendation, and free equipment (facilitators).

The most frequently mentioned barrier to mHealth adoption was the lack of knowledge on how to use mobile technology to help manage HF. This is in line with the findings of Mercer et al., who found that older adults had low self-efficacy as regards learning how to use mobile health technology and viewed it as something that was designed for the younger generation.[31] This is to be expected given that today's older generation did not grow up with these technologies, and that the use of mobile technology for health-related purposes is fairly recent. In particular, mHealth use in HF self-management is still in its infancy [32], and is still not considered routine care [33]. Despite this lack of knowledge, older adults expressed a willingness to learn how to use mHealth.

A contextual facilitator that could address older adults' lack of knowledge is the provision of adequate training and support in the use of mHealth. Adequate technical support was also found to be a facilitator of telehealth use in study by Cimperman et al.[34] Special consideration should be given to tailoring the training process according to the older adult's ability to learn the new technology. As one participant pointed out, a one-time training

session might not be sufficient. This is important given that dissatisfaction with the technical support provided has been reported to play a role when older adults discontinue the use of technology [35]. It is widely known that working memory declines as one ages [20]. While this decline in cognitive ability does not prevent the acquisition of new knowledge (e.g. learning how to operate mobile technology), it does mean that older adults will require more time to learn. Future researchers seeking to implement mHealth-based HF self-management interventions should consider tailoring the training process to the older user's ability to learn. Refresher training sessions should be provided, at least in the beginning stages of the intervention, until the older adult user has sufficiently mastered how to operate the device. In addition, technical support should be readily available to assist the older adult user in troubleshooting problems that could crop up.

Mobile health technology should be designed so that it is easy to use and requires only a few simple steps to operate in order to facilitate the older adult's learning process and promote mHealth adoption. The importance of ease of use was also emphasized in a study by Tsai et al.[23] The study found that older adults preferred tablets to regular computers because using the devices required only a few swipes of the finger instead of having to learn a series of steps to accomplish the same task. Another important factor to consider when designing an mHealth device is the physical limitations of older adults. The design should accommodate for the age-related vision and hearing impairments that are common among older adults. In a study by Kim and Sundar, a larger screen size was found to be associated with higher rates of technology adoption.[36] Therefore, tablets, which have larger screens compared to mobile phones, might be more appealing to older adults users. Getting audio feedback in addition to a visual read-out was also very popular among the participants. Older adults who have difficulty seeing their results could benefit from audio feedback. Similarly, older adults who have difficulty hearing could benefit from visual cues, such as reminders/alarms that use light instead of sound.

The cost of obtaining and maintaining mobile devices was identified as another barrier to mHealth adoption. Financial cost is especially pertinent to older adults considering that many of them are retired and on fixed incomes. This finding is supported by Steele et al. who reported that cost was the most influential factor when it came to the adoption of wireless sensor technology in older adults.[37] This finding has important research and policy implications. Further research is needed to determine whether mHealth-based HF self-management interventions are cost effective, and if so, changes in policy to cover or subsidize the cost of these technologies by Medicare or private insurance should be considered. Eliminating the cost barrier would facilitate mHealth adoption among older adults.

Finally, a recommendation from a physician was identified as a contextual facilitator of mHealth adoption. The trust that older adults have in their physicians and the perception that physicians have only their best interests in mind added weight to a physician's recommendation when it came to anything related to their health, even the adoption of mobile health technology. This finding is supported by Cimperman et al. who also found that physicians' recommendations influenced older adults' intention to use telehealth services.[34]

While this study yielded important findings on factors that could influence mHealth adoption among older adults with HF, it is not without limitations. First, the study was confined to one geographical setting (an urban area in the United States), which could limit the generalizability of our findings. However, generalizability was not the major concern of this qualitative study; our purpose was to gain a deeper understanding of older adults' perceptions of mHealth. In addition, care was taken to ensure that older adults with varying intention to use mHealth were included in the study in order to minimize selection bias. Finally, we acknowledge that our findings could be biased by our beliefs and assumptions. We tried to address this issue by evaluating the findings among our group and by presenting multiple participant quotes to substantiate our interpretation.

In summary, this qualitative study explored the perceptions of older adults regarding the use of mobile health technology to help manage HF. Potential facilitators of and barriers to mHealth adoption were identified that could help guide the development and implementation of future mHealth-based HF self-management interventions. Overall, the findings suggest that older adults are willing to use mobile health technology albeit with reservations. Future researchers seeking to implement mHealth-based interventions should address the person-related, technology-related, and contextual barriers, and capitalize on the influence of potential facilitators, such as physician recommendations, to promote mHealth adoption.

Acknowledgments

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Table 1

Perceived Facilitators and Barriers to mHealth Adoption

	Facilitators	Barriers
Person-Related	• Previous experience with mobile technology • Willingness to learn	• Lack of knowledge • Decreased sensory perception • Lack of need for technology
Technology-Related	• Overall ease of use • Presence of useful features	• Poorly designed interface • Cost of technology
Context-Related	• Adequate training • Doctor's recommendation • Free equipment	• Limited/fixed income