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Using mHealth App to Support Treatment Decision-Making for Knee Arthritis: Patient Perspective

Hua Zheng
University of Massachusetts Medical School, Hua.Zheng@umassmed.edu

Bengisu Tulu
Worcester Polytechnic Institute, bengisu@wpi.edu

Wonchan Choi
Worcester Polytechnic Institute, wchoi@wpi.edu

Patricia Franklin
University of Massachusetts Medical School, patricia.franklin@umassmed.edu

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Abstract

Introduction: Mobile health (mHealth) technology can be used to integrate into medical decision-making for patients with advanced knee arthritis. We explored patient preferences on content and design of a mobile health app to facilitate daily symptom capture and summary feedback reporting, in order to inform treatment decisions, including use of total knee replacement surgery (TKR).

Methods: Patient focus groups were conducted to gather requirements for mHealth app development and to refine the design and content of the app. Clinician (physical therapist, surgeon) interviews were conducted to understand clinician expectations from the summary trend report generated by the app.

Results: Sixteen patients attended focus groups with an average age of 67 and 63% female, and three clinicians participated in clinician interviews. The preliminary findings revealed that the patients preferred easy tap user interfaces to multitap or slider methods, and vertical question layout to horizontal orientation. Patients liked to be engaged by progress feedback reports and educational tips. Both patients and clinicians found a trended outcome summary report helpful which provides more precise details on whether and how the symptoms are changing over time.

Discussion: User input can inform the design and implementation of mHealth technology to meet patient needs for their treatment decisions. Patient priorities must be considered through patient-centered app design.

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Keywords

mHealth App, Patient-Reported Outcomes (PROs), Decision Making

Disciplines

Health Information Technology | Musculoskeletal Diseases | Orthopedics

eGEMs
Generating Evidence & Methods to improve patient outcomes

Using mHealth App to Support Treatment Decision-Making for Knee Arthritis: Patient Perspective

Hua Zheng, PhD;[i] Bengisu Tulu, PhD;[ii] Wonchan Choi, PhD;[ii] Patricia Franklin, MD, MPH, MBA[i]

ABSTRACT

Introduction: Mobile health (mHealth) technology can be used to integrate into medical decision-making for patients with advanced knee arthritis. We explored patient preferences on content and design of a mobile health app to facilitate daily symptom capture and summary feedback reporting, in order to inform treatment decisions, including use of total knee replacement surgery (TKR).

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[i]University of Massachusetts Medical School

Introduction

Arthritis is the most common physical disability in U.S. adults, affecting 50 percent of adults over age 65.[1] There is no cure for knee arthritis, so patients use chronic pain medications and physical therapy to limit the associated disability. When medication and rehabilitation are no longer effective, total knee replacement (TKR) is the most common surgical treatment and can effectively eliminate pain and improve physical function.[2] However, many patients do not seek help for their arthritis until their symptoms become unbearable, due to a misunderstanding of their condition and lack of information about treatment options.[3] Thus, it is critical for patients to be able to better understand their knee arthritis and its progression, and to seek appropriate treatment, including TKR surgery when indicated.

Patient-reported outcomes (PROs) have been widely used in orthopedic clinical research to capture the patient's assessment of arthritis pain severity and functional limitations before and after TKR. Implementing PRO collection in clinical practice presents significant challenges, including fitting within existing clinic work flow and reducing clinician, staff, patient time, and effort.[4] In contrast, with Web and mobile tools, home-based symptom data collection ensures consistent timing and supports complete data capture.[5,6] Using direct-to-patient data capture strategies, a national research registry, Function and Outcomes Research for Comparative Effectiveness in Total Joint Replacement (FORCE-TJR), successfully collected PRO measures from 13,000 primary TKR patients receiving care from over 150 surgeons in 28 states with high response rates—91 percent for before surgery and 85 percent for after surgery.[7,8] In contrast to one-time surveys in clinic, direct-to-patient methods capture the patient's history of *progressive* joint pain and associated limitations in daily function. These real-life trends provide important details for planning orthopedic care, and guide patient and clinician decisions. To further understand the patient's symptoms over time, new tools for home-based PRO assessment and daily symptom data capture are needed.

Mobile technology allows efficient 24/7 capture and dissemination of information. Mobile health (mHealth) tools, such as a mobile app, can be used to capture, monitor, and manage patients' health and activities in real-time at the patients' convenience.[9-11] In 2015, 68 percent of American adults owned a smartphone.[12] While the osteoarthritis population is older, with an average age of 50 years, the latest Pew report documents that 54 percent of the 50–64-year-old age group and 27 percent of adults over 65 years owned a smartphone in 2015. The prevalence of smartphone use is growing rapidly among older adults as these rates are almost double the rates in 2012.[12,13] Thus, mobile apps will be accessible to older adults and have the potential to improve healthcare delivery.

To date, mHealth tools have not been integrated into medical decision-making for patients with advanced knee arthritis. Through an Agency for Healthcare Research and Quality (AHRQ) funded research award, we will generate new knowledge on best designs for the following: (1) collecting health symptoms using mHealth systems in arthritis patients, (2) summarizing and displaying individualized patient information effectively so that the patient and the clinician can use the information for shared decision-making, and (3) integrating such patient-centered mHealth tools in clinical practice. In this paper, we report our preliminary findings in this study. These preliminary data will inform the design and implementation of the mHealth tools to support shared patient-clinician decisions for the treatment of knee arthritis, including TKR.

Volume 5 (2017) Issue Number 2

Methods

Mobile App Design

The mobile app is designed for advanced knee arthritis patients who are seeking new treatments for knee arthritis and considering TKR surgery.[14] We followed user-centered design principles[15] and an iterative development approach to build the prototype. The functionality includes daily joint pain and activity monitoring, joint-specific PRO assessment, and feedback and reminders to optimize data capture. Reports with trended pain and activity data over time are generated for patients' self-monitoring, and a PRO report generated with pain and function assessments is prepared for review with the clinician at the next office visit.

Patient focus groups and clinician interviews were conducted to refine the design and content of the app, and were followed by usability and pilot testing to evaluate usefulness, satisfaction, and acceptance of the app. Usability testing was done in early 2017, and will be reported in a future paper.

Patient Recruitment

The study was approved by Institutional Review Board (IRB) for the protection of human subjects at the University of Massachusetts Medical School. The study recruiter screened all knee arthritis patients who see a clinician at the UMass Memorial Arthritis and Joint Center. The enrollment criteria include adults 55 years of age and older with knee osteoarthritis, who use a smartphone and have experience using mobile apps, and who understand and speak English—to participate in the evaluation sessions. After confirming eligibility, the study recruiter contacted all potential subjects, answered their questions, and obtained consent from interested patients.

Patient Focus Groups

Patient focus groups were conducted to gather requirements for app development. During focus groups, participants were asked to comment about interfaces and functionality of potential app designs. Each focus group reviewed a new iteration of the app prototypes, on paper or on the phone, to collect requirements and to better understand the way users will interact with the system in their routine daily lives. Each patient focus group included 4–6 participants at a time, and the study PI moderated the discussion. Participants spoke aloud their opinions on app design and completed a survey on app user interface. A total of 13 participants attended the focus groups. Each of the sessions took 60–90 minutes and was audio recorded. A final "lab usability testing" session included three patients who used and evaluated the app functions during the session. Participants received a stipend of $25 and valet parking for attending the session.

Clinician Interviews

Three clinicians (two physical therapists and one TKR surgeon) were recruited for clinician interviews. The goal of the interviews was to understand clinician expectations from the individualized PRO report generated by the app. The individual interviews took 30 minutes and were audio recorded. Participating clinicians received an honorarium of a $50 e-Amazon gift card for the session.

Data Analysis

Data were analyzed using descriptive statistics methods. Means and proportions were used to describe the demographic variables and characteristics of the study population. Qualitative findings summarized the focus group and interview data into several topics, investigating the needs of target populations and exploring their preference of design and comprehension of the app.

Findings

Patient Participant Characteristics

Of the 28 eligible patients, 19 agreed to participate and 16 attended the interview sessions: 13 in one of three focus groups, and 3 in the lab usability testing session. Participant characteristics are shown in Table 1. Participant age ranged from 55 to 80 years old with an average of 67 years; 11 (68.8 percent) were older than 65 years; 10 (62.5 percent) were female; 14 (87.5 percent) had at least a college education level; and 7 (43.8 percent) were still working.

Findings from Patient Focus Groups

During focus groups, the participants were specifically asked for feedback on the following: (1) their experience in mobile app use, (2) their assessment of different data entry interfaces, (3) their preferences on data- and report presentations, and (4) their thoughts on using the app for treatment decision-making.

All participants had prior experience using mobile apps primarily for social purposes, such as Facebook or Maps, and entertainment. The majority of participants visit websites regularly, such as Google, WebMD, and even CMS, to get arthritis information. Very few (2 out of 16) use health-related apps, such as Fitbit, and none use an app related to arthritis or joint pain management.

Effective ways to collect arthritis joint pain were discussed. Compared to a 0–100 scale, participants like a 0–10 or 0–5 scale more because that is "sufficient and pretty universal." Smiley face icons

Table 1. Patient Participant Characteristics (N=16)

	N	%
GENDER		
Female	10	62.5%
Male	6	37.5%
AGE		
<65	5	31.3%
>=65	11	68.8%
EDUCATION		
High school graduate	2	12.5%
1–3 years of college	6	37.5%
College graduate	8	50.0%
WORK		
Yes	7	43.8%
No	9	56.3%

Volume 5 (2017) Issue Number 2

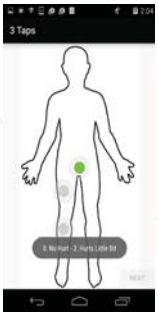
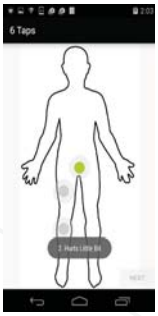
and red to green colors were intuitive and easy to understand. Participants suggested recording symptoms no more than twice a day for pain data and recommended recording morning pain and evening pain to represent the condition at rest and after activities.

Six data entry user interfaces (UIs) were tested by the participants on study smartphones. These interfaces are currently used in other arthritis tracking apps, including vertical response options (UI#1), horizontal response options (UI#2), vertical response options with a movable slide (UI#3), horizontal response options with a movable slide (UI#4), three-point multitapping (UI#5), and six-point multitapping (UI#6). The last two UIs (UI#5 and UI#6) were designed based on the "Tap-Tap-Tap" data input method, where users could choose certain levels of pain by multiple taps. The participants also completed a survey about their perceptions of easiness and usability of the six UIs tested. The survey includes eight 5-point Likert scale items (1-Strongly Disagree to 5-Strongly Agree). Survey data, mean with standard deviation (SD), are shown in Table 2. Tap from vertical response options (UI#1) was ranked highest. UI#3 and UI#4 with a slide were ranked in the middle. Tap-Tap-Tap options (UI#5 and UI#6) were ranked lowest.

The options of summary data presentation shown to participants included bar charts, calendars, and progress line charts. Calendar summary is the one that most participants preferred; it shows a month calendar with "good" days or "bad" days selected by using green or red colors. The progress line charts were also thought to work well as they show "a trend of symptoms over time—getting better or worse." Participants also liked to see comparative data, such as month to month, "my knee pain in this month is better than last month." And some participants would like the app to be able to drill down to specific data points and allow users to add notes to provide a better understanding of the circumstances that lead to major fluctuations.

Participants discussed how the app would help with treatment decision-making. Generally, participants liked the visual summaries of their data, and thought it was "good to see the whole (progress and picture)" in one screen, and "it would be helpful for

Table 2. Data Entry User Interfaces

	UI#1: TAP-VERTICAL	UI#2: TAP-HORIZONTAL	UI#3: SLIDE-VERTICAL	UI#4: SLIDE-HORIZONTAL	UI#5: TAP-TAP-TAP-3	UI#6: TAP-TAP-TAP-6
						
Summary Score	4.28 (0.58)	4.17 (0.69)	4.11 (0.77)	4.01 (0.85)	2.13 (0.91)	2.26 (0.96)

the doctor and me to review together my joint pain the last month." Participants suggested adding a field for them to add notes, so that they can put in notes and questions at any time and bring those to their doctor at their next visit.

The participants also discussed the motivation to use the app and to record their daily pain and activity data. They recommended useful tips and links regarding arthritis management to be provided as educational resources, and believed a reminder was necessary each day. Finally, participants wanted the ability to set daily record times at the beginning of a week, and to review summary feedback and trends from the prior week's data.

The participants did not like some app functions. For example, participants did not favor including the option to take pictures because they were not comfortable uploading or attaching pictures. They also mentioned that "there should not be too many technical things to do," such as printing a report from an app, because that would not work for them.

Clinician Interviews

Two physical therapists (PT) and one Total Joint Replacement (TJR) surgeon have completed interviews at this time. One PT has 20 years of practice experience with arthritis patients and is pilot testing apps for exercise tracking. The second is a junior PT with no experience with health apps. The TJR surgeon has over 20 years of practice experience with arthritis and TJR, and has limited experience with arthritis-related apps, but personally uses apps.

The two PTs liked activity management functions more than pain tracking. Both of them would like their patients to focus on exercises and activities and the things that they can do. One PT hoped to be able to access patient-entered data and review trends with patients, in order to work out treatment strategies based on those data. The other PT suggested adding arthritis exercise guidelines to the app and setting it as a goal line in activity graphs. Both of them liked summary data in a trend format that "gives a nice, quick snapshot." They found it "really helpful" for PT and patient to discuss issues and change treatment intensity and timing. One PT suggested alternative tools for the patients who are not app savvy. The other PT preferred asking about pain at rest and pain with activity, as opposed to in the morning and evening.

The TJR surgeon thought that while daily reports of pain or symptoms would be good for patient's monitoring, for surgeons, he would like to see summary changes by week or by month to make decisions. He uses a trend report in clinic and thought it useful. For activity records, he suggested including both time and intensity, "for example, for biking, how much tension do they put on the wheel, how fast, that makes difference." In addition, the surgeon thought that this kind of app would be useful for postoperative exercise management if adding exercise pictures or videos.

Discussion and Lessons Learned

mHealth technology has the potential to provide new ways to assist arthritis patients with pain and activity monitoring, management, and treatment decision-making. We developed an Android-based smartphone app for knee arthritis patients to assess arthritis symptoms and individual readiness for TKR surgery.

By 2040, 22 percent of U.S. adults will be over 65 years of age. Older adults have aging-related functional limitations, such as vision decline, motor skill diminishment, and cognitive decline. Older people have special needs and wishes for mobile app user interfaces. They prefer big buttons, simple navigation, easy functions, and intuitive data display. For example, in this case study, the patient

Volume 5 (2017) Issue Number 2

participants in focus groups wanted to change "Save" button to "Next" button, because they liked clear wording and disliked an extra click. For multichoice data entry, they found simple tap user interfaces were easier to use than multitapping or slider methods. In a summary report, they didn't need day-to-day data, but wanted to see if they were getting better or worse. Complicated interface and unnecessary information confused them. Advanced functions may not be appropriate for today's older adults.

Patients like *useful* health apps. Using the app and recording daily symptoms should not be a burden for patients. Patients discussed their motivations for using an app and reported that they like receiving educational tips or recommendations related to their daily arthritis management and periodic feedback reports of symptom progress in order to compare their current state against their past state. The idea of a note field was important because patients can record notes when they think of questions or problems and can prepare for discussion with their doctors and physical therapists. Usefulness is another important dimension for app use. mHealth app developers must understand the patient's priorities for use.

Clinicians see health apps from a different perspective. They prioritized the precision of presentation and interpretation of questions and data such as accurate location of joints, pain at rest and activity, rather than pain in the morning and evening, activity intensity in addition to minutes engaged in the activity, etc. In addition, clinicians emphasized that different patients may not be comfortable with apps. Thus, if we want to introduce an mHealth app into clinical practice to assist clinicians in managing care and making decisions, clinicians and patient priorities must be considered during the app content design.

Both patients and clinicians believed that a trended outcome summary report would be helpful for their discussion of treatment decisions. Today, patients report symptoms with general recall of the days and weeks prior to the office visit. In contrast, this app provides convenient, homebased, daily symptom recording, which allows the patient to summarize the symptom trends based on precise details to document *whether* and *how* the symptoms are changing over time. The next stage of the study is pilot testing to allow patients to use the app at home and to bring recorded data to their clinicians for discussion. We will learn more about the feasibility of integrating the app into the clinical evaluation and how useful the app is in assisting patients and clinicians in shared decision-making.

This study is limited by its small sample size. Sixteen (16) patient participants were enrolled in focus groups and three clinicians were in individual interviews. The preliminary data will be used to refine protocols for a larger future trial in a national sample to evaluate the impact of the app on self-assessment and treatment decisions, including optimal timing and use of TKR. Ideally, ongoing updates to the mHealth app will disseminate future research findings as they become available, to facilitate informed and shared clinical decision-making regarding arthritis care.

Conclusion

An mHealth app was designed for knee arthritis patients to record arthritis symptoms, complete assessments at home, and share summary symptom reports with clinicians to inform treatment decisions. User input effectively guided the design and implementation of this mHealth app to meet patient needs. At completion of the in-home testing, the tool will be available to support future knee arthritis patient decisions regarding the need for, and timing of, TKR surgery.

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References

1. Centers for Disease Control and Prevention (CDC). Prevalence of doctor-diagnosed arthritis and arthritis-attributable activity limitations - United States, 2010-2012. MMWR. Morbidity and Mortality Weekly Report 2013;62(44):869-73.
2. HCUPnet Nationwide Inpatient Sample (NIS). Agency for Healthcare Research and Quality (AHRQ) 2011.
3. Hudak PL, Clark JP, Hawker GA, Coyte PC, Mahomed NN, Kreder HJ, Wright JG. "You're perfect for the procedure! Why don't you want it?" Elderly arthritis patients' unwillingness to consider total joint arthroplasty surgery: a qualitative study. Medical Decision Making. 2002 Jun 1;22(3):272-8.
4. Harle CA, Listhaus A, Covarrubias CM, Schmidt SO, Mackey S, Carek PJ, Fillingim RB, Hurley RW. Overcoming barriers to implementing patient-reported outcomes in an electronic health record: a case report. Journal of the American Medical Informatics Association. 2016 Jan 1;23(1):74-9.
5. Zheng H, Yang W, Lemay C, Ayers, DC, Franklin PD. Direct to Patient PRO Collection to Support Quality Improvement in TJR. Concordium 2015, Washington, DC. 2015 Sep.
6. Franklin PD, Lewallen D, Bozic K, Hallstrom B, Jiranek W, Ayers DC. Implementation of patient-reported outcome measures in US Total joint replacement registries: rationale, status, and plans. J Bone Joint Surg Am. 2014 Dec 17;96(Supplement 1):104-9.
7. Franklin PD, Allison JJ, Ayers DC. Beyond joint implant registries: a patient-centered research consortium for comparative effectiveness in total joint replacement. JAMA. 2012 Sep 6;308(12):1217-8.
8. Zheng H, Li W, Harrold LR, Ayers DC, Franklin PD. Web-based Comparative Patient-reported Outcome Feedback to Support Quality Improvement and Comparative Effectiveness Research in Total Joint Replacement. eGEMs. 2014, 2(1):1130.
9. Turner-McGrievy GM, Beets MW, Moore JB, Kaczynski AT, Barr-Anderson DJ, Tate DF. Comparison of traditional versus mobile app self-monitoring of physical activity and dietary intake among overweight adults participating in an mHealth weight loss program. Journal of the American Medical Informatics Association. 2013 May 1;20(3):513-8.
10. Hamine S, Gerth-Guyette E, Faulx D, Green BB, Ginsburg AS. Impact of mHealth chronic disease management on treatment adherence and patient outcomes: a systematic review. Journal of Medical Internet Research. 2015;17(2):e52.
11. Kirwan M, Vandelanotte C, Fenning A, Duncan MJ. Diabetes self-management smartphone application for adults with type 1 diabetes: randomized controlled trial. Journal of medical Internet research. 2013;15(11):e235.
12. Smith A. US smartphone use in 2015. Pew Research Center. 2015.
13. Fox S, Duggan M. Mobile health 2012. Pew Research Center. 2012.
14. Choi W, Tulu B, Zheng H, Franklin P. Developing an mHealth Application for Osteoarthritis Patients. Proceedings of Healthcare Informatics and Information Technology. AMCIS 2016, San Diego. 2016 Aug.
15. Abras C, Maloney-Krichmar D, Preece J. User-Centered Design. Encyclopedia of Human-Computer Interaction: Thousand Oaks: Sage Publications; 2004.