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Title:
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Date:
2017-12-01

Citation:
Hinman, R. S., Nelligan, R. K., Bennell, K. L. & Delany, C. (2017). “Sounds a Bit Crazy, But It Was Almost More Personal:” A Qualitative Study of Patient and Clinician Experiences of Physical Therapist–Prescribed Exercise For Knee Osteoarthritis Via Skype. Arthritis Care and Research, 69 (12), pp.1834-1844. https://doi.org/10.1002/acr.23218.

Persistent Link:
https://hdl.handle.net/11343/293819

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<<st2>>ORIGINAL ARTICLE

<<title>>“Sounds a Bit Crazy, But It Was Almost More Personal”: A Qualitative Study of Patient and Clinician Experiences of Physical Therapist–Prescribed Exercise For Knee Osteoarthritis Via Skype

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Supported by the National Health and Medical Research Council (grant 631717). Dr. Hinman’s work was supported by an Australian Research Council Future Fellowship (FT130100175). Dr. Bennell’s work was supported by a National Health and Medical Research Council Fellowship (1058440).

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Submitted for publication August 4, 2016; accepted in revised form February 14, 2017.

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Objective. To explore the experience of patients and physical therapists with Skype for exercise management of knee osteoarthritis (OA).

Methods. This was a qualitative study. The Donabedian model for quality assessment in health care (structure, process, and outcomes) informed semistructured individual interview questions. The study involved 12 purposively sampled patients with knee OA who received physical therapist–prescribed exercise over Skype, and all therapists (n = 8) who delivered the intervention in a clinical trial were interviewed about their experiences. Interviews were

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1002/acr.23218

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audio recorded and transcribed. Two investigators undertook coding and analysis using a thematic approach.

Results. Six themes arose from both patients and therapists. The themes were Structure: technology (easy to use, variable quality, set-up assistance helpful) and patient convenience (time efficient, flexible, increased access); Process: empowerment to self-manage (facilitated by home environment and therapists focusing on effective treatment) and positive therapeutic relationships (personal undivided attention from therapists, supportive friendly interactions); and Outcomes: satisfaction with care (satisfying, enjoyable, patients would recommend, therapists felt Skype more useful as adjunct to usual practice) and patient benefits (reduced pain, improved function, improved confidence and self-efficacy). A seventh theme arose from therapists regarding process: adjusting routine treatment (need to modify habits, discomfort without hands-on, supported by research environment).

Conclusion. Patients and physical therapists described mostly positive experiences using Skype as a service delivery model for physical therapist–supervised exercise management of moderate knee OA. Such a model is feasible and acceptable and has the potential to increase access to supervised exercise management for people with knee OA, either individually or in combination with traditional in-clinic visits.

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<<hd1>>**INTRODUCTION**

Knee osteoarthritis (OA) is world-wide problem affecting one-quarter of adults (1). As OA has no cure, management aims to minimize pain and optimize function and quality of life, while delaying or preventing arthroplasty. Exercise is advocated as a fundamental component of nonsurgical management of knee OA (2) because of its beneficial effects on pain, physical function, and quality of life (3). Physical therapists commonly prescribe exercise for patients with knee OA, yet access to physical therapy services is limited for many (e.g., physical proximity, inability to pay, and/or availability of therapists), necessitating new models of service delivery to address this rising chronic health problem (4,5). Tele-rehabilitation via video conferencing is a potentially effective and cost-effective strategy for this patient group that remains unexplored to date.

Significance & Innovations

- Tele-rehabilitation via Skype was feasible for patients with knee

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osteoarthritis, primarily due to familiarity with the technology and the convenience of having physical therapy consultations within the home.

- Patients and physical therapists found this service delivery model was empowering for patients and that positive therapeutic relationships were developed, contributing to high levels of patient satisfaction with care provided.

<<significance&innovations>>

Video conferencing has been used successfully by physical therapists for rehabilitation of patients following total knee arthroplasty. In that population, a systematic review showed that patients receiving consultations via videoconferencing at home achieved comparable outcomes to conventional face-to-face rehabilitation (6). As 84% of Australian and US households own a home computer and 74–79% have internet access (7,8), the use of freely available videoconferencing software such as Skype represents a viable option for provision of physical therapist–prescribed exercise for knee OA. Our randomized controlled trial (RCT) evaluated the effectiveness of Skype-delivered physical therapist–prescribed exercise combined with internet-delivered pain coping skills training for knee OA symptoms (9). Findings showed that the intervention conferred clinically relevant benefits for pain and function compared to online educational material alone.

The limited research available suggests that both patients after arthroplasty, and their physical therapists, hold positive views of tele-rehabilitation service models, although these data come predominantly from surveys (10,11), and this topic has only been explored in depth in a single small qualitative study of 5 patients (12). In that study (12), patients reported high satisfaction with service delivery and improved access to services. Elimination of transport time to visit a therapist in person was highly regarded, particularly in early rehabilitation when postoperative pain was greatest. However, people with knee OA undergoing nonsurgical management may be less receptive to tele-rehabilitation than those following arthroplasty, because they do not share the same sense of urgency to overcome the effects of surgery and may have greater mobility outside the home. For therapists, the use of videoconferencing for assessment and provision of exercise is likely to be unfamiliar, given the general dearth of clinical tele-rehabilitation services for OA beyond the research setting.

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When evaluating experiences with and quality of health care services, several elements should be considered. The Donabedian model is a conceptual model for quality assessment in health care (13,14) that is advocated to review physical therapy services (15). It considers 3 elements of health care quality: structure (environment where the service is provided), process (clinician and patient activities involved in delivering/receiving care), and outcomes (effects of care provided). Guided by the Donabedian model, the aim of this qualitative study was to explore the experience of patients and physical therapists using Skype as a service delivery model for physical therapist–prescribed exercise management of knee OA.

<<hd1>>**PATIENTS AND METHODS**

<<hd3>>**Design.** A qualitative approach was used, drawing from principles of grounded theory for data collection and analysis (16). Semistructured individual interviews for data collection allowed participants to provide rich information from their own perspective and experience (17).

<<hd3>>**Participants.** Patients with persistent knee pain associated with OA, and physical therapists, were recruited as key informants from our RCT (9) evaluating efficacy of internet-delivered physical therapist–prescribed exercise and pain coping skills training. Selection criteria for participants with knee OA have been published previously (18). Recruitment of patients for this study involved purposive sampling to ensure data collected represented the experiences of people from both sexes, a range of ages, and metropolitan and rural areas. Patients were invited 3–6 months after completing therapy sessions. The final sample (n = 12) was dictated by the principle of theoretical saturation, when no new categories and themes emerged in the interviews (19). Recruitment of physical therapists (n = 8) included all therapists who delivered the intervention in the RCT (after ≥30 treatment sessions each). Participants provided written informed consent and the Institutional Ethics Committee approved the study.

<<hd3>>**Intervention.** The intervention has been described previously (18). Briefly, participants were provided 7 internet-based Skype-delivered physical therapy sessions for 3 months, the main purpose being to prescribe an individualized home-based strengthening program to be undertaken 3 times per week. The therapist selected 5–6 suitable exercises from the study protocol (see Supplementary Appendix A, available on the *Arthritis Care & Research* web site at http://onlinelibrary.wiley.com/doi/10.1002/acr.23218/abstract), based on

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patient goals, clinical history, and observation of walking, sit-to-stand, and squat tasks. Exercises were demonstrated by the therapist, and the participant performed the exercise while the physical therapist watched. At subsequent sessions, exercises were reviewed and progressed. Prior to the first session, participants received exercise equipment via courier (ankle weights, resistance exercise band, and a booklet with exercise instructions) and were assisted over the telephone by researchers to set up Skype. Patients without access to a portable computer were loaned an iPad.

<<hd3>>**Procedure.** Two semistructured interview guides were developed (1 each for patients and therapists) drawing from the Donabedian framework (13,14) (see Supplementary Appendix B, available on the *Arthritis Care & Research* web site at http://onlinelibrary.wiley.com/doi/10.1002/acr.23218/abstract). These guides ensured sufficient flexibility for participants to discuss their experiences and enable further probing by the interviewer to explore concepts in greater depth, to develop an explanatory theory of their experience, irrespective of questions being anchored within the Donabedian framework. Interviews were conducted over the telephone for convenience by the same investigator (RKN, a physical therapist), who was trained in conducting interviews. Interviews were audio recorded and transcribed verbatim by an external company.

A thematic and constant comparative analytical approach (16) was used to identify, compare, contrast, and synthesize themes arising from the data. This process was done initially by RKN in collaboration with a qualitative researcher (CD, a physical therapist) who had no contact with participants, to identify and interpret recurrent patterns and themes. Interviews were read by RKN soon after transcription to ensure accuracy and to further familiarize with the data. Transcripts were then reread and coded to identify common patterns and concepts. Segments of coded data were grouped into categories using Microsoft Excel spreadsheets in collaboration with CD. The 2 researchers discussed and refined categories and compared them across participants to develop themes and subthemes. The research team of physical therapists (RKN, CD, RSH, KLB) then deliberated to finalize themes, which were loosely grouped to the Donabedian framework for reporting.

<<hd1>>**RESULTS**

Participant characteristics are described in Table 1 and Table 2.<<T1>><<T2>> Patients were ages 62 years on average, half (n = 6) were women, and 42% (n = 5) lived in rural areas

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of Australia. They reported mild to moderate OA symptoms. Physical therapists had an average of 15 years of clinical experience, and half (n = 4) were women. Therapists had delivered an average of 58 Skype consultations to 9 different patients, prior to interviews. Seven themes regarding structure (Table 3), process (Table 4), and outcomes (Table 5) were identified.<<T3>><<T4>><<T5>> Six themes arose from both patients and therapists, and the seventh (Adjusting routine treatment) from therapists only.

<<hd3>>**Structure.** The themes Technology and Patient convenience were relevant to the structure of the service (Table 3). Both patients and therapists discussed the ease of using Skype for consultations. While most participants were satisfied with the quality of the video consultation, occasionally there were technical difficulties (such as poor internet connection causing video pixilation or audio problems) that could disrupt the flow of the consultation. Despite this problem, physical therapists discussed the quality of technology, both video and audio, to be suitable for providing instructions and prescribing exercises. Using Skype provided them with instantaneous feedback and the ability to observe facial expressions and body language. For patients, assistance from the research team in initially setting up Skype, and trouble-shooting difficulties, was appreciated.

Both patients and therapists considered Skype-delivered care to be convenient for patients, because of the time efficiency, flexibility, and the access it afforded. Patients appreciated not having to travel to a clinic, find parking, wait in the waiting room, or walk long distances when in pain. The structure of Skype consultations allowed them to fit treatments in between their daily activities. Patients enjoyed the flexibility to participate in sessions anywhere they could connect to the internet, including at work, while on day trips to the beach, or on holidays. However, patient flexibility could come at a cost to the therapist sometimes, with one noting it allowed patients to reschedule at the last minute.

<<hd3>>**Process.** The theme Patient empowerment to self-manage emerged from both patients and physical therapists (Table 4). The home environment was important in achieving this empowerment. Patients emphasized being comfortable and relaxed, enabling them to focus on performance of and adherence to prescribed exercises. Therapists also noticed the empowering effect of the home environment on patient adherence with the exercise program and felt it facilitated correct and safe exercise technique. In addition, physical therapists noted that using Skype as the medium for interaction, as opposed to traditional in-clinic visits,

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distilled their focus to the most important and effective treatment elements to facilitate patient self-management. There was a sense of not getting bogged down with hands-on treatments that were viewed as adjunctive, rather than essential to self-management.

Positive therapeutic relationships was also a theme. Patients appreciated the personal and undivided attention they received from their physical therapist, as well as the supportive and friendly relationships they felt were developed. Patients felt the therapist concentrated on their particular needs, with patient descriptions suggesting a subtle shift in the power balance in the relationship, such that the patient was more the focus of the consultation, rather than the therapist. Physical therapists described patients being more relaxed in their home environment and felt this relaxation resulted in patients being more receptive to the information the therapists provided.

For the therapist, Adjusting routine treatment emerged as an important theme related to the process of Skype-delivered consultations. Therapists were forced to modify usual habits and rely more on information shared by patients, rather than information derived from routine physical assessment tasks. They expressed some discomfort without hands-on assessment, which prevented both the palpation of the patient's knee to determine the source of symptoms and the hands-on facilitation of exercises. Despite this limitation, all therapists felt patients responded favorably to the exercises prescribed. Physical therapists also commented on the safety net that the research environment provided for consultations, expressing a sense of comfort in knowing that research staff had previously screened all patients for comorbidities and yellow flags upon enrollment to the trial and had assisted all patients in setting up Skype prior to consultations.

<<hd3>>**Outcomes.** Overall, both patients and physical therapists expressed Satisfaction with care as a theme (Table 5). Patients described the care provided as efficient and effective. In addition, therapists acknowledged the hands-off approach was physically less demanding compared to usual care and contributed to their sense of satisfaction. All patients expressed a desire to use Skype for future consultations and would highly recommend it to peers. Although 3 patients favored an initial in-person consultation so the therapist could "poke and prod" and "see the knee up close," all reflected that such a model would not have changed their overall outcomes, given their beliefs that exercise was more relevant than hands-on manipulation. Most therapists similarly felt Skype consultations were more suitable as

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adjunctive to usual in-clinic care, as they preferred to conduct an initial assessment in person in the clinic, rather than remotely.

Numerous Patient benefits were described as a theme. Patients discussed reductions in knee pain and improvements in physical function that enabled them to participate more fully in activities that were meaningful for them. Therapists emphasized the functional improvements experienced by their patients and noted these were observable using Skype. Importantly, patients described improved confidence and a greater sense of self-efficacy in managing their knee OA. This change was echoed by therapists, who observed greater confidence to exercise among their patients.

<<hd1>>**DISCUSSION**

This study used the Donabedian model for quality assessment in health care (13,14) to explore the experience of patients and physical therapists using Skype as a service delivery model for physical therapist–prescribed exercise management of knee OA. It was nested within an RCT that showed Skype-delivered physical therapist–prescribed exercise, combined with internet-delivered pain coping skills training, was effective at improving knee pain and physical function, and that benefits were sustained 6 months after intervention (9). Our qualitative study shows that patients and therapists had generally positive experiences, and that physical therapist–delivered exercise management of knee OA via Skype is feasible and acceptable for those delivering and receiving care. Importantly, our data also provide insight into how and why positive outcomes occurred.

Our findings support and expand the limited qualitative research in this field to date, which has focused on videoconferencing for rehabilitation after total knee arthroplasty. A small study explored the perceptions of 5 patients who received postoperative rehabilitation from physical therapists using a complex videoconferencing platform (12). Similar to our findings, patients reported high satisfaction, improved access to services with reduced need for transportation and an ongoing sense of support throughout their rehabilitation. They valued developing a bond with the therapist while maintaining privacy and personal space. Survey data showed therapists reported high levels of satisfaction with goal achievement, patient-therapist relationships, and quality and performance of the technologic platform (10), which agrees with our findings.

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Participants felt Skype technology was easy to use and efficient. The reasons for this centered around their familiarity with Skype and having assistance with set-up and troubleshooting when difficulties arose. These findings have important implications for implementation of similar services. Our use of widely and freely available Skype software meant most people had some familiarity with the software at the study outset, and that no expenditure on technologic infrastructure was required. Familiarity also enabled research staff to assist participants with setting up technology over the telephone. This ease contrasts with other more complex videoconferencing systems that required a researcher to visit the patient's home to install infrastructure and conduct communication tests (20), making it unlikely that such systems could be implemented outside research settings. Our findings suggest Skype-delivered physical therapy will be most useful and acceptable when accompanied by assistance setting up software and troubleshooting difficulties if they arise. Scalable methods of assistance could be provided by written instructions and/or video clips of software set-up, development of trouble-shooting guides, and/or training administrative/reception staff in physical therapy clinics to assist patients over the phone.

Physical therapists were uncomfortable being unable to touch patients when consulting via Skype. This discomfort was reflected in the data, where physical therapists expressed a desire to palpate the patient's knee to determine the source of symptoms or to facilitate exercise. Somewhat paradoxically, the therapists also emphasized that a benefit of Skype was that it allowed them to focus on the most important and effective treatment elements for patients with knee OA, namely exercise, education, and self-management skills, rather than "getting bogged down with hands-on stuff that wasn't going to ultimately be what they [patients] needed." Accordingly, therapists felt Skype consultations would be most useful as an adjunct to an initial in-clinic visit, so that they could perform their usual examination procedures. Similar to patients following knee arthroplasty (12), 3 of our patients also favored an initial in-person visit prior to Skype consultations. These same patients also believed their overall treatment outcomes would not have changed had the therapist been able to touch the knee.

Future research should determine whether Skype-delivered physical therapy services should be supplemented by an initial in-clinic visit. Treatment outcomes may be optimized with a blended approach, and some patients may prefer and/or respond better to a combination of in-clinic and Skype consultations. Knee OA can be diagnosed through subjective clinical criteria (21,22), such as patient age, history of knee pain (e.g., duration, severity, and aggravating

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factors) and morning knee stiffness (e.g., duration), and presence of clicking (crepitus) on knee motion. Asking patients via the internet “Have you ever been diagnosed by a health professional with osteoarthritis of the knee?” has a sensitivity of 73% and specificity of 96% for correctly identifying clinical knee OA, diagnosed by history and physical examination (23). However, when a differential diagnosis is required, or red flags raise concern about more serious pathology, a mechanism for direct physical examination of the patient and/or referral to medical practitioners is needed. Future research should establish the utility and validity of the patient performing modified knee diagnostic tests over Skype, under direction of the therapist. A recent study evaluated the reliability of an online physical therapist assessment of the knee using a more complex, commercial tele-rehabilitation videoconferencing system, such as eHAB, with capabilities for measuring joint motion (24). Compared to traditional face-to-face assessment, the primary pathoanatomical diagnoses in 18 patients with knee pain were in exact agreement in 67% of cases and similar in 89% of cases. Although Skype does not allow quantitative measurement of joint motion, patient self-palpation of the knee under therapist guidance is possible, as is postural examination, gait analysis, and observation of joint motion using categorical assessment scales.

An interesting and paradoxical finding was the positive effect reported by both patients and therapists on the quality of the therapeutic interaction/relationship. Despite Skype being used to increase the distance between therapist and patient, both parties described it as more patient-focused than traditional care. Inability to touch the patient meant therapists were forced to rely more on their subjective assessment of the patient, leading them to spend more time talking with and listening to patients, with 1 therapist (Caitlin) identifying the fact that this focus on communication led her to reflect more on the language she used and the cues she gave her patients during consultations. Physical examination focused on activities of daily living, with therapists observing patients performing functional tasks within the home environment, which contributed to patients’ feelings of more personal, individualized, and concentrated care. Similarly, the hands-off treatment approach intensified the therapists’ focus on the patient’s capacity to perform the exercises. Patients focused more thoroughly on exercise performance because they were more comfortable and confident at home and the exercises were performed within a familiar environment.

We found patients became more active participants in managing their knee OA. This result was noticed by the therapists, often as increased adherence to their recommendations and

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exercise instructions. Schermer (25) distinguishes between 3 degrees of patient self-management that can be promoted via tele-rehabilitation. The first represents an extension of the role of the clinician, involving the patient taking over some practical tasks (e.g., recording measurements) but without undertaking decision-making themselves. The second involves the patient being assisted to learn more about their condition as they begin to adopt some interpretative/decisional tasks of the clinician. Patients become more adherent to treatment and less dependent on the clinician, but are not enabled to formulate and live their own views on successful disease management. The third enables the patient to find their own way of living with their condition, because clinicians use the technology to enhance the patient's knowledge, understanding, and practical abilities. The patient/clinician relationship is one of collaboration, rather than of compliance. An important aspect of this third type of self-management is that the patient's own views, values, and goals are more prominent in the goals of treatment. Our data suggest that the degree of self-management facilitated by physical therapists over Skype lies somewhere between the second and third models. Future research is required to determine whether physical therapy consultations via Skype lead to improved self-efficacy and patient empowerment than traditional face-to-face consultations.

Implementation of physical therapy service models via Skype for managing patients with knee OA requires therapists to change their usual clinical practice habits, and possibly, private-practice business models. A potential disincentive to implementing Skype service models is lack of reimbursement by health insurers for tele-rehabilitation services. Future research is needed to evaluate the cost-effectiveness of this model of service delivery, to better inform uptake and implementation of such services and provide evidence needed for health insurers to fund tele-rehabilitation service models. The theory of disruptive innovation is a conceptual framework from the field of business administration that explains how industries outside the health service sector have coupled cost-reducing technologies with innovative business models to deliver affordable and accessible products and services (26). Ultimately, disruptive innovations are successful because the new product or service is more convenient and affordable and creates increased access by allowing participation of a new set of customers previously excluded from the market. If matched with appropriate business models, Skype could deliver affordable and accessible physical therapy services to patients with knee OA who would otherwise have difficulty accessing such health care.

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Service providers planning a Skype service model for people with knee OA should consider participant suggestions for improvement. Some patients suggested more consultations, particularly in the early stages of treatment when beginning the exercise program, while others thought consultations could be extended over a period longer than 3 months. Some patients and therapists felt the intervention should commence with an initial in-clinic visit prior to Skype consultations. Among therapists, suggestions for improvement also included expanding the scope for patient functional assessment beyond what our intervention allowed, development of a website for patients containing necessary resources, including exercise instructions, and/or adapting the technology to allow a split screen with the video image of the therapist/patient on one side and video clips of exercises on the other.

A strength of our study is inclusion of both patients and physical therapists as key informants. Although patient satisfaction with health services is critical to facilitate engagement with services and adherence to treatment recommendations, satisfaction of health care professionals involved in delivering care is also important to ensure that new service models are successfully implemented into practice. Use of the Donabedian framework to guide interviews yielded comprehensive data and enabled us to theorize service structure, processes, and outcomes to inform implementation of similar service models. Our study has a number of limitations. It was embedded within an RCT, so that our sample of physical therapists was constrained to the 8 who participated in the trial, and their perceptions of, and experiences with, the intervention may not be representative of the wider population of therapists. Our patients and therapists all volunteered for the RCT and may have been highly motivated and/or biased towards positive experiences and outcomes with the intervention. We excluded patients who could not understand English, so it is unclear whether our findings apply to non-English speakers. Our findings are only generalizable to patients with moderate levels of pain and dysfunction and characteristics similar to our sample. Finally, our recruitment of patients 3–6 months after completing treatment sessions may have influenced recall accuracy.

In conclusion, patients and physical therapists described mostly positive experiences using Skype as a service delivery model for physical therapist–supervised exercise management of moderate knee OA. Such a model is feasible and acceptable, and has the potential to increase access to supervised exercise for people with knee OA, either individually or in combination with traditional in-clinic visits.

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AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Dr. Hinman had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study conception and design. Hinman, Nelligan, Bennell, Delany.

Acquisition of data. Hinman, Nelligan.

Analysis and interpretation of data. Hinman, Nelligan, Bennell, Delany.

<<hd1>>**REFERENCES**

<<ref1>>

1. Pereira D, Peleteiro B, Araujo J, Branco J, Santos RA, Ramos E. The effect of osteoarthritis definition on prevalence and incidence estimates: a systematic review. Osteoarthritis Cartilage. 2011;19:1270–85.
2. Nelson AE, Allen KD, Golightly YM, Goode AP, Jordan JM. A systematic review of recommendations and guidelines for the management of osteoarthritis: the Chronic Osteoarthritis Management Initiative of the U.S. Bone and Joint Initiative. Semin Arthritis Rheum. 2014;43:701–12.
3. Fransen M, McConnell S, Harmer AR, Van der Esch M, Simic M, Bennell KL. Exercise for osteoarthritis of the knee. Cochrane Database Syst Rev 2015;1:CD004376.
4. Pietrzak E, Cotea C, Pullman S, Nasveld P. Self-management and rehabilitation in osteoarthritis: is there a place for internet-based interventions? Telemed J E Health 2013;19:800–5.
5. Russell TG. Physical rehabilitation using telemedicine. J Telemed Telecare 2007;13:217–20.
6. Shukla H, Nair SR, Thakker D. Role of telerehabilitation in patients following total knee arthroplasty: evidence from a systematic literature review and meta-analysis. J Telemed Telecare 2017;23:339–46.
7. Australian Bureau of Statistics. 8146.0 - Household use of information technology, Australia, 2010–2011. URL: http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/8146.02010-11.

This article is protected by copyright. All rights reserved

8. File T, Ryan C. Computer and internet use in the United States: 2013. Washington, DC. 2014. URL: https://www.census.gov/history/pdf/2013computeruse.pdf.
9. Bennell K, Nelligan R, Dobson F, Rini C, Keefe F, Kasza J, et al. Effectiveness of an internet-delivered exercise and pain coping skills training intervention for persons with chronic knee pain: a randomised trial. Ann Intern Med 2017;166:453–62.
10. Tousignant M, Boissy P, Moffet H, Corriveau H, Cabana F, Marquis F, et al. Patients' satisfaction of healthcare services and perception with in-home telerehabilitation and physiotherapists' satisfaction toward technology for post-knee arthroplasty: an embedded study in a randomized trial. Telemed J E Health. 2011;17:376–82.
11. Russell TG, Buttrum P, Wootton R, Jull GA. Rehabilitation after total knee replacement via low-bandwidth telemedicine: the patient and therapist experience. J Telemed Telecare 2004;10 Suppl 1:85–7.
12. Kairy D, Tousignant M, Leclerc N, Cote AM, Levasseur M, Researchers TT. The patient's perspective of in-home telerehabilitation physiotherapy services following total knee arthroplasty. Int J Environ Res Public Health. 2013;10:3998–4011.
13. Donabedian A. An introduction to quality assurance in health care. New York: Oxford University Press; 2003.
14. Donabedian A. The quality of care: how can it be assessed? JAMA 1988;260:1743–8.
15. Grimmer K, Beard M, Bell A, Chipchase L, Edwards E, Fulton I, et al. On the constructs of quality physiotherapy. Aust J Physiother 2000;46:3–7.
16. Charmaz K. Discovering chronic illness: using grounded theory. Soc Sci Med 1990;30:1161–72.
17. Taylor M. Interviewing. In: Holloway I, editor. Qualitative research in health care. Maidenhead (UK): Open University Press; 2005.
18. Dobson F, Hinman RS, French S, Rini C, Keefe F, Nelligan R, et al. Internet-mediated physiotherapy and pain coping skills training for people with persistent knee pain (IMPACT - knee pain): a randomised controlled trial protocol. BMC Musculoskelet Disord. 2014;15:279.
19. Bowen G. Naturalistic inquiry and the saturation concept: a research note. Qual Res 2008;8:137–52.
20. Tousignant M, Boissy P, Corriveau H, Moffet H, Cabana F. In-home telerehabilitation for post-knee arthroplasty: a pilot study. Int J Telerehabil 2009;1:9–16.
21. National Institute for Health and Care Excellence. Osteoarthritis: care and management. Clinical guideline CG177. 2014. URL: https://www.nice.org.uk/Guidance/CG177.

Author Manuscript

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22. Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K, et al. Development of criteria for the classification and reporting of osteoarthritis: classification of osteoarthritis of the knee. Arthritis Rheum 1986;29:1039–49.
23. Ratzlaff C, Koehoorn M, Cibere J, Kopec J. Clinical validation of an internet-based questionnaire for ascertaining hip and knee osteoarthritis. Osteoarthritis Cartilage 2012;20:1568–73.
24. Richardson BR, Truter P, Blumke R, Russell TG. Physiotherapy assessment and diagnosis of musculoskeletal disorders of the knee via telerehabilitation. J Telemed Telecare 2017;23:88–95.
25. Schermer M. Telecare and self-management: opportunity to change the paradigm? J Med Ethics 2009;35:688–91.
26. Hwang J, Christensen CM. Disruptive innovation in health care delivery: a framework for business-model innovation. Health Aff (Millwood) 2008;27:1329–35.

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Table 1. Characteristics of the participants with knee osteoarthritis (n = 12)

Pseudonym	Age, years	Sex	Geographical location*	Previous Skype use	Knee pain†	Physical function‡
Allan	71	male	metropolitan	yes	7	21
Lois	51	female	rural	no	8	49
Nathan	68	male	rural	yes	4	31
Evelyn	60	female	metropolitan	yes	7	46
Diana	67	female	rural	yes	7	35
Roland	56	male	metropolitan	no	5	25
Patricia	57	female	metropolitan	no	7	44
Sean	69	male	rural	yes	4	27
George	52	male	rural	yes	4	23
Roy	61	male	metropolitan	yes	9	39
Carol	62	female	metropolitan	yes	5	25

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Rachel	68	female	metropolitan	no	4	24
Mean ± SD	62 ± 7	–	–	–	6 ± 2	32 ± 10

* Metropolitan and rural classification was based on residential postcode, in accordance with Australian Standard Geographical Classification and Rural, Remote, and Metropolitan Areas classification.

† Measured by 11-point numeric rating scale (0 = no pain, 10 = worst pain possible) at baseline.

‡ Measured by Western Ontario and McMaster Universities Osteoarthritis Index at baseline, where physical function scores range 0–68, and higher scores indicate poorer function.

Table 2. Characteristics of the physical therapists (n = 8)

Pseudonym	Age, years	Sex	Clinical experience, years	Previous Skype use	Patients treated, no.	Consultations completed, no.
Hayden	44	male	15	yes	6	38
Jade	28	female	4	yes	11	77
Bianca	36	female	12	yes	10	64
Connor	52	male	28	yes	9	60
Cody	35	male	12	yes	10	66
Jamie	27	male	3	yes	9	60
Gemma	41	female	17	yes	9	63
Caitlin	47	female	25	no	6	38
Mean ± SD	39 ± 9	–	15 ± 9	–	9 ± 2	58 ± 23

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Table 3. Themes and subthemes relevant to structure of Skype-delivered physical therapist–prescribed exercise, with exemplary quotes	
Patient	**Physical therapist**
Theme: technology	
Easy to use	
Roland: "Very easy. I haven't had a lot of experience with Skype previously, but it was very easy. No problems there."	Cody: "I already had Skype and I was familiar with it, so it was very simple for me."
Diana: "Very limited (experience with Skype)...I found it really easy. I hadn't done it before. It was really, really good. I really liked it."	Caitlin: "I didn't feel intimidated or anything like that, I just loaded the app and added a contact and away I went with it. It was very easy."
Sean: "There was nothing difficult whatsoever about it."	
Quality can be variable	
Sean: "It was really good. You saw, could see and hear it, and it was very good reception so...we didn't have any problems. It was good."	Connor: "The quality of the calls, the volume and the picture were sufficient."
	Gemma: "You could see the patient clearly, you could see them moving around clearly, you could hear them clearly. I think it was good."
Patricia: "It was very good. It was spot on. There were no issues with that at all."	
Nathan: "We had to sort of repeat things a couple of times. But in general, it worked, worked extremely well. I think the only negative was there were times when the transmission was not	Jamie: "One of the patients sort of had a bit of a dodgy Internet connection so they sort of glitched up every now and again, but we certainly got through everything we needed to."

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great. So, I thought it was very, it was very positive."	Hayden: "The negatives are if you've got a dodgy internet or Wi-Fi connection, you get a little bit of a delay, or you might actually drop out, depending on where you are, and it stuffs around with the continuity of your session."
Lois: "We lost the vision at one stage but still had voice so we were still able to get through the sessions that way."	
Set-up assistance helps	
Sean: "I think I had to call you because I couldn't access the Skype because I think I hadn't keyed in the password for my Wi-Fi. So you got me started there…after the technical problems were overcome it was good."	
Evelyn: "We had the practice...I made sure that it was ready, and I could just have the Skype program and just press the button and so I think the practice was really worthwhile, because it made me sort of ready to go."	
Theme: patient convenience	
Time efficient	
Nathan: "You don't have to go out, get dressed, go travel wherever you have to go, and then wait invariably…there's always delays...so it's [Skype], it's very convenient."	Hayden: "They don't actually need to leave anywhere and physically travel to somewhere. So the time management side of it, I think, is a real plus for the patient."
Carol: "Well I think that's the way the world is moving, to be honest, and instead of wasting half an hour driving somewhere, and then finding a carpark and the costs involved	Jade: "They didn't have to leave their house. That makes compliance much higher."

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and all that sort of thing, I think it's far better that they can be done by Skype."	
Flexibility	
Lois: "I could be in different places to use it, I wasn't having to take the time out of the day to go to somewhere or to find a set position, so I was able to Skype from work. The sessions went over the holiday so I was actually at the beach and I was able to just have the iPad and still go through without actually having to drive to somewhere to use it." Roy: "And I was using it on a little handheld tablet, so I was able to move around the house to where there was light...there were some exercises where he required stairs, or areas that I could step up onto, so it was good to be able to move from one area of the house to another...and he could observe me using the stairs. So the portability was good."	Caitlin: "One particular participant was away on camp and Skyped from their tent." Gemma: "Convenience was a massive benefit for all of them, particularly the patients that were still working, in some circumstances you were treating them in their lunch break."
Increased access	
Diana: "I didn't have to go into town anywhere because I live in the country, so for me I didn't have to drive anywhere to go and see somebody, and I just found it really good."	Jade: "When you've got patients who are on the other side of the country or quite remotely as well, that wouldn't normally have access to this regular kind of intervention…it's really valuable and...something that we should be doing more of." Caitlin: "People who have mobility issues or they simply can't get to

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	the clinic, it just opens up, opens up access.”

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Table 4. Themes and subthemes relevant to process of Skype-delivered physiotherapist–prescribed exercise, with exemplary quotes	
Patient	**Physical therapist**
Theme: patient empowerment to self-manage	
Home environment	
Evelyn: “I was at home, I could relax, I could feel okay about what I was doing and I didn’t feel intimidated at all.” George: “You are in your own home environment. It does remove those clinical constraints...it does engage a more relaxed environment in which to talk.” Nathan: “It’s nice to be in your own environment to do this, it makes the sort of followup and the repetition of the exercises easier, too, because you’re doing them in the same room as you had the Skype session, and you’re using the same equipment. And there’s that element of familiarity, which makes life easier as well.” Diana: “Because you’re in your own environment and that’s where you live and that’s where you’ve got to do your exercises	Hayden: “They’re in their home environment and they have that comfort level...I reckon that’s a real plus. I reckon that’s a driver of compliance.” Cody: “The majority of the patients that I had were very positive and probably very happy that they had the opportunity to work in their own home. So they were very grateful, which helped with the rapport and helped with them actually doing what they were told to do.” Hayden: “Straightaway you’re showing them that they’re able to do these exercises at home, yet if you have a patient in the clinic and you give them home exercises, well, the first thing they do is they get home and they scratch their head and think, well, what am I going to do this on.” Jamie: “Good to be able to see them doing the exercises in the environment that they were going to do the exercises in...you can make

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anyway when you've finished with your physio. So it's not as if now I've got to go home and find a spot where I do my stuff. It was just really good because I was in my own environment."	sure they're going to do it correctly on the chair that you've got in your office, but then when they go home they find that all the chairs are lower and then they can't do it correctly...you can really troubleshoot to exactly what they need." Jade: "I was going to say a lot safer as well, they knew they were going to be safe doing their exercises...where they were going to do them and what they were going to do."
Focus on effective treatment elements	Bianca: "It was good that there wasn't the option of getting bogged down with hands-on stuff that wasn't going to ultimately be what they needed to self-manage. They understood from the outset that it was going to be exercises, it was going to be self-management and that you weren't going to end up having large chunks of time taken up with doing hands-on things which might only give temporary relief." Connor: "You couldn't do any manual therapy so you had to emphasize the exercise component because it was the only tool you had. Sometimes clinically you can get a bit caught up doing the hands on...and it actually dilutes your message. But when all you can do is your exercise...it really emphasizes to the client well this is it, this is what you've got to do..." Cody: "They already had this sense of a personal responsibility that they

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	were going to do self-management, and it was going to be an active exercise approach but also a little bit of an educational focus as well. So that was probably better for a lot of them.”
Theme: positive therapeutic relationships	
Personal undivided attention	
Allan: “I felt, this sounds a bit crazy, but it was almost more personal than in the past...the therapist was coming to you so I felt more personal using the electronic communications...than you do face to face.” Evelyn: “I think with the Skype physio, it’s more individualized and very much you. You know it was more concentrated.”	Gemma: “I did feel that it was quite easy to make a strong connection to the patients because they were in their own environment, and that made it better for me as a physio.” Hayden: “I think when patients come into your clinic and into your room, their guard’s up a bit, and I felt that in their home environment their guard wasn’t up...I think that immediately their guard was down. So that was pretty good because it meant that, you know, you break bread with the patient pretty quickly, communication wise.”
Supportive and friendly	
Allan: “You did develop a relationship, you know, next Friday is the time to have a chat and do your exercises and it was, I hate using a word like positive, but it was positive, it was reinforcing, it was something you kind of look forward to, having a chat with your trainer who you got to know reasonably well.” Diana: “I think it was just lovely...if I’d have gone to an office	

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where he was or do it on Skype, to me there wasn't much difference if you know what I'm saying. I wasn't feeling like I missed out on a connection somehow because there still was that connection that you knew him."	
Theme: adjusting routine treatment	
Modifying usual habits	
	Jamie: "Required them to give me a lot more input, you know, describing what's going on a little bit more, it will eliminate, I suppose, some of my normal go-to tactics." Hayden: "You can't really walk them up and down the stairs and follow them...watch them walk for a long period of time, and see what they're doing. Everything's very short...you're kind of limited with assessing activities of daily living stuff. A lot of it came down to subjective (assessment)." Caitlin: "I found myself really reflecting on the language and the cues that I was telling the patient to use. That was good to refine that process." Gemma: "I couldn't change my perspective...I couldn't change their alignment with anything manual, obviously. Despite those things I was very confident that they were doing it [exercise] safely and effectively. I could still see them do it. You can still see control, so I can see

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	alignment...in a grosser sense.”
Discomfort without hands-on	Caitlin: “Couldn’t get that feedback from your palpation skills, which then might change the way you address a movement restriction. It’s not as informed decision making from that particular point of view, or with that aspect of the assessment.” Cody: “(A bad feature is) the lack of hands-on. If someone’s knee is particularly troublesome on that day and you might get a lot of crepitus or something like that, often it’s good to have a bit of hands-on to see where that’s coming from.”
Research environment as a safety net	Gemma: “An issue for me if it was in my usual practice would be risk management...because I knew the patients had been screened by you and by the Uni under quite tight constraints related to their pathology, and other issues, it made me feel more confident when the patients were talking about their symptoms and other things.” Connor: “In a clinic setting you would need someone whether it be admin staff or somebody to provide that up-front education. To the clinician

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	that would prove frustrating if you were trying to teach everybody how to use Skype." Cody: "The study was so focused on that pure strengthening, whereas in a normal clinical setting you may be looking to diagnose something different or shoot off on a slightly different tangent. So, not as it applied to the study, but as it would apply to your day-to-day patient, I think it [Skype] would impede."

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Table 5. Themes and subthemes relevant to outcomes of Skype-delivered physiotherapist-prescribed exercise, with exemplary quotes	
Patient	**Physical therapist**
Theme: satisfaction with care	
Satisfaction and enjoyment	
Roy: "That was just as efficient doing it online as it would have been in the rooms." George: "I think Skype is quite an effective way of receiving information, advice, and direction from a physio." Lois: "I think it's absolutely brilliant. I think it's great, yeah."	Jade: "It was easier on my body. I didn't have to do any massage or anything like that. I thought it was good. I don't know if it was any better or any worse [than in clinic]." Gemma: "I'd rave about it. I think it was great. I really enjoyed being part of the program and part of that was because it was effective.

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Carol: "If I needed something for anything else in the future, I'd love to be able to just ring up and book a Skype appointment and run with it."	But I think as a physio the main outcome you want to see is that the patient sees that the treatment's effective and that they see some positive improvements in their function and how they move around. And I think definitely I saw that really clearly...I've got no doubt that the intervention is effective."
Recommend to others	
Nathan: "I would recommend it to anybody, and I have. As I said, I've spoken to a number of people about it and, you know, how it works, and I think it's a great concept." Rachel: "I think it works wonderfully and I would definitely recommend it."	
Skype as adjunct to usual practice	
	Caitlin: "I wouldn't do an initial consultation that way. I think the first time ever presentation to the clinic, I wouldn't be happy doing it over Skype. I'd probably like to do an initial consultation and look at scans and so on...and then subsequent consultations could be done via Skype." Cody: "If I was going to see a patient on Skype in the future, I would probably insist on seeing them to assess them in person at the start and definitely on discharge as we'll just do some more physical objective measures."

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Theme: Patient benefits	
Physical	
Diana: "It's changed 100% to what it was. My knee pain, when I first started it was so bad. It was really bad. I could just hobble around. And the improvement came really quickly after I started the exercises. The improvement is absolutely amazing."	Cody: "They all progressed really well in terms of strength and then functional outcomes. A lot of the people were actually looking at surgery and then at the end of the program thought that they wouldn't actually need surgery."
Roy: "I can go out and play golf now, 18 holes with minimal pain, whereas I used to hobble around like a retired racehorse."	Gemma: "They had better quality of movement in their lower limb in functional tasks, definitely. I could see that across the board. They were much more confident with movement. So definitely I could see that functionally they had improvements, subjectively and physically you could see that."
Confidence and self-efficacy	
Sean: "I just feel better...I feel more confident. I just feel hopeful going into the future and I don't feel that I'm looking at an operation in the immediate future anyway. So I feel stronger in the leg and I think from a self-esteem point of view that's good."	Gemma: "Most of my patients are much more confident to exercise and so they did, and they did a really good job of it. And confidence was a really common theme, and particularly for a couple of patients that probably had some fear avoidance I think was massive for them."
Diana: "I know I have a problem with my knee; it's not gone, but I feel that I have control over it in that I'm doing these exercises and that has helped me to have some sort of feeling of control over it, and I'm sure I have. I know now I have."	Connor: "Confidence in knowing and completing an appropriate level of exercise to self-manage their knee, I think that was a big thing. Even though the efficacy of it is to increase functional status, and I think for many of mine that happened as well, but right in the first

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	bit, I think they attained that confidence they were like okay, this is what I should be doing now. And that's what you really want to see in patients, that they're compliant, confident, safe."

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