Exploring the Challenges and Opportunities of Health Mobile Apps for Individuals with Type 2 Diabetes Living in Rural Communities

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Abstract

Background: *Many adults with type 2 diabetes (T2D), living in rural communities, are not optimally managing the disease through their diet and physical activities. Mobile apps have the potential to facilitate self-management activities, such as providing educational content, assisting with problem solving, and self-regulation. The goal of this study was to understand the perceived barriers, benefits, and facilitators among rural adults with T2D regarding the use of free mobile apps available in Apple App store or Google Play store for diabetes management or behavior monitoring.* ***Materials and Methods:*** *Four focus groups were conducted with 18 participants with T2D who owned a smartphone (age: M = 54.4, SD = 12.7; 27.8% male). The participants were asked about their general app and health-specific app usage. They were then shown features of four apps related to diabetes self-management (Glucose Buddy, mySugr, MyFitnessPal, and MapMyWalk) and prompted to provide feedback. The focus groups were audio recorded, transcribed verbatim, and coded using inductive thematic analysis.* ***Results:*** *Four themes were identified as follows: (1) perceived barriers to use or continuous use, (2) perceived benefits of desired features of diabetes self-management, (3) facilitators to motivate use, and (4) information sharing with family, friends, and health professionals.* ***Conclusions:*** *The findings provide initial user perceptions regarding the feasibility and acceptability of mobile apps for T2D self-management. These findings regarding perceived barriers, benefits, and facilitators can guide the development and design of apps for individuals with T2D and help researchers determine best practices when developing apps for other chronic conditions.*

Keywords: *health mobile apps, technology adoption, type 2 diabetes, qualitative research, chronic disease self-management, m-health, rural community, telemedicine*

Background

Approximately 29.1 million American adults have type 2 diabetes (T2D) and this number is still rising.[1] Once an individual is diagnosed with T2D, there are several recommended lifestyle changes, such as healthy eating and exercise, which rely significantly on self-management. These changes reduce the risk of complications and in some cases may even reverse many of the symptoms. Unfortunately, research suggests that many adults with T2D are not optimally managing their behaviors to control blood glucose.[2–4] Past literature suggests that individuals face a myriad of barriers to diabetes management, including lack of education or knowledge about the disease.[5–9]

One way to help overcome the barriers is through self-management programs, specifically those that focus on education.[10] Research has demonstrated that individuals who are actively involved in these types of programs experience improved health outcomes.[10–13] However, patient participation tends to be poor because they require people to attend a real-time group.[14] This can be especially true in more rural settings where participants may have to drive long distances.[25] Thus, innovative approaches to providing these activities may be beneficial in helping individuals in rural communities adhere better to their treatment plan and reduce their risk of complications.[26]

One innovative approach that may help is mobile health (m-health). Increasingly, m-health is being viewed as a promising technology in assisting people to manage a variety of health-related concerns.[15] m-Health apps have the potential to reduce barriers of adherence to self-management activities through disease education, data logging and viewing trends, connecting to others, and transferring data to the individuals' healthcare providers. Several studies have investigated the use of mobile phones for diabetes care to improve adherence to treatment regimens and health outcomes.[16–20] In addition, a systematic review examining both T1D and T2D found that many of the studies demonstrated a positive trend in outcomes.[21] Despite the positive trends, there seems to be a problem of continued engagement of the apps, which has implications on long-term health outcomes we can expect from apps. For instance, market research indicates that

majority of users engage less than 10 times with downloaded apps.[22] One study showed that frequency of using a health app declines rapidly after initial use.[23] Another study used an expert panel to review diabetes self-management apps in Google Play and Apple App stores, revealing only moderate to good usability. They called for patients and physicians to be more involved in the design and development process of these apps.[24] Therefore, the goal of this study is to understand the perceptions of rural adults with T2D regarding using mobile apps for diabetes management. The findings provide users' perspectives regarding the feasibility and acceptability of app-based self-management, which can guide the development of apps for T2D management for long-term use.

Materials and Methods

PARTICIPANTS

Eighteen individuals with T2D (female = 13), with an average age of 54 years (SD = 12.7), participated in four focus groups with three to six participants per focus group. Most participants were white ($n = 16$), with one Asian/Pacific Islander, and one African American. Fourteen participants were recruited from a rural community in the Midwest region of the United States. Eight had college or graduate degrees. On an average, participants reported a diabetes diagnosis of 8 years (SD = 5.3), had 11–20 apps on their smartphones, and used apps for ~31–60 min/day, over 22 months. Two-thirds of the participants had a health app on their phone, and used it about once every other week.

PROCEDURE

The participants were recruited by phone through a family clinic practice in a rural community or through an e-mail sent to a listserv of the Midwest region of the United States. The study was approved by the institutional review board. Inclusion criteria were as follows: (1) have a smartphone, (2) diagnosed with T2D, and (3) aged between 18 and 70. The moderator followed a prepared discussion guide to direct the conversation. Participants were first provided an overarching introduction about the purpose of the study. They were then asked general questions about (1) their overall app usage, (2) knowledge about health apps, including diabetes apps and their usage, and (3) reasons for liking or disliking apps. Next, the moderator conducted a brief workshop on currently available mobile apps for diabetes self-management, demonstrating the features of each and how it could be used for diabetes self-management. The apps were as follows: Glucose Buddy, mySugr, MyFitnessPal, and MapMyWalk. *Table 1* summarizes the brief workshop content. The focus groups lasted between 45 and 80 min (excluding the 30-min workshop).

DATA ANALYSIS

All data collected in the focus groups were audio recorded, transcribed verbatim, and coded using the software NVivo. Inductive thematic analysis[27] was used to analyze the data. Each recording was coded separately by at least two members of the research team, who independently came up with labels to attach to text segments that appeared to indicate important user perspective. Then, the team came together to compare their codes and revise the codes in an iterative manner to develop a set of themes. Further refinement was conducted by merging, adding, and removing redundant themes. At the end, four themes were identified as follows: perceived barriers to use or continuous use, perceived benefits of desired features of diabetes self-management apps, facilitators to motivate use, and information sharing with family, friends, and health professionals. The following section describes each with illustrative quotes.

Results

PERCEIVED BARRIERS TO USE OR CONTINUOUS USE

Among the 18 participants, only 2 had diabetes self-management-related apps. Participants shared six overarching perceived barriers to using apps for diabetes self-management.

Table 1. Content of the Four Apps for Diabetes Self-Management Introduced in the Brief Workshop

	GLUCOSE BUDDY	MYSUGR	MYFITNESSPAL	MAPMYWALK
Tracking	✓	✓	✓	✓
Progress	✓	✓	✓	✓
Setting (personal profile)	✓	✓	✓	✓
Reminder	✓		✓	
Forum or friends	✓	✓	✓	✓
Analysis of tracked data		✓		
Export tracked data	✓	✓		
Data sharing			✓	✓
Gamification		✓		✓
Goal setting			✓	

First, many of the participants were not aware that these tools were available and the barrier is the information gap. One participant stated, "I didn't realize that they had an app" (female 47 years old [female 47]). Second, they faced a technical literacy barrier. One participant said, "I've never used it [these apps] because I never got it to work the way I wanted it to" (male 57). Third, they did not use mobile apps because they found the tools they were using, such as a paper logbook or a glucometer, already satisfied their needs. Fourth, some participants did not use any tools for self-management because their doctor did not ask them to. Many of them expressed that they wanted recommendations from their healthcare providers regarding health apps. Fifth, the barrier comes from inside as follows: some participants acknowledged that they did not use apps or other tools for self-management because they did not want to be accountable for their behaviors. "There's that whole accountability piece. If I'm doing this … then I'm going to have to pay more attention. I want to eat my candy or my doughnut or whatever the case is" (female 38). The last barrier was the required time and effort to use the apps for self-monitoring. One participant stated, "The only thing on the negative side is that [the apps] take a lot of input, all the time [it takes] to put all the food in" (female 62). One female participant who had a diabetes self-management app shared that using the app over time became burdensome and annoying because it repeatedly asked her to enter information.

PERCEIVED BENEFITS OF DESIRED FEATURES OF DIABETES SELF-MANAGEMENT APPS

Examples of existing apps were introduced to the participants to solicit their evaluation of the various features, and these features can be interpreted as benefits for patients to use these apps. All of the participants agreed that the app needs to be intuitive and easy to use. "If you're not very tech savvy, which I am not, I don't care how easy it is. It's not always that easy" (male 57).

Besides ease of use as an overarching need, specific features the participants liked included tracking, educational information, customized feedback, reminders, and goal-setting. Tracking was present in all self-management apps presented. Most of the participants have used other traditional tools for tracking, such as notepads or logbooks. However, they felt mobile apps have advantages over these traditional tools because of the mobility, built-in camera, accelerometer, and Global Positioning System (GPS) in smartphones. These features enable easy logging of packaged food using the Universal Product Code and automatic tracking of physical activities, which were liked by most of the participants. The complexity of putting in the detailed information of homemade food is a barrier to tracking. The participants also expected the app to not only track one but also all the metrics related to diabetes management, including diet, exercise, blood glucose, and weight. They wanted to see not only just numbers but also visual representation of the data to show history, trends, and progress on a long-term basis. Participants, who had tracked their diet or blood glucose in the past, liked doing so because they found it increased their awareness of carbohydrate intake as well as identified causal links of food intake and change in blood glucose.

The participants also wanted to get more information and guidance for diabetes management, including nutritional education, such as glycemic index information, diet tips, diabetes recipes, and recent research findings. For example, one participant stated, "Even a suggestion that says 'Scrape the toppings off, just the toppings, and throw the rest away.' Every time you go to eat something you probably shouldn't, a little notification comes up and suggests something" (male 63).

Participants wanted an app to provide personalized or customized information, including customized feedback and recommendation based on individuals' tracked data. For instance, one participant said, "Something you put your sugars in and they base a diet on that for you, so you know how much of something you should be eating." However, the participants also noted that the feedback and recommendation from the app should not be "preachy." If the suggestions were perceived to be annoying or demanding, the participants would ignore or not follow at all.

The fourth type of feature wanted was a better reminder system. Reminders help the users enter the key data for tracking; however, the current reminders are easy to ignore. They expected the effective reminders to be customizable and attention-grabbing. "Even to pop up on your actual screen when you're looking at it. It takes up the whole screen.… To me that would be better than just having a little notification or a little bar to just pop up on your screen" (female 20).

Enabling goal setting is another feature individuals with T2D considered a benefit in a diabetes self-management app. The participants expressed that goal-setting can only be helpful when the goals are realistic, such as small daily or weekly goals rather than long-term goals. "I think it's easier to do daily goals than long term goals. Like the losing weight stuff … every week you want to lose a pound, like each day you want to do this many carbs" (female 63).

FACILITATORS TO MOTIVATE USE

Facilitators to motivate use are the factors that help individuals either start or maintain the use of an app. We found that participants wanted tangible rewards. They stated that they would be more likely to stay engaged with the app over

time if they received tangible rewards, such as gift cards, cash, reduction in health insurance premiums, or other monetary incentives. One participant said, "Each time you try, you get the points. And if these points can be converted to something else. Because you know, you're not really working for the badge but if the virtual badge can turn into something tangible, I would want that" (female 63). Currently, most health mobile apps use intangible virtual reward systems (e.g., points, badges) in their design to attract more users; this was not found to be motivating for the participants in our focus groups. They did speculate that it might work for the younger audience.

INFORMATION SHARING WITH FAMILY, FRIENDS, AND HEALTH PROFESSIONALS

Besides the perceived barriers, benefits, and facilitators, participants discussed with whom they would be willing to share data and their perceptions regarding social support features of the apps. Very few participants actually shared data related to their diabetes management online. Those who had shared their data through the app liked it, particularly when they shared the data with friends in similar situations (i.e., both trying to lose weight). Overall, the participants were more open to the idea of sharing data to a small circle of dedicated individuals they know rather than to big public social networks. They would share data with someone whom they believed to be able to provide social support. The participants had reservations regarding sharing of personal information for the following two reasons: (1) concerns the information might be used by advertisers and (2) health information was personal and private. However, all the participants were open to sharing their self-tracked data with their healthcare team and they were excited about the possibility of synching their self-tracked data to their existing online personal health record available through a patient portal provided by their healthcare team.

Discussion and Conclusions

With the increasing number of health apps available in the market, it is important to understand how to leverage those apps for health promotion and disease self-management.[28] Currently, little evidence is available regarding how these "off-the-shelf" apps can be adopted and used for chronic disease management. The current study investigated rural T2D individuals' perceptions of using health apps for diabetes management.

When deploying app-based interventions, identifying and recognizing these barriers will help researchers and designers identify the appropriate target audience, anticipate roadblocks, and prepare possible solutions in advance. One of the primary barriers to health apps adoption is limited awareness of existing health apps and their functions. This is not just an issue among our participants. In fact, only 19% of cellphone users use health- or medical-related mobile apps,[29] which is a low adoption rate compared to other categories of apps, such as games or online banking apps. We also found that the lack of a doctor's recommendation is one reason for not using health apps. It demonstrates the important role that the healthcare providers play in the process of technology adoption for health management. It is important to examine the perceptions of health apps from the healthcare providers' perspective and investigate whether healthcare providers should be more involved in suggesting technology.

As with other technologies, literacy is an important determinant for adoption. Good usability design is crucial for the adoption and continued usage of health apps. For all the participants, time and effort are major barriers to health app usage. This finding is consistent with other research showing ease of use as the most important determinant for continued use of a health app (i.e., MyFitnessPal).[23] Ease and intuitive apps should include interface design with easy navigation and intuitive graphics, utilization of smartphone capabilities for automatic tracking, such as camera-based scanning or GPS-based tracking, and smooth integration of health app data with other existing tools, such as glucometers.

Another barrier to using health apps for T2D self-management is the lack of motivation and personal accountability among some users. This study demonstrates that participants would be more willing to use apps regularly if they could receive some type of tangible incentive. Previous studies have shown that financial incentives worked for smoking cessation and weight loss.[30,31] Future research may examine what stakeholders (e.g., insurance company) would provide the incentives. In addition, virtual rewards were not appealing to these participants, suggesting that app designers need to consider the characteristics of the target population to include appropriate motivating features.

Based on the four apps shown in the workshop, we were able to identify some favorite features among existing apps related to diabetes self-management. First, tracking is one of the most important features, similar to other research on health apps.[23,28] The function of tracking is related to the self-monitoring aspect of self-regulation.[32] Self-monitoring and tracking self-behaviors are essential, as self-management of diabetes depends on the management of diet, exercise, and medication or insulin.

Another feature considered to be highly valuable is providing education.[7] Particularly, T2D patients wanted information that was customized and tailored. Customization of educational information was one of the most requested features that is not

currently available in existing apps. Beyond customized educational content, participants expect personalized feedback based on their tracked data. They also hope to have the ability to customize the frequency and timing of reminders based on their own needs. Tailoring has been found effective in many health communication and education studies.[33,34] With ubiquitous computing, sensor-based automatic user behavior data collection, and machine learning techniques, it is possible to move from tailoring, but only limited messages in a predetermined manner to personalized dynamic tailoring. How to execute precise tailoring and customization is an important future research direction.[35]

This research also found that setting realistic goals was perceived to be helpful for diabetes self-management. More specifically, participants indicated that daily small and specific goals are more likely to be achieved than long-term goals. This is consistent with the findings in goal-setting theory, which states that moderately difficult and specific goals work the best to stimulate the highest level of effort from individuals.[36]

In terms of data sharing, participants showed both concerns and reception depending on with whom the data will be shared with. Participants also expressed concerns regarding privacy, similar to other research findings regarding data sharing in mobile apps.[28] However, synching tracked data to their personal health record and sharing them with their healthcare team was welcome. Some participants wanted their healthcare providers to read their shared data and expected some feedback. However, it is important to consider from the perspective of healthcare providers whether they would like to receive the shared data from their patients, and if so, what type of data they would want to see.

There are several limitations that may affect the strength and generalization of the conclusions. First, the sample size was relatively small, and the majority of the participants were white. Therefore, the findings might not be generalizable to the minority rural population. Second, most of the participants did not actually use these apps, but only observed the features of the apps in the workshop. The discussion is based on their hypothetical use. Nevertheless, as our goal was to identify why they did not use and how to facilitate them to use, the workshop in the focus group provided detailed description of the apps to enable us to gather information regarding "perceived" benefits, barriers, and facilitators.

In conclusion, the current study investigated the perceived challenges and opportunities of using health mobile apps among rural individuals with T2D. The specific needs and concerns revealed in this study provided researchers and app designers a better understanding of the potential barriers, effective motivators, and other factors that can help individuals improve their diabetes self-management with technologies. The findings provided empirical feedback for app designers on the desired features to motivate the use or continuous use of apps and the current barriers to using apps. More importantly, the current study identified the barriers outside of the app designs as well as facilitators to motivate use, which could also inform possible solutions for T2D patients to adopt health apps.

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