

BMJ Open Qualitative study to elicit patients' and primary care physicians' perspectives on the use of a self-management mobile health application for knee osteoarthritis

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ABSTRACT

Objective To elicit perspectives of family physicians and patients with knee osteoarthritis (KOA) on KOA, its treatment/management and the use of a mobile health application (app) to help patients self-manage their KOA.

Design A qualitative study using Cognitive Task Analysis for physician interviews and peer-to-peer semistructured interviews for patients according to the Patient and Community Engagement Research (PaCER) method.

Setting Primary care practices and patient researchers at an academic centre in Southern Alberta.

Participants Intentional sampling of family physicians (n=4; 75% women) and patients with KOA who had taken part in previous PaCER studies and had experienced knee pain on most days of the month at any time in the past (n=5; 60% women).

Results Physician and patient views about KOA were starkly contrasting. Patient participants expressed that KOA seriously impacted their lives and lifestyles, and they wanted their knee pain to be considered as important as other health problems. In contrast, physicians uniformly conceptualised KOA as a relatively minor health problem, although they still recognised it as a painful condition that often limits patients' activities. Consequently, physicians did not regard KOA as a condition to be proactively and aggressively managed. The gap between physicians' and patients' conceptualisation of KOA and its treatment extended to the use of an app for self-management. While patients were supportive of the app, physicians were sceptical of its use and focused more on accountability and patient resources.

Conclusions The clear discord between physicians' mental models and patients' lived experience and perceived needs around KOA emphasised a gap in understanding and communication about treatment and management of KOA. As such, this preliminary and formative research will inform a codesign approach to develop an app that will act as a communications tool between patients and physicians, enabling patient-physician discussions regarding modifiable self-management options based on a patient's perspectives and needs.

Strengths and limitations of this study

- We used a multistage method of patient engagement, which provides a more robust, collective patient voice compared with simple patient representation.
- The elicitation of physicians' perspectives was conducted according to the Cognitive Task Analysis methodology, a rigorous structured method with a long track record in multiple domains of knowledge work.
- Patient and physician perspectives were deliberately considered to inform mobile health app design.
- Our sample sizes were appropriate to provide a frame of reference for future codesign work; however, they may be limited in capturing the full nuance of variability in this area.

INTRODUCTION

Knee pain is a common and persistent problem affecting 25% of people in middle and old age.^{1 2} Clinical risk and self-management tools developed for patients with chronic diseases can aid family physicians and patients to implement lifestyle changes, and there is ample evidence on the effectiveness of self-management strategies in primary care including exercise,^{3 4} weight management and physiotherapist-led programmes. However, previous studies reveal patients with knee osteoarthritis (KOA) do not always adopt or sustain engagement in such strategies.⁵ We hypothesised that by eliciting the perspectives of patients with KOA and the family physicians that help treat these patients, we would gain a better understanding of how patients and physicians conceptualise KOA, its management and whether a mobile health (mHealth) tool would support their sustained engagement in self-management strategies.

The increased reliance on, and access to, high-speed internet and associated technologies has resulted in electronic health (eHealth) emerging as an important information outlet for patients about health outcomes and resources.⁶ mHealth⁷ is becoming more prominent, as smartphones and tablets dominate the technological landscape. The use of mobile devices in daily life is growing exponentially; therefore, mHealth tools are becoming increasingly important for physicians and patients.⁸ Furthermore, recent studies have identified eHealth and mHealth applications as an effective mode for increasing patients' uptake and maintenance of such strategies,⁹ tracking patients' history, providing guidance and improving communication between patients and physicians.^{6 10} However, one of the major shortcomings of current mHealth approaches among patients with chronic diseases is the low adherence and lack of mainstream acceptance,¹¹ which is mainly reported to be due to the methodology used to design and implement the tool.^{10 12}

Eliciting and examining the perspectives of patients with KOA and family physicians provides an opportunity to bridge the gap in understanding between healthcare providers and people suffering with KOA. This is crucial to the design of effective tools and resources to support shared decision making and management between clinicians and people with lived experience. A recent systematic review¹⁰ on mHealth technologies for osteoarthritis (OA) self-management and treatment has identified a need for this type of codesign work for mHealth tools. Choi *et al* suggests a framework focused on patient-facing mobile apps that enable patients to get involved in the process of OA treatment with their clinicians. Three main modules are recommended for inclusion in mobile apps: (A) self-management; (B) decision support; and (C) shared decision making.¹⁰ The aim of this article is to report on our findings on patient and physician perspectives of KOA, its management and whether they would use an mHealth self-management application (app).

METHODS

Our team of academic and patient researchers conducted peer-to-peer research on patient and family physician perspectives of KOA and the use of an mHealth tool that would help with the self-management of KOA. Enhancing Alberta Primary Care Research Networks (EnAct) conducted the physician interviews using Cognitive Task Analysis (CTA), while the patient interviews were conducted by and using the Patient and Community Engagement Research (PaCER) approach. EnAct and PaCER then came together to discuss and compare results.

Enhancing Alberta Primary Care Research Networks

EnAct is an infrastructure created to support primary care research in Alberta. The EnAct research team used CTA^{13 14} to develop a rich understanding of how family

physicians think about managing early KOA and if they would use or recommend a self-management tool for KOA. Interviews were conducted by a group of experienced improvement advisors with specialised training in CTA who were intentionally selected due to their established relationship with primary care practices in Alberta.¹⁵

CTA is a family of methods designed to reveal experienced individuals' or teams' thinking in performing knowledge work in real-world contexts. It uses specialised interview methods and framework-guided analysis to uncover the crucial processes, known generically as 'macrocognition', by which individuals, teams and organisations make decisions, make sense of events and experiences, use and share knowledge, plan and replan, coordinate, monitor their work, detect problems, manage the unknown and adapt to changing conditions.¹⁴

We used a specific method of CTA called the Critical Decision Method or CDM. The CDM focuses on one particular type of decision, in this case the management of early KOA. We used the CDM to elicit family practitioners' mental models¹⁴ of KOA: their understanding of what KOA is, how it happens, why and how they treat it as they do, what actions produce what effects under what circumstances and what cues among the myriad in any clinical situation are important. In addition, we asked physicians if they would use, or would suggest patients use, an mHealth tool for self-management.

CTA participants

Sampling was intentional; we used EnAct's and the improvement advisors' relationships with practices and primary care networks across Alberta to request nominations of physicians for interview. We specified that we wanted to speak to family physicians who often see patients experiencing early KOA but are not sports or specialty physicians. In addition, we asked that they nominate physicians that were noticed to adopt initiatives not right at the start but once they had the opportunity to see others try it. This allowed us to focus on eliciting the mental models of the 'early majority'; the first sizeable segment of the population to adopt an innovation after seeing others try it.¹⁶ The early majority represent about 34% of the practising community¹⁶ and while they make deliberate efforts and are open to adopt change, they approach interventions differently than the smaller group of innovators and early adopters.¹⁶ Thus, the mental models of early majority physicians would best inform whether a self-management tool for early KOA would be used and found beneficial by the larger practising community.

We also selected physicians for variation in region of practice (ie, rural vs urban location). Our approach to this work and in using CTA was to gain a deep and rich exploration of an individual's mental model and to consider if a shared conceptualisation of KOA existed among those physicians interviewed. As such, we were more concerned with taking our time to gain insight into each physician's

mental model than with interviewing a high number of physicians. Four physicians were interviewed: one man and three women from rural (3) and urban (1) practices in Southern Alberta. Participants varied in years since graduation (6–22 years) and the number of physicians working in their clinics (4–15). The CTA team determined that the diversity of the participants among these practice characteristics was sufficient to gain knowledge of family physicians' mental models of KOA and an early sense of their perceptions of a self-management KOA tool.

CTA data collection and analysis

Once a physician was nominated, an introduction between the nominator and a key member of the team was made to establish contact, review consent and schedule an interview. Prior to the interview, participants were asked to review one or two KOA cases (recent and typical) in their practices where they offered lifestyle type advice, treatment, or treatment recommendations, for example, referral to physiotherapy, kinesiology or other services, but not to a rheumatologist or orthopaedist.

Participants had access to their electronic medical record for reference during the interview. No patient identifying information was shared, only sex and approximate age.

The interviews included four sweeps of information:

1. Details of the particular case to be discussed.
2. Development of a timeline for the course of diagnosis and treatment.
3. Deepening of information as it relates to macrocognitive functions.
4. Positing counterfactuals ('what if this had happened instead') and establishing 'rules of thumb'.

Interviews were conducted in pairs using the standard CTA method of a lead questioner and a note-taker/secondary questioner. Audio-recorded, transcribed interview data were combined with the interviewers' field notes for analysis. An interview guide was developed (online supplementary appendix A) as a general guide only, since in CTA, interviewers rely on intensive training and knowledge of macrocognition rather than scripted questions to elicit the information of interest.¹⁴

Transcripts were coded for macrocognition processes¹⁴ using a standard template the team employs across projects. Team analysis meetings were held to derive detailed descriptions of each subject's mental model of KOA and their approach to each macrocognition process around KOA. The final stage of analysis was to consider the CTA results across subjects, the range of mental models and macrocognitive processes and how those findings would affect use of a self-management support tool for KOA.

PaCER researchers and patient participants

PaCER researchers are citizens with a variety of health conditions who are trained in engagement and qualitative health research that brings a collective patient voice to health system change. To explore the patient

perspective in this project, two PaCER patient researchers conducted a qualitative study that built on the findings of two earlier OA PaCER studies: an internship study and the PaCER component of the Arthritis Society Models of Care research project,¹⁷ unpublished reports are available directly from PaCER. The results of these two earlier studies served as the starting point for our focus on understanding patient needs and the potential of using a tool to help patients self-manage their arthritis.

The PaCER method is designed to maximise patient engagement throughout the research process creating a robust collective patient voice¹⁸ and combining principles of participatory research that 'involves all relevant patients in actively examining disease-related issues that are deemed currently problematic in order to change and improve it'.¹⁹ It has three phases: *set*, *collect* and *reflect*. The *set* phase focus group clarifies the scope and direction of the study. The *collect* phase gathers data from patients using focus groups, interviews, observation or questionnaires. In the *reflect* phase, patient participants come to a common understanding of the *collect* phase findings and make suggestions on future research directions and knowledge dissemination.

Patient research participants

Patient participants were purposively recruited from those who had taken part in our previous OA PaCER studies¹⁷ and expressed interest in providing input on the use of an mHealth tool. Seven people received email invitations. The purposive sampling took into account the variability of patients in terms of disease severity and age, that is, four were diagnosed with OA more than 5 years ago and three within the past 5 years. Five people (three women; two men) consented to take part and met the inclusion criteria: they had experienced knee pain on most days of the month at any time in the past and any pain in the last 12 months.²⁰ Their ages ranged from 57 years to 72 years (mean=63.6).

Typically they had experienced knee pain for several years before diagnosis or seeking help from their family physicians and had received injections in the past few years. At the time of the interviews, none of the participants had experienced knee replacement surgery.

Patient research data collection and analysis

PaCER researchers (Miller and Teare) developed the interview guide, which was approved by the research team. The interview guide included questions to elicit patients' perspectives of KOA, their experience visiting physicians about their KOA, managing KOA and if they would find an mHealth tool beneficial (see online supplementary appendix B).

Five individual face-to-face semistructured interviews were conducted in a conversational style, using the interview guide. Both PaCER researchers were present for 4 of the 5 interviews; one as interviewer and one as note taker. The interviewers (as patient researchers) took an active role in the discussion as interviews became a three-way

conversation on patients' KOA, management and treatment options, and their willingness to use an mHealth app for self-monitoring their disease status.

The audio-recorded, transcribed interview data were sorted according to the interview guide. Next, the two PaCER researchers coded and analysed these data for key messages. By identifying significant patterns among patient responses to the questions delineated in the interview guide, and drawing meaning from such patterns, PaCER researchers identified key messages for: (1) information related to participants' visits to their family physicians about their KOA; (2) management and treatment options; and (3) patients' perspectives on a tool to help them and their physicians monitor their KOA and self-management strategies.

Comparison of the EnACT and PaCER data

Once the data from patient and physician perspectives were summarised, PaCER and EnACT researchers met as a team to review and compare the findings. Through a consensus process,²¹ the team agreed on the identified points of contrast in the conceptualisation of KOA and its management by patients and physicians as well as the perceptions on an mHealth tool. In the consensus process, each team member from PaCER and EnACT shared the identified key messages to ensure there was equitable discussion before reaching consensus. This discussion and our findings informed our subsequent codesign process for the KOA app.

Patient and public involvement

The study involved patient researchers from PaCER who designed and conducted the qualitative research involving interviewing those members of the public with OA. These OA patients reviewed previous data collected and suggested questions and topics to explore in following stage of interviews and focus groups. At the end of the study, we provided the final results to patients with OA who were asked to participate in further codesign work of an mHealth tool. The physicians who participated in interviews were also invited to participate in future codesign work.

RESULTS

Comparison of the EnACT and PaCER data revealed that patients and physicians hold different views regarding the seriousness of early KOA, which impacts both how they approach its management and treatment options and the patient/physician relationship itself. We also observed that while patients and physicians are aware of the differing views each holds, they continue to rely on assumptions about why these views have been formed. Furthermore, although patients were interested in the mHealth tool, physicians were concerned that the older population commonly diagnosed with KOA would have difficulty managing a technical device.

Conceptualisation of KOA

Physicians' mental models of KOA were quite consistent across individuals. Individual differences existed in degrees of richness and detail, but no differences were found in basic conceptualisation of KOA, its causes and mechanisms.

Physicians uniformly subscribed to the 'wear and tear' model of KOA. They conceptualised KOA as the wearing out of joint surfaces over time, exacerbated by age and weight; some included a familial or genetic susceptibility component, and some an overuse or impact-loading component. They also regarded it as something that inevitably worsens over time, though appropriate management might slow its progress.

... it's more of an issue with wear and tear, so those people who have a lot of pressure on their knee. Any type of occupation where they're using a lot of pressure on their knee, bending or kneeling as well, but also most commonly it is the people who are overweight and so the weight pressure is the biggest thing.

Notably, physicians also uniformly conceptualised KOA as a relatively minor health problem. They recognised it as painful, and often activity limiting, but did not put it in the same mental 'bucket' as chronic conditions with potentially fatal outcomes, such as cardiovascular disease or diabetes.

I don't think it's quite serious. ... I have a little bit of trouble labeling it as a disease per se, because as soon as over 50% of the population has it, it's not really a disease, it's the 'natural state of being'. It's only when you get the symptoms that come with it, then you've got to do something about that.

I mean I think in terms of the global scale of medical problems it's not like the highest one on my list of like 'oh my gosh, it's osteoarthritis, I'm so sorry', but at the same time I think as somebody who's really active and young and doesn't have osteoarthritis, it's one of the diseases I don't want to get because I think it really, really affects people's lifestyles.

Patients' perceptions about their KOA and of how they view its seriousness and treatments paint a different picture from that of physicians we interviewed. Patients were well aware that physicians did not consider KOA a 'serious' condition:

It's (OA) one of those things they can't do much about so they don't want to deal with it.... there are other more important things.... I don't know, I just feel it's not that important to him.

Patients reported that not having their knee pain taken as seriously as their more life-threatening health problems caused gaps in physician/patient care expectations, particularly since for patients KOA creates serious impacts on their lives and lifestyles.

Treatment and management of KOA

In terms of the treatment and management of KOA, physicians did not regard it as a condition to be proactively and aggressively managed as a disease per se, but rather as something that distresses patients, to be addressed when patients present with complaints about it. Minor differences were found in mental models of treatment, but a stepwise logical progression of treatments from conservative (eg, minor pain relievers) to more aggressive (eg, joint injections) was a consistent feature. Encouraging activity and lifestyle changes (eg, exercise and weight loss), and physiotherapy were frequent recommendations. Pain management was also a consistent feature, though physicians did differ somewhat in their conceptualisations of the contributions of different specific medications and interventions such as joint injections. There was an unmistakable sense that there is only limited ability to make a major difference in KOA, except for joint replacement. The goal of medical treatment was widely conceptualised as managing symptoms and maintaining activity to delay surgery as long as possible.

Patients, however, felt that physicians needed to be more open about listening to patient needs and current management strategies, not just exercise and weight loss. They wanted to openly discuss with physicians how they manage their KOA, including some treatments that are not within the scope of evidence-based medicine (eg, magnets on knees).

There's more than... lose weight, get exercise and take pain pills: and I'm a living example of that.

With respect to non-traditional approaches, when one participant told her physician she was taking turmeric, adding that the Arthritis Society classed it in the '*maybe category*' of treatments, he told her not to take it as it's not a recognised treatment '*He said I don't want to hear you talking about that stuff, it's not in my protocol*'. When another participant referred to information on the web, her doctor told her, '*I'm the sole source, do not use the web, do not ever tell me you look at it*'.

It was this type of interaction that simultaneously led to communication breakdowns and patients hiding their self-management treatments from physicians.

Patient–physician relationship

A tension in the patient–physician relationship was present in both physician and patient descriptions of KOA management. For instance, some physicians reported frustration when patients did not exercise or pursue activities and weight loss as suggested. There also existed a common belief among the physicians interviewed that patients desired easy or quick fixes and held unrealistic expectations.

Typically and not just OA but in general, all patients want a quick fix, but they want to understand why it's happening and so we talk about that.

... a lot of patients come expecting... they want to leave with a prescription, they're upset when they

don't... I think sometimes the expectation is pain relief, but they expect it as pain relief through medication.

This belief, mixed with the conceptualisation that KOA was not a 'serious' condition, left patients feeling there was a definite lack of communication and understanding between themselves and their physicians. Patient participants indicated that this lack of communication left them wondering about many aspects of their KOA including: what lies ahead and what they should do to manage their KOA; when they should return to their family physicians; and what self-management strategies are available such as what exercises to do, what equipment (eg, knee brace) to try and where to find good sources of trusted information. These concerns and questions were identified as key information physicians need to provide to their patients.

I've never heard about what stage I am, no one has ever mentioned that to me... surprisingly I've asked and I've been told that's not important at this stage, whatever that means.

Participants need their relationship with health professionals to be an ongoing partnership, one that supports *their* self-management of *their* KOA; however, lack of information and halted communication where patients 'learn not to mention' their concerns or the treatments that work for them are a clear barrier in this process.

The use of an mHealth tool

When asked about an mHealth tool or app, the majority of the physicians stated they would not use or recommend the app but would refer patients to a website as a source for printing resources. One physician was enthusiastic about an app, but only if it had accountability capabilities for patients. The physicians' main apprehensions were the age of patients with KOA (ie, 60–90s), logistics of having to show patients how to work the app, needing Wi-Fi in offices and rural settings and giving patients too much information on what may lie ahead and causing anxiety or concern.

Patients, however, responded positively to the idea of an mHealth tool and did not report any concerns about learning and using the technology; in fact, they had more concerns about what it would and would not track (pain severity, alternative treatments, monitor progress but not necessarily weight loss, and provide trusted resources). Participants were mainly excited to use the app as a communication tool with physicians.

If it helped my communication with my doctor that would be positive...

One participant explained that the app might help her doctor pay more attention to her OA during her appointments, '*He wants to focus on my heart all the time and I can understand that... maybe they (physicians) should think about your lifestyle and how it (OA) affects you... take more time to listen about arthritis vs. heart problem that's (now) under control*'.

Overall, patient participants felt that an mHealth tool would give them specific information about OA, allow them to enter information, monitor their progress and facilitate communication with their family physicians.

DISCUSSION

Our in-depth interviews with physicians and patients about their perspectives of early KOA revealed stark contrasts. Patients and physicians viewed the seriousness of KOA differently. Patient participants expressed that KOA seriously impacted their lives and lifestyles, and they wanted their knee pain to be considered as important as other health problems. In contrast, physician participants uniformly conceptualised KOA as a relatively minor health problem, although they recognised it as a painful condition that often limits activities. Consequently, these physicians did not regard KOA as a condition to be proactively and aggressively managed. This discord between physicians' mental models of KOA and patients' lived experience and perceived needs around KOA highlighted gaps in understanding and communications about treatment and management of their KOA.

Examining these contrasts between patients' and physicians' perspectives provides an opportunity to understand the needs of both patients and physicians in terms of KOA management and how they would approach the use of mHealth tools. These insights may help address a current gap that has been identified in OA mHealth technology studies that do not include design and usability testing with patients and physicians and thus do not consider the perspectives of both patients and physicians in terms of OA self-management.¹⁰ For instance, patients clearly desired and did not have concerns about using an mHealth tool. They saw its value in assisting with self-management and possibly improving communication with their physicians, and while physicians were wary of an mHealth tool, they did see the value in a source for patient resources and accountability. If an app was created to include some of features physicians request, without needing office Wi-Fi or physician involvement in the learning process, it could easily address both patient needs and physician concerns. This insight allowed us to move forward in planning the development of an mHealth app based on these stakeholders views and needs, to potentially improve communication^{6 9 10} and to create new perspectives on patient and physician roles—ones that may facilitate shared decision making.^{10 22}

The rationale for the qualitative work conducted with PaCER and EnACt was to ensure that we knew the mHealth app was the correct tool to develop and would meet the needs described to us by both physicians and patients. Originally, we had planned to implement a risk calculator for physicians to use with their patients with early KOA. However, by completing a pilot study with physicians using similar methods described in this article, we discovered that such a risk calculator tool would not change physicians' practice style and that a self-management tool for patients would be more useful. Similarly, our previous patient-led research

with patients^{17 23 24} also found that patients want tools for self-management and improved communication with their physicians. These were our first steps in understanding the importance of eliciting the perspectives and needs of physicians and patients prior to design and development of any type of intervention.

In the era of eHealth, codesign approaches are increasingly relevant in order to make lasting change, improve outcomes in the long term and create sustainable adoption by patients, health professionals and policy makers.^{6 25} Recent studies highlight the need for a philosophical shift in conceptualisation of knowledge implementation in healthcare from a 'pipeline' approach to the one that recognises the potential of collaboration or 'co-design'.^{10 25 26} Different terminologies are used to refer to such approaches^{8 27–33}; however, their ontology promotes genuine collaboration of all stakeholders from the initial phase of a research project, to framing the question, to the processes of knowledge generation and ultimately uptake^{34 35} and implementation.²⁸ Codesign approaches involving patients, clinicians, researchers and other health professionals need to be applied to ensure that this collective knowledge drives improvements in patients' health²⁹ and the healthcare system.^{31 36} While there is an increasing trend in using mHealth apps for self-tracking and self-management of chronic diseases,³⁷ codesign approaches could prevent potential problems patients face in using apps that burden patients with too much information or cause feelings of shame or guilt.^{37 38}

The results presented here will inform subsequent patient and physician codesign sessions. For instance, considering the contrast between patients wanting physicians to take their KOA seriously and physicians not seeing it as a serious condition, the app could be used by patients to facilitate discussions with their healthcare provider around their daily activities, self-management strategies and how KOA impacts their quality of life. Patients can use the app to collect their own data and share it with their physicians, providing a touchstone for meaningful discussions about best practices for self-management and interventions that have been successful for the patient. Several studies showed that patients would use mHealth technologies if the devices were connected to, or facilitated communication with, a healthcare provider—a goal that can be achieved according to codesign or Integrated Knowledge Translation approach principles.³⁹

The app itself cannot solve or close the gaps that already exist, but it can be a tool that patients and physicians view together, creating the space and opportunity within the context of the patient–physician relationship.

The most important limitation of our study was the small number of patient and physician interviewees. It is unlikely that we achieved saturation in this project. However, while saturation is commonly the goal of qualitative research projects, it was not our goal here. We sought, and found, understanding that would advance the codesign process. It is possible, perhaps even likely, that other significant factors remain undiscovered.

CONCLUSION

The insight we have gained into the contrasts between patient and physician perceptions of KOA, its management and the use of an mHealth tool has illuminated the need for a codesign approach to creating an mHealth app. Our codesign method cannot simply include opinions and reactions but must involve all end-users in the project development to obtain a rich understanding of everyone's perspectives, needs and ideas. This way of codesigning will create a tool that engages patients and physicians in a productive space for self-management of KOA.

We look forward to the results of the next phase, formal codesign sessions, to verify the need for this first stage of uncovering the thinking, values and strategies of patients and physicians. This first stage has created a strong codesign motivation and a shift in the original plan—to provide physicians with a risk management tool for KOA. The focus of the app now clearly recognises that the perspectives and needs of patients and physicians are the drivers of this unique codesign process. Furthermore, this collaboration of physicians, patients and research team is ideally positioned to assist in creating a new partnership between physicians and patients.

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conception and design of codesign methodology and was a primary contributor to the draft paper and revisions. JM agrees to be accountable for all aspects of the work. BrS made contributions to the design, analysis and interpretation of qualitative data, drafting and critical revision of the paper and final approval of the version to be published. BrS agrees to be accountable for all aspects of the work. LAG made contributions to the conception and design of qualitative work and codesign methodology, data acquisition, analysis and interpretation of physician data, recruitment of physicians, critical revision of the paper and final approval of the published version. LAG agrees to be accountable for all aspects of the work. NM contributed to the conception and design of the qualitative work and codesign methodology, analysis and interpretation of the data, revisions to the draft paper and provided final approval of the published version. NM agrees to be accountable for all aspects of the work. JC made contributions to the conception and design of work, data acquisition, critical revision, final approval of published version and agrees to be accountable for all aspects of the work. KM and DC-S made contributions to the conception design of work, interpretation of data, critical revision of the paper and agrees to be accountable for all aspects of the work. TW made contributions to the conception and design of work, data interpretation, critical revision of the paper and final approval of the paper. TW agrees to be accountable for all aspects of the work. LCL was involved in the conception and design of work, acquisition of data, critical revision of the paper, final approval of the paper and agrees to be accountable for all aspects of the work. DAM made contributions to the design, acquisition of and interpretation of the qualitative data, reviewing the work critically, provided final approval of the version to be published and agrees to be accountable for all aspects of the work.

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REFERENCES

1. Ehrlich GE. The rise of osteoarthritis. *Bull World Health Organ* 2003;81:630.
2. Peat G, McCarney R, Croft P. Knee pain and osteoarthritis in older adults: a review of community burden and current use of primary health care. *Ann Rheum Dis* 2001;60:91–7.
3. Zhang W, Moskowitz RW, Nuki G, et al. OARS recommendations for the management of hip and knee osteoarthritis, part I: critical appraisal of existing treatment guidelines and systematic review of current research evidence. *Osteoarthritis Cartilage* 2007;15:981–1000.
4. Christensen R, Bartels EM, Astrup A, et al. Effect of weight reduction in obese patients diagnosed with knee osteoarthritis: a systematic review and meta-analysis. *Ann Rheum Dis* 2007;66:433.
5. Bliddal H, Leeds AR, Christensen R. Osteoarthritis, obesity and weight loss: evidence, hypotheses and horizons - a scoping review. *Obes Rev* 2014;15:578–86.
6. Martínez-Pérez B, de la Torre-Díez I, López-Coronado M. Mobile health applications for the most prevalent conditions by the World

- Health Organization: review and analysis. *J Med Internet Res* 2013;15:e120.
7. Bhuyan SS, Lu N, Chandak A, et al. Use of mobile health applications for health-seeking behavior among us adults. *J Med Syst* 2016;40:1–8.
 8. McKibbin KA, Lokker C, Wilczynski NL, et al. A cross-sectional study of the number and frequency of terms used to refer to knowledge translation in a body of health literature in 2006: a Tower of Babel? *Implement Sci* 2010;5:16.
 9. Slater H, Dear BF, Merolli MA, et al. Use of eHealth technologies to enable the implementation of musculoskeletal Models of Care: Evidence and practice. *Best Pract Res Clin Rheumatol* 2016;30:483–502.
 10. Choi W, Zheng H, Franklin P, et al. mHealth technologies for osteoarthritis self-management and treatment: A systematic review. *Health Informatics J* 2017;146045821773567.
 11. Hamine S, Gerth-Guyette E, Faulx D, et al. Impact of mHealth chronic disease management on treatment adherence and patient outcomes: a systematic review. *J Med Internet Res* 2015;17:e52.
 12. Free C, Phillips G, Felix L, et al. The effectiveness of M-health technologies for improving health and health services: a systematic review protocol. *BMC Res Notes* 2010;3:250–6.
 13. Potworowski G, Green LA. *Cognitive task analysis: methods to improve patient-centered medical home models by understanding and leveraging its knowledge work*: Agency for Healthcare Research and Quality, 2013.
 14. Crandall B, Hoffman RR, Klein G. *Working minds a practitioner's guide to cognitive task analysis*. Cambridge, MA: MIT Press, 2006.
 15. Potworowski G, Green LA. Training change agents in CTA to bring health care transformation to scale. *J Cogn Eng Decis Mak* 2016;10:328–49.
 16. Rogers EM. *Diffusion of innovations*. 5th edn. New York: Free Press, 2003.
 17. Miller JL, Teare SR, Marlett N, et al. Support for living a meaningful life with osteoarthritis: a patient-to-patient research study. *Patient* 2016;9:457–64.
 18. Marlett NJ, Emes C, Jennett P. *Grey matters: a guide to collaborative research with seniors*. Calgary: University of Calgary Press, 2010.
 19. Wadsworth YJ. *What is participatory action research? Action Research International*, 1998.
 20. Cibere J, Zhang H, Thorne A, et al. Association of clinical findings with pre-radiographic and radiographic knee osteoarthritis in a population-based study. *Arthritis Care Res* 2010;62:1691–8.
 21. Hill CE, Knox S, Thompson BJ, et al. Consensual qualitative research. *Journal of Counseling Psychology* 2005;52:196–205.
 22. Bozic KJ, Belkora J, Chan V, et al. Shared decision making in patients with osteoarthritis of the hip and knee: results of a randomized controlled trial. *J Bone Joint Surg Am* 2013;95:1633–9.
 23. Marlett N, Shklarov S, Marshall D, et al. Building new roles and relationships in research: a model of patient engagement research. *Qual Life Res* 2015;24:1057–67.
 24. Shklarov S, Marshall DA, Wasylak T, et al. “Part of the team”: mapping the outcomes of training patients for new roles in health research and planning. *Health Expect* 2017;20:1428–36.
 25. Bowen S, Graham ID. Integrated knowledge translation. In: Straus SE, Tetroe J, Graham ID, eds. *Knowledge translation in health care: Moving from evidence to practice*. 2nd ed. Chichester, UK: John Wiley & Sons, 2013:14–23.
 26. Rycroft-Malone J, Burton CR, Bucknall T, et al. Collaboration and co-production of knowledge in healthcare: opportunities and challenges. *Int J Health Policy Manag* 2016;5:221–3.
 27. Jagosh J, Macaulay AC, Pluye P, et al. Uncovering the benefits of participatory research: implications of a realist review for health research and practice. *Milbank Q* 2012;90:311–46.
 28. Nowotny H, Scott P, Gibbons M. *Rethinking science: knowledge in an age of uncertainty*. Cambridge: Polity Press, 2001.
 29. Van de Ven AH. *Engaged scholarship: a guide for organizational and social research*. Oxford, NY: Oxford University Press, 2007.
 30. Scott A, Skea J, Robinson J, et al. *Designing “interactive” environmental research for wider social relevance (special briefing no.3)*: ESRC Global Environmental Change Programme, 1999.
 31. Straus SE, Tetroe J, Graham ID, eds. *Knowledge translation in healthcare: moving from evidence to practice*. 2nd edn. West Sussex: ChichesterWiley Blackwell, 2013.
 32. Graham ID, Tetroe JM, Pearson A, eds. *Turning knowledge into action: practical guidance on how to do integrated knowledge translation research*. 1st edn. Philadelphia: Wolters Kluwer/MR Books Joanna Briggs Institute (JBI) Lippincott Williams & Wilkins (LWW), 2014.
 33. Boyd H, McKernon S, Mullin B, et al. Improving healthcare through the use of co-design. *N Z Med J* 2012;125:76.
 34. Laloo C, Jibb LA, Rivera J, et al. “There’s a pain app for that”: review of patient -targeted smartphone applications for pain management. *Clin J Pain* 2015;31:557–63.
 35. Aitken M, Lyle J. IMS Institute for Healthcare Informatics. *Patient adoption of mHealth: Use, evidence and remaining barriers to mainstream acceptance*, 2015.
 36. Carr EC, Babione JN, Marshall D. Translating research into practice through user-centered design: an application for osteoarthritis healthcare planning. *Int J Med Inform* 2017;104:31–7.
 37. Lupton D. M-health and health promotion: the digital cyborg and surveillance society. *Social Theory & Health* 2012;10:229–44.
 38. Lupton D. ‘I just want it to be done, done, done!’ food tracking apps, affects, and agential capacities. *Multimodal Technologies and Interaction* 2018;2:29.
 39. Parker SJ, Jessel S, Richardson JE, et al. Older adults are mobile too! Identifying the barriers and facilitators to older adults’ use of mHealth for pain management. *BMC Geriatr* 2013;13:43.