Running head: Systematic review of e-Health interventions in knee pain

Bright, P. and Hambly, K., 2017. What Is the Proportion of Studies Reporting Patient and Practitioner Satisfaction with Software Support Tools Used in the Management of Knee Pain and Is This Related to Sample Size, Effect Size, and Journal Impact Factor?. TELEMEDICINE and e-HEALTH. tmj.2017.0207 **doi:org/10.1089/tmj.2017.0207**

Title: What is the proportion of studies reporting patient and practitioner satisfaction with software support tools used in the management of knee pain and is this related to sample size, effect size and journal impact factor?

Author names and affiliations:

Philip Bright (corresponding author – email: philbright@eso.ac.uk) [1,2].

Dr Karen Hambly (email: k.hambly@kent.ac.uk) [2].

[1]European School of Osteopathy, The Street, Boxley, Maidstone, Kent, ME14 3DZ, UK, ☎(+44) 1622 671558

[2]School of Sports and Exercise Sciences, University of Kent at Medway, Medway Building, Chatham, Kent, ME4 4AG, UK

Running head: Systematic review of e-Health interventions in knee pain

Abstract

Introduction: E-health software tools have been deployed in managing knee conditions. Reporting of patient and practitioner satisfaction in studies regarding e-health usage is not widely explored. The objective of this review was to identify studies describing patient and practitioner satisfaction with software use around knee pain.

Materials and Methods: A computerised search was undertaken; four electronic databases were searched from January 2007 until January 2017. Key words were: decision dashboard; clinical decision; web-based resource; evidence support; knee. Full texts were scanned for effect of size reporting and satisfaction scales from participants and practitioners. Binary regression was run; impact factor and sample size were predictors with indicators for satisfaction and effect size reporting as dependent variables.

Results: Seventy seven articles were retrieved; thirty seven studies were included in final analysis. Ten studies reported patient satisfaction ratings (27.8%); a single study reported both patient and practitioner satisfaction (2.8%). Randomised control trials were the most common design (35%) and knee OA most prevalent condition (38%). Electronic patient reported outcome measures and web-based training were the most common interventions. No significant dependency was found within the regression models ($p>0.05$).

Discussion and Conclusions: The proportion of reporting of patient satisfaction was low; practitioner satisfaction was poorly represented. There may be implications for the suitability of administering e-health; a medium for capturing further meta evidence needs to be established and used as best practice for implicated studies in future. This is the first review of its kind to address patient and practitioner satisfaction with knee e-health.

Introduction

The scope for technology assisted healthcare is far reaching; there are combinations of software, hardware and electronic applications across a range of platforms which come together under the banner of e-health.[1] The growth of web-based resources and software in healthcare has made major leaps forward since the advent of Web 2.0 with the expectation that traditional methods of accessing and delivering health services will irrevocably change.[2] E-health encompasses technologies such as clinical decision support systems (CDSS), decision dashboards, management systems, feedback systems, tele-health, information or web-based resources such as electronic patient reported outcomes and educational packages.[3] Technology driven clinical encounters are becoming accepted as a common experience within a healthcare setting but satisfactory patient engagement in the process may be lacking.[4]

CDSS have been used to augment primary healthcare since the wider availability of computing technology from the 1970's and, particularly, the impact of desk-top computing in the 1990's.[5] CDSS are computer systems designed to enhance clinical reasoning and can be differentiated as Computer-Based Comprehensive Clinical Support Systems, expert systems or evidence-adaptive CDSS.[6] They are designed to assist practitioners dealing with individual patients at the time of a clinical encounter by providing dynamic access to epidemiology and expert knowledge data.[7] If used in an appropriate setting, CDSS are proposed to have the potential to change medical education and practice but dependency on currency and quality of information is vital.[8] In the time since Bates et al.'s[9] article on effective clinical decision support, the issues of deploying evidence-based practice in musculoskeletal (MSK) medicine prevail. Bates et al.'s[9] ten technology commandments that include speedy data retrieval, anticipation of needs, real time delivery and a natural fit into the mode of practice do not guarantee practitioner compliance with support systems. This may be more heavily influenced by audit requirements, punitive fear of reprisal for eschewing established guidelines and monetary incentive.[10]

Decision aids are used in a variety of conditions and have been seen to improve people's knowledge regarding options, facilitating rationalisation around conflicting advice and patients feeling uninformed or confused about their personal values and choices.[11] The effectiveness of evidence delivery systems and benefit to practitioner performance has been established but influence on patient reported outcome measures (PROMS) is equivocal.[12] It has been determined that software tools assist in a qualified management approach for patients in a number of clinical scenarios with adaptation to shifts in the evidence base.[6]

These tools exist to support a range of conditions and healthcare scenarios such as respiratory disease, diabetes, depression and anxiety.[13–17] Within any support system, four key attributes should be present: automatic provision of decision support as part of clinician or patient workflow, provision of recommendations rather than just assessments, provision of decision support at the time and location of decision making with a computer based platform.[18] In this framework of structure and conditions there appears to be a place for physical therapy;[19] it is not clear how practitioners feel that software tools complement clinical skills and management processes in terms of MSK medicine of the knee. In the light of equivocal evidence that entry level practitioners may not be fully equipped to deal with demands of the knee patient population, engagement with support tools is warranted.[20]

The use of software tools in knee MSK medicine is expected to increase alongside delivery of physical therapy through e-measures such as tele-health.[21] A number of web-based rehabilitation tools are available which effectively provide an inventory of exercises.[22] These provide no reliable indication of the evidence supporting when to use the exercise and how challenging progression should be, especially in an aging population.[23] There may be an abdication of responsibility with such applications but ultimately the practitioners' base knowledge has to provide the concomitant guidance to the patients in deploying these tools.[24] Deployment in the field of MSK rehabilitation has been seen to have some success in return to work but further studies are needed to explore effective outcomes.[25] The satisfaction with the use of clinical software in the field of knee pain and rehabilitation is not fully understood and the extent of the impact on the patient has yet to be established.[5,26] Patient satisfaction may be overlooked in the drive to embrace technological change in the clinical encounter. In a recent Cochrane review exploring a range of decision aids, satisfaction was explored in respect of decision outcome; only 17.4% measured satisfaction with the outcome and a single study from the 115 reviewed described higher satisfaction related to the use of the decision instrument itself.[11] The reporting of patient and practitioner satisfaction in published studies regarding e-health for rehabilitation of the knee is not widely explored.

Aims & Objectives

The aim: to review how practitioners and patients satisfaction with the use of software systems in clinical support in knee rehabilitation is reported in relevant studies.
Objective: Systematically identify relevant studies describing patient and practitioner experiences of software use within knee pain and rehabilitation studies to answer the research question:

"What is the proportion of studies reporting patient and practitioner satisfaction with software support tools used in the management of knee pain and is this related to sample size, effect size and journal impact factor?"

Method

Design: Systematic review

Procedure

This study comprised of a systematic literature search with data extraction and regression analysis.

Systematic Literature Search

The review investigated quantitative studies exploring user experience of e-health for a range of knee-related conditions. A systematic search for identifying and extracting studies was undertaken by the primary author and reported using a PRISMA flow diagram. Four electronic databases were searched from January 2007 until January 2017 (Cochrane, Medline, Science Direct and Google Scholar). The key words were:

Decision dashboard; Clinical decision; web-based resource; evidence support; knee.

The full search string used was: Search **(((((((decision dashboard) OR clinical decision) OR web-based resource) OR internet) OR software) AND knee)))** Filters: **published in the last 10 years; Humans; English; Adult: 19+ years.**

Criteria for Selecting Studies

The eligibility criteria were identified through the sample, phenomenon of interest, design, evaluation, research type[27] framework. The sample (S): Adult rehabilitation patients; for the purpose of this study, rehabilitation patients are defined as those going through an enabling process that helps them to reach and/or maintain their optimal physical knee function. The phenomena of interest (PI): to be included articles had to have considered the use of software tools with patients undergoing knee pain management or physical rehabilitation. Design (D): all types of designs were used including experimental and cohort designs; reviews and purely qualitative studies were excluded. Evaluation (E): the analysis of rating of satisfaction in relation to e-health measures applied to the knee. Research type (R): quantitative and mixed-method approaches including randomised control trials (RCTs), non-randomised, quasi-experimental studies, cohort studies and single case studies/reports.

Mendeley Desktop version 1.17.8 (Mendeley Ltd, London, UK) was used to store and organise retrieved studies. Data was extracted from the articles into a Microsoft Excel version 14 (Microsoft Corporation, Redmond, WA, USA) spreadsheet table. The categories extracted were: authors, year of publication, article title, journal, intervention type, design type, population, age (range), sample size, outcome measures, effect size reported, patient satisfaction reported, practitioner satisfaction reported, journal impact factor. Satisfaction had to be reported in regard to the experience of using the intervention under investigation and not the knee-associated outcome. An independent researcher extracted data from a randomly selected 10% of the main sample of studies which was used for process validation.

Inclusion criteria: any studies involving knee pain management or knee rehabilitation that employed software technology in the form of decision aids (patient or practitioner), patient compliance monitoring, outcome reporting, progressive goal setting and exercise management were included. Knee and hip pain studies where combined populations of sufferers were reported

Studies were excluded if interventions focused on purely non-software based interventions such as advisory, paper-based patient information sheets, verbal educational practice offering guidance only and technology assisted surgery. Studies involving technology assisted interpretation of imaging for clinicians and patient-independent evaluation, purely cost-effectiveness or epidemiological designs were also excluded.

Theses, protocols, conference proceedings, and non-peer reviewed articles were excluded because they lacked sufficient quality and detail. Articles not written in the English language were excluded because translation facilities were unavailable and selected from 2007 onwards to only include the most recent literature. Samples were limited to adults to allow for autonomous patient engagement rather than experience filtered through a parent, guardian or carer.

Statistical analysis

Summary statistics for the study characteristics were calculated using Microsoft Excel. Full texts were scanned for inclusion of effect size reporting and satisfaction scales from participants and practitioners related to the use of the intervention. A binary value of Y or N was recorded and the proportions of these values allowed for dichotomous grouping that was used to determine if a difference in impact factor score existed between groups that reported satisfaction and those that did not. A binary regression was run with impact factor and sample size allotted as predictors in the model with indicators for satisfaction and

effect size reporting as dependent variables. Effect size, sample size and journal impact factor were selected as indicative of reporting quality. [28] Odds ratios (OR) and 95% confidence intervals (CI) were calculated with a significance threshold set at 5%. Analyse-it version 3.76 (Analyse-it Software, Ltd., Leeds, UK) was used to calculate all binary regression statistics.

Results

Seventy seven studies were retrieved following title and abstract screening from a total of 743 initial returns. After application of inclusion and exclusion criteria, a total of 37 studies were included in the final analysis. The process of exclusion is detailed in Figure1.

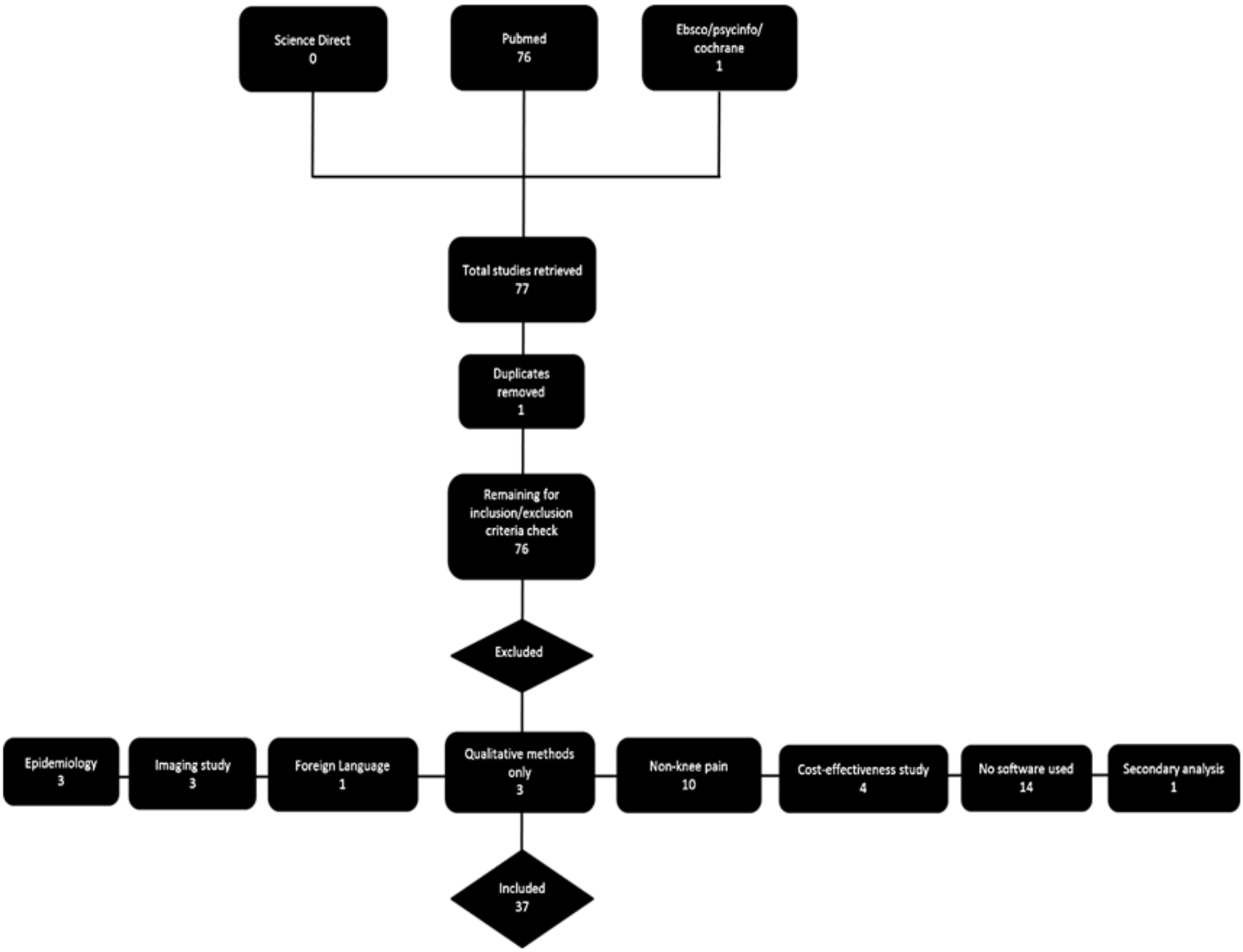

Figure1. PRISMA Flowchart depicting the extraction and selection of study retrieval.

The 37 studies analysed can be viewed in Table1 with their related characteristics; a key for the categories of intervention type, design type and outcome measures can be found in Tables 2-4. Ten studies reported patient satisfaction ratings (27.8%) while only a single study reported both patient and practitioner satisfaction (2.8%). Of the 10 studies reporting patient satisfaction, 2 captured data via a 10cm analogue line;[29,30] 2 captured data via a multi-item (17-18) questionnaire of 5-point Likert scales; [31,32] 1 reported via a single 7-point scale; [33] 1 reported using an ordinal Acceptability Scale with a satisfaction component; [34] 3 introduced satisfaction results in the discussion with no a prior analytical strategy described;[35–37] 1 study reported satisfaction using the Healthcare Satisfaction Questionnaire for patients and a technical quality subjective appreciation questionnaire for practitioners.[38] Independent extraction demonstrated 100% agreement on the presence of reporting on these satisfaction measures.

Author(s) & Year	Article/paper title	Journal	Intervention Type	Design Type	Population	Age (mean or range)	Sample Size	Outcome Measures	Effect Size Reported Post Hoc?	Patient Satisfaction With Intervention Reported?	Practitioner Satisfaction With Intervention Reported ?	Journal Impact Factor 2015 - Thompson Reuters
Reeve & Williams 2016[39]	When to operate: online patient-reported outcome measures (PROMs) can help decide.	BMJ Case Rep.	D	ScR	KoA	64	1	Oxford Knee Score, HowRU	N	N	N	0
Kim et al. 2016[40]	Internet-Based Exercise Therapy Using Algorithms for Conservative Treatment of Anterior Knee Pain.	JMIR Rehabilitation and Assistive Technologies	E	RcT	KnP	52	60	VAS pain, UCLA activity score	Y	N	N	4.532
Taylor & Williams 2015[41]	An acute knee injury: tracking a two-year recovery online.	Int J Electron Healthc.	D	ScR	AkI	62	1	Oxford Knee Score	N	N	N	0
Yin et al. 2015[29]	Web-Based Education Prior to Knee Arthroscopy Enhances Informed Consent and Patient Knowledge Recall.	J Bone Joint Surg Am.	F	RcT	MnT	48	55	Likert Scale	N	Y	N	5.163
Gakhar et al. 2013[42]	A pilot study investigating the use of at-home, web-based questionnaires compiling patient-reported outcome measures following total hip and knee replacement surgeries.	J Long Term Eff Med Implants.	D	PtS	HkA	80	21	Oxford Knee Score/ Oxford Hip Score	N	N	N	0

Slover et al. 2015[43]	Feasibility of integrating standardized patient-reported outcomes in orthopedic care.	Am J Manag Care.	D	CaS	KnP	18-96	666	EQ-5D, KOOS	N	N	N	1.657
Levinger et al. 2016[44]	A real time biofeedback using Kinect and Wii to improve gait for post-total knee replacement rehabilitation.	Disabil Rehabil Assist Technol.	B	CaS	TkA	70	4	Timed Up&Go (TUG), ROM, Gait, WOMAC, AQoL	N	N	N	0
Stacey et al. 2016[45]	Impact of patient decision aids on appropriate and timely access to hip or knee arthroplasty for osteoarthritis.	Osteoarthritis Cartilage.	F	RcT	HkA	67	343	Hip-knee osteoarthritis decision quality instrument, SURE tool, Preparation for decision making scale	N	N	N	0
Umapathy et al. 2015[46]	The Web-Based Osteoarthritis Management Resource My Joint Pain Improves Quality of Care.	J Med Internet Res.	F	QeS	HkO	61	277	heiQ, OAQI	N	N	N	4.532
Kwasnicki et al. 2015[47]	A wearable mobility assessment device for total knee replacement.	Int J Surg.	A	FeS	TkA	60-84	29	TUG, ROM, Gait	N	N	N	1.657
Rini et al. 2015[48]	Automated Internet-based pain coping skills training to manage osteoarthritis pain.	Pain.	E	RCT	HkO	68	113	AIMS2, Arthritis Self-Efficacy Scale, Pain Anxiety Symptoms Scale, Positive and Negative Affect Scale	Y	N	N	5.557
Pua et al. 2015[49]	Evaluation of the Wii Balance Board for walking aids prediction: proof-of-concept study in total knee arthroplasty.	PLoS One.	F	ObS	TKA	67	89	NRS, ROM, Active knee lag, Standing balance	Y	N	N	3.057
Hoffman et al.	Launching a virtual decision	BMC Med Inform	F	FeS	KoA	18-	126	Osteoarthritis Decision Quality	N	Y	N	2.042

2014[34]	lab: development and field-testing of a web-based patient decision support research platform.	Decis Mak.				85		Index Knowledge Subscale, Preparation for Decision Making Scale, Decisional Conflict Scale, Acceptability Scale				
Calliess et al. 2014[35]	Clinical evaluation of a mobile sensor-based gait analysis method for outcome measurement after knee arthroplasty.	Sensors (Basel).	A	CaS	TuK	52-68	6	Knee Society Score, Oxford Knee Score, TUG,	N	Y	N	2.033
Kawi et al. 2015[50]	Activation to self-management and exercise in overweight and obese older women with knee osteoarthritis.	Clin Nurs Res.	E	QeS	KoA	52-72	16	Patient Activation Measure (PAM)	N	N	N	1.359
Bisson et al. 2014[51]	Accuracy of a computer-based diagnostic program for ambulatory patients with knee pain.	Am J Sports Med.	F	CoS	KnP	18-84	527	Sensitivity of diagnosis	N	N	N	4.517
Peter et al. 2015[52]	Development and preliminary testing of a computerized animated activity questionnaire in patients with hip and knee osteoarthritis.	Arthritis Care Res (Hoboken).	D	QeS	HkO	46-82	110	AAQ, H/KOOS ADL subscale (19,20), and pain NRS.	N	N	N	0
Brooks et al. 2014[53]	Web-based therapeutic exercise resource center as a treatment for knee osteoarthritis.	BMC Musculoskelet Disord.	E	CoS	KoA	33-76	52	WOMAC, WHO-QOL, K-SES, GRC, User satisfaction	Y	Y	N	1.684
Marsh, Bryant, MacDonald, et al. 2014[37]	Feasibility, effectiveness and costs associated with a web-based follow-up assessment	J Arthroplasty.	D	RcT	HkA	38-86	256	WOMAC, Harris Hip Score, SF-12 v2	N	Y	N	2.515

	following total joint arthroplasty.											
Stacey et al. 2014[54]	Decision aid for patients considering total knee arthroplasty with preference report for surgeons.	BMC Musculoskelet Disord.	F	RcT	KoA	67	142	Hip-knee osteoarthritis decision quality instrument, SURE tool, Preparation for decision making scale	N	N	N	1.684
Marsh et al. 2014[55]	Are patients satisfied with a web-based followup after total joint arthroplasty?	Clin Orthop Relat Res.	D	RcT	HkA	38-86	256	7-point Satisfaction Scale	N	Y	N	0
Bossen, Veenhof, et al. 2013[56]	Effectiveness of a web-based physical activity intervention in patients with knee and/or hip osteoarthritis.	J Med Internet Res.	E	RcT	HkO	62	199	PASE, KOOS/HOOS, SPE, NRS (pain & fatigue), HADS, Arthritis Self-Efficacy Scale, Pain Coping Inventory	Y	N	N	4.532
Bossen, Buskermolen, et al. 2013[57]	Adherence to a web-based physical activity intervention for patients with knee and/or hip osteoarthritis.	J Med Internet Res.	E	MmS	HkO	61	100	PASE, KOOS/HOOS, SPE, NRS (pain & fatigue), HADS, Arthritis Self-Efficacy Scale, Pain Coping Inventory	N	N	N	4.532
Senanayake et al. 2013[58]	3-D kinematics and neuromuscular signals' integration for post ACL reconstruction recovery assessment.	Conf Proc IEEE Eng Med Biol Soc.	A	QeS	AcL	31	12	Activity Based Recovery Classification	N	N	N	0
Marsh, Bryant, Macdonald, et al. 2014[59]	Patients respond similarly to paper and electronic versions of the WOMAC and SF-12 following total joint arthroplasty.	J Arthroplasty.	D	QeS	HkA	50-90	59	WOMAC, SF-12(v2), Global Rating of Change	N	N	N	2.515
Bossen, Veenhof, et al. 2013[60]	The usability and preliminary effectiveness of a web-based	BMC Med Inform Decis Mak.	E	PtS	HkO	64	20	KOOS, HOOS, SQUASH	N	N	N	2.042

	physical activity intervention in patients with knee and/or hip osteoarthritis.											
Puh et al. 2014[61]	Effects of Wii balance board exercises on balance after posterior cruciate ligament reconstruction.	Knee Surg Sports Traumatol Arthrosc.	E	CaS	PcL	22	1	ROM, Stabilometry	N	N	N	3.097
Piqueras et al. 2013[62]	Effectiveness of an interactive virtual telerehabilitation system in patients after total knee arthoplasty.	J Rehabil Med.	E	RcT	TkA	73	142	Goniometry, Dynamometry, TUG test, VAS (pain), WOMAC	N	N	N	1.595
Howells et al. 2013[63]	The assessment of postural control and the influence of a secondary task in people with anterior cruciate ligament reconstructed knees using a Nintendo Wii Balance Board.	Br J Sports Med.	E	CaS	AcL	26	90	Centre of Pressure	N	N	N	6.724
Arterburn et al. 2012[64]	Introducing decision aids at Group Health was linked to sharply lower hip and knee surgery rates and costs.	Health Aff (Millwood).	F	ObS	HkO	66	9515	Surgery Rates	N	N	N	5.23
Fung et al. 2012[32]	Use of Nintendo Wii Fit in the rehabilitation of outpatients following total knee replacement.	Physiotherapy.	E	RcT	TkA	38-81	50	Length of outpatient rehabilitation, 2-minute walk test, knee range of motion, timed standing, Activity-specific Balance Confidence Scale, Lower Extremity Functional Scale and Numeric Pain Rating Scale	Y	Y	N	1.814

Baltaci et al. 2013[65]	Comparison between Nintendo Wii Fit and conventional rehabilitation on functional performance outcomes after hamstring anterior cruciate ligament reconstruction.	Knee Surg Sports Traumatol Arthrosc.	E	RcT	AcL	29	30	Star Excursion Balance Test (SEBT), Functional Squat, Leg Tracking Ability, Dynamometry	N	N	N	3.097
Hawamdeh et al. 2012[66]	Development of a decision support system to predict physicians' rehabilitation protocols for patients with knee osteoarthritis.	Int J Rehabil Res.	C	VtS	KoA	55	170	Prediction Accuracy	N	N	N	1.25
Gudbergsen et al. 2011[67]	Test-retest of computerized health status questionnaires frequently used in the monitoring of knee osteoarthritis.	BMC Musculoskelet Disord.	D	CxS	KoA	54-76	20	KOOS, VAS pain, function and patient global, SF-36, Physical Activity Scale, pain DETECT, and the ADL Taxonomy	N	Y	N	1.684
Tousignant et al. 2011[38]	Patients' satisfaction of healthcare services and perception with in-home telerehabilitation and physiotherapists' satisfaction toward technology for post-knee arthroplasty.	Telemed J E Health.	E	RcT	TkA	66	42	Patients' perception of telehealth, Patients' satisfaction with healthcare services received, Health professionals' satisfaction with the technology	N	Y	Y	1.791
Russell et al. 2011[30]	Internet-based outpatient telerehabilitation for patients following total knee arthroplasty.	J Bone Joint Surg Am.	E	RcT	TkA	68	65	WOMAC, Patient-Specific Functional Scale, Spitzer Quality-of-Life Uniscale36, TUG, VAS (pain), ROM, Knee lag, Girth measurements at the knee, Gait	N	Y	N	5.163

								Assessment Rating Scale				
Hambly & Griva 2010[68]	IKDC or KOOS: which one captures symptoms and disabilities most important to patients who have undergone initial anterior cruciate ligament reconstruction?	Am J Sports Med.	D	CrS	AcL	33	126	KOOS, IKDC	N	N	N	4.517

Table 1. Study characteristics and reporting indicators.

Summary statistics

The following tables summarise the interventions, design types and populations under investigation in the reviewed studies.

Intervention	ID	Total Reported (%)
Activity sensor	(A)	3 (8.33)
Biofeedback	(B)	1 (2.7)
Clinician Decision Aid	(C)	1 (2.7)
ePROM	(D)	10 (27.03)
eTraining	(E)	14 (37.84)
Patient Decision Aid	(F)	8 (21.62)

Table 2. Intervention types with identifiers

Design	ID	Total Reported (%)
Case Study	(CaS)	5 (13.51)
Cohort Study	(CoS)	2 (5.41)
Crossover Study	(CxS)	1 (2.7)
Cross-sectional study	(CrS)	1 (2.7)
Feasibility study	(FeS)	2 (5.41)
Mixed-methods	(MmS)	1 (2.7)
Observational	(ObS)	2 (5.41)
Pilot Study	(PtS)	2 (5.41)
Quasi-experimental	(QeS)	5 (13.51)
Randomised Trial	(RcT)	13 (35.14)
Single Case Report	(ScR)	2 (5.41)
Validation Study	(VtS)	1 (2.7)

Table 3. Study types with identifiers

Population	ID	Total Reported (%)
ACL Repair	(AcL)	4 (10.81)
Acute Knee Injury	(AkI)	1 (2.7)
Hip/Knee OA	(HkO)	7 (18.92)
Knee OA	(KoA)	7 (18.92)
Knee Pain	(KnP)	3 (8.11)
Meniscal Tear	(MnT)	1 (2.7)
PCL Repair	(PcL)	1 (2.7)
Total Knee Arthroplasty	(TkA)	7 (18.92)
Hip/Knee Arthroplasty	(HkA)	5 (13.51)
Total/Unicompartment	(TuK)	1 (2.7)

Table 4. Population of interest with identifiers

Electronic patient reported outcome measures and web-based training initiatives were the most common intervention investigated. Randomised control trials were the most reported study design and the most common knee populations of interest were knee OA (with and without hip OA) (37.84%).The age range of study participants encompassed 18-96 year olds (mean $59.95_{\pm 16.71}$) and an equal representation of gender was seen. The most common knee

outcome measures (14% each) were range of motion and the Western Ontario and McMaster Universities Arthritis Index (WOMAC) and the variety of outcome measures can be viewed in Figure2.

Figure2. Word cloud representing reported outcome measures.

Regression analysis

The OR demonstrate that there was no significant prediction within the models ($p>0.05$) with regard to journal impact factor or sample size influencing the reporting of effect size, patient satisfaction or practitioner satisfaction. Table 5 provides the details of OR and CI for the associated models.

Dependent variable	Predictors	Odds ratio	95% CI
Effect size	Journal Impact Factor	1.33	0.81 to 2.19
	Sample Size	0.99	0.99 to 1.01
Patient satisfaction	Journal Impact Factor	0.99	0.67 to 1.46
	Sample Size	0.99	0.99 to 1.00
Practitioner satisfaction	Journal Impact Factor	0.82	0.26 to 2.64
	Sample Size	0.99	0.95 to 1.03

Table 5. Results of regression models for effect size, patient and practitioner satisfaction

Discussion

This study aimed to explore the proportion of studies reporting patient and practitioner satisfaction with software support tools used in the management of knee pain. The proportion of reporting of patient satisfaction was relatively low, with just over a quarter capturing this engagement; the practitioner satisfaction was poorly represented with a single study reporting this item. There was no statistical significance seen with regard to association of reporting satisfaction and effect size, with the size of sample or journal impact factor as indicators of article quality.

Patient satisfaction is generally reported in other areas of healthcare and with the adoption of e-health initiatives this is regarded as a key criterion.[69] One proposed benefit of e-health may be the cost saving it makes to the delivery of care which has been explored with tele-health and particularly remote outpatient scenarios.[70,71] Cost-effectiveness may offset the need for shared patient decision which is also an agenda in clinical engagement and is reported to lead to improved outcomes and consequently satisfaction.[72] This review excluded studies conducted purely to assess cost-effectiveness but one single study that include a cost measure also reported patient satisfaction;[37] the Web-based resource reportedly saved almost 50% on standard care with moderate to high satisfaction levels. [37] The study did not report explicitly how satisfaction ratings were achieved a priori suggesting the lack of attention to this measure.

Practitioner satisfaction may be implicit within the augmented reality of e-health but can be implicated in multidimensional models of practice that can account for variation between clinician and patient experience. [73] Study design may be the influence here, in that single case, validation or cohort studies may be delivered by the developer of the initiative in these reviewed articles.[31,39,52,74,75] This is akin to a pharmaceutical manufacturer not only paying for the research but also administering the drug to the patient, which implicates further bias.[76] The randomised trials within this review fared no better than lower quality designs in terms of reporting, although the single incidence of patient and practitioner satisfaction was an RCT of small sample size in a journal of low impact.[77]

Study design may have the additional impact in terms of reporting of effect size and the related sample size.[28] Lower quality evidence will not support suitable statistical power to detect required effect; there may be an assumption that when an effect size is generated it supports suitability as well as effectiveness of the outcome.[78] Despite recommendations to reliably report effect size in a range of study designs alongside RCTs,[79,80] only a quarter of the 12 trials in this review demonstrated this requirement.[32,48,56] The studies in this review looked to address function and perspective around knee pain and associated conditions and measures. Effect was explored with these outcomes in mind but the suitability of administering the intervention is not evidently reported and patient experience does not inform these effects. Patient satisfaction and treatment acceptance have been qualitatively described as being influenced by shared decision making with practitioners.[81] Qualitative investigation may elicit the experiential viewpoint more readily than the satisfaction measures reported in this review[82,83] whereas Rasch analysis may be a more sensitive statistical tool to use with satisfaction scales beyond reporting effect size.[26]

Satisfaction is generally high with regards to physical therapy in Western culture[84] and it would be appropriate to contextualise satisfaction data on knee e-health as an ongoing

process within MSK. Patient experience has to be taken into account in order to demonstrate the satisfaction with using the measure itself alongside the measure's outcome; the so-called Fit between Individuals, Task and Technology (FITT).[85] The assumption that all technological change is an improvement on healthcare has to be better qualified and supported by meta evidence of satisfaction. Exploration of satisfaction measures such as the After-Scenario Questionnaire (ASQ), Post Study System Usability Questionnaire (PSSUQ) and the Tele-health Usability Questionnaire (TUQ)[86] should be routinely included in e-health studies into knee-related pain management. The recent proposal of using the standardised Enlight measure[87] to rate e-health interventions is welcome but further consideration of tempering usability criteria with satisfaction outcomes is warranted. This could facilitate therapists' understanding, critical clinical reasoning and competencies to readily engage in patient and population-centred healthcare.[88]

Limitations within this review are the heterogeneity of the studies in terms of design and intervention. Qualitative synthesis of thematic analysis may allow for a more refined understanding to overcome this, with the advent of sufficient published, experiential material. The reporting standards scrutinised may not have been deemed appropriate or a necessity by all study authors due to the novel interventions involved. The inclusivity adopted was determined by an attempt to define the scope of e-health initiatives within the context of knee pain sufferers; this is the first review of its kind to address patient and practitioner satisfaction in this population. Future studies engaging with the varied forms of e-health in the management of knee-related pain and interventions should look to apply the capture of satisfaction with all interested parties as standard best practice.

Conclusion

Patient and practitioner satisfaction with the use of e-health measures in the management and rehabilitation of knee pain is not routinely reported. This may have implications for the suitability of administering technology in this population; a medium for capturing this meta evidence needs to be established and used as best practice for studies involving e-health and knee pain in the future. Reporting standards around the use of technology in clinical and domiciliary scenarios should be revisited in the light of this review.

References

1. Eysenbach G. What is e-health? J Med Internet Res. 2001;3:E20.
2. Vedder A, Cuijpers C, Vantsiouri P, Ferrari MZ. The Law as a "Catalyst and Facilitator" for Trust in E-health: Challenges and Opportunities. Law, Innov Technol. 2014;6:305-325.
3. Mair FS, May C, O'Donnell C, Finch T, Sullivan F, Murray E. Factors that promote or inhibit the implementation of e-health systems: an explanatory systematic review.

Bull World Health Organ. 2012;90:357-364.

4. Wilson, EV, ed. Patient-centered e-health. IGI Global, 2008:3 4
5. Hunt DL, Haynes RB, Hanna SE, Smith K. Effects of computer-based clinical decision support systems on physician performance and patient outcomes. JAMA J Am Med Assoc. 1998;280:1339-1346.
6. Sim I, Gorman P, Greenes RA, et al. Clinical decision support systems for the practice of evidence-based medicine. J Am Med Informatics Assoc. 2001;8:527-534.
7. Bose R. Knowledge management-enabled health care management systems: capabilities, infrastructure, and decision-support. Expert Syst Appl. 2003;24:59-71.
8. Berner ES, La Lande TJ. Overview of Clinical Decision Support Systems. In: Springer International Publishing; 2016:1-17.
9. Bates DW, Kuperman GJ, Wang S, et al. Ten Commandments for Effective Clinical Decision Support: Making the Practice of Evidence-based Medicine a Reality. J Am Med Informatics Assoc. 2003;10:523-530.
10. Murphy E V. Clinical Decision Support: Effectiveness in Improving Quality Processes and Clinical Outcomes and Factors That May Influence Success. Yale J Biol Med. 2014;87:187.
11. O'Connor AM, Bennett CL, Stacey D, et al.. Decision aids for people facing health treatment or screening decisions. Cochrane Database Syst Rev. 2009;Jul 8;3.
12. Garg AX, Adhikari NKJ, McDonald H, et al. Effects of computerized clinical decision support systems on practitioner performance and patient outcomes. JAMA J Am Med Assoc. 2005;293:1223-1238.
13. Litvin CB, Ornstein SM, Wessell AM, Nemeth LS, Nietert PJ. Adoption of a clinical decision support system to promote judicious use of antibiotics for acute respiratory infections in primary care. Int J Med Inform. 2012;81:521-526.
14. Velickovski F, Ceccaroni L, Roca J, et al. Clinical Decision Support Systems (CDSS) for preventive management of COPD patients. J Transl Med. 2014;12:S9.
15. O'Reilly D, Holbrook A, Blackhouse G, Troyan S, Goeree R. Cost-effectiveness of a shared computerized decision support system for diabetes linked to electronic medical records. J Am Med Informatics Assoc. 2012;19:341-345.
16. Fortney JC, Pyne JM, Steven CA, et al. A Web-based clinical decision support system for depression care management. Am J Manag Care. 2010;16:849-54.
17. Knowles SE, Toms G, Sanders C, et al. Qualitative Meta-Synthesis of User Experience of Computerised Therapy for Depression and Anxiety. Harris F, ed. PLoS One. 2014;9:e84323.
18. Kawamoto K, Houlihan CA, Balas EA, Lobach DF. Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. BMJ. 2005;330:765.
19. Tomaszewski W. Computer-Based Medical Decision Support System based on

guidelines, clinical pathways and decision nodes. 2012;14.

20. Bright P, Hambly K. Exploring Cross-Curriculum Content of Undergraduate Musculoskeletal Therapy Courses Regarding Articular Cartilage; Implications of Surveying UK Healthcare Curriculum Providers. J Musculoskelet Disord Treat. 2016;2.
21. Levy CE, Silverman E, Jia H, Geiss M, Omura D. Effects of physical therapy delivery via home video telerehabilitation on functional and health-related quality of life outcomes. 2015;52:361-370.
22. Pearson J, Walsh N, Carter D, Koskela S, Hurley M. Developing a Web-Based Version of An Exercise-Based Rehabilitation Program for People With Chronic Knee and Hip Pain: A Mixed Methods Study. JMIR Res Protoc. 2016;5:e67.
23. Taylor D. Physical activity is medicine for older adults. Postgraduate medical journal. 2013 Nov 19.
24. Roshanov PS, Fernandes N, Wilczynski JM, et al. Features of effective computerised clinical decision support systems: meta-regression of 162 randomised trials. BMJ Br Med J. 2013;346.
25. Gross DP, Zhang J, Steenstra I, et al. Development of a Computer-Based Clinical Decision Support Tool for Selecting Appropriate Rehabilitation Interventions for Injured Workers. J Occup Rehabil. 2013:1-13.
26. Küçükdeveci A, Tennant A, Grimby G, Franchignoni F. Strategies for assessment and outcome measurement in Physical and Rehabilitation Medicine: An educational review. J Rehabil Med. 2011;43:661-672.
27. Cooke A, Smith D, Booth A. Beyond PICO. Qual Health Res. 2012;22:1435-1443.
28. Zwarenstein M, Treweek S, Gagnier JJ, et al. Improving the reporting of pragmatic trials: an extension of the CONSORT statement. BMJ. 2008;337:a2390-a2390.
29. Yin B, Goldsmith L, Gambardella R. Web-Based Education Prior to Knee Arthroscopy Enhances Informed Consent and Patient Knowledge Recall: A Prospective, Randomized Controlled Study. J Bone Joint Surg Am. 2015;97:964-71.
30. Russell TG, Buttrum P, Wootton R, Jull GA. Internet-Based Outpatient Telerehabilitation for Patients Following Total Knee Arthroplasty. J Bone Jt Surgery-American Vol. 2011;93:113-120.
31. Brooks MA, Beaulieu JE, Severson HH, et al. Web-based therapeutic exercise resource center as a treatment for knee osteoarthritis: a prospective cohort pilot study. BMC Musculoskelet Disord. 2014;15:158.
32. Fung V, Ho A, Shaffer J, Chung E, Gomez M. Use of Nintendo Wii Fit in the rehabilitation of outpatients following total knee replacement: a preliminary randomised controlled trial. Physiotherapy. 2012;98:183-188.
33. Marsh J, Bryant D, MacDonald SJ, et al. Are patients satisfied with a web-based followup after total joint arthroplasty? Clin Orthop Relat Res. 2014;472:1972-81.

34. Hoffman AS, Llewellyn-Thomas HA, Tosteson ANA, et al. Launching a virtual decision lab: development and field-testing of a web-based patient decision support research platform. BMC Med Inform Decis Mak. 2014;14:112.
35. Calliess T, Bocklage R, Karkosch R, Marschollek M, Windhagen H, Schulze M. Clinical evaluation of a mobile sensor-based gait analysis method for outcome measurement after knee arthroplasty. Sensors (Basel). 2014;14:15953-64.
36. Gudbergsen H, Bartels EM, Krusager P, et al. Test-retest of computerized health status questionnaires frequently used in the monitoring of knee osteoarthritis: a randomized crossover trial. BMC Musculoskelet Disord. 2011;12:190.
37. Marsh JD, Bryant DM, MacDonald SJ, et al. Feasibility, effectiveness and costs associated with a web-based follow-up assessment following total joint arthroplasty. J Arthroplasty. 2014;29:1723-8.
38. Tousignant M, Boissy P, Moffet H, 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 e-health. 2011;17:376-382.
39. Reeve WJE, Williams DH. When to operate: online patient-reported outcome measures (PROMs) can help decide. BMJ Case Rep. 2016;2016:10.1136/bcr-2015-214153.
40. Kim TWB, Gay N, Khemka A, Garino J. Internet-Based Exercise Therapy Using Algorithms for Conservative Treatment of Anterior Knee Pain: A Pragmatic Randomized Controlled Trial. JMIR Rehabil Assist Technol. 2016;3:e12.
41. Taylor CF, Williams DH. An acute knee injury: tracking a two-year recovery online. Int J Electron Healthc. 2015;8:1-8.
42. Gakhar H, McConnell B, Apostolopoulos AP, Lewis P. A pilot study investigating the use of at-home, web-based questionnaires compiling patient-reported outcome measures following total hip and knee replacement surgeries. J Long Term Eff Med Implants. 2013;23:39-43.
43. Slover JD, Karia RJ, Hauer C, Gelber Z, Band PA, Graham J. Feasibility of integrating standardized patient-reported outcomes in orthopedic care. Am J Manag Care. 2015;21:e494-500.
44. Levinger P, Zeina D, Teshome AK, Skinner E, Begg R, Abbott JH. A real time biofeedback using Kinect and Wii to improve gait for post-total knee replacement rehabilitation: a case study report. Disabil Rehabil Assist Technol. 2016;11:251-62.
45. Stacey D, Taljaard M, Dervin G, et al. Impact of patient decision aids on appropriate and timely access to hip or knee arthroplasty for osteoarthritis: a randomized controlled trial. Osteoarthr Cartil. 2016;24:99-107.
46. Umapathy H, Bennell K, Dickson C, et al. The Web-Based Osteoarthritis Management Resource My Joint Pain Improves Quality of Care: A Quasi-

Experimental Study. J Med Internet Res. 2015;17:e167.

47. Kwasnicki RM, Ali R, Jordan SJ, et al. A wearable mobility assessment device for total knee replacement: A longitudinal feasibility study. Int J Surg. 2015;18:14-20.
48. Rini C, Porter LS, Somers TJ, et al. Automated Internet-based pain coping skills training to manage osteoarthritis pain: a randomized controlled trial. Pain. 2015;156:837-48.
49. Pua Y-H, Clark RA, Ong P-H. Evaluation of the Wii Balance Board for walking aids prediction: proof-of-concept study in total knee arthroplasty. Buchowski M, ed. PLoS One. 2015;10:e0117124.
50. Kawi J, Schuerman S, Alpert PT, Young D. Activation to self-management and exercise in overweight and obese older women with knee osteoarthritis. Clin Nurs Res. 2015;24:644-60.
51. Bisson LJ, Komm JT, Bernas GA, et al. Accuracy of a computer-based diagnostic program for ambulatory patients with knee pain. Am J Sports Med. 2014;42:2371-6.
52. Peter WF, Loos M, de Vet HCW, et al. Development and Preliminary Testing of a Computerized Animated Activity Questionnaire in Patients With Hip and Knee Osteoarthritis. Arthritis Care Res (Hoboken). 2015;67:32-39.
53. Brooks MA, Beaulieu JE, Severson HH, et al. Web-based therapeutic exercise resource center as a treatment for knee osteoarthritis: a prospective cohort pilot study. BMC Musculoskelet Disord. 2014;15:158.
54. Stacey D, Hawker G, Dervin G, et al. Decision aid for patients considering total knee arthroplasty with preference report for surgeons: a pilot randomized controlled trial. BMC Musculoskelet Disord. 2014;15:54.
55. Marsh J, Bryant D, MacDonald SJ, et al. Are patients satisfied with a web-based followup after total joint arthroplasty? Clin Orthop Relat Res. 2014;472:1972-81.
56. Bossen D, Veenhof C, Van Beek KE, Spreeuwenberg PM, Dekker J, De Bakker DH. Effectiveness of a web-based physical activity intervention in patients with knee and/or hip osteoarthritis: randomized controlled trial. J Med Internet Res. 2013;15:e257.
57. Bossen D, Buskermolen M, Veenhof C, de Bakker D, Dekker J. Adherence to a web-based physical activity intervention for patients with knee and/or hip osteoarthritis: a mixed method study. J Med Internet Res. 2013;15:e223.
58. Senanayake SMNA, Malik OA, Iskandar M, Zaheer D. 3-D kinematics and neuromuscular signals' integration for post ACL reconstruction recovery assessment. Conf Proc . Annu Int Conf IEEE Eng Med Biol Soc IEEE Eng Med Biol Soc Annu Conf. 2013;2013:7221-5.
59. Marsh JD, Bryant DM, Macdonald SJ, Naudie DDR. Patients respond similarly to paper and electronic versions of the WOMAC and SF-12 following total joint arthroplasty. J Arthroplasty. 2014;29:670-3.

60. Bossen D, Veenhof C, Dekker J, de Bakker D. The usability and preliminary effectiveness of a web-based physical activity intervention in patients with knee and/or hip osteoarthritis. BMC Med Inform Decis Mak. 2013;13:61.
61. Puh U, Majcen N, Hlebš S, Rugelj D. Effects of Wii balance board exercises on balance after posterior cruciate ligament reconstruction. Knee Surgery, Sport Traumatol Arthrosc. 2014;22:1124-1130.
62. Piqueras M, Marco E, Coll M, et al. Effectiveness of an interactive virtual telerehabilitation system in patients after total knee arthoplasty: A randomized controlled trial. J Rehabil Med. 2013;45:392-396.
63. Howells BE, Clark RA, Ardern CL, et al. The assessment of postural control and the influence of a secondary task in people with anterior cruciate ligament reconstructed knees using a Nintendo Wii Balance Board. Br J Sport Med. 2013;47:914-919.
64. Arterburn D, Wellman R, Westbrook E, et al. Introducing decision aids at Group Health was linked to sharply lower hip and knee surgery rates and costs. Health Aff (Millwood). 2012;31:2094-104.
65. Baltaci G, Harput G, Haksever B, Ulusoy B, Ozer H. Comparison between Nintendo Wii Fit and conventional rehabilitation on functional performance outcomes after hamstring anterior cruciate ligament reconstruction: prospective, randomized, controlled, double-blind clinical trial. Knee Surgery, Sport Traumatol Arthrosc. 2013;21:880-887.
66. Hawamdeh ZM, Alshraideh MA, Al-Ajlouni JM, Salah IK, Holm MB, Otom AH. Development of a decision support system to predict physicians' rehabilitation protocols for patients with knee osteoarthritis. Int J Rehabil Res. April 2012:1.
67. Gudbergsen H, Bartels EM, Krusager P, et al. Test-retest of computerized health status questionnaires frequently used in the monitoring of knee osteoarthritis: a randomized crossover trial. BMC Musculoskelet Disord. 2011;12:190.
68. Hambly K, Griva K. IKDC or KOOS: which one captures symptoms and disabilities most important to patients who have undergone initial anterior cruciate ligament reconstruction? Am J Sports Med. 2010;38:1395-404.
69. Jackson DE, McClean SI. Trends in telemedicine assessment indicate neglect of key criteria for predicting success. J Health Organ Manag. 2012;26:508-523.
70. Dávalos ME, French MT, Burdick AE, Simmons SC. Economic Evaluation of Telemedicine: Review of the Literature and Research Guidelines for Benefit–Cost Analysis. Telemed e-health. 2009;15:933-948.
71. Bergmo TS. How to Measure Costs and Benefits of e-health Interventions: An Overview of Methods and Frameworks. J Med Internet Res. 2015;17:e254.
72. Lé Garé F, Thompson-Leduc P. Twelve myths about shared decision making. Patient Educ Couns. 2014;96:281-286.
73. Salisbury C. Patients' experience and satisfaction in primary care: secondary

analysis using multilevel modelling. Bmj. 2010;341(c5004).

74. Taylor CF, Williams DH. An acute knee injury: tracking a two-year recovery online. Int J Electron Healthc. 2015;8:1-8.
75. Hawamdeh ZM, Alshraideh MA, Al-Ajlouni JM, Salah IK, Holm MB, Otom AH. Development of a decision support system to predict physicians' rehabilitation protocols for patients with knee osteoarthritis. Int J Rehabil Res. April 2012:1.
76. Schulz KF, Altman DG, Moher D. Open Access CORRESPONDENCE CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. BMC Med Obstet Gynecol PLoS Med Ann Intern Med Open Med J Clin Epidemiol BMC Med Trials. 2010;8.
77. Tousignant M, Moffet H, Boissy P, Corriveau H, Cabana F, Marquis F. A randomized controlled trial of home telerehabilitation for post-knee arthroplasty. J Telemed Telecare. 2011;17:195-198.
78. Sullivan GM, Feinn R. Using Effect Size—or Why the P Value Is Not Enough. J Grad Med Educ. 2012;4:279-282.
79. Eldridge SM, Chan CL, Campbell MJ, et al. CONSORT 2010 statement: extension to randomised pilot and feasibility trials. Pilot Feasibility Stud 21. 2016;64.
80. Vohra S, Shamseer L, Sampson M, et al. CONSORT extension for reporting N-of-1 trials (CENT) 2015 Statement. Journal of clinical epidemiology. 2016 Aug 31;76:9-17.
81. Quaschning K, Körner M, Wirtz M. Analyzing the effects of shared decision-making, empathy and team interaction on patient satisfaction and treatment acceptance in medical rehabilitation using a structural equation modeling approach. Patient Educ Couns. 2013;91:167-175.
82. Heijne A, Axelsson K, Werner S, Biguet G. Rehabilitation and recovery after anterior cruciate ligament reconstruction: patients' experiences. Scand J Med Sci Sports. 2008;18:325-335.
83. Pearson J, Walsh N, Carter D, Koskela S, Hurley M. Developing a Web-Based Version of An Exercise-Based Rehabilitation Program for People With Chronic Knee and Hip Pain: A Mixed Methods Study. JMIR Res Protoc. 2016;5:e67.
84. Hush JM, Cameron K, Mackey M. Patient Satisfaction With Musculoskeletal Physical Therapy Care: A Systematic Review. Phys Ther. 2011;91:25.
85. Ammenwerth E, Iller C, Mahler C. IT-adoption and the interaction of task, technology and individuals: a fit framework and a case study. BMC Med Inform Decis Mak. 2006;6:3.
86. Schutte J, Gales S, Filippone A, Saptono A, Parmanto B, McCue M. Evaluation of a telerehabilitation system for community-based rehabilitation. Int J telerehabilitation. 2012;4:15-24.
87. Baumel A, Faber K, Mathur N, Kane JM, Muench F. Enlight: A Comprehensive Quality and Therapeutic Potential Evaluation Tool for Mobile and Web-Based e-

health Interventions. J Med Internet Res. 2017;19:e82.

88. Frenk J, Chen L, Bhutta ZA, et al. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. Lancet. 2010;376:1923-1958.